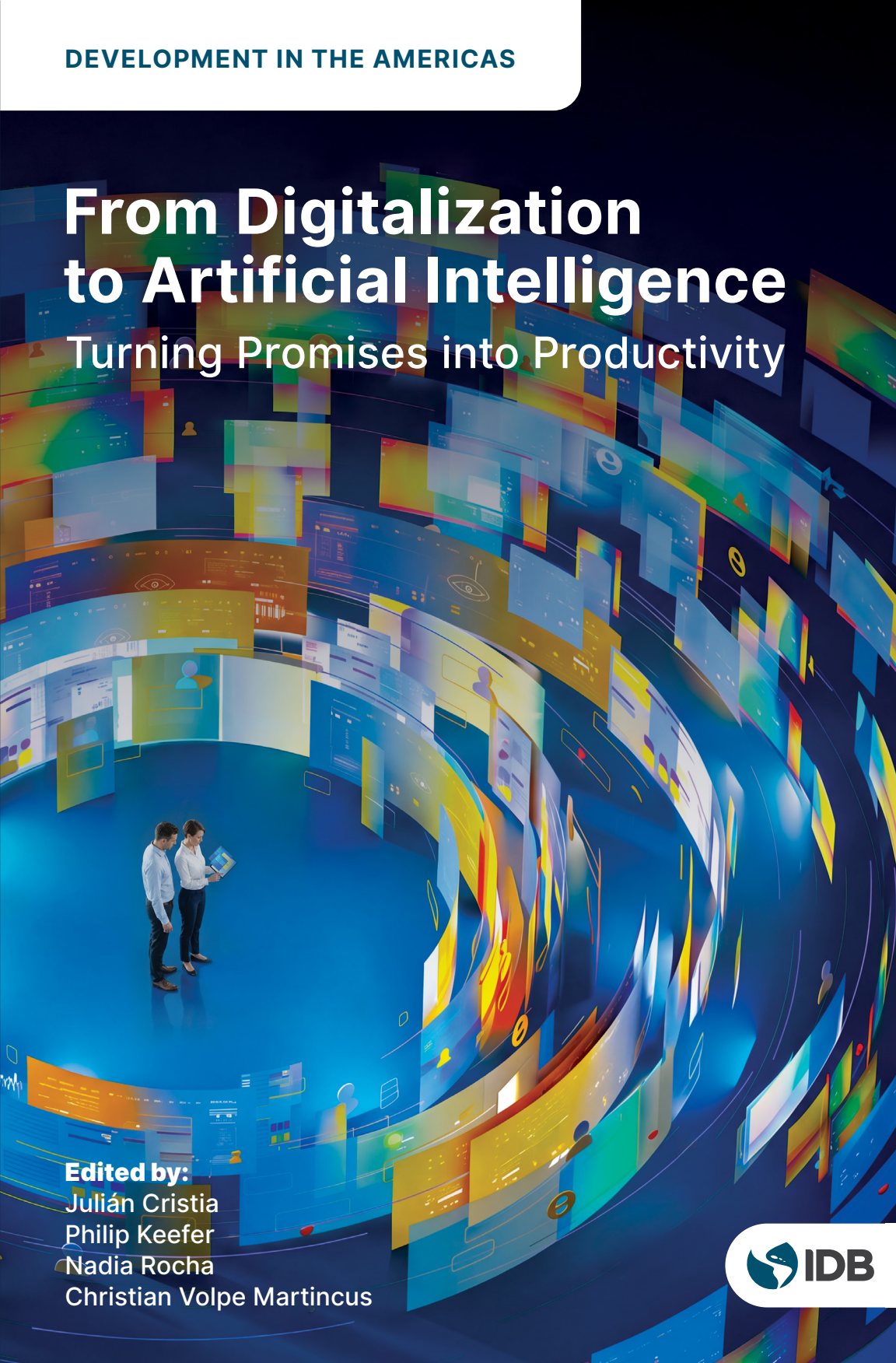
DEVELOPMENT IN THE AMERICAS

From Digitalization to Artificial Intelligence

Turning Promises into Productivity



Edited by:
Julián Cristia
Philip Keefer
Nadia Rocha
Christian Volpe Martincus

IDB

FROM DIGITALIZATION TO ARTIFICIAL INTELLIGENCE

FROM DIGITALIZATION TO ARTIFICIAL INTELLIGENCE

Turning Promises into Productivity

Edited by
Julián Cristia
Philip Keefer
Nadia Rocha
Christian Volpe Martincus

Inter-American Development Bank

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

From digitalization to artificial intelligence: turning promises into productivity / edited by Julián Cristia, Philip Keefer, Nadia Rocha, Christian Volpe Martincus.

p. cm.
Includes bibliographical references.
978-1-59782-617-4 (Paperback)
978-1-59782-618-1 (PDF)

1. Internet in public administration-Latin America. 2. Internet in public administration-Caribbean Area. 3. Public administration-Effect of technological innovations on-Latin America. 4. Public administration-Effect of technological innovations on-Caribbean Area. 5. Artificial intelligence in public administration-Latin America. 6. Artificial intelligence in public administration-Caribbean Area. I. Cristia, Julián, editor. II. Keefer, Philip, editor. III. Rocha, Nadia, editor. IV. Volpe Martincus, Christian, editor. V. Inter-American Development Bank. Department of Research and Chief Economist.

JF1525.A8 .D54 2026
IDB-BK-315

Copyright © 2026 Inter-American Development Bank (IDB). This work is subject to a Creative Commons Attribution 4.0 International Public License CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/legalcode). The terms and conditions indicated in the URL link must be met and the respective recognition must be granted to the IDB.

Any and all disputes arising under this license that cannot be settled amicably shall be resolved in accordance with the following procedure. Pursuant to a notice of mediation communicated by reasonable means by either you or the licensor to the other, the dispute shall be submitted to non-binding mediation conducted in accordance with the World Intellectual Property Organization (WIPO) Mediation Rules. Any dispute that cannot be settled amicably shall be submitted to arbitration pursuant to the United Nations Commission on International Trade Law (UNCITRAL) rules. The use of the IDB name for any purpose other than the respective recognition and the use of the IDB logo are not authorized by this license and require an additional license agreement.

Note that the URL link includes terms and conditions that are an integral part of this license.

The opinions expressed in the work are those of its authors and do not necessarily reflect the views of the IDB, its Board of Executive Directors, or the countries they represent.



This report was prepared with assistance from ChatGPT, Claude, DeepL, and Gemini for drafting and editing text, translating content, and improving clarity and consistency. The authors reviewed the AI-assisted content and take full responsibility for the final report.

Cover illustration: Andriy Onufriyenko via Getty Images
Cover design: Lina María Botero Estrada

Contents

List of Tables vii
List of Figures. ix
List of Boxes. xiii
Preface xv
Acknowledgments xvii
List of Authors xxi

1 The Artificial Intelligence Dividend: Promise, Paradox, and Policy. 1
2 Digital Transformation, AI, and the Path to Inclusive Growth 29
3 Digital Adoption: Broad Access, Shallow Use 55
4 The Policy Challenges of Effective Digital Adoption 77
5 Improving Student Learning: The Role of Learning Platforms and AI. 99
6 Connected Health, Controlled Diseases 117
7 Digital Technologies and the Future of Social Protection 135
8 Beyond Adoption: Making Digital Tools Work for Infrastructure 153
9 Digital Tools for Safer Societies. 171
10 Unleashing Digital Technologies on Tax Administration 189
11 From Red Tape to Real Time: Digitalizing Government Transactions. 211
12 Removing Barriers to the Technology Sector. 231

13 Firms' Adoption of Digital Technologies: Drivers and Effects 249

14 Facilitating and Promoting Trade and Investment through Digital Technologies 271

References 297

List of Tables

Table 1.1	Cumulative 10-Year GDP Gains under Two Scenarios (percent)	4
Table 1.2	Digitalization and AI: Core Functions and the Tasks Each Enhances	7
Table 2.1	AI Exposure by Country and Formality Status, 2018–22 (percent)	48
Table 2.2	Cumulative Change in TFP and GDP Levels from AI Adoption over a 10-Year Horizon, by Scenario (percent)	49
Table 5.1	Evidence on the Effectiveness of Learning Platforms	105
Table 7.1	Summary of Digital Tool Incorporation through the Four Stages of Social Protection	146
Table 9.1	Evidence on Technology and Crime in Latin America and the Caribbean	177
Table 11.1	Available Digital Public Services in Mexico and Brazil	226
Table 11.2	Accessibility Analysis of Latin American and Caribbean Governments' Websites	227
Table 12.1	Share of Firms Reporting Given Factor as an Obstacle to Innovation	239
Table 12.2	Public Policies to Promote Digital Service Providers	246
Table 13.1	AI Adoption, by AI Type and Firm Size	256
Table 14.1	Taxonomy of Digital Technologies and Trade Cost Reduction	278

List of Figures

Figure 1.1	GDP Per Capita Relative to the United States, 1960 versus 2025, by Region	2
Figure 1.2	Effects of Digital Interventions in Developing Countries	8
Figure 1.3	Online Interactions with Government across Country Groups	10
Figure 1.4	Front-End Digitalization versus Back-End Transformation	11
Figure 1.5	Generative AI Use across Countries	13
Figure 1.6	Depth of Generative AI Use among Firms	14
Figure 1.7	Prevalence of Companies Providing AI Services	15
Figure 1.8	Policy Framework for Effective Digital Adoption	19
Figure 1.9	Selected Indicators of Enabling Conditions for Effective Digital Adoption	21
Figure 2.1	Latin America and the Caribbean's Productivity Deficit	30
Figure 2.2	Effects of Digital Technologies on Productivity, Output, Employment, and Wages: Transmission Channels	34
Figure 2.3	AI Exposure, Informality, and GDP Gains from AI	51
Figure 3.1	Internet Use across Country Groups	57
Figure 3.2	Internet Use across Countries	58
Figure 3.3	Frequency of Internet Use across Demographic Groups	59
Figure 3.4	Internet Use across Broad Activity Categories	60
Figure 3.5	Internet Use across Specific Activities	62
Figure 3.6	Social Network Use across Countries	63
Figure 3.7	Online Purchasing across Countries	64
Figure 3.8	Online Interactions with Government across Countries	68
Figure 3.9	Generative AI Use across Countries	70
Figure 3.10	Generative AI Use across Demographic Groups	72

Figure 3.11	Work-Related Generative AI Use across Countries	73
Figure 3.12	Work-Related Generative AI Use across Demographic Groups	74
Figure 3.13	Reasons for Not Using Generative AI, across Demographic Groups	75
Figure 4.1	Software Spending as a Share of GDP	78
Figure 4.2	Policy Framework for Effective Digital Adoption	81
Figure 4.3	Fixed and Mobile Broadband Price Baskets across Country Groups	82
Figure 4.4	Government Effectiveness and Rule of Law	83
Figure 4.5	Cybersecurity Capacity Maturity Model Scores	87
Figure 4.6	Skills Required by the Digital Activities Individuals Undertake	91
Figure 4.7	Mobile and Fixed Internet Use by Income Group	94
Figure 5.1	Secondary Students Failing to Achieve a Minimum Math Standard across Countries	100
Figure 5.2	Learning Gaps by Socioeconomic Status across Countries	101
Figure 5.3	Learning Challenges and Digital Solutions	103
Figure 5.4	Learning Platform Effects: Replacing versus Supplementing Instruction	108
Figure 5.5	Effects of Learning Platforms Targeting Both Math and Language	109
Figure 5.6	Learning Platform Effects across Grades	110
Figure 6.1	Hypertension Care for Latin American and Caribbean People	118
Figure 6.2	Digital Ecosystem for Redesigned NCD Care	120
Figure 6.3	Population Use of Digital Health Services	127
Figure 6.4	Types of Digital Services Used	128
Figure 6.5	Use of Telemedicine by Health Status, Compared with the United Kingdom	129
Figure 6.6	Availability of and Use for Teleconsultations	130
Figure 6.7	Average Inequities in Use of Digital Health Services	131
Figure 6.8	Data and Functions of Digital Information Systems for NCD Care	132
Figure 7.1	Cash Transfer Beneficiaries, by Poverty Status and Digitalization Level	137
Figure 7.2	The Four Stages of Social Protection	138
Figure 7.3	Poverty-Targeting Accuracy in Chile, by Migration Status	142

Figure 7.4	Digital Social Protection: Dynamic Registries and Digital Transfers across Country Groups	149
Figure 8.1	How Digital Technologies Affect Infrastructure Outcomes	156
Figure 8.2	Smart Meter Adoption	159
Figure B8.2.1	Causal Effects of Smart Meters on Measured Consumption and Outage Frequency	160
Figure B8.3.1	EPMAPS Inspections using AquaData versus Other Methods	163
Figure B8.3.2	Infractions per Inspection	163
Figure 10.1	Regional Tax Burden and Revenue Composition	190
Figure 10.2	On-Time Payment Rate across Country Groups	191
Figure 10.3	Active Personal Income Taxpayers across Country Groups	193
Figure 10.4	Adoption by Tax Administrations of Selected Best Data Practices across Country Groups	194
Figure 10.5	Data Analytics Capabilities across Country Groups	195
Figure 10.6	Global Comparison of E-Filing of Tax Returns across Country Groups	199
Figure 10.7	Tax Administrations Requiring E-Invoices across Country Groups	201
Figure 10.8	Tax Administrations Prefilling Personal Income Tax Declarations across Country Groups	202
Figure 10.9	Use of Artificial Intelligence by Tax Administrations across Country Groups	203
Figure 10.10	Institutional Conditions for Digital Transformation across Country Groups	206
Figure 11.1	Transactions Administered by Central Governments across Countries	213
Figure 11.2	Most Common Transactions	214
Figure 11.3	Average Time to Complete Government Transactions across Countries	216
Figure 11.4	Average Time for Procedures using Digital versus In-Person Channels across Countries	219
Figure 11.5	Most Common Transactions versus Digital Channel Use	222
Figure 11.6	Level of Digital Skills in the Last Procedure, by Channel Used	223
Figure 11.7	Awareness of the Main Central Government Portal across Demographic Groups	225
Figure 12.1	Prevalence of Digital Firms	233

Figure 12.2	Exports and Multinational Activity	234
Figure 12.3	Innovation Intensity and Skill Level	236
Figure 12.4	Sources of Funding for Investment in Innovation	236
Figure 12.5	Average Total Funding per Company	238
Figure 12.6	Obstacles to Growth Faced by Digital Service Providers	240
Figure 12.7	AI Talent Flows and Concentration	241
Figure 12.8	Relationship of AI Research Activity to AI Firms	242
Figure 12.9	STRI in Computer Services	243
Figure 13.1	Productivity and Digital Technology Adoption Gaps	250
Figure 13.2	Extent of Digitalization across Business Functions and Firm Size	253
Figure 13.3	Use of Cloud Services, by Type and Firm Size	255
Figure 13.4	GenAI Adoption over Time by Usage Mode	256
Figure 13.5	Firm Size and AI Adoption: Effects by Technology and Business Area	257
Figure 13.6	Firm Characteristics and the Sophistication of Digital Portfolios	260
Figure 13.7	Main Obstacles to AI Adoption	263
Figure 13.8	Effects of CTDE Participation on Firm Performance	269
Figure 14.1	Trade and FDI in Latin America and the Caribbean	273
Figure 14.2	Trade Costs: Latin America and the Caribbean versus Other Regions	276
Figure 14.3	Administrative Procedures and Information Frictions as Sources of Trade Costs	277
Figure 14.4	Digitalization to Facilitate Trade: 2015 versus 2025	279
Figure 14.5	Border Processes and the Electronic Trade Single Window	281
Figure 14.6	Implementation and Export Effects of ETSWs	283
Figure 14.7	Single Windows for Investment: Implementation across the Region	285
Figure 14.8	Costa Rica's Electronic Investment Single Window	286
Figure 14.9	The Impact of Costa Rica's Electronic Investment Single Window	287
Figure 14.10	Impact of Digital Platform on Colombian Firms' Entry into New Foreign Markets	290
Figure 14.11	Model Performance for Investment Promotion: Capturing Actual Establishments	293

List of Boxes

Box 2.1	Digital Technologies, AI, and the Region's Economy	44
Box 4.1	Investing in Interoperability: Chile's ClaveÚnica	95
Box 6.1	Transforming the Digital Ecosystem for NCDs with GenAI	124
Box 6.2	Building a Model of NCD Care Enabled by Digital Tools	126
Box 8.1	Powering AI: The Infrastructure Demands of Data Centers	155
Box 8.2	Energy Smart Meters in Brazil	160
Box 8.3	AquaData: Machine Learning versus Water Fraud	162
Box 8.4	Smart Cards and Bogotá's Bus Rapid Transit System	165
Box 8.5	TransMilenio: AI for Operations, Safety, and Maintenance	166
Box 9.1	PRiSMA: Colombia's Risk Assessment Tool for Pretrial Detention	182
Box 14.1	Digital Trade Definitions	274

Preface

We are living through a period of extraordinary technological change. Artificial intelligence is advancing at a pace that would have been difficult to imagine only a few years ago, changing how people work, how firms produce and innovate, and how governments can serve their citizens. For Latin America and the Caribbean, this transformation comes at a particularly important moment. After decades of weak productivity growth, the region needs new sources of dynamism to grow faster and more equitably, and to improve public services.

Artificial intelligence offers one such source. But technology alone will not transform our economies. Transformative technologies deliver benefits when societies build the foundations for adoption and create the conditions for their widespread use throughout the economy. Countries that move decisively can capture a sizable AI dividend; those that do not risk falling further behind.

This edition of the *Development in the Americas* series examines how Latin America and the Caribbean can seize that opportunity. It quantifies the potential AI dividend for our region and, just as importantly, shows why realizing it is a policy choice. AI can raise productivity, accelerate innovation, and improve public service delivery. But the scale of these gains depends on how widely and deeply countries adopt the technology and how effectively they prepare their economies and societies for it.

That task begins with the region's unfinished digitalization agenda. AI is layered on digital foundations; where those foundations are incomplete, adoption remains shallow. Effective institutions, skilled people, data, connectivity, computing capacity, and digital infrastructure all matter. So does the ability of firms and governments to reorganize around new technologies. The hardest part is often not acquiring a new tool but changing the systems, processes, and organizations around it.

This report, therefore, calls for action on three fronts. First, countries need to strengthen the enabling conditions for digital transformation and AI. Second, they

must accelerate diffusion across the public sector, using technology to improve government and service delivery. And, third, they should promote productive adoption across the private sector. These areas must advance together if the region is to move from individual applications and experiments to adoption at scale.

The path will not be identical everywhere. Countries across Latin America and the Caribbean have different starting points, capabilities, and priorities. But they face many of the same challenges and share the same goal: broad, productive adoption that raises productivity, improves public services, and spreads gains widely. This creates an important opportunity for countries to learn from one another and accelerate progress across the region.

Realizing these gains will also require managing the risks that accompany AI. Changes in labor markets, cybersecurity, privacy, and the use of AI in areas such as education all require attention. Recognizing these risks is not about slowing innovation but rather about creating the conditions for sustained adoption and ensuring that the benefits of technological change are broadly shared.

The IDB Group has an important role to play in this effort. We can help bring policymakers and technology leaders together, creating a common framework and a joint alliance for AI adoption. And we can work around an AI-for-growth agenda for Latin America and the Caribbean, connecting rapidly evolving technological possibilities with the region's development priorities. We provide rigorous evidence about where the largest opportunities lie and what countries need to do to capture them. And, as a longstanding development partner to the region, we can help translate that knowledge into country-level action.

AI does not offer a shortcut around the difficult work of development. But it can become a powerful accelerator of that work if countries make the choices and investments needed to use it well. The question for leaders is, therefore, not whether AI will matter. It is whether their countries will build the conditions to benefit from it, and whether those benefits will reach firms, governments, workers, and citizens across our region.

The opportunity is significant, and so is the responsibility to act. The IDB Group is committed to bringing together the knowledge, partnerships, and resources needed to help Latin America and the Caribbean turn the promise of AI into higher productivity, better public services, and broadly shared growth.

Ilan Goldfajn
President
Inter-American Development Bank Group

Acknowledgments

Development in the Americas (DIA) is the flagship publication of the Inter-American Development Bank (IDB). This issue was produced under the direction of Julián Cristia, principal economist in the Research Department; Philip Keefer, president of the Ronald Coase Institute and former principal economic advisor in the IDB's Institutions for Development Sector; Nadia Rocha, principal economic advisor in the Vice Presidency for Countries and Regional Integration; and Christian Volpe Martincus, principal economic advisor in the Productivity, Trade, and Innovation Sector.

Ana María Ibáñez, vice president for Sectors and Knowledge, Anabel González, vice president for Countries and Regional Integration, Laura Alfaro, chief economist and economic counselor, Mariano Bosch, principal advisor at the Vice Presidency for Sectors and Knowledge, and Ernesto Schargrodsky, deputy chief economist, provided constant support, comments, and guidance throughout the life of this project.

The main chapter authors are as follows:

Chapter 1	Julián Cristia, Philip Keefer, Nadia Rocha, and Christian Volpe Martincus
Chapter 2	David Scott Kaplan, Marcelo Zouain Pedroni, and Christian Volpe Martincus
Chapter 3	Diether W. Beuermann, Juan Pablo Chauvin, and Julieth Santamaria
Chapter 4	Florencia Aguirre, Samuel Berlinski, Bridget Hoffmann, Philip Keefer, Arturo Muente Kunigami, Ariel Nowersztern, Miguel Talamas, and Razvan Vlaicu
Chapter 5	Elena Arias Ortiz, Julián Cristia, and Gregory Elacqua
Chapter 6	Pedro Bernal Lara, María Fernanda García Agudelo, Catalina Durán Calderón, Carolina Bernal Macías, and Jennifer Nelson

Chapter 7	Diego A. Vera-Cossio, Luis Tejerina, and Paula Vera Pérez
Chapter 8	Eduardo Cavallo and Carolina Tojal Ramos dos Santos
Chapter 9	Daniel Jaramillo Calderon, David Ortigosa Izquierdo, and Santiago M. Perez-Vincent
Chapter 10	Laura Ospina and Gerardo Reyes-Tagle
Chapter 11	Nazly López-Peña and Benjamin Roseth
Chapter 12	Juan S. Blyde, Matteo Grazzi, Yuri Suarez Dillon Soares, and Rodolfo Stucchi
Chapter 13	Alessandro Maffioli, Gabriel Scattolo, Fernando Vargas, Christian Volpe Martincus, and Patricia Yañez-Pagans
Chapter 14	Christian Volpe Martincus

Avi Goldfarb served as general external advisor, providing invaluable guidance and critical feedback. Ajay Agrawal, Paola Abril Campos Rivera, Maggie X. Chen, Chiara Criscuolo, Patricio Domínguez, Eduardo Engel, Sebastian Gallegos, Hernan Galperin, Philip Oreopoulos, Fabrizio Santoro, Johannes Van Biesebroeck, Eric Verhoogen, and Tom Vogl served as external advisors to individual chapters, contributing specialized expertise and detailed comments at key stages of their development.

Additional inputs, comments, and suggestions were provided by Nicolás Albornoz Basto, Jean-Michel Baudoin, Marcelo Cabrol, Germán Caruso, Gustavo Crespi, Lourdes Gallardo Montoya, Amanda Glassman, Rafael de Hoyos, Eduardo Levy Yeyati, Cristina Pombo, Miguel Porrúa, Pau Puig Gabarró, Magdalena Rossetti, Carlos Scartascini, Virginia Snyder, and numerous participants in the two workshops held during preparation of this book.

The book benefited from feedback gathered through IDB Group–wide circulation. Many specialists provided valuable comments and ideas, particularly those from the Country Department Andean Group; the Country Department Caribbean Group; the Country Department Central America, Haiti, Mexico, Panama, and the Dominican Republic; the Country Department Southern Cone; the Energy Division and the Transport Division of the Infrastructure and Energy Sector; the Office of Strategic Planning and Development Effectiveness; and the Social Sector.

Several chapters of this book draw on a special module on digital access, use, skills, and adoption of generative AI in the 2025–26 round of the AmericasBarometer, conducted by the LAPOP Lab at Vanderbilt University in 16 Latin American countries, and on the 2026 Barbados Digital Literacy Survey, conducted by PARSTATS. Together, these data constitute the main empirical basis of Chapter 3 and inform analyses throughout the book. María Fernanda Boidi, director of fieldwork and regional partnerships at the LAPOP Lab, and the LAPOP Lab

team collaborated in implementing the module and delivering the data. Ramiro Flores Cruz and the team at PARSTATS coordinated and conducted the survey in Barbados.

The book is accompanied by two interactive tools, the Digital Adoption Dashboard and the Digital Impact Dashboard, whose development was coordinated by Sebastián Oliva, a consultant in the Research Department. The Digital Adoption Dashboard provides insights into digital access, use, skills, and AI adoption across 17 Latin American and Caribbean countries. Julieth Santamaria directed the initiative, and David Rodríguez-González processed the underlying data. The Digital Impact Dashboard presents evidence on the impacts of digitalization and AI interventions across eight sectors in low- and middle-income countries. Diether W. Beuermann directed its development, Andrea Velasco García coordinated the work, and Adriana Arce, Hugo Salgado, and Rossy Talancha reviewed the studies and compiled and systematized the evidence. Lina María Botero Estrada, Andrés Cavelier, Mónica Hernández, Romina Nicaretta, Tom Sarrazin, and Carlos Savignano collaborated in the development of the website that hosts the dashboards.

In addition to her outstanding research support, Paula Vera Pérez played a central role in managing and coordinating the many components of the project. Her organization, initiative, and dedication were instrumental in ensuring the timely and successful completion of the book in English.

Invaluable research assistance was provided by David Barraza, Alejandra Barrientos, David Caraballo, Cecilia Chávez, Malena Dolcet, Pablo Fernández, Yeiner Fernández, Davi Ferreira, María de los Ángeles Gutiérrez, Valentín Mannarino, Mallika Matharu, René Nieto, Alonso Ramírez, Nicolas Valle, Andrea Velasco García, Valentina Vergara, Estefanía Walker, David J. Zegarra, and María Agostina Zulli.

Tom Sarrazin of the Research Department managed the production of this book. The English manuscript benefited from the excellent editorial work of Lisa Ferraro Parmelee and Anne Himmelfarb. Sarah Schineller proofread the volume prior to typesetting. The Spanish translation was produced using DeepL, reviewed by Alonso Ramírez, with the authors ensuring its technical accuracy and Clara Sarcone serving as Spanish-language editor. The Portuguese translation was also produced using DeepL, reviewed by Jéssica Gagete Miranda, and edited by Andressa Rovani. The administrative team of the Research Department at the Inter-American Development Bank, including Myriam Escobar, Elton Mancilla, Carla Merchán, Mariela Semidey, Montserrat Urquiola, and Federico Volpino, devoted great effort and dedication to advancing all steps required to produce this book. Lina María Botero Estrada, Andrés Cavelier, Ángela Funes, Rafael Mathus, María Fernanda Polini, Ana Ramos, and Tom Sarrazin helped with the communication and dissemination strategy of the book.

Notwithstanding the valuable contributions of the many people who provided inputs to this volume, the editors and authors assume full responsibility for any errors in information or analysis. The opinions expressed in this publication are those of the editors of the project and authors of the corresponding chapters and do not necessarily reflect the views of the IDB, its board of directors, or the countries they represent.

List of Authors

Florencia Aguirre, a citizen of Uruguay, served as a consultant in the Institutional Capacity of the State Division at the Inter-American Development Bank. She holds a master's degree in public policy from the University of Erfurt, Germany.

Elena Arias Ortiz, a citizen of Costa Rica, is a lead education specialist in the Education Division of the Inter-American Development Bank. She holds a PhD in economics from the Université libre de Bruxelles, Belgium.

Samuel Berlinski, a citizen of Argentina, is a principal economist at the Research Department of the Inter-American Development Bank. He holds a DPhil in economics from the University of Oxford, United Kingdom.

Pedro Bernal Lara, a citizen of Mexico, is a senior health economist in the Health, Nutrition, and Population Division of the Inter-American Development Bank. He holds a PhD in public policy from the University of Chicago, United States.

Carolina Bernal Macías, a citizen of Colombia, is a consultant in the Health, Nutrition, and Population Division of the Inter-American Development Bank. She holds a master's degree in economics from Universidad del Rosario, Colombia.

Diether W. Beuermann, a citizen of Germany and Peru, is a principal economist in the Caribbean Country Department of the Inter-American Development Bank. He holds a PhD in economics from the University of Maryland–College Park, United States.

Juan S. Blyde, a citizen of Venezuela, is a principal economist in the Productivity, Trade, and Innovation Sector of the Inter-American Development Bank. He holds a PhD in economics from the University of Colorado Boulder, United States.

Eduardo Cavallo, a citizen of Argentina and the United States, is the principal economic advisor in the Infrastructure and Energy Sector of the Inter-American Development Bank. He holds a PhD in public policy from Harvard University, United States.

Juan Pablo Chauvin, a citizen of Ecuador, is an economic specialist in the Research Department of the Inter-American Development Bank. He holds a PhD in public policy from Harvard University, United States.

Julián Cristia, a citizen of Argentina, is a principal economist in the Research Department of the Inter-American Development Bank. He holds a PhD in economics from the University of Maryland, United States.

Catalina Durán Calderón, a citizen of Colombia, is a research consultant in the Fiscal Management Division of the Inter-American Development Bank. She holds a master's degree in economics from Universidad del Rosario, Colombia.

Gregory Elacqua, a citizen of the United States, is a principal economist in the Education Division of the Inter-American Development Bank, where he coordinates the division's knowledge cluster. He holds a PhD in public policy from Princeton University, United States.

María Fernanda García Agudelo, a citizen of Colombia, is a consultant in the Health, Nutrition, and Population Division of the Inter-American Development Bank. She holds a master's degree in economics of public policy from the Universidad del Rosario, Colombia.

Matteo Grazzi, a citizen of Italy, is a lead sector specialist in the Strategic Operational Quality Review Division of the Inter-American Development Bank. He holds a PhD in international law and economics from Bocconi University, Italy.

Bridget Hoffmann, a citizen of the United States, is a sector principal advisor in the Climate Change and Sustainable Development Sector of the Inter-American Development Bank. She holds a PhD in economics from Northwestern University, United States.

Daniel Jaramillo Calderon, a citizen of Canada and Ecuador, is a consultant in the Citizen Security Division of the Inter-American Development Bank. He holds a PhD in economics from the University of British Columbia, Canada.

David Scott Kaplan, a citizen of the United States, is a lead labor market specialist in the Social Protection and Labor Markets Division of the Inter-American Development Bank. He holds a PhD in economics from Cornell University, United States.

Philip Keefer, a citizen of the United States, is the president of the Ronald Coase Institute, and previously served as the principal economic advisor in the Institutions for Development Sector at the Inter-American Development Bank. He holds a PhD in economics from Washington University in St. Louis, United States.

Nazly López-Peña, a citizen of Colombia, is a digital government research consultant in the Institutional Capacity of the State Division of the Inter-American Development Bank. She holds a PhD in economics from Universidad del Rosario, Colombia.

Alessandro Maffioli, a citizen of Italy, is the managing director of Development Effectiveness at IDB Invest. He holds a PhD in production and development economics from the University of Insubria, Italy.

Arturo Muente Kunigami, a citizen of Peru, is a lead modernization of the state specialist in the Institutional Capacity of the State Division of the Inter-American Development Bank. He holds a master of business administration from the Goizueta Business School, Emory University, United States.

Jennifer Nelson, a citizen of the United States, is a senior digital health specialist in the Health, Nutrition, and Population Division of the Inter-American Development Bank. She holds a master's degree in public health from Case Western Reserve University, United States.

Ariel Nowersztern is a lead specialist in the Institutional Capacity of the State Division of the Inter-American Development Bank. He holds a master of science degree in management sciences.

David Ortigosa Izquierdo, a citizen of Spain, is a senior specialist in digital transformation in the Citizen Security Division of the Inter-American Development Bank. He holds a master's degree in information systems and technologies for public administration from Menéndez Pelayo International University, Spain.

Laura Ospina, a citizen of Colombia, is an economic consultant in the Fiscal Management Division of the Inter-American Development Bank. She holds

a master's degree in public policy and management from Carnegie Mellon University, United States.

Marcelo Zouain Pedroni, a citizen of Brazil and Italy, is a senior economic specialist in the Research Department of the Inter-American Development Bank. He holds a PhD in economics from the University of Minnesota, United States.

Santiago M. Perez-Vincent, a citizen of Argentina, is a professor in the Department of Economics at Universidad de San Andrés in Argentina. He holds a PhD in economics from Bocconi University, Italy.

Gerardo Reyes-Tagle, a citizen of Mexico, is a principal fiscal economist in the Fiscal Management Division of the Inter-American Development Bank. He holds a PhD in economics from George Washington University, United States.

Nadia Rocha, a citizen of Colombia and Italy, is a principal economic advisor in the Vice Presidency for Countries and Regional Integration of the Inter-American Development Bank. She holds a PhD in international economics from the Graduate Institute of International and Development Studies in Geneva, Switzerland.

Benjamin Roseth, a citizen of the United States, is a senior modernization of the state specialist in the Institutional Capacity of the State Division of the Inter-American Development Bank. He holds a master's degree in international relations from Columbia University, United States.

Julieth Santamaria, a citizen of Colombia, is a regional economist in the Country Department of the Southern Cone of the Inter-American Development Bank. She holds a PhD in applied economics from the University of Minnesota, United States.

Gabriel Scattolo, a citizen of Argentina, is a consultant in the Productivity, Trade, and Innovation Sector at the Inter-American Development Bank. He holds a bachelor's degree in economics from the Universidad de Buenos Aires and is a master's candidate in economics at the Universidad Nacional de La Plata, Argentina.

Yuri Suarez Dillon Soares, a citizen of Brazil and the United States, is the principal impact officer of the Inter-American Development Bank's IDB Lab. He holds a PhD in economics from Michigan State University, United States.

Rodolfo Stucchi, a citizen of Argentina, is the chief of operations of the Inter-American Development Bank in Brazil. He holds a PhD in economics from Universidad Carlos III de Madrid, Spain.

Miguel Talamas, a citizen of Mexico, is an economist in the Research Department at the Inter-American Development Bank. He holds a PhD in managerial economics and strategy from Northwestern University's Kellogg School of Management, United States.

Luis Tejerina, a citizen of Bolivia, is a principal specialist in the Social Protection and Labor Markets Division of the Inter-American Development Bank. He holds a master's degree in economics from the University of Maryland, United States.

Carolina Tojal Ramos dos Santos, a citizen of Brazil, is a specialist in the Research Department of the Inter-American Development Bank. She holds a PhD in economics from the University of Michigan, United States.

Fernando Vargas, a citizen of Chile, is a senior specialist in the Competitiveness, Technology, and Innovation Division of the Inter-American Development Bank. He holds a PhD in economics and governance from Maastricht University, the Netherlands.

Diego A. Vera-Cossio, a citizen of Bolivia, is a senior economic specialist in the Research Department of the Inter-American Development Bank. He holds a PhD in economics from the University of California, San Diego, United States.

Paula Vera Pérez, a citizen of Chile, is a consultant in the Research Department of the Inter-American Development Bank. She holds a master's degree in economic analysis from the Universidad de Chile, Chile.

Razvan Vlaicu, a citizen of the United States, is a senior economist in the Research Department of the Inter-American Development Bank. He holds a PhD in economics from Northwestern University, United States.

Christian Volpe Martincus, a citizen of Argentina and Italy, is the principal economic advisor in the Productivity, Trade, and Innovation Sector of the Inter-American Development Bank. He holds a PhD in economics from the University of Bonn, Germany.

Patricia Yañez-Pagans, a citizen of Bolivia and Spain, is the director of Development Impact Intelligence in the Development Effectiveness Division of IDB Invest. She holds a PhD in applied economics from the University of Wisconsin–Madison, United States.

1

The Artificial Intelligence Dividend: Promise, Paradox, and Policy

Artificial intelligence (AI) has emerged as one of the most consequential technologies of our time. For Latin America and the Caribbean, the central question is whether it can help reverse one of the region's most persistent challenges: six decades of weak productivity growth. This book argues that AI offers an opportunity to change that trajectory. Realizing this potential requires understanding why digital technologies have, so far, diffused slowly across the region, what economic forces hold back their adoption, and what policies can help overcome those barriers.

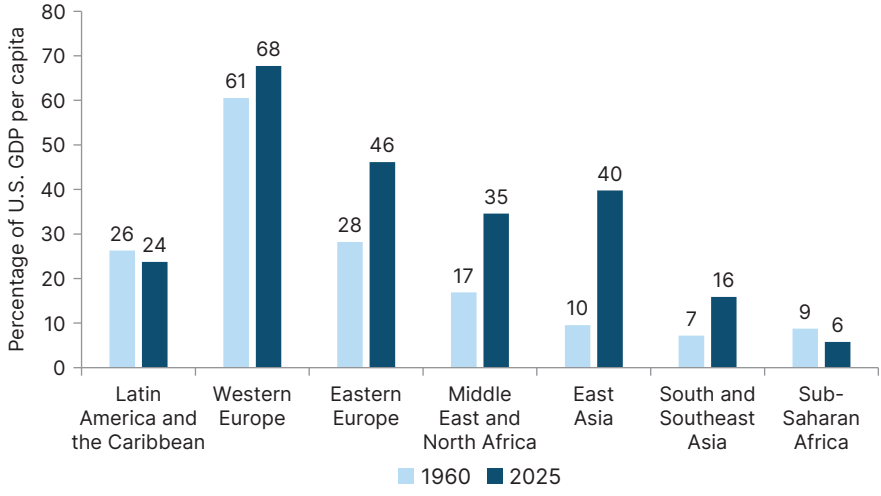
The ambition extends beyond catching up: AI could allow the region to leapfrog toward more productive ways of operating firms, running governments, and delivering public services. Doing so requires more than introducing new tools into existing activities; it calls for redesigning processes and making complementary investments in skills, data, and infrastructure. Countries that establish the enabling conditions and promote innovation and diffusion in both the public and private sectors, while preparing for potential disruptions, can secure a sizable AI dividend. Those that fail to act risk falling further behind.

The Challenge: Six Decades in a Low-Productivity Trap

For some 60 years, Latin America and the Caribbean has been stuck in a low-productivity trap (Alviarez et al. 2025). Regional gross domestic product (GDP) per capita stood at just 24 percent of the U.S. level in 2025, down from 26 percent in 1960 (Figure 1.1). Almost all other regions, in contrast, converged significantly. The Middle East and North Africa, for instance, rose from 17 percent to 35 percent of the U.S. level, while East Asia rose from 10 percent to 40 percent. This stagnation in relative GDP per capita reflects a deeper problem of weak productivity growth across firms, supply chains, and the public sector.

Beyond GDP, the region trails on important development indicators. In education, 76 percent of the region's 15-year-old students do not achieve basic

Figure 1.1. GDP Per Capita Relative to the United States, 1960 versus 2025, by Region



Source: IDB staff calculations, based on the Maddison Project Database, 2023, and the World Development Indicators, World Bank, 2026.
Note: Reported values are population-weighted averages across countries with available data. GDP per capita is measured in 2011 international dollars at purchasing power parity. Values for 2025 are estimated by extending each country's 2022 level of GDP per capita from the Maddison Project Database, including that of the United States, with annual growth rates of real GDP per capita for 2023–25 from the World Development Indicators. The sample includes the same 135 countries in 1960 and 2025. Estimates for Latin America and the Caribbean are based on Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, and Venezuela.

math proficiency, compared with 31 percent in Organisation for Economic Co-operation and Development (OECD) countries outside Latin America and the Caribbean (OECD 2026b). In health, life expectancy is about five years lower than in advanced economies (OECD and World Bank 2023), and avoidable mortality remains high (OECD 2025b). In public safety, the homicide rate of 18 per 100,000 inhabitants is about three times the global average of 5.6 (UNODC 2023). These deficits point to a problem of public as well as private sector productivity, since education, health, and public safety depend heavily on how effectively governments deliver services. Any credible policy agenda, therefore, must raise productivity in firms and in the state.

The Promise: Leapfrogging the Productivity Trap

Can new technologies—especially AI—help the region break out of this trap? AI can accelerate the region's growth by raising productivity in both the private and public sectors. In the private sector, these gains operate through three main channels, explored in Chapter 2.

First, task reallocation and labor augmentation change how tasks are divided between workers and machines. Machines may displace workers from some tasks, augment their productivity in others, and create new tasks, occupations, and goods that raise demand for labor.

Second, capital augmentation raises output without directly changing which tasks workers and machines perform. Cheaper and better digital capital allows firms to use more capital per worker, while lower transaction costs make it easier for buyers and sellers to find each other and expand markets.

And, third, innovation expansion and acceleration increase the pace at which new products and processes are created. By lowering the cost of research and development (R&D) and serving as a new method of invention, AI can raise not only the level of total factor productivity (TFP) but its long-run growth rate. Innovation also creates new tasks, reinforcing the demand for workers under the first channel.

Realizing and broadly distributing these gains will require that firms and public institutions adopt and effectively use AI; that technology diffuse across the economy; and that workers and resources move toward more productive activities. Broader market and institutional conditions should give firms incentives to adopt, innovate, and improve their performance, while allowing resources to move toward their most productive uses. Competition is one important part of this environment. Weak competition reduces firms' incentives to innovate and adopt new technologies, as reflected in the region's low investment in R&D relative to advanced economies (Alviarez et al. 2025). Without this broader enabling environment, AI risks being layered onto existing structural weaknesses, limiting its aggregate impact and the diffusion of its gains across firms and workers.

Estimates of the potential gains from part of the first channel, the displacement and augmentation of workers in existing tasks, are substantial over a 10-year horizon. Under a high-adoption, high-productivity impact scenario, in which AI is adopted in 80 percent of tasks exposed to it and raises productivity in those tasks by 40 percent, the region's TFP could increase by 2.3 percent and its GDP by 5.1 percent after a decade. Country GDP gains range from 4.3 percent in Ecuador to 6.1 percent in Argentina (Table 1.1). These contrast with gains under a low-adoption, low-productivity impact scenario, in which AI is adopted in 11.5 percent of exposed tasks and raises productivity in those tasks by 13.5 percent. GDP then rises by only 0.3 percent, on average, after a decade, with country estimates ranging from 0.2 to 0.3 percent. The contrast highlights how strongly the potential gains from AI depend on the breadth of its adoption and the productivity improvements it delivers in the tasks for which it is used. Policy could, therefore, play an important role by helping firms and public agencies adopt and use AI effectively.

Table 1.1. Cumulative 10-Year GDP Gains under Two Scenarios (percent)

Country	Low adoption, low productivity	High adoption, high productivity
Argentina	0.3	6.1
Colombia	0.3	5.7
Costa Rica	0.3	5.6
Chile	0.3	5.4
Peru	0.3	5.2
Dominican Republic	0.3	5.2
Brazil	0.3	5.1
Panama	0.3	5.1
Mexico	0.2	5.0
Honduras	0.2	4.9
El Salvador	0.2	4.7
Guatemala	0.2	4.4
Ecuador	0.2	4.3
Latin America and the Caribbean	0.3	5.1

Source: Douenne, Pedroni, and Schweitzer (forthcoming), Figure 5.
Note: The table shows the simulated cumulative increase in gross domestic product (GDP) under a low-adoption, low-productivity impact scenario and a high-adoption, high-productivity impact scenario. GDP gains assume a 10-year capital adjustment period (Acemoglu 2025). The estimates for Latin America and the Caribbean are unweighted averages across the 13 countries included.

These potential gains do not necessarily imply that the region will narrow its income gap with the United States; that will also depend on how quickly the United States adopts AI. In 2025, the region's GDP per capita stood at about 24 percent of the U.S. level (Figure 1.1). If the United States adopts AI rapidly while the region does not, this ratio could fall further, to about 23 percent—a small decline, but one that would extend six decades of limited convergence.

The effects on workers exposed to automation depend on how workers and resources adjust across the economy. If, under the high-adoption, high-productivity impact scenario, market and institutional conditions inhibit labor mobility, lower demand for workers in exposed tasks outweighs the wage benefits generated by higher productivity. In every country examined, estimated wages decline by between 14 and 21 percent over a decade. When workers can move from shrinking to expanding activities, however, whether across jobs, occupations, or sectors or by taking on new tasks within their current jobs, the estimated wage effects instead become positive, ranging from 2.3 to 5.3 percent. The difference between these outcomes, a reallocation gap of about 19 to

26 percentage points, shows that workers' ability to move toward expanding activities is crucial for translating aggregate productivity gains into higher wages. Realizing these gains will require policies that facilitate labor mobility, avoid tax and regulatory distortions that encourage excessive automation, support current workers through reskilling and social protection, and adapt education systems to prepare the next generation for an AI-shaped labor market.

The effects of AI are also likely to be distributed unevenly because workers differ both in their exposure to AI and in their opportunities to benefit as the economy adjusts. Tertiary-educated workers are the most exposed, reflecting their concentration in cognitive tasks that AI can increasingly perform. Women tend to be more exposed than men of the same age and education, particularly among tertiary-educated workers, while differences by age are relatively small. As the economy adjusts, some workers with lower levels of education may gain because they face lower displacement risk and benefit from the demand expansion that accompanies higher output, while some highly exposed groups may recover only part of their initial wage decline. Formal workers are more directly exposed than informal workers, although the latter can be affected indirectly through economy-wide adjustments and sectoral spillovers. These patterns suggest the gains from AI may not be shared evenly.

Informality, which accounts for more than half of employment in the region, also limits the gains, since informal firms are less likely to adopt digital technologies and have weak links to the supply chains and networks through which they spread, while inadequate unemployment insurance and training systems could push displaced formal workers into informality.

These estimates indicate the cumulative effects of automating some tasks and increasing workers' productivity in others, but they exclude the creation of new tasks and two channels that could further increase growth: capital augmentation, through cheaper and better digital capital and lower transaction costs, and accelerated innovation. While these additional channels could amplify the estimated gains, particularly if AI accelerates innovation and raises long-run productivity growth, the overall magnitude of the effects of AI on GDP growth remains highly uncertain (Jones 2026).

Gains from innovation, however, will depend on greater investment in domestic R&D, which in Latin America stood at 0.7 percent of GDP in 2018, as compared to a global average of 1.8 percent (UNESCO 2021). They will also depend on stronger skills, including managerial capabilities, which are scarce in many of the region's firms (Cirera et al. 2021; Cusolito and Maloney 2018), and on the pool of future researchers, which may be influenced by access to tertiary education. In 2024, the gross tertiary enrollment rate in Latin America and the Caribbean stood at 59 percent, compared to 79 percent in OECD countries (World Bank 2026).

The potential gains from AI extend beyond firms and labor markets to the public sector. This matters because many of the development deficits discussed above reflect limitations in state capacity and the delivery of public services. Simulations across selected applications suggest AI-based algorithms, when deployed effectively, could generate substantial improvements in the quality, targeting, and efficiency of public services. According to Chapter 7, AI applications for social protection programs in Colombia and Costa Rica could improve the targeting of cash transfers to poor households, reducing exclusion errors—the share of poor households that do not receive transfers—by 17 percent and 26 percent, respectively, without increasing existing budgets (Noriega-Campero et al. 2020).

Sizable gains could also emerge in public safety. Chapter 9 explains how, in Colombia, the PRiSMA tool uses machine-learning models trained on judicial, arrest, and incarceration records to estimate the likelihood that individuals facing pretrial detention will reoffend. The system could help judges and prosecutors distinguish between higher- and lower-risk cases, improving decisions on pretrial detentions. Simulations suggest that applying these risk assessments could reduce recidivism by 25 percent without increasing detention rates. These gains, however, depend on interoperable data across police, prosecution, and prison systems, as well as institutional and governance arrangements that support transparency, auditing, and independent evaluation. That PRiSMA is not currently in use reinforces the point that realizing the gains from AI calls for more than developing an effective model; it requires the data systems, governance arrangements, and institutional capacity needed to embed it in decision making (Mejía 2025b).

Simulated gains may diverge from real-world effects, since they do not account for how individuals or institutions may change their behavior once a tool is introduced. Even so, the broader implication is clear. In policy areas where prediction, targeting, and risk assessment are central to outcomes, AI could improve the quality and efficiency of public service delivery, allowing governments to deliver better services at the same fiscal cost or maintain current outcomes with fewer resources.

These projections do not emerge independently of broader technological and institutional conditions. AI systems depend on the existence of digital infrastructure that generates, organizes, and makes information usable at scale. Digitalization, which involves the collection, storage, standardization, and processing of digital data, improves the efficiency of tasks based on explicit rules and codified procedures, such as transactions, record management, logistics, and administrative processing. AI builds on that digital foundation through three main uses: Predictive AI generates predictions, classifications, and recommendations; generative AI creates text, images, and other content; and agentic AI plans

Table 1.2. Digitalization and AI: Core Functions and the Tasks Each Enhances

	Digitalization	+AI
Core function	Collects, processes, stores, and transmits information	Makes predictions, generates content, takes actions toward goals
Type of tasks enhanced	Tasks that follow explicit rules *Filing, transactions, data entry*	Tasks needing inference and judgment *Diagnosis, advice, analysis, creative work*

Source: IDB staff.

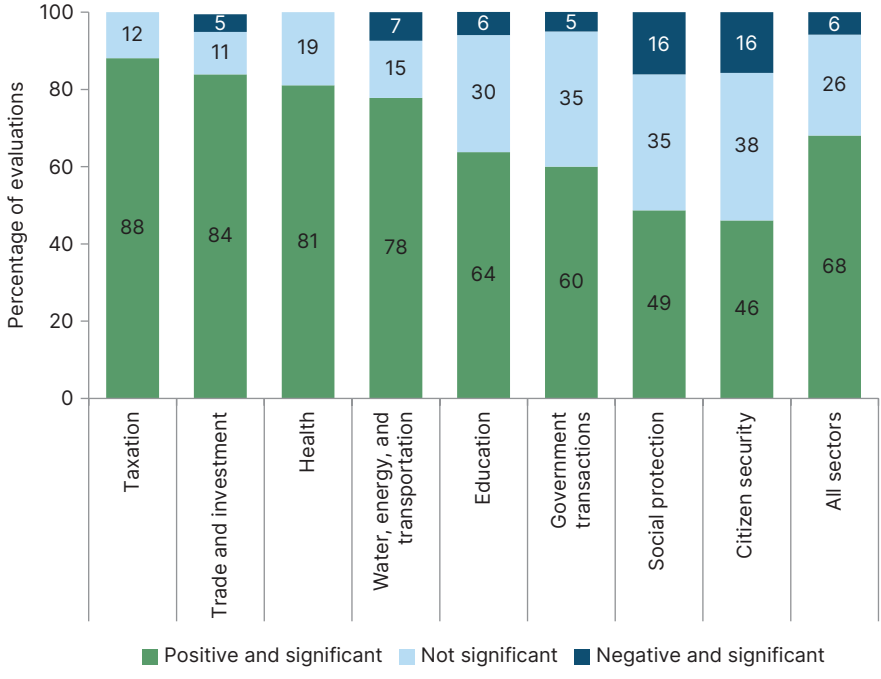
and carries out sequences of actions toward defined goals (Table 1.2). In this sense, digitalization enables, while AI amplifies.

The distinction is important because the economic and institutional impact of AI depends on the maturity of the underlying digital ecosystem. Countries and sectors with more advanced digitalization are better positioned to integrate AI into production processes and public service delivery, since the performance of AI systems is conditioned on the quality, interoperability, and availability of data. Digitalization provides the informational infrastructure on which AI operates, while AI increases its value by improving predictions and targeting, generating content, and planning and executing actions toward defined goals.

The good news is that digitalization is not an untested premise; it is already delivering positive results. Causal evidence compiled for this book shows that digital technologies have generated measurable gains across a range of sectors.[1] The evidence base remains dominated by digitalization, as only 2 percent of the impact evaluations focus on AI applications. Across 188 rigorous causal evaluations of digital technology interventions in eight sectors in developing countries, 68 percent are found to have had positive and statistically significant effects on outcomes, while only 6 percent produced negative and significant effects. The most positive results are observed in taxation, where 88 percent of the evaluated interventions produced positive and significant effects, followed by trade and investment at 84 percent, health at 81 percent, and water, energy, and transportation at 78 percent (Figure 1.2). While these findings are typically based on specific applications rather than broader systemwide digital transformation initiatives, they demonstrate the potential of digital technologies to improve development outcomes and suggest that digital systems augmented by AI could deliver even larger gains.

[1] This evidence is compiled and organized in the IDB Digital Impact Dashboard, an online companion to this book that allows users to search for evaluations of digital technology applications by sector, outcome, and country.

Figure 1.2. Effects of Digital Interventions in Developing Countries



Source: IDB staff calculations, based on the IDB Digital Impact Dashboard, 2026.
Note: The dataset compiles 188 impact evaluations of digital technology interventions in developing countries across the eight sectors shown in the figure. Developing countries are defined as those classified by the International Monetary Fund as emerging market economies or low-income developing countries. It includes studies published since 2012 that use rigorous empirical methods to estimate causal effects on development outcomes. Studies were selected based on predefined eligibility criteria, including the presence of a comparison group and minimum sample size requirements. See Velasco et al. (2026) for details.

The experiences of different sectors show how digitalization generates benefits of its own while creating opportunities for AI to add further value. Trade, education, and water illustrate how digital tools can reduce information frictions, lower transaction and monitoring costs, and streamline service delivery and operations. AI can then build on these digital foundations to improve prediction, targeting, personalization, content generation, and decision making.

In trade, as discussed in Chapter 14, evidence from Costa Rica shows that introducing an electronic single-window system, which allows firms to submit export documentation through a single digital platform, has substantially reduced administrative border processing costs. The reform increased export values by 46 percent, raised the number of exporting firms, and generated additional gains when trading partners adopted compatible systems, reflecting strong cross-border network effects. The underlying mechanisms included faster administrative processing, lower compliance costs, and greater predictability in

trade transactions. AI could extend these gains further by making risk management systems more effective and optimizing logistics, thereby improving the efficiency of border operations and supply chains (Carballo et al., forthcoming; Volpe Martincus 2016).

In education, as Chapter 5 shows, digital technologies already show strong effects when used to complement, rather than substitute for, teachers. Evidence from developing countries indicates digital learning platforms that complement teacher instruction have increased student learning by the equivalent of 31–46 percent of a typical year's learning, with the largest gains observed in math. AI could deepen these gains by enabling more adaptive and personalized instruction, helping teachers to tailor lesson plans, monitor student progress in real time, and identify students at risk of falling behind before learning deficits widen (Arias Ortiz et al. 2025).

In the water sector, according to Chapter 8, digitalization can improve service delivery by enabling utilities to track consumption, identify losses, and detect irregular connections. Better metering and digital billing systems generate more accurate information on water use, improving accountability, billing, and incentives for efficient consumption. These digital records also provide a foundation for AI applications that could help detect anomalies and prioritize inspections. Whether these applications improve on standard procedures, however, requires careful evaluation and depends on data quality, integration into operational routines, and coordination between analytical and field teams.

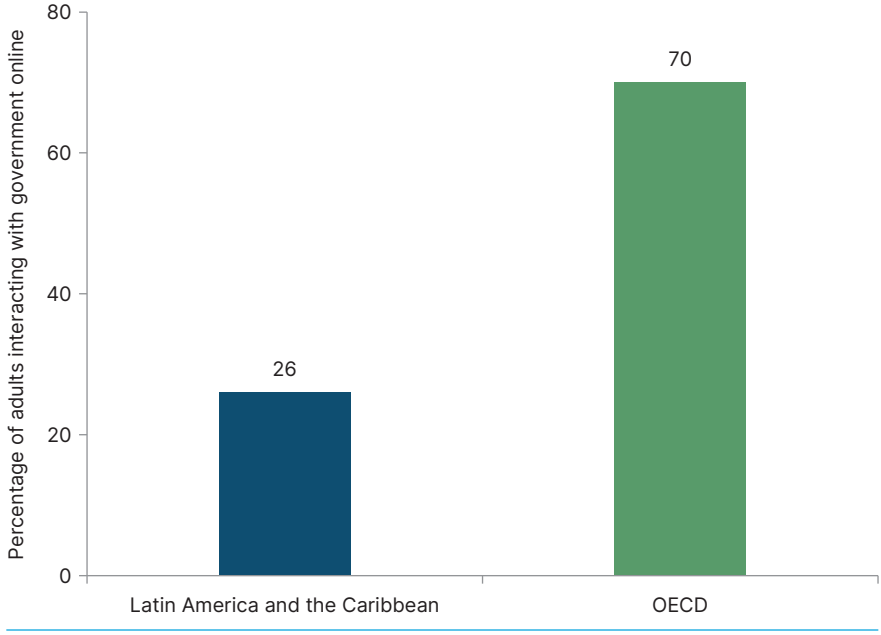
Taken together, these examples show why the digital foundation matters. AI's potential gains depend on systems that already generate usable data, standardized processes, and actionable information. This complementarity creates scope for countries to move from basic digital adoption toward more adaptive, predictive, and efficient systems.

The Paradox: High Potential, Limited Adoption

Despite the gains demonstrated from digitalization, adoption across Latin America and the Caribbean remains shallow. Firms, governments, and individuals use digital technologies primarily for basic activities, with limited integration into more complex and productive uses. Diffusion of AI, with its broader potential, is at an even earlier stage. Although applications are expanding, organizations are still learning how to integrate the technology into their operations. Measurable effects will take time to emerge. Yet the limited diffusion of AI reflects more than its novelty; it also reflects the shallow digitalization on which it builds. Effective AI use depends on supportive institutional conditions, relevant skills, reliable data, adequate digital infrastructure, and complementary capabilities. Weaknesses in these foundations inhibit both the diffusion of AI and the translation of its technological potential into productivity and development gains at scale.

As discussed in Chapter 3, the digital foundation of government is still incomplete. Only 26 percent of adults report having interacted with government digitally in the previous three months, compared with 70 percent in the OECD (Figure 1.3). This gap is far wider than that in internet use: About 83 percent of the region's population is online, compared with 93 percent in OECD countries. Access, therefore, does not appear to be the main constraint. These patterns show that deploying AI at scale will require the region to accelerate its digitalization agenda, including strengthening the digital foundation and expanding the availability and use of digital public services. These digitalization gaps constitute a major constraint on the region's ability to realize the potential gains from AI.

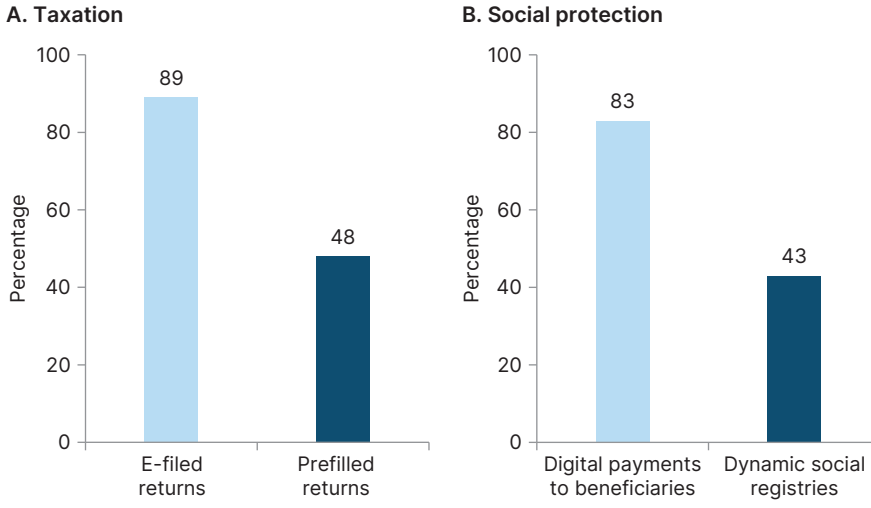
Figure 1.3. Online Interactions with Government across Country Groups



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD, and the ITU DataHub, 2022–25 (latest year available), for OECD countries not covered by Eurostat.
Note: The figure shows internet use for online interactions with government within the three months preceding the survey. The survey question asked, "Did you carry out any transaction with a government agency online, such as downloading or filling out forms or making payments to the government?" Reported values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. The estimate for Latin America and the Caribbean is based on Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. The sample for Latin American and Caribbean countries includes adults ages 18 and older. See note to Figure 3.4 (Chapter 3) for further details about the sample. OECD estimates combine Eurostat data (individuals ages 16 and older) with ITU data, and exclude Latin American and Caribbean countries.

Where governments have advanced, they have often digitalized the customer interface but moved more slowly to digitalize the data beneath it. In taxation, as Chapter 10 documents, 89 percent of personal income tax returns are filed online, yet only 48 percent of countries provide prefilled returns—forms already populated with taxpayer information drawn from integrated data sources (Figure 1.4, Panel A). Chapter 7 on social protection reports that 83 percent of beneficiaries receive public assistance through digital payments, yet only 43 percent of countries operate dynamic social registries, which are the back-end data infrastructure that lets governments target programs accurately and respond to shocks (Figure 1.4, Panel B). Customer-facing interfaces have been widely digitalized, but the underlying systems that integrate, update, and reuse data remain much less developed, limiting the scope for automation, targeting, and, ultimately, AI.

Figure 1.4. Front-End Digitalization versus Back-End Transformation



Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), for Panel A. For Panel B, calculations are based on Guven, Yeachuri, and Almenfi (2025, Table B.5) and the Global Findex Database, World Bank, 2025.
Note: Reported values are unweighted averages across Latin American and Caribbean countries with available data. Panel A shows the percentage of personal income tax returns filed electronically and the percentage of tax administrations that prefilled personal income tax declarations in 2024. Estimates are based on 18 and 23 Latin American and Caribbean countries, respectively. In Panel B, the estimate for digital payments shows the share of individuals who received government financial support in the 12 months preceding the survey, deposited into a card, a bank, or other financial institution account or a mobile money account in 2024. Within each country, estimates use sampling weights for national representativeness, and the sample includes individuals ages 15 and older; the countries included are Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Mexico, Peru, and Uruguay. The dynamic social registries estimate includes countries whose social registries allow continuous updates and real-time interoperability with administrative data.

Among individuals, AI adoption is still at an early stage, but use is already widespread in parts of the region. The barriers to experimentation are relatively low for chatbot applications, although more advanced uses require greater technical capacity and complementary investments. In 2025–26, 35 percent of adults in Latin America and the Caribbean reported having used generative AI in the previous three months, compared with 44 percent in European OECD countries and 58 percent in the United States.[2] The regional average masks substantial variation. Reported use reaches 54 percent in Argentina, 52 percent in Chile, and 51 percent in Uruguay, placing all three well above the European OECD average (Figure 1.5, Panel A).

AI use for professional purposes is somewhat lower but follows a broadly similar pattern. Among adult workers, 26 percent in Latin America and the Caribbean report using generative AI for work, compared with 27 percent in OECD Europe and 43 percent in the United States, leaving the region close to the OECD Europe average but substantially below the United States. Argentina, Uruguay, and Chile lead the region, with reported use ranging from 35 to 37 percent, while several other countries also exceed the OECD Europe average (Figure 1.5, Panel B). As Chapter 3 notes, these results are important because early deficits in AI use can widen quickly, as the people and firms that begin using AI for work accumulate skills, build complementary processes, and pull further ahead of those that do not.

Many firms have adopted digital and AI tools, but adoption often remains shallow. Websites are now widespread, yet fewer than 40 percent actively use theirs to engage customers, market products, or conduct transactions, indicating adoption does not necessarily translate into effective use (Vilgis, Jordán, and Patiño 2024; Vargas and Muente 2025). Consistent with this pattern, only 27 percent of adults in the region report having made an online purchase in the previous three months, compared with 66 percent in OECD countries.

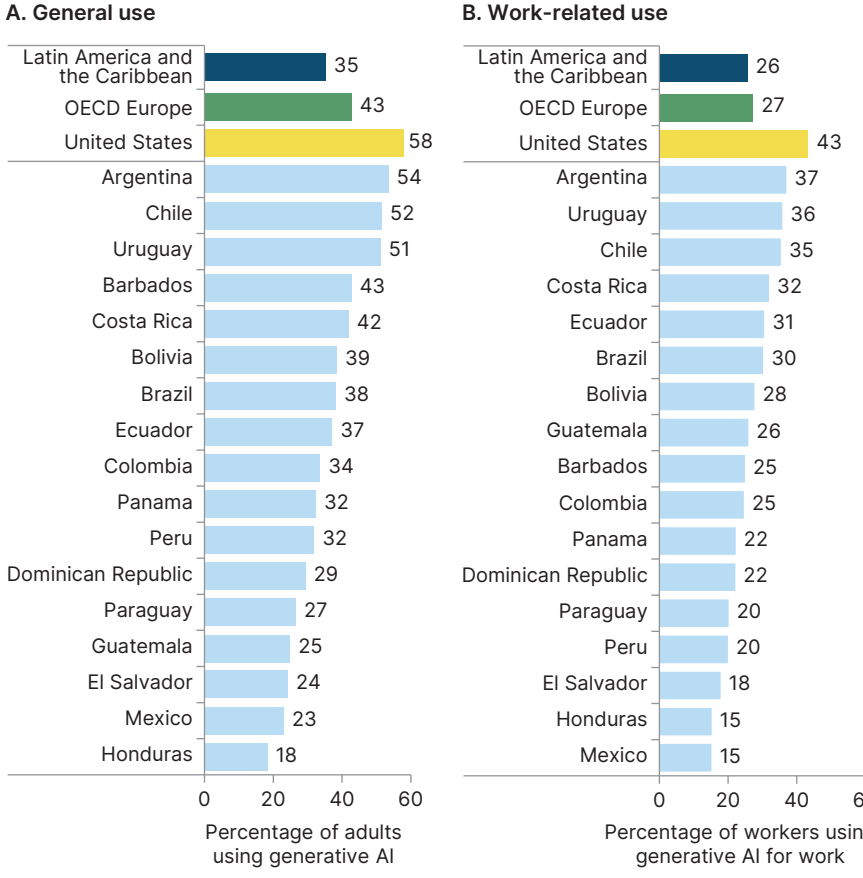
A similar pattern emerges with AI. According to a survey of firms participating in ConnectAmericas, the online business platform created by the Inter-American Development Bank (IDB), generative AI adoption has expanded rapidly, reaching 63 percent by 2025 (Figure 1.6).[3] Most use, however, remains relatively shallow, with 28 percent of firms using generative AI through out-of-the-box applications and 24 percent reporting only minor adaptations. Just 11 percent use advanced customization.

---

[2] As part of the production of this book, harmonized household survey data on internet access, internet use across a broad range of activities, and generative AI adoption were collected in 17 countries in Latin America and the Caribbean. Country-level statistics are available in the IDB Digital Adoption Dashboard, an online companion to this book that allows users to explore patterns of digital adoption and compare countries in the region with international benchmarks.

[3] The survey covers 1,549 firms in 25 Latin American and Caribbean countries participating in the ConnectAmericas platform. Because participation was voluntary and ConnectAmericas firms are relatively digitally engaged, the sample is not representative of firms in the region and likely overstates average levels of generative AI adoption. The estimates should therefore be interpreted with caution.

Figure 1.5. Generative AI Use across Countries



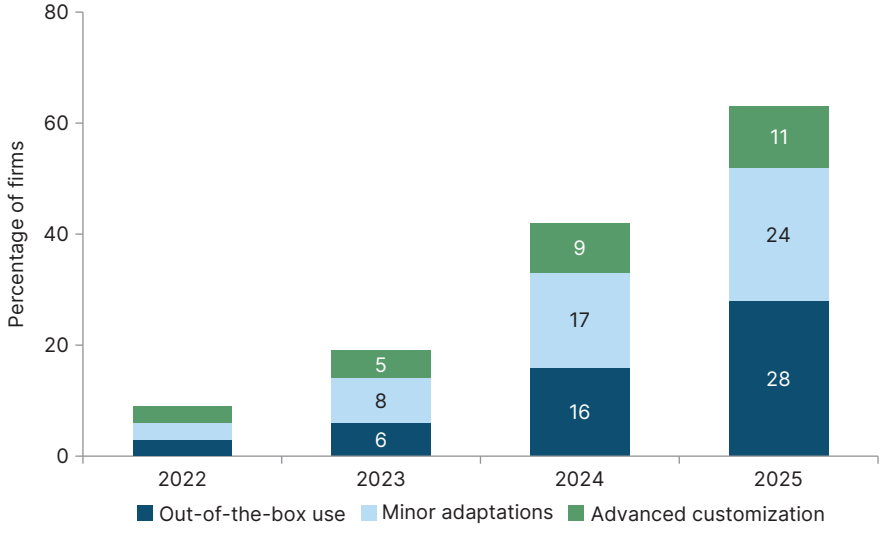
Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. For OECD Europe, calculations are based on Eurostat, 2025, and, for the United States, the Harvard Project on Workforce's Generative AI Adoption Tracker, 2026.
Note: Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. Panel A shows the use of generative AI among adults within the three months preceding the survey. For estimates in Latin America and the Caribbean and the United States, the sample includes adults ages 18–64. For OECD Europe, it includes individuals ages 16–64 and covers European countries that are members of the OECD. Panel B shows the use of AI among workers within the three months preceding the survey. Estimates follow the same country coverage and sample as in Panel A, except for OECD Europe, where the sample is restricted to individuals ages 25–64. Applying the same age range to Latin America and the Caribbean reduces the estimated average use to 24 percent.

The evidence presented in Chapter 13 suggests that while generative AI is spreading quickly as a low-cost entry point for experimentation, it is not yet systematically embedded in firms' production processes, decision making, or organizational routines. More broadly, basic digital applications are increasingly widespread, while more data-intensive and integrated uses remain concentrated among firms with stronger capabilities. Among surveyed firms, for example,

83 percent of microenterprises (those employing up to 10 workers) use cloud-based storage, compared with 92 percent of large firms (those employing more than 250 workers). The difference is much larger for advanced analytics, used by only 37 percent of microenterprises compared with 74 percent of large firms. The challenge, therefore, is not only to encourage adoption of digital and AI tools but to help firms integrate them deeply into their business processes. Such integration could be essential to realizing productivity gains (Brynjolfsson, Rock, and Syverson 2021).

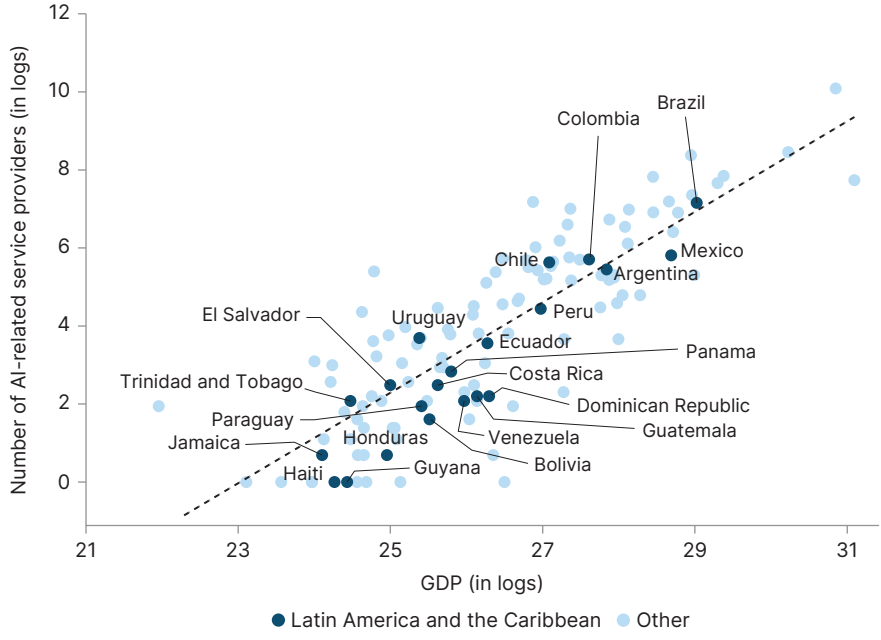
Behind these adoption gaps lies a thin domestic technology ecosystem. As discussed in Chapter 12, the importance of this ecosystem lies not only in supplying digital and AI solutions but in providing the local expertise needed to adapt technologies to local needs and support their effective integration into firms and government operations. Many countries in the region have fewer AI-related service providers than might be expected for the size of their economies (Figure 1.7), reflecting a shortage of domestic firms that can customize solutions, provide specialized services, and help diffuse new technologies across sectors. This limitation is also visible in the size of the digital sector, with computer programming and information services accounting for only 1.1 percent of output in the average Latin American and Caribbean country, compared with 3.2 percent in OECD countries.

Figure 1.6. Depth of Generative AI Use among Firms



Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: The figure shows the cumulative share of firms reporting any generative AI use by year of first adoption and usage mode. The sample covers 1,549 firms in 25 Latin American and Caribbean countries.

Figure 1.7. Prevalence of Companies Providing AI Services



Source: IDB staff calculations, based on data from Crunchbase, 2025.
Note: The figure shows the number of firms offering AI-related solutions. The dashed line indicates the linear fit. Other covers countries and economies outside Latin America and the Caribbean with available data.

In sum, the evidence presented here suggests that, although the region has made important advances, digitalization remains incomplete, transformation is partial, firm adoption lacks depth, and the broader ecosystem remains underdeveloped.

The Explanation: Why Adoption Can Remain Shallow

Why, then, does the adoption of digital technologies and AI remain so shallow in Latin America and the Caribbean, despite their large potential benefits? As general-purpose technologies, digital technologies and AI can be applied across many sectors and activities, creating broad opportunities for innovation and productivity. But deep, productivity-enhancing adoption requires four conditions: complementary investments, sufficient scale, organizational redesign, and the capacity to learn and coordinate under considerable uncertainty.

Like the steam engine, electricity, and computing before them, digital technologies and AI tend to diffuse gradually and unevenly. This uneven diffusion reflects substantial differences across countries in their ability to meet these four conditions. In Latin America and the Caribbean, weaknesses in the foundations for digital transformation, discussed in Chapter 4, together with such structural

features as the prevalence of small firms with limited managerial capacity and access to credit, examined in Chapter 13, leave many countries poorly positioned to meet these conditions. These conditions help explain why adoption often remains shallow even when the potential gains are large.

Complementarity of Inputs

The effectiveness of digital systems, including AI tools, depends on a bundle of complementary inputs arriving together, among which are an adequate regulatory framework, digital skills, connectivity, devices, and stable energy. Provided separately, these inputs generate weak returns; combined, they can generate large impacts. Education technology in the region illustrates this well. Although Peru's One Laptop per Child program raised the ratio of computers per student from 0.12 to 1.18 in targeted schools, it produced no gains in test scores (Cristia et al. 2017; Cueto et al. 2025). The reason was that the widespread distribution of devices achieved by the program was not accompanied by the other changes needed to improve educational activities. In contrast, Chile's Conecta Ideas program paired devices with connectivity, curriculum-aligned software, and structured, teacher-supported sessions, fundamentally changing how technology was used in the classroom and generating large gains in math achievement (Araya et al. 2025).

The contrast illustrates a more general principle: Digital technologies generate their largest returns only when they are deployed together with the complementary inputs needed to make them effective. Skills provide a clear example of why access to AI alone is not sufficient for effective adoption. Adults with tertiary education in Latin America and the Caribbean are more than twice as likely to use generative AI as those with only secondary education (62 percent versus 30 percent), suggesting that access to AI alone is not enough. Individuals also need the necessary skills to integrate these tools into their work and daily activities. As Chapter 4 notes, few governments and firms hold the full set of complementary inputs, which helps explain why adoption remains shallow even where potential gains are large.

Economies of Scale and Scope

Digital technologies exhibit strong economies of scale and scope, making their returns multiply as organizations expand their use. Economies of scale mainly arise because digitalization replaces labor-intensive, per-unit activities with software that requires a large upfront investment but whose marginal cost of serving an additional user is close to zero. Providing printed textbooks, for example, requires purchasing and distributing a new copy for every student, whereas a digital library requires a one-time investment but gives additional students access to the same content at virtually no cost. Economies of scope arise because the

same digital infrastructure and capabilities can be reused across numerous activities and services. A digital identity system, for example, can support tax filing, social protection, health services, and financial transactions, while firms operating across multiple business lines can take advantage of the same cloud infrastructure, software platforms, engineering teams, and AI capabilities to develop a wide range of digital services.

These features make digital adoption more profitable for larger organizations, which can spread fixed costs across more users and extract greater value from shared digital assets. Consistent with this, as Chapter 13 shows, larger firms are systematically more likely to adopt digital technologies (McElheran et al. 2024; Cirera, Comin, and Cruz 2022). This is particularly important in Latin America and the Caribbean, where firms with one to five workers employ 57 percent of the workforce, compared with fewer than 5 percent in the United States (Alviarez et al. 2025).

High informality compounds this scale disadvantage. As Chapter 2 shows, more than half of the region's workers are informally employed, and informal firms tend to operate in low-complexity markets, are excluded from technology financing, and remain largely outside the formal supply chains and professional networks through which technologies and knowledge diffuse. Digital adoption, therefore, tends to be concentrated in larger formal firms, which leaves a substantial share of economic activity beyond its direct reach and limits the diffusion of productivity gains across the economy.

Organizational Redesign

General-purpose technologies pay off only when organizations rebuild how they work around them, and that rebuilding—not the technology itself—is the hard part. The pattern is an old one. When factories first electrified, productivity barely moved until they stopped simply replacing the steam engine with one large electric motor and redesigned production around small electric motors located at individual machines, a transformation that took decades (David 1990). Computing repeated the lesson, as returns came not from hardware investments alone but from the organizational changes firms made alongside them, including redesigned processes and new work practices (Brynjolfsson and Hitt 2000). And the same lesson appears in today's digital transformation. Introducing prefilled tax returns, for example, is not just a matter of digitalizing tax forms. It requires tax administrations to redesign how information is collected, shared, and processed by integrating data from employers, banks, and other third parties into a common system that uses these data to populate taxpayers' returns automatically. In short, the technology is only one component; the productivity gains come from reorganizing workflows around integrated data.

More broadly, redesigning organizations requires reengineering processes, redefining roles, retraining workers, and changing incentives and managerial practices. These changes are costly and disruptive, while their payoff is gradual and uncertain, so many firms and governments choose to layer new technology onto existing ways of working rather than undertake the deeper organizational transformation needed to realize its full productivity potential. In a region characterized by many small firms with limited managerial capacity and restricted access to credit, undertaking this type of organizational transformation can be particularly challenging.

Uncertainty

New technologies create considerable uncertainty regarding both their benefits and their costs. Firms and governments must make large, partly irreversible investments in complementary assets and organizational redesign, yet the returns depend on factors that are difficult to anticipate. When investments cannot easily be reversed, postponing adoption until uncertainty resolves can, therefore, be a rational response, even when the long-run benefits are substantial (Dixit and Pindyck 1994). For general-purpose technologies such as AI, uncertainty also extends to the nature, scale, and distribution of the risks that may accompany adoption, reinforcing the need for experimentation, learning, and institutional adaptation.

The uncertainty has two distinct sources. The first concerns the technology itself. Organizations do not know which technological standards, business models, or organizational practices will ultimately prove most effective, nor how quickly the technology will evolve. Because no established blueprint exists for integrating AI into production processes, organizations learn by experimenting. The knowledge thus generated by early adopters benefits many others, a phenomenon economists refer to as a knowledge externality. But because the private return to experimentation falls short of the social return, firms and governments tend to underinvest in it (Foster and Rosenzweig 1995; Bloom, Schankerman, and Van Reenen 2013).

The second source of uncertainty concerns the behavior of others. The returns to adoption often depend on complementary investments by customers, suppliers, governments, and other organizations through interoperable digital infrastructure, common technical standards, or widespread technology use. When organizations or individuals are uncertain whether others will also adopt, many rationally choose to wait, even though all would be better off if they adopted together. Economists refer to this as a coordination failure: Individually rational decisions to postpone adoption can trap the economy in a low-adoption equilibrium, despite large potential productivity gains (Katz and Shapiro 1985; Cooper and John 1988; Higgins 2024).

The Framework: Three Areas That Must Move Together

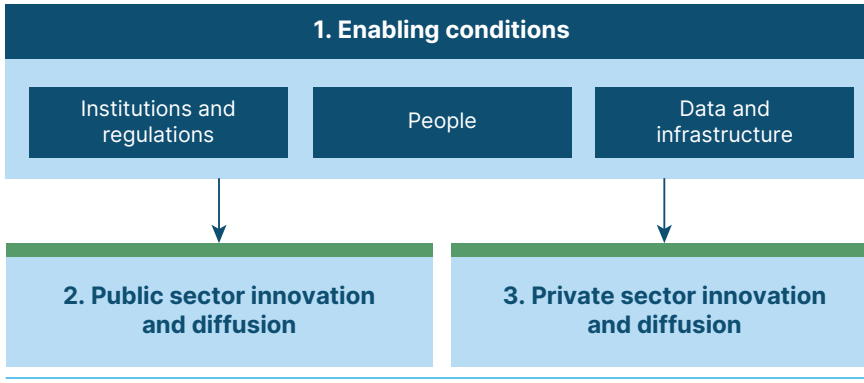
The four conditions described above define the requirements for effective, productivity-enhancing adoption of digital technologies at scale. The importance of complementary factors calls for strong institutions and regulations, adequate skills, and reliable data and infrastructure. Harnessing economies of scale and scope requires shared digital infrastructure and interoperable systems that can be reused across organizations and activities. Organizational redesign requires firms and governments to have the capabilities, incentives, and resources needed to transform how they work. Finally, uncertainty calls for policies that support innovation, experimentation, adaptation, the dissemination of evidence on what works, and the coordination of investments.

Together, these requirements motivate the framework developed in Chapter 4, which organizes coordinated action across three complementary policy areas: establishing the enabling conditions; promoting innovation and diffusion in the public sector; and promoting innovation and diffusion in the private sector.

Enabling Conditions

The first policy area focuses on establishing the enabling conditions for effective digital adoption. These conditions comprise three components. The first, *institutions and regulations*, involves establishing the governance arrangements, legal frameworks, and incentives that enable deep digital transformation. These arrangements provide the legal certainty needed to implement services such as digital payments, electronic signatures, telemedicine, and data sharing while protecting privacy, strengthening cybersecurity, and promoting competition. Because some risks related to AI cannot be fully anticipated, institutions must also be capable of monitoring outcomes and adapting rules and safeguards as evidence and technologies evolve.

Figure 1.8. Policy Framework for Effective Digital Adoption



Source: IDB staff.

The second component, *people*, has to do with developing the necessary human capabilities to adopt digital technologies effectively. Managers, public officials, and workers need the skills not only to use digital technologies but to contribute to organizational transformation by integrating digital tools into production and service delivery and adapting processes, workflows, and managerial practices so technology translates into productivity gains.

The third component, *data and infrastructure*, concerns the connectivity, computing capacity, interoperable data systems, and digital public infrastructure on which digital technologies rely. These investments provide the digital backbone that makes data usable at scale while helping organizations benefit from economies of scale and scope by allowing many users to share common digital assets, spread fixed costs across organizations, and reuse digital capabilities across multiple applications.

Figure 1.9 provides a snapshot of the three components of the enabling conditions in Latin America and the Caribbean. Although several scorecards and composite indices have been developed to benchmark countries' progress in digitalization and AI—such as the ITU (International Telecommunication Union) Digital Development Dashboard and the Oxford Insights Government AI Readiness Index—the purpose here is not to construct a comprehensive measure of digital readiness but, rather, to illustrate some of the dimensions highlighted in the framework. The indicators show that, while the region has already established important elements of the foundations for digital transformation, substantial gaps remain.

On the institutional side, roughly two-thirds of the region's countries have established cybersecurity and data protection agencies, yet only about one-third have adopted a national AI strategy. Among people, only half of adults possess at least basic digital skills, while fewer than one-third demonstrate basic digital problem solving or foundational math skills. The picture is similarly mixed for data and infrastructure. Smartphone ownership is widespread, but fewer than half of countries have developed the core digital public infrastructure or other shared data systems needed to support deep digital adoption.

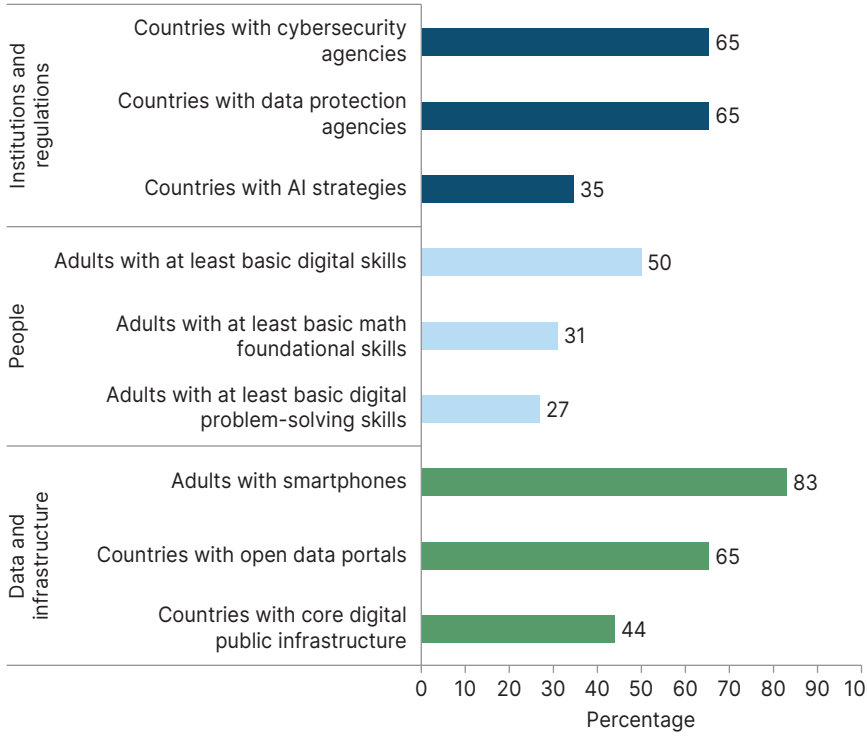
Taken together, these indicators show that, while the region has already put into place important elements of the digital foundation, significant investments in institutions, people, and data and infrastructure remain necessary to realize fully the productivity gains that digitalization and AI can offer.

Public Sector Innovation and Diffusion

Public sector innovation and diffusion involve developing, adapting, and spreading digital solutions that improve public administration and service delivery. Strong enabling conditions make this possible, but individual agencies may still lack the mandate, incentives, and resources to experiment or to reorganize how

they work. The benefits of testing a new approach often extend beyond the agency that bears its costs, while the returns to adoption may depend on complementary investments by other agencies or levels of government. These knowledge spillovers and coordination failures can leave governments with isolated pilots, fragmented systems, and limited learning across institutions. Addressing them is essential for moving from shallow adoption toward the effective integration of digital technologies into public services.

Figure 1.9. Selected Indicators of Enabling Conditions for Effective Digital Adoption



Source: IDB staff calculations, based on the OGDILAC Digital Enablers, IDB, 2026; the Survey of Adult Skills (PIAAC), Cycle 1, 2011–18; the Institute for Innovation and Public Purpose's Digital Public Infrastructure Map, 2025; IDB (forthcoming); and LAPOP AmericasBarometer, 2025–26.
Note: The figure shows unweighted averages across Latin American and Caribbean countries with available data for each indicator. For institutions and regulations and open data portals: Values are the percentages of countries that have the corresponding digital enabler in place (OGDILAC 2026). For people: Values for basic math foundational skills and digital problem-solving skills are the percentages of adults scoring at proficiency Level 2 or above in numeracy and in problem solving in technology-rich environments, respectively, based on the Survey of Adult Skills, Cycle 1 (proficiency ranges from below Level 1 to Level 5); the result for basic digital skills is the percentage of the population with basic ICT skills, based on ITU, 2020, and the Network Readiness Index, 2021; see IDB (forthcoming). For data and infrastructure: The value for adults with smartphones refers to the percentage of individuals reporting ownership of a mobile phone that can connect to the internet, based on data from LAPOP, 2025–26; core digital public infrastructure shows the average percentage of countries with each foundational system in place (digital ID, data exchange, and digital payments), based on the Digital Public Infrastructure Map, 2025.

Public policy can, therefore, support both experimentation and the expansion of proven solutions. Governments can provide funding and institutional support for agencies to develop and test applications, rigorously evaluate their effects and costs, and share the resulting evidence across the public sector. Collaboration with the private sector and universities is essential to developing effective solutions, combining governments' knowledge of public needs with firms' technological capabilities and universities' research expertise. Scaling up successful approaches requires coordinating complementary investments, connecting agencies through interoperable systems and shared digital platforms, and redesigning workflows, responsibilities, and incentives around the technology. Including monitoring and feedback mechanisms in implementation will allow solutions to be adapted as they spread across different settings, with clear accountability and human oversight for high-stakes decisions. Chapters 5–11 examine how these actions can improve public administration and service delivery across sectors, ranging from education and health to taxation and public safety.

Private Sector Innovation and Diffusion

Private sector innovation and diffusion involve developing and adapting digital solutions and spreading their productive use across firms. Strong enabling conditions support these processes, but firms may still invest too little in experimentation because some of the knowledge they generate benefits competitors and other businesses. Adoption can also depend on complementary investments by suppliers, customers, and technology providers, the absence of which may create coordination problems that slow diffusion. These barriers are particularly significant for smaller firms, which often lack the managerial capabilities, technical expertise, and financing needed to identify suitable technologies and integrate them into their operations. As a result, effective use may remain concentrated among a few advanced firms, limiting productivity gains across the economy.

Public policy can, therefore, support the development of solutions suited to local needs and help firms adopt and use them effectively. Collaboration among firms, universities, and research centers can bring technological expertise to practical business challenges, while competitive research funding and support for experimentation can encourage innovations whose benefits extend beyond individual firms. Demonstration projects, digital extension services, and information sharing can reduce uncertainty about effective applications. Targeted financing, combined with diagnostics, technical assistance, and managerial training, can help firms adapt technologies and redesign production processes. Common standards, shared platforms, and business networks can also facilitate coordinated adoption across supply chains. These interventions can address identifiable market failures and be evaluated to establish whether they generate

additional adoption and productivity gains. Chapters 12–14 examine how innovation and diffusion can strengthen the technology sector, raise firm productivity, and expand opportunities through international trade and investment.

Managing Risks

AI adoption will bring risks as well as benefits. Managing them is not about slowing adoption but, rather, about ensuring the gains are broadly shared and countries can sustain investments. Some effects are uncertain and require countries to prepare for disruptions, particularly in labor markets and education.

AI will automate some tasks while expanding others, in some cases creating difficult transitions for workers. As discussed above, the consequences will depend largely on whether workers can move toward expanding tasks, occupations, and sectors. Disruption may be greater if high labor taxes and rigid regulations encourage excessive automation. Managing this risk will require income protection for displaced workers, employment services that link them to new opportunities, and measures to reduce barriers to mobility across jobs, occupations, and sectors.

In addition, education systems will need to adapt to AI-driven changes in skill demand. Because these changes remain difficult to predict, it will be important to strengthen general skills—including literacy, numeracy, analytical thinking, communication, and digital literacy—that support productivity, continued learning, and adaptability across different tasks and occupations. These capabilities can be developed if curricula, teaching practices, and assessments evolve together. Education systems can also help the workforce develop specialized expertise throughout life if they avoid premature, narrow specialization and expand flexible pathways, including short-cycle tertiary programs and opportunities for working adults.

Other risks can be addressed more directly through the institutions and regulations that underpin the enabling conditions in the framework set forth above. Although threats to and responses regarding cybersecurity are known, technological change continually reshapes both. As AI expands the scale and sophistication of digital activity, countries will need institutions that can identify, prevent, and respond to evolving threats. They can mitigate this risk by strengthening national cybersecurity agencies and incident response teams and drawing on private sector expertise where needed.

Growing data collection raises the stakes for effective privacy protection. Ways to manage this risk include building regulatory capacity to weigh privacy costs and benefits, establishing clear rules for accessing, sharing, and reusing data securely in ways that preserve privacy, and adapting safeguards as technologies and evidence evolve.

Also in need of attention are algorithmic bias, market concentration, and institutional control. Algorithmic systems can reproduce or amplify bias, while economies of scale, economies of scope, and network effects can strengthen dominant firms. Consequential automated decisions can weaken transparency, due process, and accountability. Managing these risks requires proportionate, evidence-based regulation; stronger competition and contestability; transparency and auditability; human responsibility for high-stakes decisions; meaningful avenues for explanation and appeal; and independent oversight.

Targeted Applications versus Systemwide Transformation

Why does the framework place so much emphasis on strengthening enabling conditions and promoting innovation and diffusion, rather than simply encouraging the adoption of individual digital applications? The answer is that while isolated targeted applications can generate meaningful benefits, the largest productivity gains come from transforming how entire systems operate. This is not because targeted applications fail to deliver value where conditions are unfavorable. They often deliver value even under these conditions. Even where uncertainty is high, institutions are weak, and data are thin, useful targeted applications can generate value. A mental health app evaluated in Mexico, for example, reduced depression by 20 percent at a cost of six dollars per person (Angelucci, Fabregas, and Vazquez 2026).

But the same feature that makes such applications work under adverse conditions also limits how far their effects reach. Built to ask little of their environment, targeted applications adapt the technology to weak environments rather than inducing the changes in the environment needed to accommodate the technology. They can, therefore, generate value quickly, but they also create little incentive to invest in the interoperable data systems, shared infrastructure, organizational capabilities, and institutional arrangements that deep digital adoption requires. As a result, they forgo the key mechanisms through which digital technologies generate their largest productivity gains. They rarely reach the scale at which fixed costs are spread and returns compound. They do not share data across services, so they capture none of the economies of scope that come from combining information across domains. And because organizations can adopt them without fundamentally changing how they operate, existing workflows, roles, and incentives remain largely intact, so the organizational redesign discussed earlier never takes place. The simplicity that lets a targeted application succeed as a pilot is precisely what keeps it from changing the system around it.

Systemwide change requires the opposite: deployments built on the foundations and spread by diffusion, which capture the key mechanisms targeted applications forgo. The health system in São Paulo, Brazil, based on the "phygital" model explained in Chapter 6, illustrates the difference. It reaches 3.4 million app

users and integrates 1.5 billion health events into a single interoperable layer, realizing the economies of scope that pooled data make possible; and it uses that integrated base to reorganize care, shifting from reactive treatment toward proactive monitoring and management of patients at greatest risk of adverse health outcomes. Scale, scope, and redesign are what the foundations and innovation and diffusion make possible, and together they turn a service that helps individuals into one that reshapes how a health system works. Applied across public services and private production, this is what transforms isolated digital applications into systemwide productivity gains.

The Path Forward: Shared Destination, Country-Specific Routes

The largest productivity gains come from systemwide transformation, but countries differ in the resources and capabilities they can mobilize. The destination—the enabling conditions necessary for digitalization and AI adoption and the spread of effective use across the public and private sectors—is shared. The route must be country specific.

Establishing enabling conditions and promoting innovation and diffusion in the public and private sectors are complementary priorities. Strong enabling conditions support both sectors, while experience developing and deploying digital solutions helps identify where those conditions need strengthening.

The order and pace of reforms should reflect each country's starting point, fiscal space, institutional capabilities, and policy priorities. Countries with tighter constraints can begin with targeted applications that offer high benefit-to-cost ratios while selectively strengthening the conditions those applications need to function effectively. Those with more advanced digital systems and greater resources can move on several fronts at once. Risk management should accompany either route throughout.

Whatever the sequence, the following recommendations establish priorities for each component of the enabling conditions and for each of the two innovation and diffusion areas. Together, they form a set of priorities recommended for all countries in the region. Chapters 5–14 complement them with sector-specific recommendations.

Enabling conditions. Countries should strengthen the institutions that guide digital transformation, develop the skills and foster the initiative needed to drive organizational change, and deploy shared digital services that support adoption across government and firms.

Institutions and regulation: Strengthen institutional capacity to coordinate and advance digital transformation. Countries should designate an authority with the mandate, technical capacity, resources, and political backing to coordinate digital transformation across government. That authority should promote

collaboration across ministries and levels of government, ensure that systems are interoperable, and make procurement more efficient. Countries should also strengthen cybersecurity by building the technical capacity to prevent, detect, and respond to cyber threats and to protect critical systems. Finally, they should assess regulatory needs using sound evidence. New rules to address emerging risks should be adopted only when evidence-based analysis shows that their social and economic benefits outweigh their costs.

People: Develop digital skills among public- and private-sector managers and empower internal innovators. Managers have an outsized influence on how their organizations perform. Building their digital skills can raise organizational productivity and prepare them to lead organizational change: redesigning workflows and putting in place the changes needed to realize technology's benefits. At the same time, organizations should give internal innovators who understand operational challenges the mandate, time, and resources to propose, develop, and test new solutions to drive change internally.

Data and infrastructure: Deploy digital identity, data sharing, and digital payments. These foundational services provide shared capabilities that agencies and firms can use across multiple applications. They generate economies of scale because serving additional users entails minimal marginal costs, economies of scope because the same capabilities support services across multiple sectors, and network effects because their value grows as more users and organizations participate. Secure, interoperable systems with appropriate privacy safeguards help translate these benefits into better services.

Public-sector innovation and diffusion. *Transform public services through reorganization, data integration, and AI.* Governments should simplify procedures and reorganize workflows to improve how public services operate, reducing unnecessary steps and designing services around the needs of citizens and firms. Connecting information across agencies can then provide a fuller view of those needs, support coordinated service delivery, and reduce repeated requests for information. Embedding AI in these integrated systems can help governments anticipate needs, tailor services, and make better operational decisions. Governments should test new approaches, evaluate their effects on service quality and costs, and scale up effective solutions across agencies. Together, these changes can make public services more personalized, proactive, and efficient.

Private-sector innovation and diffusion. *Boost firms' capacity to develop and adopt digital technologies.* Governments should expand STEM and AI education and support applied research partnerships that develop solutions for local needs. To ease implementation barriers, support should combine financing calibrated to market failures with diagnostics, technical assistance, and training

tailored to firms' readiness. Business networks and technology centers, together with policies that facilitate trade and investment, can spread knowledge and effective practices across firms. Governments should evaluate whether these interventions generate additional adoption and productivity gains, using the results to guide decisions about continued funding and expansion.

These priorities define a common policy core while leaving countries room to determine the order, pace, and combination of actions appropriate to their circumstances.

Conclusion

Latin America and the Caribbean has spent 60 years in a low-productivity trap that conventional policy has been unable to overcome. The consequences of that stagnation extend well beyond slow income growth to reach many sectors, including education, health, and public safety. For the first time in decades, however, the region has access to technologies with the potential to raise productivity in firms and the public sector simultaneously.

But aspiration is not destiny. The opportunity will be realized only if countries confront the structural reasons general-purpose technologies are difficult to adopt—the absence of complementary inputs, the need for organizational redesign, scale and scope disadvantages, rational uncertainty, and genuine risks—and they will succeed only if they establish the necessary enabling conditions and promote innovation and diffusion in both the public and private sectors with equal seriousness. None of those obstacles is a law of nature, and every one of them is something policy can affect. AI has the potential to help the region break out of its longstanding productivity trap. Realizing that potential is worth working for.

2

Digital Transformation, AI, and the Path to Inclusive Growth

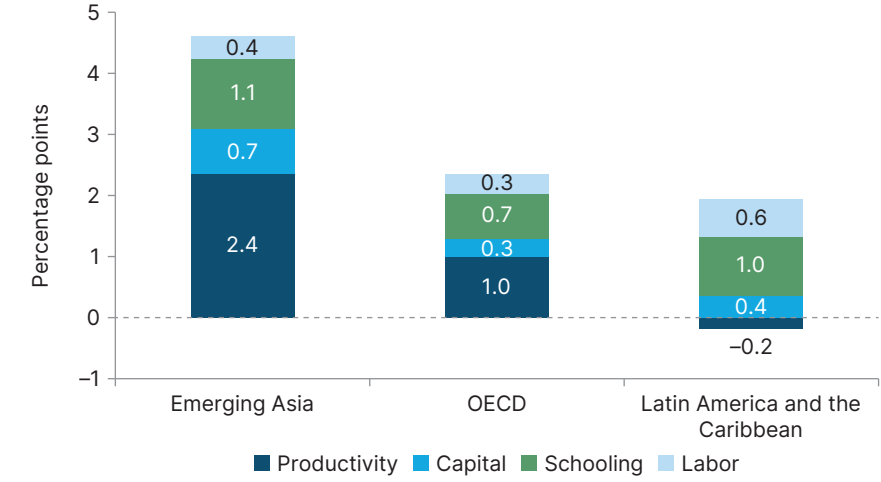
As Chapter 1 shows, the gross domestic product per capita of Latin America and the Caribbean has stagnated relative to that of the United States since 1960, while other regions, primarily emerging Asia, have narrowed the gap substantially (Figure 1.1). The reason is six decades of slow growth: The region's GDP per capita has increased by an average of 1.8 percent per year, compared with 2.3 percent in Organisation for Economic Co-operation and Development (OECD) economies and 4.6 percent in emerging Asia (Figure 2.1, Panel A).[1] This is mainly because the region produces too little with the inputs it has. Growth in aggregate total factor productivity (TFP), the standard measure of how efficiently capital and labor are allocated and combined into output, has been persistently weak (IDBG 2025; Busso, Madrigal, and Pagés 2013; Daude and Fernández-Arias 2010; Restuccia 2013). During this period, TFP contributed about −0.2 percentage points per year to GDP per capita growth, compared with close to 1 percentage point in OECD economies and more than 2 percentage points in emerging Asia. Relative to the United States, and starting from a normalized value of 1 in 1960, the region's TFP fell to about 0.56 by 2023, while emerging Asia's rose to about 1.30 (Figure 2.1, Panel B). At its core, the region's development deficit is, therefore, a productivity deficit.

Central to both this record and the prospects of improving it are labor markets. Part of the productivity shortfall originates there, as an average of more than 55 percent of workers in Latin America and the Caribbean are informal (that is, they are not affiliated with social security). The proportion is close to or above 80 percent in countries such as Bolivia, Honduras, and Peru (Douenne, Pedroni, and Schweitzer, forthcoming). Own-account self-employment is also widespread and concentrated in low-productivity activities (La Porta

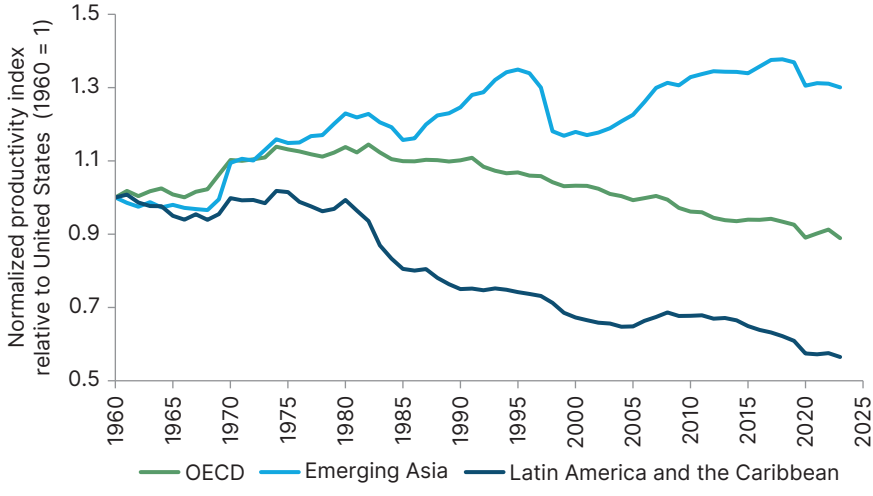
[1] To highlight the role of productivity in a comparative perspective, Figure 2.1 focuses on three regions: Latin America and the Caribbean, emerging Asia, and OECD countries. References to the OECD in this chapter, as throughout the book, exclude member countries in Latin America and the Caribbean.

Figure 2.1. Latin America and the Caribbean's Productivity Deficit

A. TFP and factor contributions to GDP per capita growth, 1960–2023



B. The relative productivity gap of Latin America and the Caribbean



Source: IDB staff calculations, based on Penn World Table 11.00 and Barro and Lee (2013, with data updated in September 2021).
Note: Estimates are unweighted averages across countries with available data. Estimates for Latin America and the Caribbean are based on 26 countries. OECD excludes Latin American and Caribbean countries. Emerging Asia includes China, Indonesia, the Republic of Korea, Malaysia, Singapore, and Thailand. Panel A reports average annual contributions to GDP per capita growth, in percentage points. Panel B reports TFP relative to the United States, normalized to 1 in 1960.

and Shleifer 2014). This can result from distortions created by labor regulations, social insurance, or tax regimes that penalize salaried relative to non-salaried work, thereby keeping wage employment inefficiently low and trapping resources in these activities (Levy 2018). These and other inefficiencies add up

to a large deficit. Labor productivity in Latin America and the Caribbean is about 26 percent of the U.S. level. Therefore, it takes nearly four workers in the region to produce what one U.S. worker does (González-Velosa et al. 2026).

How can the region raise productivity? Important to achieving this goal are *innovation* (the creation of new technologies and processes) and *technology adoption and transformation* (their diffusion across firms that put them to effective use). By allowing firms to produce more output with the same inputs, both can drive productivity and growth, especially in economies well integrated with global markets (Schumpeter 1942; Romer 1990; Aghion and Howitt 1992; Jones 2019). The effects can be large. In the United States between 1948 and 2018, periods with bursts of major inventions were followed by noticeably faster productivity growth of about 0.5 percentage points more per year in the five years that followed each burst (Kelly et al. 2021). Across countries from 1820 to 2000, differences in how technologies spread accounted for about 75 percent of the widening of the income gap between rich and poor countries (Comin and Mestieri 2018).[2]

Against this backdrop, digital technologies and, particularly, artificial intelligence (AI) offer Latin America and the Caribbean a major opportunity to escape its low-growth trap by raising TFP. They also, however, create significant risks. The analysis presented in this chapter yields four main messages in this regard.

First, digital technologies, including AI, affect productivity, employment, wages, and growth through three interacting channels: *task reallocation and labor augmentation*, *capital augmentation*, and *innovation expansion and acceleration*. While some effects operate similarly across successive digital waves—that is, periods of major advancement in digital technologies—others are sharpened or qualitatively altered by AI.

Second, the potential aggregate gains from AI adoption could be substantial. Under reasonable assumptions, and considering only the current state of the technology and the task reallocation and labor augmentation channel, the region's total factor productivity and output could be 2.3 percent and 5.1 percent higher, respectively, after 10 years if countries reach high AI adoption rates and AI substantially raises productivity in completing tasks (the high-adoption, high-productivity impact, or HA-HI, scenario). If, instead, adoption remains low and AI raises productivity only modestly (the low-adoption, low-productivity impact, or LA-LI, scenario), these gains would be just 0.1 percent and 0.3 percent, respectively. Informality could reduce these gains further by weakening the mechanisms through which they spread across the economy, including the diffusion of AI across firms, both directly, because informal firms have limited access to finance, and indirectly, because they participate less in formal supply chains and professional networks.

[2] This is mainly because poorer countries use new technologies less intensively once they arrive, not because they adopt them later.

Third, wage gains from AI depend on the successful reallocation of labor. These gains materialize only if workers can move from shrinking to expanding occupations or sectors or if they shift within their current jobs toward tasks in which they retain a comparative advantage. Without such reallocation, wage effects are estimated to be negative across countries, education groups, and genders. If, instead, workers can move across jobs or across tasks within jobs, wage effects turn positive and sizable for most groups, although some, such as young tertiary-educated women, may still experience small losses. What makes the current situation particularly challenging is that AI-driven displacement is beginning to reach workers who perform nonroutine cognitive tasks, a group for whom existing retraining options are limited. In Latin America and the Caribbean, labor regulations may compound the problem. Where high nonwage costs and dismissal protections already discourage formal wage employment, labor-replacing AI can accelerate the shift away from wage work even when it brings little productivity gain, reinforcing displacement.

Finally, potentially large gains from AI through the creation of new tasks for workers and from innovation more generally depend on complementary conditions that are weak in Latin America and the Caribbean. Research and development spending in Latin America as a share of GDP is just over a third of the global average (UNESCO 2021). Because research also builds the capacity to absorb technologies developed elsewhere, this limited research base is a constraint not only on innovation but on adoption (Griffith, Redding, and Van Reenen 2004). Absorptive capacity, including managerial quality, is also scarce among the region's many small, less productive firms (Cirera et al. 2021; Cusolito and Maloney 2018). As a result, unless these conditions are improved, new tasks may not emerge at the pace adoption requires, and the gains from AI-driven innovation could be smaller and more concentrated in the region than in advanced economies.

How Digital Technologies Affect Economic Performance

Digital technologies create economic value by reducing costs in two conceptually distinct ways. The first, which mainly concerns production, is to reduce the cost of having machines perform tasks. Tasks are the individual activities that go into producing goods and services, such as answering a customer query, drafting a contract, or assembling a part. A job typically combines many tasks, some of which are currently performed by machines and others by workers only. Digital technologies, including AI, reduce the cost of having machines perform tasks along two margins. They enable machines to do things they could not do before (the "capability margin"); and the equipment and software that embody them become cheaper with each generation, encouraging firms to use them more (the "price margin"; Greenwood, Hercowitz, and Krusell 1997; Krusell et al. 2000). The second way

these technologies create value, which mainly concerns interactions among buyers, sellers, and other economic agents, is to reduce transaction costs: the costs of searching for information, transporting information and digital goods, tracking behavior, and verifying identity and reputation. They also make digital goods almost costless to replicate (Goldfarb and Tucker 2019).[3] In addition, AI reduces the cost of prediction—an essential input for making decisions with incomplete information in both production and transactions (Agrawal, Gans, and Goldfarb 2018).

These cost reductions affect the economy through the three interacting channels of task reallocation and labor augmentation, capital augmentation, and innovation expansion and acceleration. In terms of the economy's task structure, these reductions can have three types of effects. Within the existing set of tasks, they can shift the boundary between tasks performed by labor and those performed by machines, or they can raise output at an unchanged boundary by lowering the cost of tasks already performed by workers or machines, including by making both more productive in those tasks. Beyond the existing set of tasks, they can expand the set of tasks and products itself. The size, speed, and distribution of these effects depend on several conditioning factors, presented in Figure 2.2 and discussed below. Underlying all of this, the entire process is shaped by general enabling conditions (institutions and regulations, skills, and digital infrastructure and data) and by factors specific to diffusion in the public and private sectors (such as market and coordination failures, organizational frictions, and the policies that address them), both part of the framework proposed in Chapters 1 and 4.

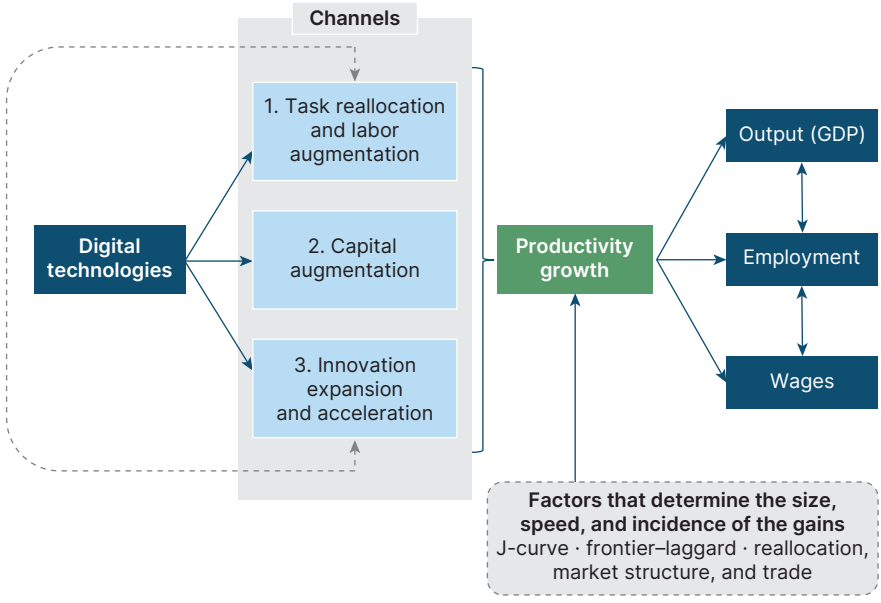
Two layers of effects cut across these channels. A common layer operates across successive waves of digital technology, with each wave deepening the channels opened by its predecessors. An AI-specific layer introduces two qualitatively new features: First, whereas earlier automation mainly affected routine tasks, AI extends automation to nonroutine cognitive tasks, typically performed by more highly skilled workers; and, second, AI can serve as a method of invention in its own right, changing how new ideas are produced.[4]

---

[3] Digital technologies make it cheaper to search for and compare information about products, prices, and potential commercial partners and workers; to move digital goods and information, which changes the role of geography; to track individuals' behavior, allowing firms to tailor products, prices, and advertising; and, through online rating and reputation systems, to verify the reputation and trustworthiness of individuals and firms. They also make digital goods almost costless to copy, and one person's use of these goods does not reduce what is available to others.

[4] Channel 1 corresponds to the task framework of Acemoglu and Restrepo (2018, 2019) and the extensive margin of automation (Zeira 1998); Channel 2 to investment-specific technical change (Greenwood, Hercowitz, and Krusell 1997) and the deepening of automation (Acemoglu 2025); and Channel 3 to endogenous growth through innovation (Romer 1990; Aghion and Howitt 1992), with AI as a method of invention (Cockburn, Henderson, and Stern 2019).

Figure 2.2. Effects of Digital Technologies on Productivity, Output, Employment, and Wages: Transmission Channels



Source: IDB staff.
Note: The box labeled "Digital technologies" reflects the full digital-technology stack (information and communication technologies, internet, robots, platforms, generative AI). Channel 1 comprises three joint forces (displacement, augmentation, and reinstatement) whose direct effects on exposed labor pull in opposite directions; the net effect on employment and wages is the balance of these forces, and its realized sign is set by reallocation within the conditioning layer. Channel 3 operates on the rate of TFP growth, with AI as a method of invention; its dashed loop to Channel 1 indicates that innovation creates the new tasks feeding the reinstatement force.

The rest of this section examines the three channels through which digital technologies and AI affect productivity, employment, wages, and growth; the factors that shape the size, speed, and distribution of these effects; and the role of informality, a conditioning factor of particular relevance to the region.

Channel 1: Task Reallocation and Labor Augmentation

Channel 1, task reallocation and labor augmentation, is where digital technologies, including AI, meet the labor market. It concerns cost reductions that arise as machines become capable of tasks they previously could not perform or as equipment and software become cheaper, and that affect either the distribution of tasks between workers and machines or workers' productivity in the tasks they perform. The effects of these cost reductions on employment, wages, and productivity operate through three forces: displacement, augmentation, and reinstatement.[5]

[5] Reinstatement, the creation of new tasks for workers, links this channel to Channel 3, which examines the broader expansion of tasks and products.

The displacement force. Displacement occurs when machines take over tasks previously performed by workers (Acemoglu and Restrepo 2019). Digital technologies have expanded the range of tasks machines can perform in two domains: a cognitive domain, in which information and communication technologies (ICT) and, more recently, AI perform information-processing tasks, and a physical domain, in which computer-controlled machinery and robots perform manual tasks.[6]

In both domains, computerization first displaced routine tasks—those that can be carried out by following explicit rules. In the United States from the 1970s onward, computerization was associated with a decline in the amount of labor devoted to routine cognitive and routine manual tasks within industries, occupations, and education groups (Autor, Levy, and Murnane 2003). Robots added a further source of displacement in manufacturing: One additional robot per thousand workers reduced the U.S. aggregate employment-to-population ratio by about 0.2 percentage points and wages by 0.4 percent, with larger effects at the local level (Acemoglu and Restrepo 2020). Across 17 developed countries, robots raised labor productivity without significantly reducing total employment, although they reduced the employment share of low-skilled workers (Graetz and Michaels 2018).

Evidence for Latin America and the Caribbean is more limited but also points to displacement. In Argentina, Brazil, and Mexico between 2004 and 2016, robots mainly replaced formal salaried jobs in more exposed districts, particularly among young and semiskilled workers, and informal employment acted as a buffer that prevented a larger increase in unemployment (Brambilla et al. 2023).[7]

Generative AI extends machine capabilities to nonroutine cognitive tasks that earlier technologies could not perform, such as drafting, summarizing, coding, and synthesizing information. An occupation's exposure to large language models—the share of its tasks that these models could perform or substantially speed up—increases with the importance of programming and writing skills in that occupation. Moreover, higher-wage occupations tend to be more exposed (Eloundou et al. 2024). Studies of earlier AI and machine-learning technologies already pointed to displacement. Within firms, tasks more exposed to them in 2010–23 subsequently experienced lower labor demand,

[6] Developments in the two domains overlapped in time rather than following one another. Industrial robots predate the diffusion of personal computers, since the first, Unimate, was produced in 1961 (Gasparetto and Scalera 2019), but their use expanded rapidly from the 1990s (Acemoglu and Restrepo 2020), alongside the spread of ICT.

[7] On average, earlier automation did not polarize labor markets in developing countries as it did in advanced economies, although there are signs of polarization in a few (Maloney and Molina 2016).

although overall employment effects were modest because productivity gains raised the demand for labor at adopting firms (Hampole et al. 2025). Evidence that exposure to GenAI translates into displacement is now emerging. In the United Kingdom, firms more exposed to large language models have reduced employment, with effects concentrated in junior positions, and have sharply curtailed new hiring, with the steepest declines in technical and creative roles (Klein Teeselink 2025). In the United States, since the widespread adoption of GenAI, workers ages 22 to 25 in the most exposed occupations have experienced a 19 percent relative decline in employment, concentrated in occupations where AI automates rather than augments human labor (Brynjolfsson, Chandar, and Chen 2026).

Two qualifications are important, the second especially for Latin America and the Caribbean. First, displacement at the task level does not translate one-for-one into job losses. When new tasks emerge or technology complements workers in the tasks they retain, occupations are reshaped rather than eliminated. In the United States, the spread of automated teller machines did not eliminate bank tellers. By lowering the cost of operating branches, it led banks to open more of them, and tellers shifted toward relationship banking (Bessen 2015a).

Second, displacement need not raise productivity. When the tax system favors capital over labor, firms may automate tasks that bring little productivity gain, displacing workers while reducing efficiency and pushing employment below its socially optimal level (Acemoglu, Manera, and Restrepo 2020). In Latin America and the Caribbean, this is not a theoretical possibility but a central policy concern, because taxes, social insurance contributions, and labor regulations raise the cost of formal salaried employment, as documented for Mexico (Levy 2018). Firms, therefore, face an artificial incentive to replace formal workers with machines, and some displacement may reflect distorted input prices rather than genuine efficiency gains. As AI widens the range of tasks that can be automated, the same distortions could steer adoption toward replacing workers rather than raising productivity.

The augmentation force. Augmentation occurs when technologies make workers more productive, both in the tasks they retain after a technology is introduced and in complementary tasks. In earlier waves of digital technologies, these gains depended on complementary investments. In the United States, firms obtained higher productivity from information technology when they combined it with complementary workplace reorganization (Bresnahan, Brynjolfsson, and Hitt 2002). In Europe, affiliates of U.S. multinationals obtained higher productivity from information technology than those of other multinationals, mainly because of their people management practices (Bloom, Sadun, and Van Reenen 2012).

In Latin America and the Caribbean, the capabilities on which these returns depend also shape adoption itself. In the Brazilian state of Ceará, most formal firms still relied on predigital technologies for general business functions, and adoption varied widely across firms, including within the same sector. Firms with better-educated managers, more structured management practices, such as formal incentives and performance monitoring, and more college-educated workers used more sophisticated technologies (Cirera et al. 2021).

Generative AI extends augmentation to cognitive tasks such as writing, coding, and customer support, with large average productivity gains in the tasks studied. At a Fortune 500 company providing business software to U.S. small businesses, whose customer-support agents were mostly based in the Philippines, the staggered introduction of an AI assistant raised the number of customer issues resolved per hour by 15 percent on average and by about 30 percent for less experienced and lower-skilled agents (Brynjolfsson, Li, and Raymond 2025). In an online experiment with college-educated professionals recruited through the Prolific platform, access to ChatGPT cut the time spent on mid-level professional writing tasks by 40 percent while raising output quality by 18 percent (Noy and Zhang 2023). In another experiment, freelance software developers, mostly from India and Pakistan, who had access to GitHub Copilot completed a programming task 56 percent faster than those without it (Peng et al. 2023).

The reinstatement force. Reinstatement occurs when new tasks are introduced for workers (Acemoglu and Restrepo 2019). The long-run effect of automation on employment thus depends on how fast these new tasks emerge relative to how fast existing ones are automated (Acemoglu and Restrepo 2018). In other words, new tasks, occupations, and goods in which labor retains a comparative advantage can help absorb displaced workers and counteract the downward pressure automation puts on the labor share. Each digital wave has created such tasks. Occupations such as software engineering, for instance, did not exist until technological innovations created a need for them (Autor 2024). New AI-related tasks, such as prompt engineering, model fine-tuning, and AI safety auditing, are now emerging, although their long-run scale is uncertain.

Reinstatement cannot be assumed to arrive at the pace adoption may require (Acemoglu and Restrepo 2019). Higher education in Latin America and the Caribbean expanded rapidly in the 2000s, but on average only half of students complete their degrees (Ferreyra et al. 2017), which limits the base for absorbing new cognitive tasks. Past adjustment to automation has also relied partly on informality: Workers displaced by robots moved partly into informal employment (Brambilla et al. 2023). Meanwhile, firms' capacity to innovate and, hence, to generate new tasks, is limited, as innovation lags among those that are less productive (Crespi, Tacsir, and Vargas 2016), which make up a relatively large share in Latin America and the Caribbean (Pagés 2010).

Channel 2: Capital Augmentation

The second channel, capital augmentation, carries the cost reductions that raise output without changing which tasks are performed by workers and which by machines. These include cheaper and better digital capital for tasks that machines already perform, as well as lower transaction costs.[8]

Capital deepening. As equipment becomes cheaper with each generation, firms accumulate more of it per worker, which raises labor productivity. The gains have been large. In the United States, technological change embodied in new, more efficient equipment accounted for close to 60 percent of postwar growth (Greenwood, Hercowitz, and Krusell 1997), and industries that produce information technology or use it most intensively accounted for virtually all of the acceleration in labor productivity after 1995 (Stiroh 2002; Jorgenson, Ho, and Stiroh 2008). Capital deepening also has distributional effects. When new equipment complements skilled workers, as many digital technologies do, it raises their relative wages. In the United States, this complementarity can account for most of the variation in the skill premium over the three decades leading up to the early 1990s (Krusell et al. 2000), consistent with broader evidence on skill-biased technological change (Autor, Katz, and Krueger 1998; Goldin and Katz 2008).

Transaction cost reductions. Lower transaction costs widen markets and improve the matching of buyers and sellers, and the effects can be large. In fisheries in the Indian state of Kerala and grain markets in Niger, mobile phones sharply reduced price differences across markets (Jensen 2007; Aker 2010). In 12 African countries, the arrival of fast internet raised the probability of being employed by 3–13 percent (Hjort and Poulsen 2019). More broadly, the internet has also increased trade in both goods and services (Freund and Weinhold 2002, 2004), and machine translation on eBay raised U.S. exports on the platform to Spanish-speaking Latin American countries by 18 percent (Brynjolfsson, Hui, and Liu 2019). AI further reduces the cost of prediction, with applications such as recommendations and translation (Agrawal, Gans, and Goldfarb 2018), and AI deployed in mobile apps has greatly increased the number of their foreign users (Sun and Trefler 2026). AI has also helped firms find commercial partners abroad and increased trade (Chen and Volpe Martincus 2026).

Channel 3: Innovation Expansion and Acceleration

The third channel, innovation expansion and acceleration, carries the falling cost of innovation to the economy. Here AI may play a distinctive role: Beyond creating

[8] In general equilibrium, the boundary can respond to Channel 2 forces; such induced movements are routed to Channel 1. The capital–skill complementarity of Krusell et al. (2000) operates through relative marginal products rather than task reassignment, which is why it belongs in this channel.

new tasks, as earlier waves of digital technology did, it can serve as a new method of invention that changes how research itself is done (Cockburn, Henderson, and Stern 2019). In the United States, firms that invested more in AI between 2010 and 2018 grew faster in sales and employment than firms that invested less, primarily through product innovation; they registered more trademarks and product patents, although their investments had not yet led to measurable productivity gains (Babina et al. 2024). In research itself, machine learning can help generate new hypotheses from large datasets (Ludwig and Mullainathan 2024), and AI can speed up discovery and raise its chances of success by predicting which candidates, such as drugs, are most worth testing (Agrawal, McHale, and Oettl 2024). Through this channel, AI could raise not only the level of productivity but its long-run growth rate. The channel also feeds back into Channel 1, as innovation creates the new tasks that drive reinstatement, and its pace helps determine whether displacement is offset in the long run (Acemoglu and Restrepo 2019).

The innovation channel operates at two levels. Firm-level innovation depends on adoption and managerial capability, while scientific discovery depends on national research systems, university capacity, and access to advanced computing and data. The two are linked, because research capacity matters even for countries that mainly adopt technologies developed elsewhere. Research and development has two roles: It generates innovation directly, and it builds the capacity to absorb and adapt advances made at the technological frontier (see Chapter 12). Across 12 OECD countries, research and development has been important both for innovation and for catching up to more productive countries (Griffith, Redding, and Van Reenen 2004).

In Latin America and the Caribbean, both levels are constrained. Research and development spending in Latin America fell from 0.73 percent of GDP in 2014 to 0.66 percent in 2018, while the global average rose to 1.79 percent (UNESCO 2021). The deficit is even wider for AI. Latin America accounts for about 6.6 percent of global GDP but only 1.12 percent of global AI investment. Brazil hosts about 90 percent of the region's supercomputing capacity; more than half of the region's countries lack critical infrastructure and advanced AI training; and the openness and standardization of data remain limited (ECLAC and CENIA 2025).[9]

[9] Estimates of the region's share of global AI activity vary with the measure, year, and source. Based on IDC data on spending on AI technologies, such as servers, software, and cloud services, Latin America accounted for 1.56 percent of the global total in 2023 (Jung and Katz 2026) and 2.57 percent in 2024 (Katz et al. 2025). The Latin American Artificial Intelligence Index measures investment in AI instead, a different concept, and puts the region's share at 1.12 percent (ECLAC and CENIA 2025). All three are well below the region's share of global GDP.

At the firm level, as noted above, the region's capacity to innovate is limited. Raising research spending alone would not close these gaps. Developing countries invest little in innovation, despite its potential returns, mainly because they lack complementary physical and human capital. In particular, firms' managerial capabilities are weak, and research-centered policies are likely to fail without capable private sector partners (Cirera and Maloney 2017). Domestic research capacity is, therefore, a strategic complement to firm-level adoption. Each raises the returns to the other, and the ability of Latin America and the Caribbean to benefit from AI depends on strengthening both.

Determinants of the Size, Speed, and Incidence of the Effects

Whether the gains from digital technologies, including AI, materialize, how quickly they materialize, and who benefits from them depends on five interrelated factors. The first is timing: Gains often appear only after firms make complementary investments. The second is diffusion: Gains spread unevenly, from the most advanced firms to the rest. The third is reallocation: Aggregate productivity rises more if resources move toward more productive firms. The fourth is market structure and trade: Scale, network, and scope effects shape whether gains are broadly shared or concentrated in a few firms, and lower trade costs determine how far they extend across borders. And the fifth is incidence: Gains and losses are distributed unevenly across workers, depending on their education, gender, and age. The following examines each in turn.

Productivity realization and the J-curve. Productivity gains from digital technologies can take time to emerge.[10] When firms adopt a new general-purpose technology, they must also invest in skills and reorganize work. Because these complementary investments are largely intangible and poorly measured in official statistics, productivity growth is initially understated and only later rises as those investments pay off, a pattern that has been called the productivity J-curve (Brynjolfsson, Rock, and Syverson 2021). In the United States, ICT contributed substantially to productivity growth, but only with sizable lags and conditional on complementary organizational and human-capital investments (Stiroh 2002; Jorgenson, Ho, and Stiroh 2008; Bresnahan, Brynjolfsson, and Hitt 2002; Brynjolfsson and Hitt 2003). A similar dynamic may now be emerging for AI. In a survey of firms in Australia, Germany, the United Kingdom, and the United States, 89 percent reported no impact of AI on labor productivity over

[10] Jones (2026) examines both AI's potential to accelerate growth and how that acceleration can be delayed by bottlenecks in tasks that remain difficult to automate.

the previous three years, yet they anticipated gains of about 1.4 percent over the next three (Yotzov et al. 2026).

Diffusion and the frontier–laggard gap. The early gains from general-purpose technologies tend to be concentrated among the most advanced firms.[11] In the United States, growth driven by AI investment has been concentrated among larger firms (Babina et al. 2024).[12] In Latin America and the Caribbean, aggregate adoption statistics can mask large differences across firms, even within the same sector, and the conditions for diffusion (absorptive capacity, managerial quality, and complementary intangibles) are precisely what laggard firms lack (Cirera et al. 2021; Cirera, Comin, and Cruz 2022; Cusolito and Maloney 2018). Closing the productivity gap, therefore, requires spreading technologies and capabilities to these firms and reallocating resources across firms, not just adoption at the frontier. Management quality is a case in point. Across more than 11,000 firms in 34 countries surveyed between 2004 and 2014, differences in management practices accounted for about 30 percent of TFP differences, both between countries and among firms within countries (Bloom, Sadun, and Van Reenen 2016). Yet these capabilities can be built. In a randomized trial with 432 small and medium-sized firms in Puebla, Mexico, one year of management consulting raised total factor productivity, and employment and the wage bill were about 50 percent higher five years later (Bruhn, Karlan, and Schoar 2018). In Colombia, group-based consulting for auto parts firms improved management practices by 8 to 10 percentage points and raised sales, profits, and labor productivity (Iacovone, Maloney, and McKenzie 2022).

Reallocation across firms and misallocation. Alongside the slow diffusion of frontier technologies, a substantial share of cross-country TFP differences arises from a misallocation of resources that leaves them trapped in less productive firms (Hsieh and Klenow 2009; Restuccia and Rogerson 2017). That misallocation is much larger in Latin America than in the United States (Busso, Madrigal, and Pagés 2013). One contributing factor is imperfect information about firms' prospects (David, Hopenhayn, and Venkateswaran 2016). Technologies that lower the cost of predicting how firms will perform could improve input, credit, and investment decisions, thereby raising aggregate TFP through the reallocation of resources toward their most productive uses. This benefit is not guaranteed, however, as resources must actually move toward the more productive firms. In Latin America and the Caribbean, such

[11] The global productivity slowdown of the first two decades of the 2000s coincides with a widening gap between frontier firms and laggards (Andrews, Criscuolo, and Gal 2016; Akcigit and Ates 2023).

[12] In Brazil, AI adoption rises sharply with firm size (see Box 2.1).

movement could be heavily conditioned by the regulatory burden (Levy 2018; Ulyssea 2020) and the availability and quality of human capital (Cusolito and Maloney 2018).

Market structure and trade. Technologies that lower costs when implemented more widely (that is, that confer scale advantages) and become more useful as more firms use them (network effects) reshape market structure and the geography of exchange. Such technologies have been linked to rising product market concentration and a falling labor share in the United States and other advanced economies (Autor et al. 2020), as well as to rising markups in the United States (De Loecker, Eeckhout, and Unger 2020). Because they shift sales toward the most productive firms, aggregate productivity gains can coexist with rising market power.[13] Economies of scope, the cost savings from producing several products together rather than separately, often because they share inputs, operate alongside scale and network effects (Panzar and Willig 1981). Since data can be used by more than one firm and reused for many purposes (Jones and Tonetti 2020), and falling costs of operating across product lines let the most efficient firms spread into new markets (Aghion et al. 2023), digital firms expand across markets as well as within them. AI intensifies these forces. Incumbents can reuse the training data they accumulate to enter adjacent services (economies of scope), and developing frontier models involves very large fixed costs (economies of scale).

On the trade side, paperless customs, single-window systems, and other facilitation measures reduce clearance times and administrative border costs that account for a substantial share of total trade costs, and they have expanded trade in Latin America and the Caribbean (Volpe Martincus 2016; see Chapter 14). AI opens new possibilities by lowering language barriers (Brynjolfsson, Hui, and Liu 2019), helping firms search for foreign buyers and suppliers (Chen and Volpe Martincus 2026), and extending the international reach of AI-intensive digital services (Sun and Trefler 2026), while also raising the potential for reshoring some offshored cognitive tasks.

Incidence across workers. The gains from digitalization are not evenly shared. Through Channel 1, AI displaces some workers and augments others; through Channel 2, capital deepening has historically favored skilled workers;

[13] One study, however, attributes the entire decline in the aggregate U.S. labor share to the recording of intellectual property products, such as software and research and development, as investment in the national accounts (Koh, Santaeulàlia-Llopis, and Zheng 2020). For a review of competing explanations and measurement issues, including intellectual property accounting, see Grossman and Oberfield (2022).

and through market structure, discussed above, gains can accrue to firms with market power.

Who bears displacement and who benefits from augmentation has shifted across waves of digital technology. Earlier technological change automated routine tasks and reduced employment in many middle-skill occupations, contributing to job polarization in the United States and Western Europe (Autor, Levy, and Murnane 2003; Acemoglu and Autor 2011; Autor and Dorn 2013; Goos, Manning, and Salomons 2014). Augmentation was also "skill biased," raising demand for skilled workers relative to unskilled ones. In Norway, for example, broadband internet improved the productivity and labor market outcomes of skilled workers and worsened those of unskilled workers (Akerman, Gaarder, and Mogstad 2015).

Generative AI partly reverses this pattern through two effects that can pull in opposite directions. Across occupations, exposure to GenAI tends to be highest in higher-wage white-collar occupations requiring highly educated workers (Eloundou et al. 2024; Felten, Raj, and Seamans 2023). Within exposed occupations, however, the largest gains in the studies available so far have gone to less experienced or lower-performing workers, narrowing productivity gaps, in contrast to the skill-biased augmentation of the ICT era (Brynjolfsson, Li, and Raymond 2025; Noy and Zhang 2023; Dell'Acqua et al. 2023; Box 2.1). The net distributional effect, therefore, depends on which occupations are exposed and who benefits within them. This helps explain the mixed distributional results of the quantitative analysis presented below.

Recent cross-country evidence suggests that, so far, the economic gains from AI have come through workers with higher education. A study of 26 countries, 6 of them in Latin America, finds that a 1 percent increase in AI spending was associated with a 0.036 percent increase in GDP in 2019–23, entirely through the greater productivity of workers with university-level education, not of machinery and equipment (Jung and Katz 2026; see Box 2.1).[14] In aggregate, then, AI's gains in the region may still follow the skill-biased pattern of earlier digital technologies, and since relatively few adults in most Latin American and Caribbean countries have such education, these gains are likely concentrated among a small group of workers.

Informality, which shapes several of these factors in the region, is discussed next.

[14] Because the study does not distinguish formal from informal employment, the skilled-labor channel may partly reflect the concentration of AI adoption in formal firms.

Box 2.1. Digital Technologies, AI, and the Region's Economy

As a complement to the task-based analysis in this chapter, additional macroeconometric evidence comes from a quarterly panel of 67 countries, covering the fourth quarter of 2022 through the second quarter of 2025. The study measures the intensity of AI adoption based on web traffic to generative AI platforms. It also documents AI spending in 2024 and 2025 and web traffic through November 2025 (Katz et al. 2025).[a] It yields the following findings.

State of AI in the region. AI spending in Latin America reached US$8.1 billion in 2024 and was projected to reach US$11.3 billion in 2025. In 2024, this was just 2.57 percent of global AI demand, even though the region accounts for about 6.6 percent of global GDP. Web traffic to GenAI platforms, by contrast, has followed an S-shaped adoption curve and, after an initial period of about a year, it entered a phase of exponential growth. In October 2025, monthly visits reached 375 million in Brazil, 129 million in Mexico, and 95 million in Colombia.

AI's effect on worker productivity. Generative AI use is associated with significantly higher productivity for workers at all education levels, with slightly larger estimated effects for those with less education, although the differences are not statistically significant. Unlike earlier digital technologies, including AI based on machine learning, GenAI thus appears to benefit educated and less-educated workers alike, consistent with the gains for less experienced and lower-performing workers discussed under Channel 1. By sector, the effect is significant only for workers in services.

Digital technologies, growth, and structural conditioning. Earlier work by some of the same study authors found that a 1 percent increase in AI spending is associated with a 0.036 percent increase in GDP, through higher-skilled labor productivity (Jung and Katz 2026). The effects of digital technologies are also conditioned by structural factors. As discussed above, informality reduces both the adoption of digital technologies and their impact on growth, a pattern that could extend to AI. Trade integration and foreign direct investment can facilitate diffusion, although the evidence for AI is still limited. AI adoption also tends to rise with firm size, since larger firms are better able to bear the costs and risks of new technologies and have more skilled workforces. In Brazil, for example, 11 percent of small firms have adopted AI, compared with 41 percent of large firms. Such differences could widen productivity gaps between large and small firms, a frontier–laggard pattern common to general-purpose digital technologies.

[a] Estimates reported in this box should be read as conditional associations rather than causal effects. The study does not collect new data but combines existing sources. AI spending estimates come from IDC, a market research firm, and cover spending on AI servers, software, and cloud services. Web traffic to generative AI platforms comes from Semrush, a commercial platform that tracks website visits by country but does not distinguish individual from business use. Data on output, capital, and employment come from the International Monetary Fund, the Penn World Table, and the World Bank. Evidence on adoption by firm size comes from a 2023 survey of AI adoption among Brazilian firms by CETIC.br.

Digital Transformation, AI, and Informality

Only 46 percent of workers in Latin America and the Caribbean contribute to social security, meaning that more than half of the workforce is informally employed (González-Velosa et al. 2026). Informality is, therefore, a primary factor shaping the region's ability to adopt digital technologies, including AI, at scale, to spread their gains broadly, and to reallocate workers toward expanding tasks. Preliminary cross-country evidence suggests informality reduces both the adoption of digital technologies and their contribution to growth (Box 2.1).

Informality can condition the impact of digitalization in four main ways. The first is an adoption divide. Digital requirements, such as electronic invoicing, apply only to registered firms (Bellon, Dabla-Norris, et al. 2022), while informal firms largely serve simple, low-value markets (La Porta and Shleifer 2014) and face tighter credit constraints (Gandelman and Rasteletti 2017). For this reason, adoption is concentrated in the larger formal firms. Second, technology spillovers can be limited for informal firms with weak links to the formal economy (La Porta and Shleifer 2014), including the supply chains and professional networks through which adoption tends to diffuse (Bellon, Chang, et al. 2022; Hardy and McCasland 2021). Third, informal employment is concentrated in occupations with lower AI exposure, limiting the share of labor costs AI can reduce (Douenne, Pedroni, and Schweitzer, forthcoming; Acemoglu 2025). And, finally, informality weakens countries' fiscal capacity by eroding the tax base that funds digital infrastructure, retraining, and e-government.

Informality is not immutable, though. It reflects firms' and workers' responses to the regulatory burden placed on formal firms (Meghir, Narita, and Robin 2015; Ulyssea 2018, 2020; Levy 2018) and to the availability and quality of human capital (La Porta and Shleifer 2014). Evidence consistently suggests that, in Latin America and the Caribbean, formal wage work is heavily and poorly regulated, so high nonwage costs and protections against dismissal discourage it (Heckman and Pagés 2004; Levy 2018). Such a setting imposes a real risk that labor-replacing AI will accelerate the move away from wage work even where it brings little productivity gain, reinforcing the displacement concern of the first channel. The risk is compounded because formal jobs are more exposed to AI than informal ones, while unemployment insurance is rare and training programs are often disjointed and uneven in quality (González-Velosa et al. 2026). Displaced workers may, therefore, move into informality, as with robots (Brambilla et al. 2023), so the impact on labor markets could be larger and informality could rise even further.

Quantifying AI's Impact: Growth, Productivity, and Wages

How large could the macroeconomic effects of AI be for Latin America and the Caribbean? Outside of advanced economies, the empirical literature on this

question remains thin. Box 2.1 summarizes complementary macroeconometric evidence for the region.

No current framework jointly captures all the interacting mechanisms reviewed in the preceding section, and the microdata needed to estimate adoption, exposure, and task-level effects rigorously are scarce. Moreover, the path of the technology itself remains highly uncertain.

A feasible approach to estimating the effects of AI is to apply a task-based framework that focuses on a well-defined subset of these mechanisms, following Acemoglu and Autor (2011) and Acemoglu and Restrepo (2018, 2022). The projections rest on the simplifying assumption, adopted here for tractability, that AI capabilities remain broadly at their current level over the projection horizon.[15] Production is modeled as a continuum of tasks performed by labor or capital, with generative AI affecting exposed tasks (defined below) through automation and task complementarities (Acemoglu 2025). This approach isolates the effects of AI specifically, through the displacement and augmentation forces of Channel 1, leaving out the creation of new tasks. The estimates, therefore, capture only part of the contribution of digital transformation, since they also leave out channels 2 and 3.[16]

Within this framework, the aggregate productivity impact of AI is the product of four components: the share of human tasks AI can technologically perform; the share of those tasks that are profitable to automate; the task-level productivity gain; and the labor share of the affected tasks. This decomposition links measurable task-level effects to aggregate TFP, GDP, and wages.[17]

Using this approach, Acemoglu (2025) estimates a TFP gain for the United States of at most 0.66 percent over 10 years, roughly 0.07 percentage points a year. Applying the same formula with a different reading of the evidence, Aghion and Bunel (2024) obtain a median estimate of 0.68 percentage points of additional TFP growth per year, with a range of 0.07 to 1.24 percentage points. This section presents model projections for Latin America and the Caribbean obtained by applying the framework to microdata from the Inter-American Development Bank's Harmonized Household Survey (Douenne, Pedroni, and Schweitzer, forthcoming).

---

[15] Faster capability gains could lead to outcomes beyond the scenarios considered here (Korinek and Suh 2024).

[16] Where the high nonwage cost of formal employment induces privately profitable yet socially inefficient substitution toward capital (see the discussions of Channel 1 and of informality), part of the measured TFP and GDP gain reflects a relative-price distortion.

[17] The TFP and GDP calibration does not separately identify automation and labor augmentation. In the wage analysis, exposure operates through automation/displacement shocks, and the wage results should be interpreted accordingly.

AI Exposure across Occupations and Countries, and Adoption Scenarios

AI exposure can be measured as the share of tasks within each occupation that AI technologies could perform or substantially accelerate. According to Eloundou et al. (2024), these are tasks that a worker using a large language model could complete at least twice as fast while maintaining quality. So measured, AI exposure differs considerably across occupations. Administrative and middle management staff display by far the highest exposure, at 47.5 percent, reflecting tasks intensive in documentation, information processing, scheduling, and communication. Professionals and technicians follow, at 19 percent, while agricultural workers (6.3 percent) and craft workers and plant operators (6.9 percent) show the lowest exposure. Weighting occupations by their share of the national wage bill yields country-level exposure. Suriname and Uruguay have the highest total exposure, at 19.0 percent and 18.4 percent, respectively, while Bolivia, Ecuador, and Guyana have the lowest, reflecting the larger wage-bill share in those countries of agricultural, manual, and elementary occupations, which involve simple and routine tasks (ILO 2012). Table 2.1 reports these country-level estimates and shows that, in every country, AI exposure is higher among formal than informal workers.

Technical exposure is an upper limit on AI's potential impact. Actual effects depend on the share of exposed tasks for which adopting AI is economically profitable and on how much AI raises productivity in those tasks. Three scenarios define the range of possibilities:

- **High-adoption, high-productivity impact (HA-HI) scenario:** AI is assumed to be adopted for 80 percent of tasks that are technically exposed to it, the upper bound proposed by Aghion and Bunel (2024).[18] This is the share of exposed tasks that, according to projections by Svanberg et al. (2024), would become profitable to automate within a decade if AI costs fell by 50 percent per year, a rate Aghion and Bunel (2024) relate to the recent pace of growth in computing power. For those tasks, AI is assumed to increase productivity by 40 percent, the upper end of the range of gains proposed by Aghion and Bunel (2024).
- **Moderate-adoption, moderate-productivity impact (MA-MI) scenario:** AI is assumed to be adopted for 23 percent of tasks that are technically exposed to it, consistent with Svanberg et al. (2024) and Acemoglu (2025). For those tasks, AI is assumed to increase productivity by 27 percent, following

[18] The adoption rates in these scenarios are assumptions about the share of technically exposed tasks in which AI is used, not estimates of the share of firms or individuals using AI. Evidence on current adoption of AI and digital technologies by individuals and firms in the region is presented in Chapters 3 and 13 of this book, respectively.

Acemoglu (2025), who averages the gains of about 15 percent and 40 percent estimated by Brynjolfsson, Li, and Raymond (2025) and Noy and Zhang (2023), respectively.

- **Low-adoption, low-productivity impact (LA-LI) scenario:** AI is assumed to be adopted for 11.5 percent of tasks that are technically exposed to it and to increase productivity in those tasks by 13.5 percent, half the values assumed in the MA-MI scenario.[19]

Table 2.1. AI Exposure by Country and Formality Status, 2018–22 (percent)

Country	Total AI exposure	Formal	Informal	Informality rate
Suriname	18.98	20.38	16.79	44.83
Uruguay	18.40	19.50	11.67	22.67
Costa Rica	18.23	19.19	13.25	24.93
Argentina	18.23	20.93	14.14	50.71
Colombia	17.28	20.19	13.18	60.79
Chile	16.61	17.31	14.07	26.10
Brazil	16.45	17.44	13.94	36.06
Peru	16.26	22.31	13.00	77.97
Dominican Republic	16.08	19.19	12.55	55.47
Mexico	16.05	18.46	13.85	66.33
Panama	15.92	18.19	12.43	50.50
Honduras	15.68	21.61	14.78	82.66
El Salvador	15.12	18.69	12.75	68.83
Guatemala	14.92	20.24	11.99	79.58
Guyana	14.30	18.08	10.63	55.85
Ecuador	13.89	16.92	10.39	61.42
Bolivia	13.38	18.48	11.29	78.25
Latin America and the Caribbean	16.22	19.24	12.98	55.47

Source: Douenne, Pedroni, and Schweitzer (forthcoming), Figures 10 and A.3.
Note: AI exposure is computed as the wage bill–weighted average of occupational AI exposure scores. Informality is defined as workers not affiliated with social security. Countries are ranked by total AI exposure. The estimates for Latin America and the Caribbean are unweighted averages across the 17 countries included.

[19] Intermediate scenarios—for instance, low-adoption, high-productivity impact (LA-HI)—are not considered because, even though the two parameters are calibrated separately in the model, they are likely to covary. Larger task-level productivity effects make AI deployment cost effective in more tasks and are, thus, associated with higher rates of adoption (Svanberg et al. 2024).

Effects on Aggregate TFP and GDP

To determine the cumulative 10-year TFP and GDP effects under full deployment of AI—that is, assuming the technology has fully diffused and capital has fully adjusted—the analysis now combines occupational exposure, adoption rates, task-level productivity gains, and country-level AI-adjusted labor shares (labor compensation weighted by AI exposure; see Table 2.2).[20]

Table 2.2. Cumulative Change in TFP and GDP Levels from AI Adoption over a 10-Year Horizon, by Scenario (percent)

	TFP			GDP		
Country	**LA-LI**	**MA-MI**	**HA-HI**	**LA-LI**	**MA-MI**	**HA-HI**
Costa Rica	0.14	0.55	2.85	0.27	1.08	5.57
Argentina	0.13	0.53	2.72	0.29	1.18	6.07
Colombia	0.12	0.48	2.49	0.28	1.11	5.73
Chile	0.12	0.49	2.51	0.26	1.05	5.40
Brazil	0.14	0.57	2.92	0.25	0.99	5.12
Peru	0.10	0.40	2.08	0.25	1.01	5.20
Dominican Republic	0.08	0.32	1.67	0.25	1.00	5.15
Mexico	0.07	0.28	1.43	0.24	0.98	5.04
Panama	0.06	0.24	1.26	0.25	0.99	5.09
Honduras	0.12	0.50	2.56	0.24	0.96	4.92
El Salvador	0.11	0.45	2.31	0.23	0.91	4.69
Guatemala	0.10	0.39	2.03	0.21	0.85	4.37
Ecuador	0.14	0.55	2.83	0.21	0.84	4.32
Latin America and the Caribbean	0.11	0.44	2.28	0.25	1.00	5.13

Source: Douenne, Pedroni, and Schweitzer (forthcoming), Figure 5.
Note: LA-LI = low-adoption, low-productivity impact; MA-MI = moderate-adoption, moderate-productivity impact; HA-HI = high-adoption, high-productivity impact. Figures are cumulative gains over 10 years. GDP gains assume 10-year capital adjustment (Acemoglu 2025). Productivity and wage effects could only be estimated for the countries with the national accounts data required. Bolivia, Guyana, Suriname, and Uruguay are excluded due to unavailability of United Nations Statistics Division (UNSD) value-added and compensation data at the industry level. Countries are listed in order of overall AI exposure (Douenne, Pedroni, and Schweitzer, forthcoming, Figure 3). The estimates for Latin America and the Caribbean are unweighted averages across the 13 countries included. Cross-country variation primarily reflects differences in occupational mixture and country-level labor shares, interacted with parameter values for AI exposure, adoption, and task-level productivity gains, drawn mainly from evidence for the United States. The percentages should be read as projections under common technology assumptions, not as behavioral estimates specific to Latin America and the Caribbean (Douenne, Pedroni, and Schweitzer, forthcoming).

[20] AI-adjusted labor shares, defined as the average of private sector industry labor shares weighted by each industry's AI exposure and value-added share, range from 0.25 in Panama to 0.64 in Ecuador. Panama's low labor shares yield the smallest TFP effect but the largest transmission from TFP to GDP.

Under the HA-HI scenario, cumulative 10-year TFP gains average 2.3 percent across the 13 Latin American and Caribbean countries with available data, ranging from 1.3 percent in Panama to 2.9 percent in Brazil. The MA-MI scenario yields an average of 0.4 percent, from 0.2 percent in Panama to 0.6 percent in Brazil. Under the LA-LI scenario, gains average just 0.1 percent, from 0.06 percent in Panama to 0.14 percent in Brazil. Because this scenario halves both adoption and productivity gains relative to MA-MI, its TFP effects are about a quarter as large (Table 2.2).[21]

Average cumulative GDP gains over the decade reach 5.1 percent under the HA-HI scenario, 1.0 percent under the MA-MI scenario, and 0.25 percent under the LA-LI scenario. Under the HA-HI scenario, country-level gains range from 4.3 percent in Ecuador to 6.1 percent in Argentina; under the LA-LI scenario, they range from 0.21 percent in Ecuador to 0.29 percent in Argentina.[22] These projections are specific to AI. Contemporaneous contributions from non-AI digital technologies would add to the figures rather than substitute for them.

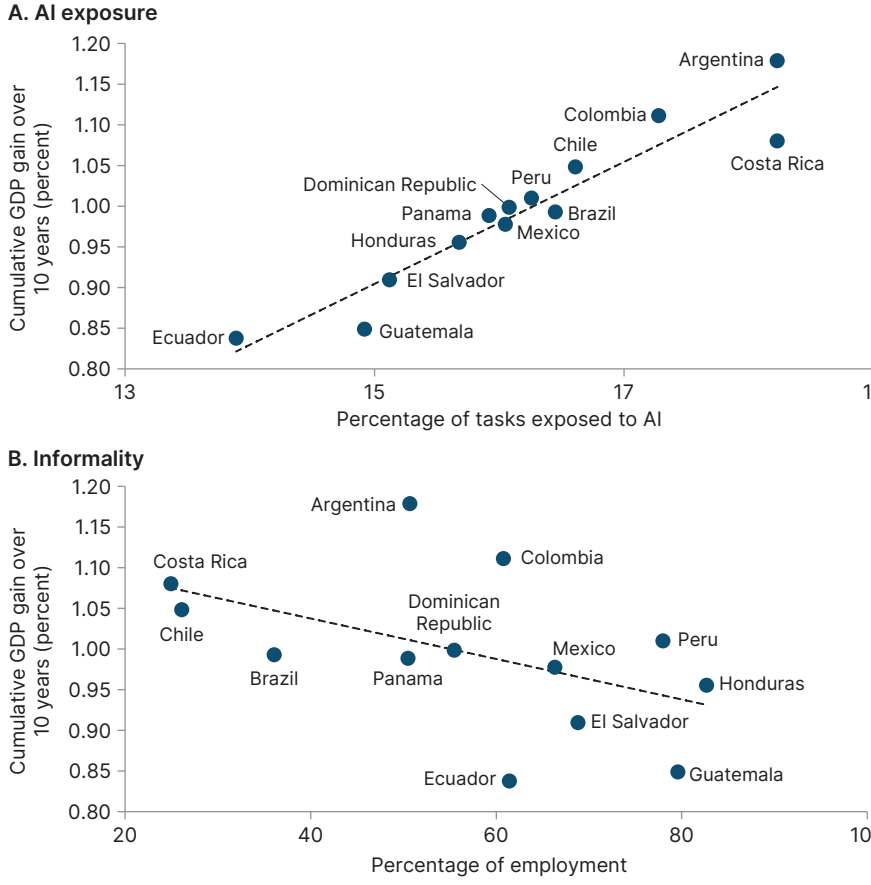
Cross-country differences in GDP gains largely mirror differences in AI exposure (Figure 2.3, Panel A). Countries where more of the wage bill is earned in professional, technical, and administrative occupations, such as Argentina, Colombia, and Costa Rica, record the largest gains, while Ecuador and Guatemala record the smallest. TFP gains vary more, because they also depend on how much of each economy's labor income is concentrated in AI-exposed industries. Mexico and Panama, for example, have average exposure but low AI-adjusted labor shares and, hence, the smallest TFP gains. Countries with higher informality, in turn, tend to have smaller gains, because informal employment is concentrated in occupations with lower exposure (Douenne, Pedroni, and Schweitzer, forthcoming). Since the model does not capture the additional effects of informality on adoption and diffusion discussed above, the estimates may overstate the gains in the most informal economies (Figure 2.3, Panel B).

A final caveat concerns what these magnitudes include. The figures in Table 2.2 are level effects: a one-time downward shift in task costs (Channel 1), amplified by capital adjustment, representing cumulative changes in TFP and GDP levels reached over the 10-year adoption horizon, not permanent increases in their growth rates. They exclude channels 2 and 3. More specifically, the exclusion of Channel 3 leaves out a potentially important growth channel. Aghion and Bunel (2024) emphasize that task-based estimates omit AI's automation of idea production, which could raise the growth rate of TFP permanently rather than only

[21] The aggregation is a first-order approximation, exact only for marginal shocks (Hulten 1978). Under the 80 percent adoption rate of the HA-HI scenario, second-order terms, which do depend on how factors reallocate, cease to be negligible (Baqaee and Farhi 2019).

[22] Capital is assumed to adjust fully over the 10-year horizon, so the implied GDP gain equals the TFP gain divided by the country's standard aggregate labor share—that is, the average of private sector industry labor shares weighted by value added rather than AI exposure.

Figure 2.3. AI Exposure, Informality, and GDP Gains from AI



Source: IDB staff calculations, based on Douenne, Pedroni, and Schweitzer (forthcoming).
Note: GDP gains are cumulative over 10 years under the moderate-adoption, moderate-productivity impact (MA-MI) scenario. Because the scenarios scale effects proportionally, the cross-country pattern is the same under the other two scenarios (HA-HI and LA-LI). The dashed lines show the linear fit. In Panel A, AI exposure is computed as the wage bill–weighted average of occupational AI exposure scores. In Panel B, informality refers to the share of employed workers not affiliated with social security.

during the adoption transition.[23] This channel could be weaker in Latin America and the Caribbean, however, because benefiting from AI in idea production requires research and innovation capacity, which, as mentioned above, is limited in the region; research and development spending in Latin America is just over a third of the global average as a share of GDP (UNESCO 2021), and innovation lags among the region's many less productive firms (see the discussion of Channel 3).

[23] The baseline holds the technology fixed. Capability acceleration would raise both exposure and the share of tasks profitable to automate, shifting outcomes beyond the HA-HI scenario (Korinek and Suh 2024), while sharpening the reinstatement risk within Channel 1.

The omission of this channel is, therefore, likely to understate the region's potential gains, though possibly by less than for economies with strong innovation systems.

Wage Effects and the Reallocation Gap

The wage impact of AI hinges on a single question: Can workers move from shrinking sets of tasks to expanding ones? Some workers may need to make transitions across jobs, occupations, or sectors, while others may adjust within their existing jobs by taking on tasks in which humans retain a comparative advantage. In the absence of any reallocation, the group-level displacement effect dominates, and wages decline in all Latin American and Caribbean countries examined, in all scenarios, even after incorporating the aggregate productivity gain.[24] The country wage estimates use demographic groups' wage-bill shares as weights. Regional wage estimates for each group give countries equal weight. Under the HA-HI scenario, these direct effects range from −13.9 percent in Ecuador to −20.9 percent in Argentina over 10 years; under the MA-MI scenario, from −3.5 percent in Ecuador to −5.5 percent in Argentina; and under the LA-LI scenario, from −1.3 percent in Ecuador to −2.3 percent in Costa Rica.

With effective labor reallocation, wages instead rise in all countries, from +2.3 percent in Panama to +5.3 percent in Ecuador under HA-HI, from +0.6 percent to +1.3 percent under MA-MI, and from +0.3 percent to +0.6 percent under LA-LI, with the same two countries at either end. The reallocation gap—the difference between the wage effect with reallocation and the direct wage effect—ranges from 19 to 26 percentage points under HA-HI, 5 to 7 under MA-MI, and 2 to 3 under LA-LI and broadly tracks overall AI exposure: It is largest in Costa Rica and Argentina, the most exposed countries, and smallest in Ecuador, the least exposed. In all three scenarios, the gap is several times larger than the eventual wage gain, so most of the wage outcome depends on whether workers reallocate. Lower adoption thus means smaller wage losses without reallocation and smaller gains with it, and less reallocation is needed in absolute terms to move from one outcome to the other.

Distributional Effects: Gender, Education, Age, and Formality

Across demographic groups, five robust patterns emerge under the MA-MI scenario. Workers are grouped by sex, age (16–25, 26–55, and 56 and older), and education (less than secondary, secondary, and tertiary). First, there is a clear education gradient: Tertiary-educated workers face the highest exposure and

[24] AI automation simultaneously raises aggregate TFP and reduces labor demand in displaced tasks. The TFP windfall accrues to capital and to workers already in complementary activities, not to those directly displaced.

the largest direct losses (−8.2 percent for tertiary-educated women ages 16–25). After accounting for worker reallocation, some but not all of these losses are recovered (the same group still records −0.5 percent). Second, women are more exposed than men of the same age and education, particularly among the tertiary educated. Third, differences across age groups with the same education are small. Fourth, men ages 26 and older with less than secondary education record the largest wage gains after worker reallocation (+2.3 percent to +2.6 percent), as they are less substitutable for displaced workers and benefit from the expansion in demand that accompanies higher output. Finally, formal-sector workers face AI exposure about 6 percentage points higher than informal workers on average and higher in every country, reflecting their concentration in more exposed occupations. Informal workers remain indirectly affected through economy-wide adjustments and sectoral spillovers.[25]

The HA-HI and LA-LI scenarios preserve these patterns in exposure and direct losses, with larger and smaller magnitudes, respectively, but differ from MA-MI in how many groups gain once workers reallocate. Wages fall after reallocation for 7 of the 18 groups under MA-MI, but for 12 under LA-LI, where output expands less, and for none under HA-HI.

Trade Exposure

In this framework, AI creates two international trade pathways for Latin America and the Caribbean, both operating through the channels already defined. A reshoring pathway arises when firms in advanced economies repatriate offshored tasks; this is Channel 1 displacement, affecting workers in Latin America and the Caribbean who perform tasks offshored to the region by firms in those economies. While earlier technology waves expanded offshoring by lowering communication costs, AI can instead substitute directly for offshored cognitive labor. In the other direction, an import-substitution pathway operates as the region develops its own AI capabilities. Trade-related exposure to AI is systematically lower than domestic exposure, since the region's tradable sectors are less AI intensive. As a result, these trade pathways become macroeconomically significant only where high AI exposure across sectors coincides with strong trade ties between the two sides.

The deeper implication concerns whether the wage effects discussed above fully play out within Latin America and the Caribbean. The improvement in wages

[25] These exposure-based results differ from the adoption-conditional productivity gains in Box 2.1, which are roughly flat across education levels, with tertiary workers facing the highest exposure to displacement while less-skilled workers experience the larger gains conditional on augmentation within remaining tasks.

after worker reallocation presumes the increase in output generated by AI is reabsorbed within the region's own labor market. In an open economy, this need not be the case. When the AI capabilities, data, and computing resources reside in leading economies, part of the output expansion that offsets domestic displacement can accrue abroad. The mitigating consideration is that much of the reabsorption in the region is likely to run through domestic services that are not traded internationally and are, therefore, insulated from reshoring.

Conclusion

Digital technologies, including artificial intelligence, offer Latin America and the Caribbean an opportunity to address its persistent productivity deficit, but their benefits are neither automatic nor evenly distributed. By reshaping tasks, augmenting labor and capital, and accelerating innovation, they can raise output and create new economic opportunities. The scale of these gains depends on how widely technologies diffuse and how effectively firms and workers use them. Whether productivity gains translate into higher wages depends critically on workers' ability to move toward expanding tasks and jobs. High informality, weak managerial capabilities, and limited research capacity can constrain these adjustments and concentrate the benefits. The central policy challenge is, therefore, to enable both broad adoption and successful labor reallocation by improving regulations, strengthening skills, and building the capacity to innovate and absorb technologies developed elsewhere. Progress on these fronts will determine whether digital transformation delivers sustained and inclusive growth.

3

Digital Adoption: Broad Access, Shallow Use

This book argues that digital technologies—including the recent advances in artificial intelligence (AI)—offer firms the potential to operate more efficiently, governments to deliver better public services, and individuals to gain access to new opportunities. Realizing this potential, however, depends on one fundamental condition: that these technologies are adopted broadly and integrated into everyday economic and social activities. Understanding how far adoption has progressed is, therefore, central to assessing the region's prospects for raising productivity and improving living standards.

Some digital technologies have diffused in the region at a remarkable pace. In just over a decade, instant-payment systems and a dynamic financial technology (fintech) ecosystem have allowed several countries to shift rapidly from cash to digital payments, with adoption in some cases now approaching levels observed in advanced economies (Vera-Cossio 2025). More broadly, internet use is now widespread, and the region performs comparatively well in activities that primarily involve searching for or exchanging information. The central question is whether widespread access has translated into uses that deliver concrete efficiency gains, such as purchasing goods and services, completing government procedures, and accessing other services, such as health care or financial services, entirely online.

The evidence shows it has done so only partially.[1] In 2025–26, 27 percent of adults in Latin America and the Caribbean reported having made an online purchase within the past three months, compared with 66 percent in Organisation for Economic Co-operation and Development (OECD) countries. Similarly, only 26 percent interacted online with a government organization, compared with 70 percent in

[1] Statistics presented in this paragraph and the next are IDB staff calculations, based on the Latin American Public Opinion Project's (LAPOP) AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. For OECD Europe, calculations are based on Eurostat, 2025; for OECD countries not covered by Eurostat, they are based on the International Telecommunication Union (ITU) DataHub, 2022–25 (latest year available); and for the United States, they are based on the Harvard Project on Workforce's Generative AI Adoption Tracker, 2026.

the OECD. The same pattern is visible within specific sectors. In health, 58 percent of adults in the region searched online for health information, close to the OECD rate of 63 percent. Yet only 21 percent booked a medical appointment online, compared with 44 percent in the OECD. These differences suggest that digital interfaces have spread more rapidly than the supporting infrastructure and systems needed to complete transactions reliably and at scale, including interoperable data systems, digital identity, logistics networks, and back-end processes. The region has become increasingly effective in connecting people to information and services but is much less effective in enabling them to carry out transactions from beginning to end.

Generative AI fits the same pattern: Adoption is relatively high when individuals can interact directly with a digital interface without depending on more demanding local systems. Around 26 percent of adult workers in the region report having used GenAI for professional purposes, close to the 27 percent observed in the European OECD countries, although still well below the 43 percent recorded in the United States. This relatively rapid adoption is consistent with the low barriers to using many AI tools intended for consumers, as workers can access them directly through an internet-connected device without waiting for local firms or governments to build interoperable data systems or redesign their back-end processes. Yet converting individual AI use into sizable productivity gains will ultimately require making precisely those deeper organizational, data, and technological changes.

Taken together, the evidence points to a pattern of broad access and extensive use of digital interfaces but much shallower integration into the systems and organizational processes through which firms and governments operate. This distinction between widespread adoption and depth of use is central to this book's broader argument about how digital technologies translate into productivity gains.

This chapter examines these patterns primarily through the results of household surveys, drawing on several international and regional data sources. The principal source of new evidence is a digital technologies module fielded specifically for this book as part of the 2025–26 wave of the Latin American Public Opinion Project (LAPOP) AmericasBarometer. Conducted in 16 Latin American countries, the module covers internet access, the use of the internet for a broad range of activities, and generative AI adoption.[2] Its questions are harmonized with international surveys, including Eurostat, allowing the region to be benchmarked against other parts of the world and providing the first comparable evidence on GenAI adoption across Latin America and the Caribbean.

Although these surveys collect information from individuals, they shed light on digital adoption beyond households. Online purchasing, for example, reflects the extent to which firms conduct transactions with consumers through digital channels, while online interactions with government organizations capture the use of digital public services. The use of GenAI chatbots, including for professional

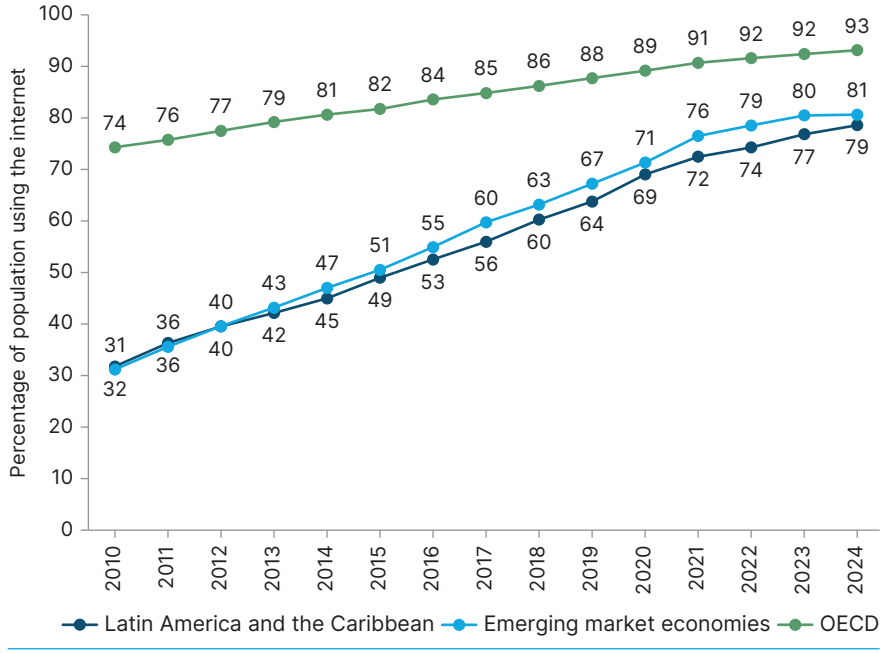
[2] The module was also fielded in Barbados as part of the Barbados Digital Literacy Survey, 2026.

purposes, shows how rapidly this new technology is spreading directly among individuals and workers, even when it has not yet been fully integrated into the organizations that employ these users. These three indicators, therefore, provide complementary perspectives on the diffusion of digital technologies across households, firms, and governments.

General Internet Use and Digital Gaps

Internet use has expanded rapidly across the world over the past two decades, although the pace of adoption has differed sharply by level of development. According to data from the International Telecommunication Union (ITU), more than 7 in 10 people in OECD countries used the internet in 2010, compared with only 3 in 10 in Latin America and the Caribbean and in emerging market economies (Figure 3.1). This digital divide has significantly narrowed over the past 15 years. Indeed, by 2024, 8 in 10 individuals were using the internet in Latin America and the Caribbean, compared to 9 out of 10 in OECD countries.

Figure 3.1. Internet Use across Country Groups

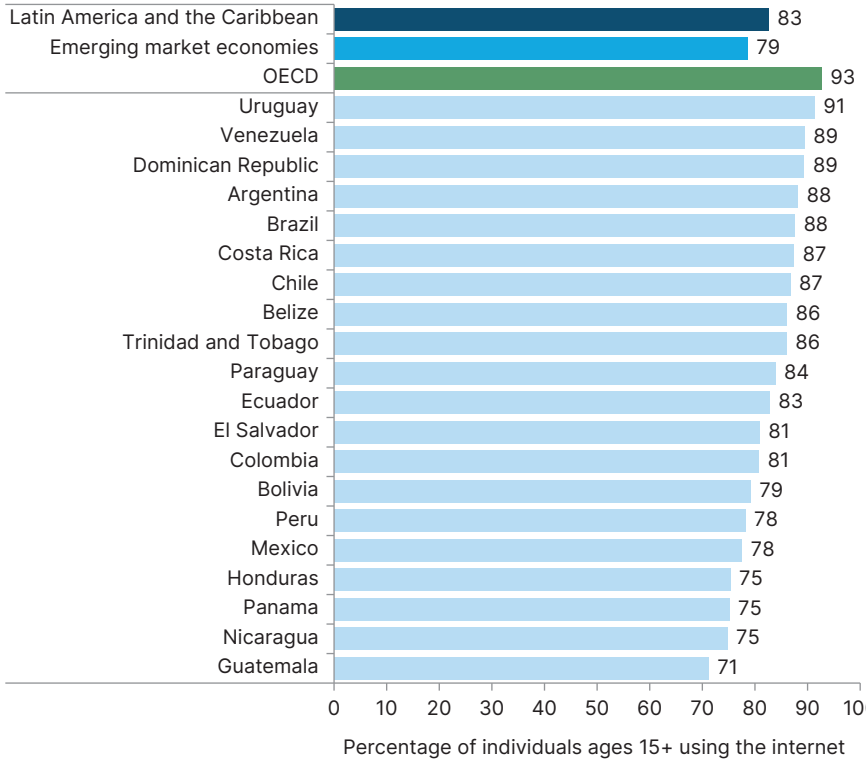


Source: IDB staff calculations, based on data from the ITU DataHub.
Note: The figure shows internet use from any location during the reference period, generally the three months preceding the survey. Age coverage varies across national sources. Where a country-year observation is unavailable, the figure uses the estimate published by the ITU. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. The estimates for Latin America and the Caribbean are based on 26 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Although the digital divide across country groups has narrowed substantially, some differences in internet use persist across countries within the region. As Figure 3.2 shows, use ranges from about 7 in 10 adults in some countries to roughly 9 in 10 in others.

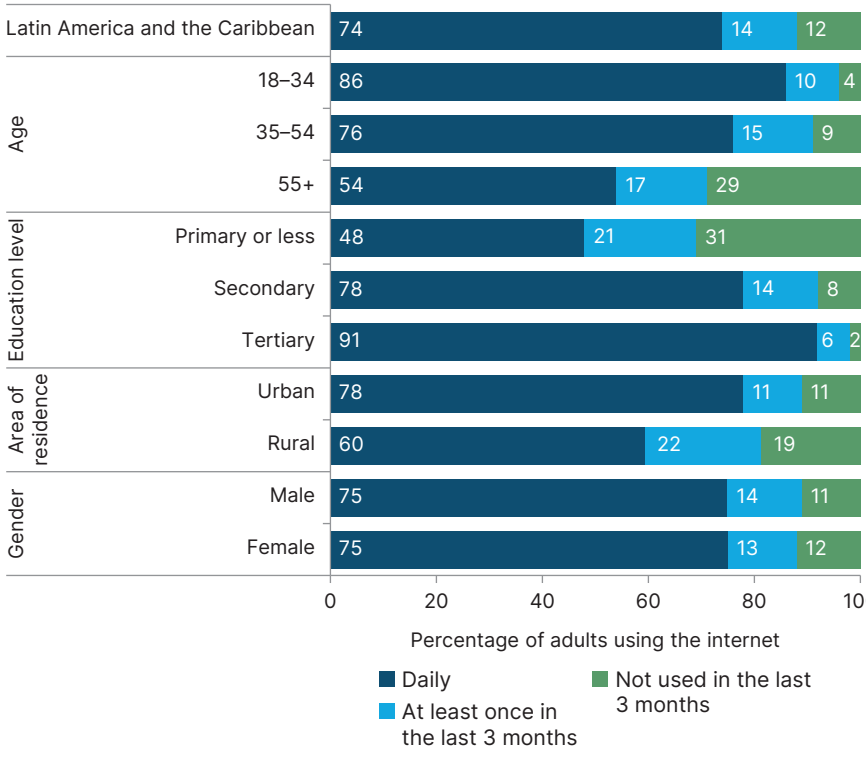
While 74 percent of adults in the region go online every day, this average masks substantial differences across demographic groups. Figure 3.3 shows that daily use is highest among younger and more educated adults. Nearly 9 in 10 of those ages 18–34 and 9 in 10 with tertiary education use the internet every day. By contrast, among those ages 55 and older and those with primary school or less education, the share is only about 5 in 10. Variation is also substantial by location: Close to 8 in 10 urban adults use the internet daily, compared with 6 in 10 rural adults. Daily use, however, differs little by gender.

Figure 3.2. Internet Use across Countries



Source: IDB staff calculations, based on the Global Findex Database 2025, World Bank.
Note: The figure shows internet use within the three months preceding the survey in 2024. The sample includes individuals ages 15 and older. Data were collected through in-person or telephone survey mode, depending on the country. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Figure 3.3. Frequency of Internet Use across Demographic Groups

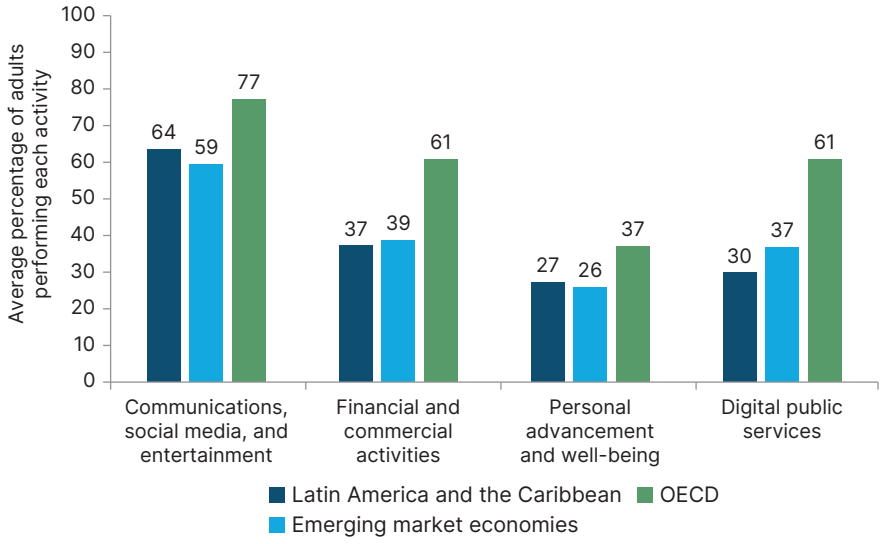


Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026.
Note: The figure shows the distribution of adults by frequency of internet use within the three months preceding the survey. The sample includes adults ages 18 and older in all countries. Data were collected through in-person household surveys. Fieldwork took place between October 2025 and May 2026, with approximately 1,000 observations per country. The reported values are unweighted averages across Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. Within each country, estimates use sampling weights for national representativeness.

How Do Individuals Use the Internet?

The previous section showed that Latin America and the Caribbean has substantially narrowed the access deficit that defined the last decade, with roughly four in five adults now online. As connectivity becomes less of an obstacle for most people, the key question is no longer whether individuals use the internet but how they use it and how those patterns compare with those of other benchmark regions. To provide an overview, this section examines 16 online activities, grouped into four broad categories: communications, social media, and entertainment; financial and commercial activities; personal advancement and well-being; and digital public services.

Figure 3.4. Internet Use across Broad Activity Categories



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD; and the ITU DataHub, 2022–25 (latest year available), for emerging market economies and OECD countries not covered by Eurostat.
Note: The figure shows internet use across broad activity categories within the three months preceding the survey. Each value is the average across the specific activities in the category, which are shown in Figure 3.5. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. Latin America and the Caribbean estimates cover Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. The sample includes adults ages 18 and older in all countries. Data were collected through in-person household surveys. Fieldwork took place between October 2025 and May 2026, with approximately 1,000 observations per country. Emerging market economy estimates use ITU data, whose age coverage varies across national surveys; OECD estimates combine Eurostat data (individuals ages 16 and older) with ITU data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Figure 3.4 summarizes internet use across the four categories and reveals substantial differences among them. The region performs comparatively well in communications, social media, and entertainment, where average use slightly exceeds that in emerging market economies, although it remains below use in the OECD.[3] Use is substantially lower for financial and commercial activities, where

[3] Data on how the internet is used in Latin America and the Caribbean and in OECD countries are generally drawn from standardized, nationally representative household surveys and are therefore relatively comparable across countries and indicators. By contrast, estimates for emerging market economies are based on a smaller and varying set of countries across indicators and on less standardized survey questions and data collection methods. Comparisons with emerging market economies should, therefore, be interpreted with caution.

the region's performance is similar to that of emerging market economies but well below that of the OECD. In personal advancement and well-being, the regional average is also similar to that of emerging market economies but below that of the OECD. Importantly, the widest disparity appears in digital public services, where use is less than half the OECD level and also below that of emerging market economies. Because these category averages combine activities that differ considerably in their prevalence and requirements, the remainder of the section examines specific uses in greater detail to assess in more depth where the region falls behind advanced economies and what factors may help explain the differences.

Communications, Social Media, and Entertainment

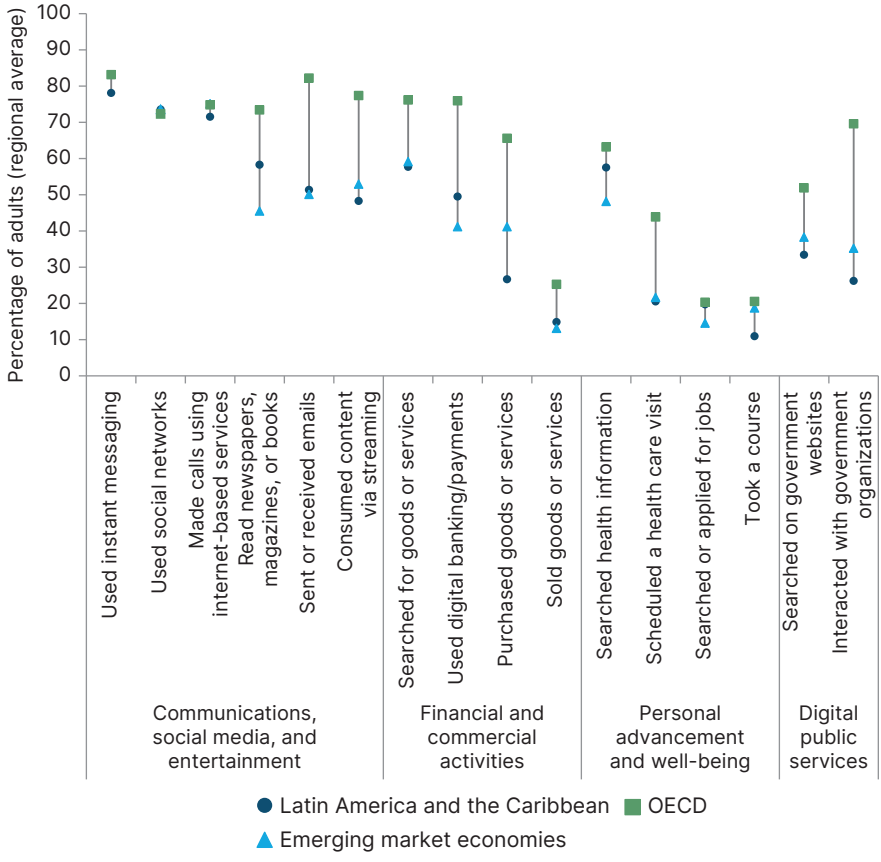
Communications is the category in which Latin America and the Caribbean comes closest to converging with advanced economies; in several activities, it even outperforms peers at similar income levels. As Figure 3.5 shows, nearly four in five adults in the region use internet calling and messaging applications such as WhatsApp. This level is broadly comparable to levels observed in both OECD countries and emerging market economies. As Figure 3.6 shows, social network use follows a similar pattern, with most Latin American and Caribbean countries clustering around the OECD benchmark. Country differences in the use of social networks are also relatively small, ranging from 82 percent in Chile to 61 percent in Honduras. This consistency is itself revealing. It may suggest the technological and behavioral requirements of social network use scale effectively once basic enabling conditions are in place, including internet access, mobile connectivity, and digital skills.

The picture changes, however, when moving to activities that may place greater demands on either infrastructure or users themselves. Reading news or downloading newspapers online remains roughly 15 percentage points below the OECD average (see Figure 3.5), although the region still performs well above the emerging market economy benchmark and thus falls between the two reference groups. The gap widens further for email and streaming. Email use trails the OECD by nearly 30 percentage points and shows no advantage relative to emerging market economy peers. The share of adults who consume content by streaming is also lower in the region than in either the OECD or emerging market economies.

Financial and Commercial Activities

Moving from communications to commerce, the relative position of Latin America and the Caribbean deteriorates sharply. Only 27 percent of adults in the region purchased goods or services online during the three months

Figure 3.5. Internet Use across Specific Activities

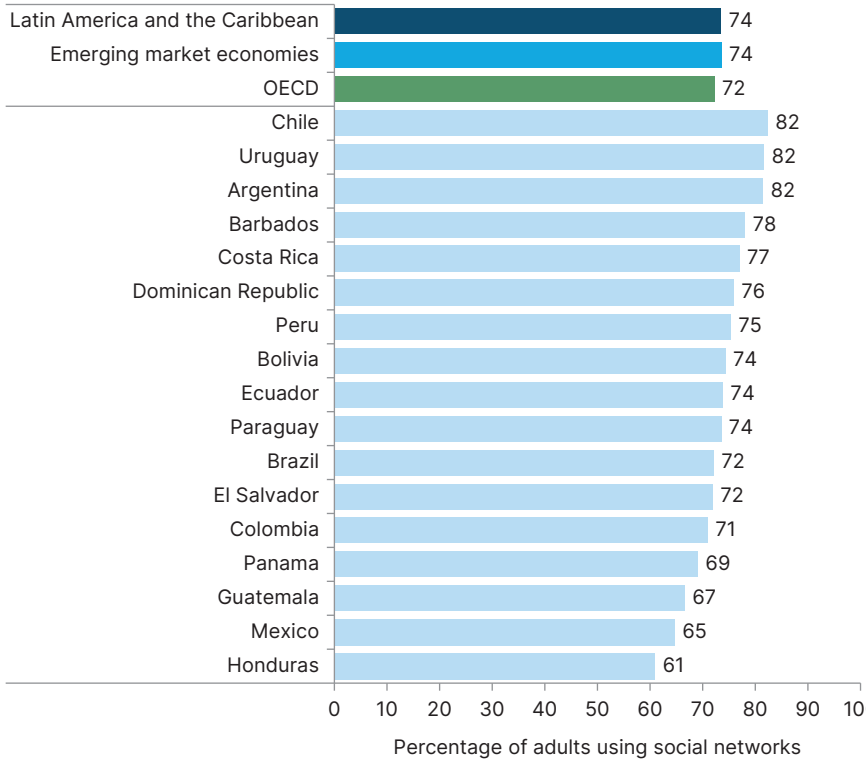


Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD; and the ITU DataHub, 2022–25 (latest year available), for emerging market economies and for OECD countries not covered by Eurostat.
Note: The figure shows internet use across specific online activities within the three months preceding the survey. Estimates follow the same country coverage and samples as in Figure 3.4.

preceding the survey, compared with 41 percent in emerging market economies and 66 percent in OECD countries. The regional average is, therefore, almost 40 percentage points below the OECD average and substantially below that of economies at similar income levels. This disparity highlights the disconnection between widespread internet use and the much more limited prevalence of digital transactions.

Figure 3.7 also reveals substantial variation across the region. Uruguay leads, with 45 percent of adults making purchases online, while in Honduras the share is just 14 percent. Even the regional leaders remain far below the OECD average.

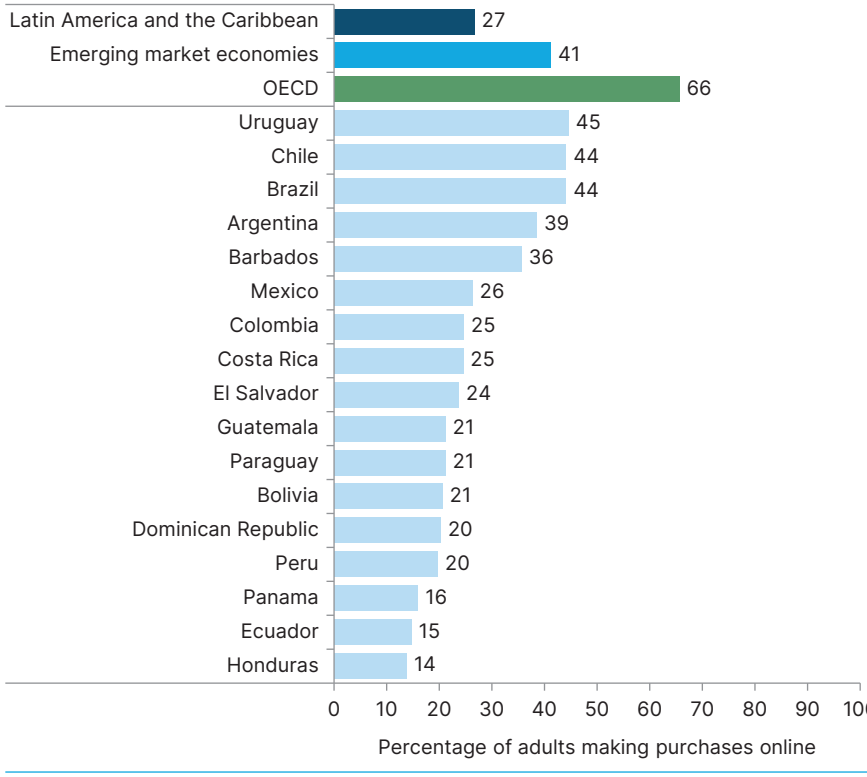
Figure 3.6. Social Network Use across Countries



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD; and the ITU DataHub, 2022–25 (latest year available), for emerging market economies and for OECD countries not covered by Eurostat.
Note: The figure shows social network use within the three months preceding the survey. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. Estimates follow the same country coverage and sample as in Figure 3.4.

The low prevalence of online purchasing contrasts with much greater use of the internet at earlier stages of the commercial process. Close to three in five adults in Latin America and the Caribbean search online for information about goods and services (Figure 3.5), placing the region broadly in line with emerging market economies. Searching requires little beyond internet access and interest in a product; no payment, identity verification, delivery arrangement, or trust in a particular seller is required. The sharp prevalence difference between searching for products and purchasing them may suggest that many consumers enter the digital marketplace but do not complete a transaction. High levels of informal commerce may reinforce this pattern, as sellers can use digital channels, including social networks, to advertise and communicate with customers while payments and delivery continue to take place offline.

Figure 3.7. Online Purchasing across Countries



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD; and the ITU DataHub, 2022–25 (latest year available), for emerging market economies and for OECD countries not covered by Eurostat.
Note: The figure shows purchase of goods or services online within the three months preceding the survey. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. Estimates follow the same country coverage and sample as in Figure 3.4.

Limited access to digital financial services does not appear to explain this pattern completely. Internet banking stands out as an area of comparatively strong adoption within the region, as nearly half of adults in Latin America and the Caribbean do banking online or use electronic wallets—a share more than 8 percentage points above the emerging market economy average, although still well below OECD levels. This progress has been supported by the rapid expansion of digital payment platforms, interoperable instant-payment systems, and a dynamic fintech ecosystem.

Selling online, the most demanding activity in this category, remains uncommon everywhere, with the region performing similarly to emerging market economies and trailing far behind advanced countries. Taken together, these patterns

indicate connectivity and payment mechanisms alone are not sufficient to support widespread e-commerce. Other features of the transactional environment, including logistics and delivery networks, systems for returns, fraud protection, consumer trust, and the depth of local online marketplaces, may also be important.

Personal Advancement and Well-Being

Another dimension of internet use involves services related to health, employment, and learning. These activities differ from financial and commercial transactions or interactions with governments because demand for them is often more episodic and contingent on individual circumstances. Only a subset of adults will need medical care, actively search for work, or seek additional training during the reference period. Aggregate adoption rates, therefore, partly reflect differences in the population who have reason to use each service and should be interpreted accordingly. Even with this qualification, comparisons across country groups reveal important differences in the extent to which the internet facilitates access to health services, employment opportunities, and learning.

Echoing the broader pattern described earlier, Figure 3.5 shows that Latin America and the Caribbean performs comparatively well when the internet is used primarily to search for information. Nearly three in five adults have searched online for health information, a share almost 10 percentage points higher than in emerging market economies and slightly below the OECD average of 63 percent.

The picture changes once the activity moves from searching for information to completing transactions online. Booking a medical appointment online, for example, is slightly less common in Latin America and the Caribbean (performed by 21 percent of adults) than in emerging market economies (22 percent) but reaches less than half the OECD adoption rate (44 percent). This disparity is particularly striking given the high demand for health services: Pombo et al. (2025) find that 32 percent of the region's population used public health care services in the previous 12 months, and this figure excludes use of the region's large private health care sector. The same report also finds that only 14 percent of the population obtained laboratory results online. These low levels of digitalization persist despite the potential benefits of digital health services, especially for more vulnerable populations, who often live far from health care centers.

With regard to employment, online job search and applications are used by 20 percent of adults in Latin America and the Caribbean. This should not be interpreted as a low adoption rate, as only a subset of the population is actively seeking work during any given period. Indeed, it exceeds the average for emerging market economies of 15 percent and is in line with the OECD average of 20 percent (Figure 3.5). The extent to which job seekers rely on online

channels may, nevertheless, vary with the structure of labor markets, in which informal recruitment networks and the occupational composition of employment are important. The high levels of labor informality prevalent in the region may reduce the relevance of formal online platforms for some workers and employers (Urquidi, González, and Ortega 2023).

A similar pattern emerges in online learning. Digital learning platforms offer several advantages: They are available all the time, allow learners to progress at their own pace, and make it easier for learners to ask questions they may hesitate to raise with teachers or peers. These features reduce the social and psychological costs of seeking help and can support more autonomous learning trajectories (Levy and Pérez Albertos 2024). Despite these advantages, however, participation remains relatively low. Only about 1 in 10 adults in the region reports taking online courses, well below the shares observed in emerging market economies (19 percent) and OECD countries (21 percent; see Figure 3.5).

Digital Public Services

Among the four categories examined, digital public services displays the largest gaps, relative both to OECD countries and emerging market economies. Even relatively simple activities, such as searching for information from government organizations, remain less common in Latin America and the Caribbean, where 33 percent of individuals report doing so online, compared with 38 percent in emerging market economies and 52 percent in OECD countries. The gap widens substantially when moving from information seeking to actual digital interaction. Only 26 percent of individuals in Latin America and the Caribbean report interacting with government institutions online, compared with 35 percent in emerging market economies and 70 percent in OECD countries—a difference of 44 percentage points relative to advanced economies.

Part of this gap reflects the limited availability of fully digital government services. Only about 30 percent of government procedures in the region can be completed online, compared with 75 percent in the European Union (IDB, forthcoming). More broadly, the evidence points to a gap between digitalizing the user-facing interface and transforming the data and back-end systems needed to deliver services digitally from beginning to end.

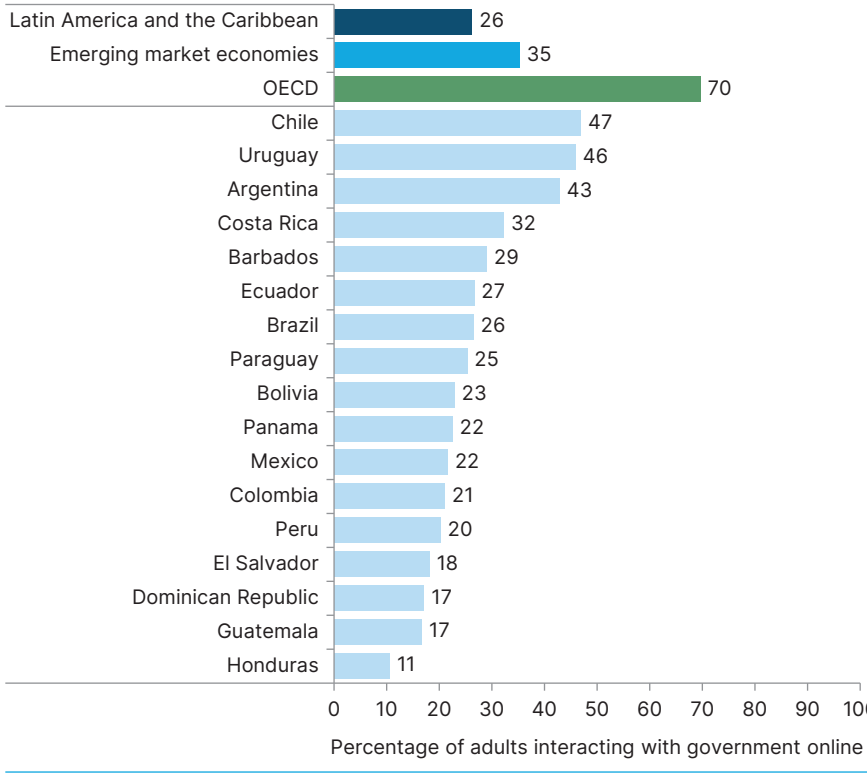
A separate regional survey examining how individuals interact with governments confirms that the use of digital channels for completing transactions is limited. Pombo et al. (2025) find that 7 in 10 individuals carried out at least one government transaction during the previous year. Yet only 14 percent of the overall population completed their most recent transactions entirely online, while nearly half (48 percent) did so fully in person. Another 10 percent of individuals combined online and face-to-face interactions.

Use of digital channels remains concentrated among more educated individuals: Of those with completed tertiary education, 29 percent used a fully digital channel for their most recent government transaction, compared with 17 percent of those with secondary education and 7 percent with primary education or less. Such differences are not unusual when digital services are first introduced, as individuals with stronger digital skills and better access tend to adopt them earlier. Higher uptake among these groups may also benefit those who continue to rely on in-person channels by reducing congestion, freeing administrative capacity, and lowering the costs of government service delivery. These savings could, in turn, be redirected toward improving targeted assistance and in-person services for more vulnerable populations.

Some of the region's most significant advances in digital public services have occurred in areas where users have greater digital capabilities or strong incentives to adopt online channels. Taxation is a clear example. The process of paying and filing taxes electronically is highly advanced across much of Latin America and the Caribbean, and in some cases adoption rates are comparable to those of OECD countries. Mandates have been important in driving this progress (Cristia and Vlaicu 2022). Argentina and Brazil have successfully introduced mandatory electronic filing for several taxes, achieving near-universal use among covered taxpayers. Several countries, including Brazil, Chile, Colombia, and Mexico, have also integrated back-end systems to offer prefilled personal income tax returns, thereby reducing compliance costs for taxpayers and administrative burdens for governments. In Chile, the introduction of prefilled tax returns was associated with an 80 percent decline in noncompliance. Among large firms in the region, the use of electronic tax payments is virtually identical to OECD levels, at 97 percent versus 98 percent. Adoption is lower among smaller firms, however, consistent with their more limited digital capabilities and administrative resources (Reyes-Tagle, Dimitropoulou, and Rodríguez Peña 2023).

The regional average for online interaction with government organizations also conceals wide differences among the adult population across countries, as the LAPOP data in Figure 3.8 show. Chile (47 percent), Uruguay (46 percent), and Argentina (43 percent) lead the region, each surpassing the average of 35 percent for emerging market economies. Costa Rica (32 percent) and Barbados (29 percent) also perform above the Latin American and Caribbean average, although they fall below the levels observed in emerging market economies overall. At the other end of the distribution are Honduras (11 percent), Guatemala (17 percent), and the Dominican Republic (17 percent). Overall, the difference between the highest and lowest performing countries reaches 36 percentage points. Explanations for this heterogeneity may include differences in the digital maturity of government systems, infrastructure quality, reliable internet access, and digital skills.

Figure 3.8. Online Interactions with Government across Countries



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD; and the ITU DataHub, 2022–25 (latest year available), for emerging market economies and for OECD countries not covered by Eurostat.
Note: The figure shows internet use for online interactions with government within the three months preceding the survey. The survey question asked: "Did you carry out any transaction with a government agency online, such as downloading or filling out forms or making payments to the government?" Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. Estimates follow the same country coverage and sample as in Figure 3.4.

Generative AI

Since the public launch of ChatGPT in late 2022, generative AI has become the fastest-spreading consumer technology in recent memory. By mid-2025, ChatGPT alone reached more than 700 million weekly users worldwide, roughly 1 in 10 of the world's adults (Chatterji et al. 2025). Some estimates suggest adoption among working-age adults stood at about 18 percent globally in early 2026 (Microsoft AI Economy Institute 2026), a faster pace than both personal computers and the consumer internet at the same point in their diffusion (Bick, Blandin, and Deming 2026). The technology itself keeps advancing, with models,

supported languages, and use cases all evolving faster than the surveys that measure them. The patterns documented here capture the earliest visible stages of that diffusion in Latin America and the Caribbean.

GenAI fits the broader pattern documented in the preceding sections of this chapter. For many users, it functions primarily as a tool for searching for, generating, and exchanging information, with relatively low barriers to adoption, as access typically requires only an internet-connected device. The leading models have also performed well in French, Portuguese, and Spanish, limiting language as a constraint on adoption in the region (Microsoft AI Economy Institute 2026).

The economic stakes of this rapid spread are already substantial. In the United States, at the adoption rates prevalent as of this writing, the productivity gain to the economy has been estimated at 1–2 percent of gross domestic product (GDP); see Bick, Blandin, and Deming (2026). Moreover, controlled field experiments in customer support, writing, software development, and consulting find that workers using these tools complete their tasks 15 to 40 percent faster than otherwise comparable colleagues without access (Brynjolfsson, Li, and Raymond 2025; Cui et al. 2026; Noy and Zhang 2023). The most striking finding across these studies is that less-experienced and lower-performance workers gain the most, as GenAI compensates for their lesser knowledge and expertise relative to more experienced, higher-performance workers. This pattern is particularly relevant for a region with high earnings inequality like Latin America and the Caribbean.

At the same time, firm-level productivity gains from generative AI have been slower to materialize than the worker-level evidence might suggest. As Chapters 1 and 13 emphasize, many firms have yet to invest at scale in the workflows, training, and organizational changes needed to translate individual time savings into higher output (Butler et al. 2025). Even so, widespread use of generative AI tools may already be producing meaningful efficiency gains, as the studies discussed above suggest. It may also be building familiarity with the technology and thus reducing the learning and adoption costs associated with more sophisticated tools.

Four data sources support the cross-country comparisons that follow. Estimates for Latin America and the Caribbean come from the LAPOP AmericasBarometer 2025–26 wave, which includes a dedicated module of questions on GenAI use and which is combined with 2026 data from the Barbados Digital Literacy Survey.[4] The other two are international benchmarks. The OECD Europe estimates come from Eurostat 2025 data, restricted to European countries

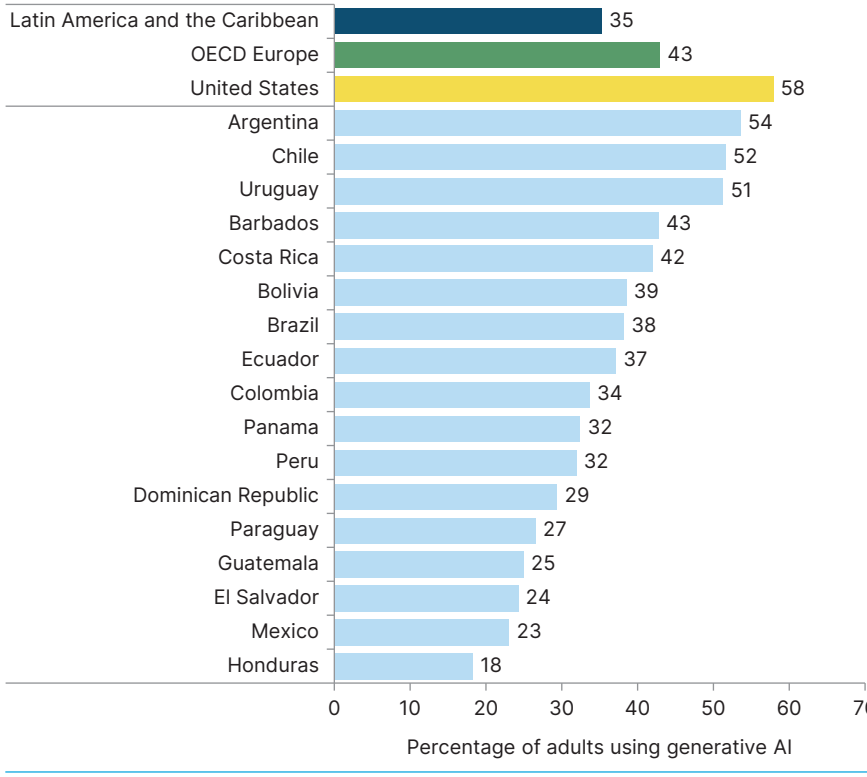
[4] The LAPOP AmericasBarometer 2025–26 wave is available for 16 Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. Additionally, harmonized data from Barbados were obtained from the Barbados Digital Literacy Survey, 2026.

that are members of the OECD. Estimates for the United States, for both any use of GenAI and work-related use of GenAI, draw on 2026 data from the Harvard Project on Workforce's Generative AI Adoption Tracker.

Generative AI Adoption across Countries and Population Groups

Figure 3.9 compares the use of generative AI in Latin America and the Caribbean as a whole and for individual countries in the region, as well as in OECD Europe and the United States.

Figure 3.9. Generative AI Use across Countries



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD Europe; and the Harvard Project on Workforce's Generative AI Adoption Tracker, 2026, for the United States.
Note: The figure shows the use of generative artificial intelligence within the three months preceding the survey. Country-group values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. For estimates in Latin America and the Caribbean, the sample includes adults ages 18–64 in all countries. Data were collected through in-person household surveys. Fieldwork took place between October 2025 and May 2026, with approximately 1,000 observations per country. For OECD Europe, the sample includes individuals ages 16–64 and covers European countries that are members of the OECD. The sample for the United States includes adults ages 18–64.

In Latin America and the Caribbean, GenAI use in the three months prior to the survey stood at 35 percent of adults, compared with 43 percent in OECD Europe and 58 percent in the United States. The difference between Latin America and the Caribbean and OECD Europe is modest, especially compared with the much larger differences observed for online purchases and digital interactions with government organizations. Adoption in the United States, however, remains substantially higher than in both regions.

The modest disparity in average adoption between Latin America and the Caribbean and OECD Europe conceals much wider differences within the region. Adoption ranges from 18 percent in Honduras to 54 percent in Argentina, a spread of 36 percentage points, compared with only about 8 percentage points between the two regional averages. Argentina and Mexico are especially revealing: Despite both having similar levels of GDP per capita, adoption in Argentina is more than twice as high. Argentina, Chile, and Uruguay also substantially exceed the OECD Europe average and approach the level observed in the United States. This variation suggests that income alone cannot explain the diffusion of generative AI across the region.

The large differences across countries are mirrored by substantial gaps within countries. Figure 3.10 shows that education and age are the strongest correlates of adoption: Use reaches 62 percent among adults with tertiary education but only 6 percent among those with primary education or less, while 50 percent of adults ages 18–34 report using GenAI, compared with 12 percent of those 55 and older.[5] In turn, adults living in urban areas report an adoption rate of 39 percent, compared with 21 percent in rural areas. Of the four subgroups examined, the gender difference is the smallest, with 38 percent of men adopting compared with 33 percent of women.

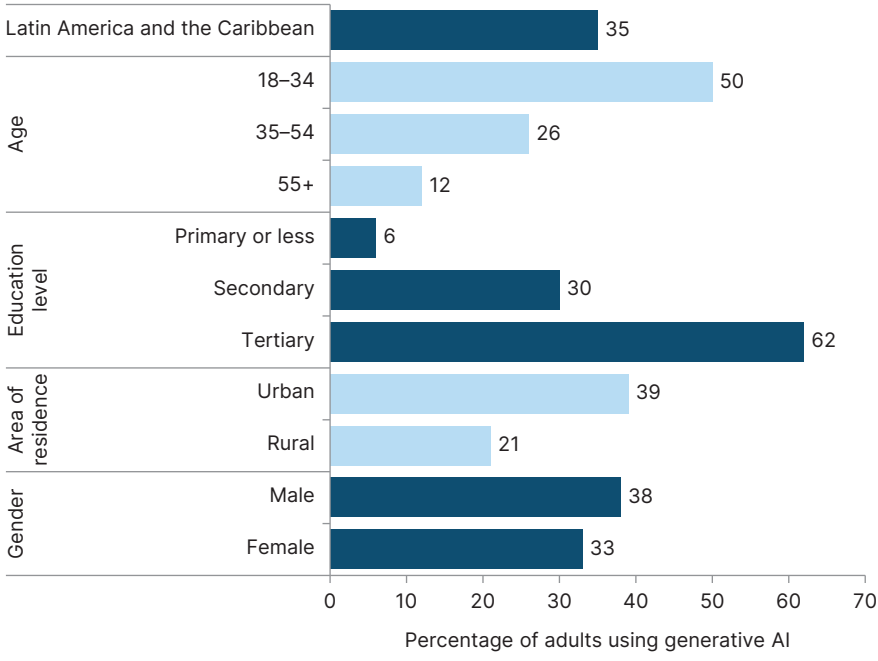
Generative AI in the Workplace

Figure 3.11 shows the percentages of adult workers who use generative AI for work across regions and countries. In Latin America and the Caribbean, this proportion is 26 percent, compared with 27 percent in OECD Europe and 43 percent in the United States.

Within Latin America and the Caribbean, country-level adoption among workers ranges from 15 percent in Mexico to 37 percent in Argentina. The spread is even larger than that between Latin American and Caribbean workers and U.S. workers. Seven countries in the region lie above the OECD Europe benchmark; they are led by Argentina (37 percent), Uruguay (36 percent), and Chile (35 percent).

[5] The same differences by education and age hold within individual countries, not just in the regional average. When adoption rates are computed within each country and then averaged, the percentages move by at most one or two percentage points. The concentration among younger adults is not unique to Latin America and the Caribbean. OpenAI's analysis of ChatGPT users finds that nearly half of all adult messages worldwide come from users under age 26 (Chatterji et al. 2025).

Figure 3.10. Generative AI Use across Demographic Groups

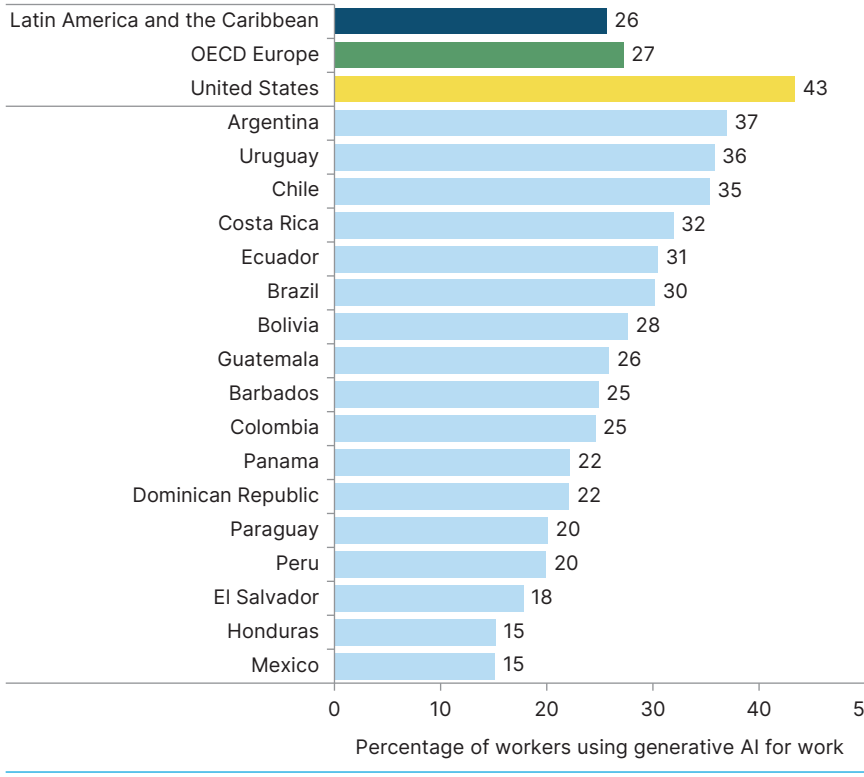


Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026.
Note: The figure shows the use of generative artificial intelligence within the three months preceding the survey. The sample includes adults ages 18–64 in all countries. Data were collected through in-person household surveys. Fieldwork took place between October 2025 and May 2026, with approximately 1,000 observations per country. The reported values are unweighted averages across Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. Within each country, estimates use sampling weights for national representativeness.

A notable example of the high levels of work-related GenAI use in the region is provided by teachers. Data from the OECD's 2024 Teaching and Learning International Survey (TALIS) indicate that adoption among teachers in several Latin American and Caribbean countries exceeds that observed in advanced economies. While 43 percent of teachers in the United States and 36 percent across OECD countries report using AI in their work, the corresponding shares range from 52 to 56 percent in Brazil, Chile, Colombia, and Costa Rica (Arias Ortiz and Giambruno 2025).

It should be noted that the adoption rates cited above measure how many people have used these tools, not how often. In the United States, only 1–5 percent of total work hours involve direct GenAI use, and users themselves report savings of about 5 percent of their working time as a result (Bick, Blandin,

Figure 3.11. Work-Related Generative AI Use across Countries



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026. Calculations are based on Eurostat, 2025, for OECD Europe; and the Harvard Project on Workforce's Generative AI Adoption Tracker, 2026, for the United States.
Note: The figure shows workers' use of generative artificial intelligence for work within the three months preceding the survey. Estimates follow the same country coverage and sample as in Figure 3.9, except for OECD Europe, where the sample is restricted to individuals ages 25–64. Applying the same age range to Latin America and the Caribbean reduces estimated average use to 24 percent.

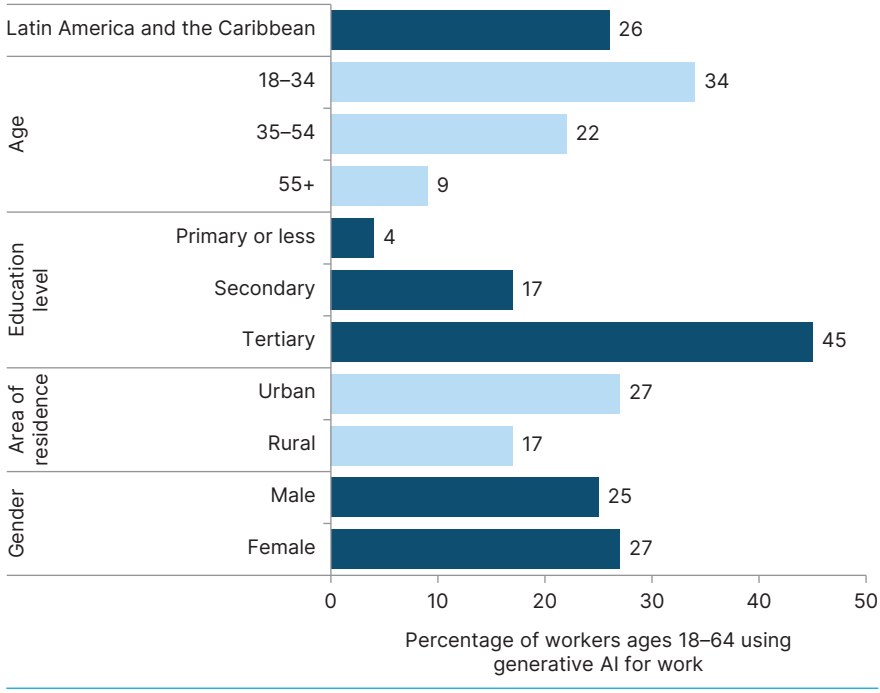
and Deming 2026). Even where many workers are users, the share of working time during which they are actually assisted by AI remains in the low single digits at the time of this writing.

What do workers actually do with generative AI? Equivalent measures are not yet available for Latin America and the Caribbean, but U.S. data provide a useful indication. Among workers who used GenAI for work, 40 percent reported using it to write communications. Other commonly reported uses included administrative tasks (26 percent), interpreting, translating, or summarizing text or data (23 percent), and searching for information (18 percent; Bick, Blandin, and Deming 2026).

As Figure 3.12 shows, workplace AI adoption varies most sharply by education and age. Adoption reaches 45 percent among workers with tertiary education, compared with just 4 percent among those with primary education or less. Differences by age are also substantial. Among workers ages 18–34, 34 percent use AI for work, compared with 9 percent of those ages 55 and older. Differences across the other demographic subgroups are smaller. Adoption among urban workers stands at 27 percent, compared with 17 percent among rural workers. The gender gap is negligible, with adoption at 25 percent among men and 27 percent among women.

The large adoption disparities within the region may limit the potential of generative AI to reduce productivity differences among workers. Although some studies find larger gains for those with less prior experience or skill, these groups are also less likely to use the technology in Latin America and the Caribbean. Broader adoption among these workers will be necessary for those gains to translate into more equal productivity outcomes.

Figure 3.12. Work-Related Generative AI Use across Demographic Groups



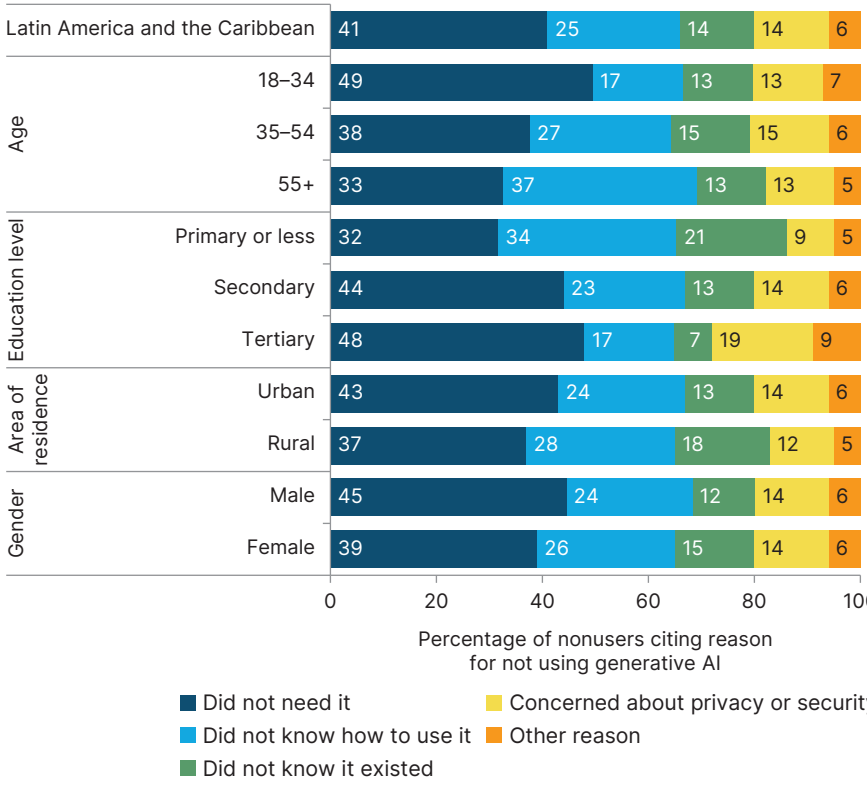
Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026.
Note: The figure shows workers' use of generative artificial intelligence for work within the three months preceding the survey. Workers are defined as those who reported being employed (employees, self-employed individuals, or unpaid family workers) during the week preceding the survey. Estimates follow the same country coverage and sample as in Figure 3.10.

Nonadoption

The evidence presented here suggests that generative AI remains in an early phase of diffusion in Latin America and the Caribbean. About one-third of adults used GenAI during the three months preceding the survey (Figure 3.9). The survey data also help explain why the remaining majority have not yet adopted these tools. Figure 3.13 presents the main reasons cited by nonusers.

Among nonusers, the most common barriers relate to perceived relevance and practical know-how rather than privacy concerns; 41 percent say they do not feel a need for GenAI, 25 percent say they do not know how to use it, and 14 percent say they did not know such tools existed. Together, these responses account for about 80 percent of nonusers, suggesting nonadoption reflects

Figure 3.13. Reasons for Not Using Generative AI, across Demographic Groups



Source: IDB staff calculations, based on data from the LAPOP AmericasBarometer, 2025–26, for Latin America and the Caribbean, except Barbados, whose data are from the Barbados Digital Literacy Survey, 2026.
Note: The figure shows the distribution of the main reasons reported for not using generative artificial intelligence in the three months preceding the survey, among those who reported not having used it during this period. Estimates follow the same country coverage and sample as in Figure 3.10.

limited awareness of potential uses and uncertainty about how to engage effectively with the technology more than active resistance to it.

Combined with the steep educational gradients in adoption shown in Figures 3.10 and 3.12, these responses underscore the central role of digital skills in expanding generative AI use. These patterns suggest that limited digital skills and practical knowledge of potential applications are important barriers to broader GenAI adoption. The broader role of skills and other complementary capabilities in enabling effective digital adoption is examined in Chapter 4.

Conclusion

The evidence in this chapter points to a consistent pattern: Latin America and the Caribbean has achieved broad access to digital technologies, but their use remains much shallower in activities that involve transactions and integration with firms and governments. Internet use is widespread, and the region approaches advanced-economy levels in relatively low-friction activities such as messaging and social networking. Yet large gaps persist in areas such as online purchasing and digital public services, where effective use depends on more complex supporting systems and organizational processes.

Generative AI broadly fits this pattern. Overall and work-related use in the region are already close to levels in OECD Europe, reflecting the ease with which individuals can access consumer-facing tools directly. But widespread individual use does not imply deep integration into production or organizational processes. Adoption also varies substantially across countries and population groups, particularly by age and education, while many nonusers report limited knowledge or skills as barriers to use.

Taken together, these findings document a central part of the book's broader argument: Widespread access and use do not by themselves imply the deep adoption needed for digital technologies to generate productivity gains. The key issue now is whether these technologies become sufficiently integrated into how firms, governments, and workers operate. For a region that has experienced weak productivity growth for decades, this distinction is central to understanding the potential of digital transformation. Chapter 4 turns to the factors that impede that transition, examining how weak or ineffective institutions, regulation, human capital, data, and infrastructure, along with market and coordination failures, prevent broad access from becoming deep, productivity-enhancing adoption.

4

The Policy Challenges of Effective Digital Adoption

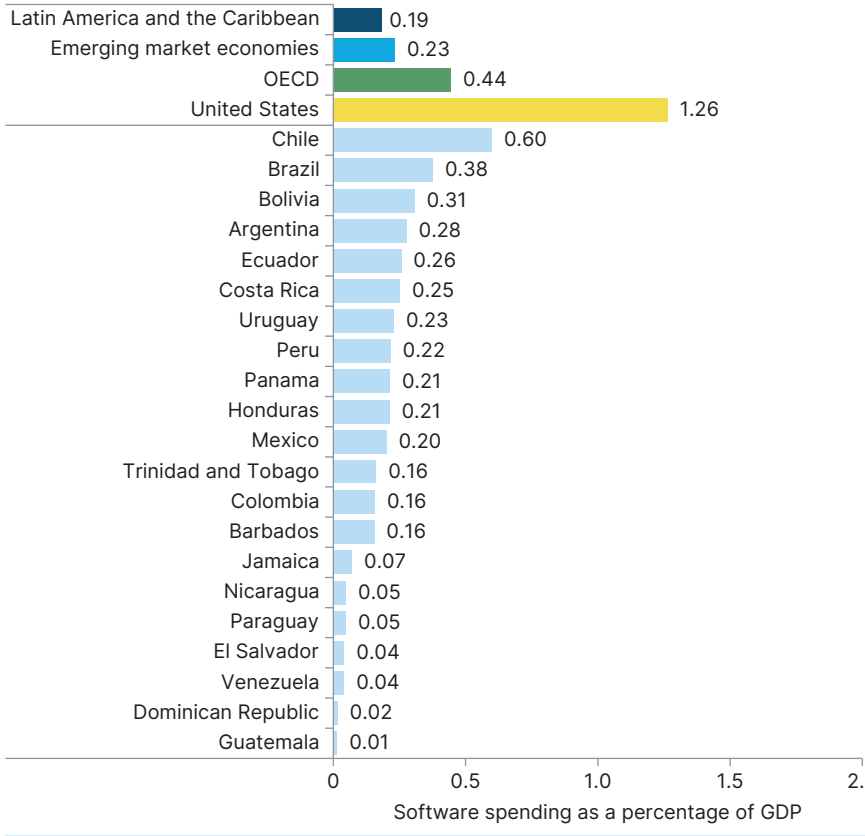
The revolution that began with digitalization and has culminated in artificial intelligence (AI) has provoked excitement, because innovation and the adoption of new technologies are central to productivity growth and economic development. It has also provoked anxiety, because the associated challenges and disruption are significant. While a country's institutions—the rules, norms, and organizations that structure how societies respond to digital technologies—are essential to overcoming the challenges and accommodating the disruption, they may instead discourage investments in these technologies and amplify their risks. The human capital required to develop the new skills that are vital to installing and using the technologies may be absent. The data and infrastructure that are indispensable to taking advantage of them may be slow to emerge. And, even if all of these prerequisites are present, market and coordination failures can impede their diffusion.

Indeed, the slow diffusion of digital technologies has long been a concern in Latin America and the Caribbean. One manifestation of this in the region's public sector is that 26 percent of adults report interacting with the government online during the three previous months, compared to 70 percent in Organisation for Economic Co-operation and Development (OECD) countries (see Chapter 3). The region spends significantly less on software as a share of gross domestic product than the OECD average (see Figure 4.1). Even among formal firms, the use of digital tools remains shallow and uneven, as Chapter 13 relates.

General-purpose technologies like digitalization and artificial intelligence—and like steam engines and electricity before them—tend to be difficult to adopt. As generic innovations that give rise to broad, economy-wide transformations, their benefits emerge when they have diffused across many sectors and enabled complementary innovations. To realize their potential, they require significant adaptation of organizational practices (Bresnahan and Trajtenberg 1995; Helpman 1998).

Technology adoption always depends on the institutional environment, human capital, infrastructure, and policies to address coordination and other

Figure 4.1. Software Spending as a Share of GDP



Source: IDB staff calculations, based on WIPO (2024).
Note: Country-group values are unweighted averages across countries with available data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

market failures that inhibit technological diffusion across the private and public sectors. As the discussion below highlights, general-purpose technologies have particular characteristics that make them, in principle, especially sensitive to institutions, human capital, infrastructure, and coordination and other market failures. In countries where these already delay technology adoption, the adoption of general-purpose technologies is likely to lag even more.

Special Challenges Posed by Digitalization and Artificial Intelligence

Realizing the potential of general-purpose technologies requires complementary investments, scale, and organizational transformation, all in the face

of significant uncertainty. Hence, productivity may initially stagnate or even decline after such technologies are introduced, before eventually increasing. Brynjolfsson, Rock, and Syverson (2021) argue that this pattern applies to digital technologies. Organizations first incur adjustment costs, invest in intangible complements, and experiment with new workflows. Only later, after complementary innovations diffuse and organizations learn how to scale effective practices, does productivity accelerate.

Four properties of general-purpose technologies account for the J-shaped evolution of productivity discussed in Chapter 2. First, they are not "plug and play"; they do not simply replace older technologies but instead require significant complementary inputs. In the case of digital technologies, the list is long and includes digitalized data assets and software and algorithms to manipulate them; servers, graphics processing units (GPUs), and sensors and internet-enabled equipment (internet of things); infrastructure, including fiber networks, mobile broadband, submarine cables, and data centers; and reliable power for data centers and high-intensity compute workloads. Digital technologies also require new skills. In the absence of any of these, the returns to digital investments plummet.

Second, the greatest productivity gains from general-purpose technologies emerge after changes in workflow and business design—that is, when organizations bundle technology adoption with management upgrades, workforce training, and process changes (Brynjolfsson, Rock, and Syverson 2021). In the public sector, for example, AI can help detect fraud, optimize inspection schedules, and personalize citizen services, but only if agencies redesign data flows, ensure interoperability, and establish accountability frameworks for how data are collected and used.

Third, general-purpose technologies exhibit significant economies of scale and scope. Returns to investments in these technologies increase as organizations and countries employ them at greater scale and across more applications. A government that builds a high-quality digital identity system, interoperable registries, and secure data-sharing frameworks can leverage these across taxation, social protection, health services, and disaster response. Similarly, a firm with strong data architecture can apply AI to marketing, operations, compliance, and human resources analytics. Once individuals have incurred the fixed costs of digitalization, they can adopt additional digital services at low marginal cost, from WhatsApp to digital government services, education platforms, or health tools.

Larger and more diversified organizations and organizations with greater access to finance are better placed to benefit from economies of scale and scope. In countries where institutions and public policies discourage firm growth and limit access to finance, economies of scale and scope are more difficult to achieve. This particularly hinders the adoption of general-purpose technologies like digitalization and AI.

These characteristics explain why general-purpose technologies are transformational: Returns increase and productivity effects multiply as complementary inputs become available, organizations are revamped, and adoption grows in scale and scope. Economies that embraced earlier general-purpose technologies had changed completely a few decades after adoption.

Uncertainty about their private and social returns, however, is the fourth critical characteristic of new general-purpose technologies. Organizations are uncertain about the productivity gains they will accrue from digital technology (they do not yet know, for example, which tasks artificial intelligence can reliably handle at low cost) and also about how to reorganize production or their interaction with customers so as to maximize those gains.[1] The benefits of digital technologies may depend on adoption by others whose behavior is itself uncertain. The speed of technological change is another unknown, but rapid cycles of obsolescence accelerate the depreciation of early investments and reduce returns to early adoption. Finally, the returns to early investments may be negative if complementary inputs, from data to energy, do not materialize. In the face of this uncertainty, individually rational decisions to postpone adoption can trap the economy in a low-adoption equilibrium, despite large potential productivity gains.

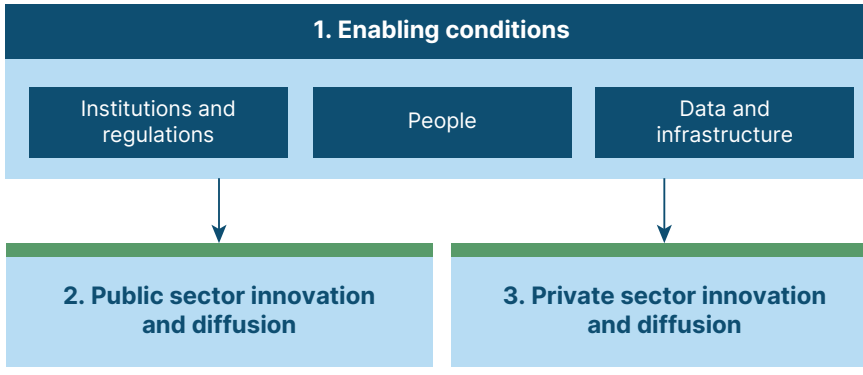
Large uncertainty about societal risks is also consequential and shapes the regulatory landscape within which technology acquisition must be navigated. The risks include labor displacement, which could be modest and gradual or large and cataclysmically rapid; the unauthorized distribution of private information, with effects ranging from moderately disturbing to highly invasive; the impact of algorithms, which may amplify human biases or moderate them; the use of digital technologies, which may advantage either criminals and rogue states or law enforcement and national security; and social media, which may reduce loneliness or harm the psychological health and cognitive capacities of young people. The magnitude of these risks, the degree to which markets can limit them, and the appropriate policy responses to market failures that may perpetuate and amplify them are all uncertain.

Challenges of Effective Digital Adoption in the Region

The unique characteristics of general-purpose technologies compared to other technologies make their adoption particularly vulnerable to weak institutions; to insufficient human capital, infrastructure, and data; and to coordination and market failures that slow diffusion (Figure 4.2). Weak regulatory institutions make the inherently

[1] Even the economic returns of the most prominent application of AI—in the creation of new software products—are uncertain. In an analysis of data from more than 100,000 GitHub developers, Demirer, Musolff, and Yang (2026) find the impact of AI on the coding productivity of developers is six times greater than its impact on the software products they actually deliver. They attribute the difference to the fact that software products require human inputs that go beyond coding and are less susceptible to AI.

Figure 4.2. Policy Framework for Effective Digital Adoption



Source: IDB staff.

uncertain returns to adoption even more uncertain. Human capital and infrastructure deficits impose greater costs when the benefits of technological adoption rise with the scale of adoption. The social costs of barriers to diffusion are greater when the returns to new technology rise with the number of organizations that adopt them.

Institutions and Effective Digital Adoption in the Public and Private Sectors

Institutions have profound effects on the adoption of new technology. When they produce predictable and efficient rules and enforce them fairly, they build trust among actors and strengthen adoption incentives. Weak institutions that produce arbitrary rules and enforce them haphazardly reduce trust and discourage adoption. Weak state institutions in Latin America and the Caribbean reduce trust. Less than 30 percent of people in the region trust their governments, compared with 44 percent in OECD countries and 38 percent in the rest of the world (Keefer and Scartascini 2022).

The effects of weak institutions on trust reverberate inside organizations and impede technology adoption. Keefer and Vlaicu (2024) find that high-trust public employees in Latin America and the Caribbean are more likely to support technological innovation and to share information and collaborate with other employees. Experience with electronic health record initiatives in Bogotá, Colombia, and Costa Rica highlights resistance from health personnel as an important barrier to adoption, one reflecting employees' concerns about how organizations will manage the impact of change (Pérez Serna 2023; Ochoa Chaves, Jiménez Alvarado, and Martínez de Lemos 2023).

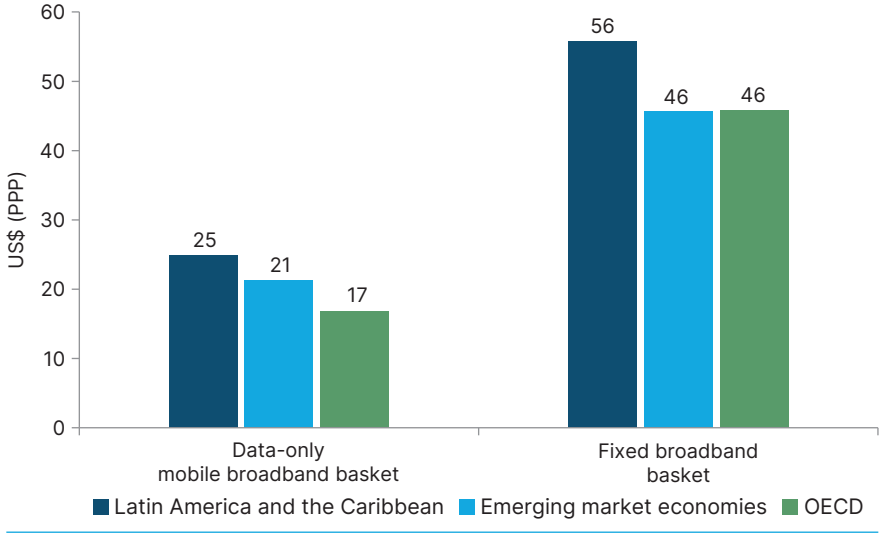
Mistrust also hinders individuals' adoption of new technologies. Survey respondents in Uruguay reported that they were eager to receive personalized health or education services, but once they were asked to share personal data, their interest declined by approximately 3 percentage points (Aguirre De Mora, Roseth, and Santamaria 2024). A survey in Argentina, Brazil, Chile, Colombia, Mexico, and Peru

identified respondents who did not use a mobile phone to pay for services or to send or receive money. Of these, 28 percent indicated mistrust of the digital payment format as the reason (Vlaicu 2025).

Weak institutions also undermine the quality of regulations required to encourage the adoption of digital technologies. Latinobarómetro data from 2020 show that three-quarters of regional respondents believe laws are not applied equally, and 84 percent doubt others obey the law. But unequal application of laws is detrimental to investment in new technology. In contrast, a level playing field for firms enhances competition, motivating firms to make investments at the technological frontier. Alviarez et al. (2025) identify firm market power and low competitive pressure as an important reason for low productivity growth (and, implicitly, slow technology adoption) in Latin America and the Caribbean. They trace these, in turn, to regulatory barriers to entry and the permissive regulation of collusive behavior.

Barriers to entry help explain why average costs of mobile broadband access in the region, adjusted for purchasing power parity (PPP), are almost 50 percent higher than in OECD countries and 20 percent higher than in emerging market economies (see Figure 4.3). Fixed broadband follows a similar pattern, with costs in the region more than 20 percent above those in OECD countries and emerging market economies.

Figure 4.3. Fixed and Mobile Broadband Price Baskets across Country Groups

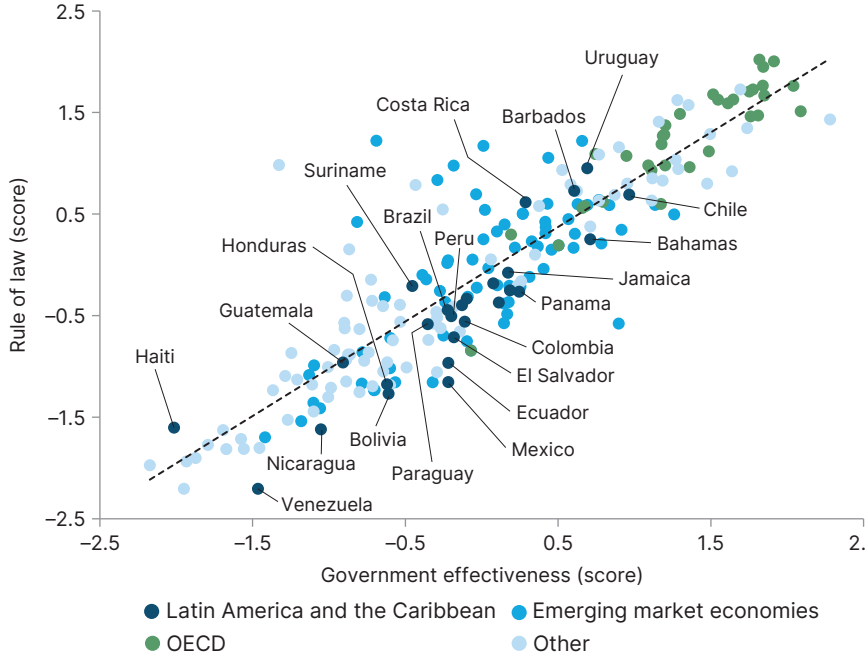


Source: IDB staff calculations, based on the International Telecommunication Union's ICT Price Baskets, 2025.
Note: The figure shows the average 2024 price of the fixed broadband basket and the data-only mobile broadband basket, expressed in purchasing power parity (PPP) terms. Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 25 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

The region also lags in the predictability and quality of its regulatory environment and, more broadly, in government effectiveness and the rule of law. If the system of rules is unstable or inefficient, investment in new technology slows. One analysis of 39 different challenges to development in the region ranked institutional capacity as among the most critical constraints (Avellán and Brito 2023). According to the World Bank's Worldwide Governance Indicators, both government effectiveness and rule of law have worsened in the region over the past decade. Between 2013 and 2023, the former fell from the 58th to the 49th percentile, and the latter from the 52nd to the 48th percentile, with a wide regional variation (Figure 4.4). In such an institutional environment, it is difficult for firms to secure the legal validation usually needed for essential organizational transformations, such as those associated with digital payments, electronic signatures, telemedicine, and data sharing.

General-purpose technologies also place new demands on institutions. Digitalization and artificial intelligence require institutions to allocate and enforce

Figure 4.4. Government Effectiveness and Rule of Law



Source: IDB staff calculations, based on the Worldwide Governance Indicators, World Bank, 2025.
Note: The rule of law score reflects reviewer assessments of contract enforcement, property rights, the police and courts, and the likelihood of crime and violence. Government effectiveness is an assessment of the quality of public services, the civil service, policy formulation and implementation, and the credibility of a government's decisions. Both indicators are expressed on a standard normal scale (approximately −2.5 to 2.5), with higher values indicating better governance. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A). "Other" covers the remaining countries and economies with available data. The dashed line indicates the linear fit.

new property and contract rights related to data; to address potential new market failures, such as those related to data privacy or biased algorithms; and to confront emerging redistributive concerns, such as labor market displacement. When institutions are effective in accomplishing these tasks, trust increases, investment returns are more predictable, and effective digital adoption accelerates.

The remainder of this section focuses on two prominent institutional challenges emerging from digitalization and artificial intelligence. One is protecting digital property rights from cybercrime—that is, maintaining the rule of law in the digital economy. Another is defining property rights related to data and the rules for data transactions—that is, determining what rights to their data people retain once they have shared them online, and under what conditions they should be allowed to waive those rights. To meet both challenges, regulatory institutions need the capacity to identify market failures, quantify their impact, and, if necessary, design and implement efficient regulatory responses to them.

Cybersecurity

A central role of the state is to ensure public safety and preserve the rule of law. Chapter 9 discusses the opportunities digital technologies offer to improve the criminal justice system and reduce crime but not the challenges they pose by enabling cybercrime. Across Latin America and the Caribbean, organizations faced an average of about 2,800 attacks a week in 2025, 40 percent more than the global average of 2,000 and 75 percent more than the European average of 1,600 (Check Point Research 2026). Media-disclosed cyberattacks in the region grew 25 percent annually between 2014 and 2023 (Vergara Cobos 2024).

Lukošiūtė, Halstead, and Righetti (2026) estimate the total global economic damage from cybercrime, including ransom payments, approached US$500 billion in 2025. In Latin America, rough estimates suggest the average cost of a data breach is approximately US$3.8 million (IBM 2025).[2] Institutions affected by a cyberattack on one U.S. banking service provider reduced their payments by 46 percent, creating liquidity shortages for banks that were not targeted (Kotidis and Schreft 2025).[3]

---

[2] These numbers reflect the total economic burden, including technical remediation, legal fees, and regulatory penalties, which accumulate on top of any direct financial theft or ransom payments. The US$500 billion figure comprises direct losses to individuals (40 percent), direct losses and response costs for firms (40 percent), and preventive defense spending (20 percent).

[3] The emotional costs of cyberattacks can also be large, and cyberbullying is pervasive. A national survey in Mexico revealed that 20 percent of individuals ages 12 and older who reported using the internet in 2025 experienced some form of cyberbullying or online harassment between August 2024 and October 2025 (INEGI 2026).

The threat of cybercrime also suppresses economic activity. It raises the cost of financing, with investors demanding an annual risk premium of up to 8.3 percent to hold stocks highly exposed to cyber risk (Florackis et al. 2023). The loss of customer trust arising from cyber incidents reduces long-term sales growth by 3.4 percentage points for large firms and 5.4 percentage points for retail businesses, while bonds lose approximately 2 percent of their value within a month of an incident (Iyer, Simkins, and Wang 2020). When firms disclose breaches involving personal financial information, the value of their stock drops an average of 1.1 percent (Kamiya et al. 2021).

Cybercrime is difficult to deter. It has low barriers to entry, which advances in AI have further reduced. Financial returns are high; according to Lukošiūtė, Halstead, and Righetti (2026), scams and ransom payments yield approximately US$200 billion a year. Cybercrime does not require significant technical skills, with over 52 percent of cyberattacks driven by easily accessible, standardized extortion and ransomware tools (Microsoft 2025). Moreover, prosecution is easy to evade. In the United States, for example, only 0.3 percent of reported cybercrime incidents result in arrests (Eoyang et al. 2018), because enforcement agencies lack technical expertise and funding, and jurisdictional divides and the absence of harmonized international laws and extradition agreements hinder enforcement (Qudus 2025). Finally, because firms fear the fallout from disclosing cybercrimes (Amir, Levi, and Livne 2018), many incidents go unreported (Romanosky 2016).

Despite the threat of cybercrime, organizations appear to invest too little in their own cybersecurity. In 80 percent of cyberattacks, attackers gained entry by exploiting unmanaged devices—such as unpatched personal hardware—or by utilizing stolen passwords purchased on the dark web (Microsoft 2025). Two market failures explain why private investment in cybersecurity is low, pointing to an important role for regulatory institutions.

First, private actors are imperfectly informed about the probability of cyber incidents, the costs they impose, and the benefits of investing in cyber defense (Vergara Cobos 2024). Their imperfect information can be inferred from the fact that once firms experience a cyberattack, they increase their cyber defenses by much more than they would have if they had been well informed: Compared to their counterparts that were not attacked, firms that experience a cybersecurity breach eventually deploy 44 percent more integrated solutions. They also typically double their reliance on leading providers of cybersecurity (Hajizada et al. 2026).

The second market failure is that private actors do not take into account the implications for others of their own investments in cyber defense. Computer viruses that successfully attack one firm are more likely to move on to attack additional firms, so action by one firm in effect protects others (Gordon et al. 2015). The 2017 NotPetya cyberattack highlights the magnitude of these externalities.

It resulted in over US$7.3 billion in collateral losses for the customers of the affected firms—an economic impact four times larger than the initial drop in profits reported by the firms that were directly targeted (Crosignani, Macchiavelli, and Silva 2023).[4]

The public sector is not immune to these failures. Individual government agencies are not well informed about cyber risks and, in addition, have weak incentives to consider the impact of their cyber defense spending, or lack of spending, on other organizations in the public and private sectors. Governments can correct these failures in both sectors by investing in cyber defense; by encouraging, monitoring, and coordinating the cyber defense investments of the private sector; and by reinforcing their capacity to respond to and prosecute perpetrators of cyberattacks.

Figure 4.5 indicates that Latin America and the Caribbean is making progress in establishing the institutional foundation for strong cyber defense, but the foundation is still weak. The average of indicators from the Cybersecurity Capacity Maturity Model increased from 0.33 in 2016 to 0.43 in 2024, but it is still far from the maximum of 1 on the 0–1 scale.

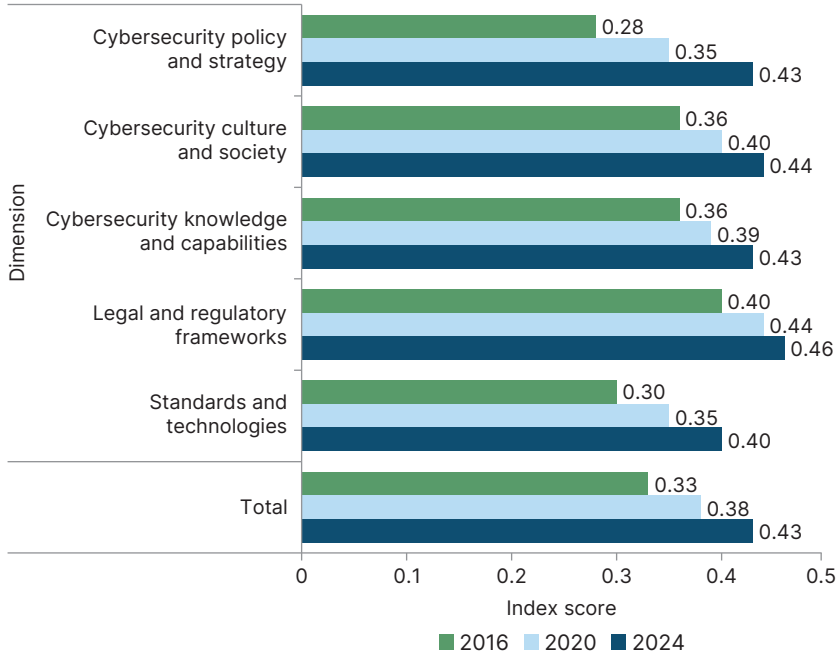
Privacy

Data privacy is another important regulatory challenge of digital technology. As privacy concerns have expanded from physical spaces to digital, the boundaries separating private from public information have also shifted (Acquisti, Taylor, and Wagman 2016), triggering demands for new regulation. To design privacy regulations that enhance the welfare gains from digital adoption, regulatory institutions need three capabilities: to verify there is a market failure or distributional objective that regulation should address; to quantify the extent of the problem—for example, the social losses related to data privacy; and to verify that the proposed regulations yield social benefits greater than their social costs. Globally and across the region, regulatory institutions overseeing data often make decisions without information on these three dimensions.

One way to assess whether individuals suffer an excessive loss of privacy is to ask whether the compensation they receive for their personal information is less than they would receive in a competitive market for their data. Several market failures can lead to this outcome: if providers of digital services have market power that allows them to acquire individuals' personal data at less than competitive prices; if individuals involuntarily use the digital services that require them to

[4] NotPetya was a 2017 global cyberattack that utilized wiper malware disguised as ransomware. Initially targeting Ukrainian infrastructure, the malware spread through supply chains to multinational companies.

Figure 4.5. Cybersecurity Capacity Maturity Model Scores



Source: IDB staff calculations, based on data from the Cybersecurity Capacity Maturity Model for Nations, IDB, and the Organization of American States.
Note: The Cybersecurity Capacity Maturity Model for Nations tracks Latin American and Caribbean countries' progress along some of the institutional dimensions of cyber defense. The policy and strategy dimension refers to the institutional and strategic frameworks governing cybersecurity; culture and society refers to digital literacy and active cyber citizenship; cybersecurity knowledge and capabilities refers to relevant education and training programs; legal and regulatory frameworks refers to the strength and enforceability of legal norms needed to safeguard the digital domain; and standards and technologies refers to technical standards, incident response processes, and technologies to reduce operational risks across national infrastructure. Reported values are unweighted averages across 30 Latin American and Caribbean countries.

share personal information; if individuals are unaware of how buyers will use their data; or if the transactions between digital service providers and their customers affect the welfare of individuals who are not parties to the transaction.

Evidence from outside of Latin America and the Caribbean suggests each of these failures may be present in the market for personal information, potentially justifying some form of regulation. Research on the General Data Protection Regulation (GDPR) of the European Union, for example, indicates that online service providers may exercise market power. The GDPR requires online firms to obtain the consent of users before collecting their personal data. Larger firms have been better able to secure consent than smaller firms. Among users of smaller e-commerce sites, 20 percent did not consent, a comparatively large share of refusals that suggests users believed they had other competitive options.

Their refusal led to a 17 percent revenue decline for these sites. Among users of larger sites, only 8 percent did not consent, suggesting users did not believe they had comparable alternatives—that these larger firms exercise market power. Revenue losses for these sites were only 8 percent (Goldberg, Johnson, and Shriver 2024).

Evidence from the United States indicates that participation in digital markets is not always voluntary. Many individuals participate in social media only to avoid the social costs of not participating, such as social stigma (see Bursztyn et al. 2026). Privacy laws that make participation in social media more costly would reduce this stigma.

Ample evidence from outside the region also indicates consumers do not know which specific entities hold their data, how that information is used, or how to limit its collection. Nor are they aware that companies routinely gather non-self-disclosed information via cookies, clickstream data, and external databases (Goldfarb and Que 2023). Consumers may, therefore, underestimate the impact of data sharing on their privacy and demand too little compensation for their personal information.

Finally, digital transactions have spillover effects on third parties who do not participate in them. Personal data collected from a fraction of a population can be enough to infer the personal characteristics of everyone else, including those who do not even use online services (Acquisti, Taylor, and Wagman 2016). Moreover, as more individuals opt out of using online services, online service providers can more accurately track the behavior of those who remain.[5]

The existence of a market failure does not, alone, justify regulation. It is also important to verify that the welfare losses from such failures are sufficient to justify regulatory interventions. In fact, global evidence, including data from Latin America and the Caribbean, suggests market failures related to privacy may not impose large social costs because individuals often do not place a high value on data privacy. Exact values placed on data privacy vary widely across types of information and countries, however—a situation that increases the demands on regulatory capacity.

The privacy paradox—which holds that people claim to value privacy highly but behave as if they do not—was originally suggested by Norberg, Horne, and Horne (2007). A decade later, Athey, Catalini, and Tucker (2017) provided experimental evidence of this discrepancy between stated preferences and

[5] When privacy-conscious users opt out, they remove anonymous data from the tracking pool. The remaining consumers are often more similar, making them more predictable and easier to track. Following the implementation of the European Union's General Data Protection Regulation, the ability of websites to track remaining users over a multi-week period increased by approximately 8 percent (Aridor, Che, and Salz 2023).

behavior. In their study, even students who expressed strong preferences for privacy were more willing to disclose their friends' email addresses when offered a free pizza. Prince and Wallsten (2020) measured individuals' willingness to pay for data privacy across six countries (Argentina, Brazil, Colombia, Germany, Mexico, and the United States). Although for more sensitive information individuals demanded more, the amounts in general were low: on average, US$8.40 monthly to share their bank balances and US$7.60 for fingerprint data. For less sensitive information, these demands dropped considerably; individuals demanded US$1.80 for location sharing and were unwilling to pay anything at all to avoid receiving targeted advertisements.

Geographical disparities in the valuation of personal data are also significant. Latin Americans, particularly in Colombia, place the highest premium on biometric data (fingerprints), requiring US$12.90 monthly, compared to US$5.90 in Germany. Where respondents in Germany and the United States required payment to accept advertisements, Colombians were willing to pay approximately US$2.50 monthly to receive text-message ads. While this evidence suggests privacy regulation may not deliver large social benefits in most cases, it also underlines the importance of regulatory capacity to estimate these benefits.

Finally, even if market failures exist and the resulting loss of privacy has large effects on social welfare, it may not be the case that regulations can make a difference at reasonable cost. Existing evidence raises doubts about both the efficacy and cost of privacy regulation. Regarding efficacy, Miller, Lukic, and Skiera (2025) conclude that data protection regulations reduce intrusive tracking but do not slow the global growth of tracking. Earlier results, from Urban et al. (2020), are similar. Fewer companies collect data, but the overall data collected about users remains unchanged. Regarding costs, privacy regulation appears to be expensive. Demirer et al. (2026) show that in response to the GDPR, EU firms became less data intensive, decreasing data storage by 26 percent and processing by 15 percent relative to comparable U.S. firms. In addition, website traffic decreased, and visitors viewed fewer pages (Goldberg, Johnson, and Shriver 2024). Privacy regulation also appears to increase the market power of large digital service providers, leading to fewer, larger companies tracking users across more websites (Urban et al. 2020).

Most of the world's data privacy laws were drafted or enacted in the 2010s (Lim and Oh 2025), before evidence was available to inform the three issues for institutions identified above (whether there is a market failure that regulation should address, whether the failure imposes large social costs, and whether regulating it would create larger social benefits than social costs). The European Union's GDPR applies uniform baseline standards, such as the requirement for explicit, opt-in consent, across all economic sectors. The United States relies on targeted privacy statutes for specific industries, such as health and finance, or particular groups, especially children. The U.S. system allows commercial

data collection by default, unless the consumer objects. In Latin America and the Caribbean, 19 countries have enacted specific personal data protection laws, with varying levels of enforcement. They approximately follow the European model, but, in general, countries make this choice without prior analysis of the existence of failures in the market for personal data, their social costs, or regulatory effectiveness in addressing them.

In sum, strong institutions are always important for investment in new technology and, even more so, for general-purpose technologies, which are particularly sensitive to the rule of law and secure property and contract rights. They are also very sensitive to regulatory arrangements that maintain a level playing field and that proceed deliberately in evaluating market failures, the harms these generate, and the efficacy and costs of regulatory responses to these failures.

Human Capital and Effective Digital Adoption

Effective digital adoption and, especially, artificial intelligence raise profound questions about the evolving demand for human capital. How, for example, will artificial intelligence change the returns to investments in technology-related human capital, such as computer science, versus returns to investments in foundational competencies (literacy, numeracy, and problem solving) and managerial competencies (such as optimization of firm structures to exploit the benefits of new technologies)?

Digital technologies, particularly AI, are likely to reduce the returns to some skills that used to be highly valued (routine data entry, information retrieval, and some coding tasks), potentially displacing workers currently dedicated to these tasks (Eloundou et al. 2024). Other tasks, many not strictly digital in nature, will become more important, such as the design and execution of complex projects, the management of digital platforms, the procurement of advanced technologies, and the development and adoption of AI solutions (Martins-Neto et al. 2025). Effective digital adoption also places unique demands on managers, who must align new digital technologies with strategy and guide organizational change efforts (Ciarli et al. 2021).

Data from the International Telecommunication Union (ITU) indicate that individuals in Latin America and the Caribbean are less likely to engage in advanced digital activities than people elsewhere. The share of the region's respondents who report undertaking tasks that require basic or intermediate skills is also lower, approximately one standard deviation below the OECD average and 0.40 standard deviations below the average for emerging market economies.[6]

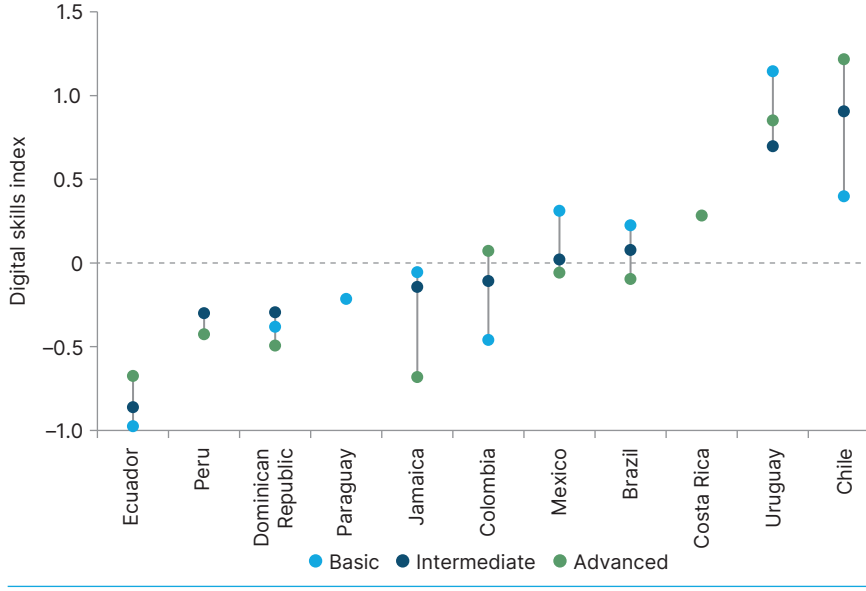
[6] These indicators are best interpreted as behavioral proxies for digital proficiency. Individuals may undertake few advanced activities because they lack advanced skills or because they have few opportunities to use advanced skills.

Reported digital activities vary substantially across countries in Latin America and the Caribbean (Figure 4.6), with respondents in Chile and Uruguay engaging in far more digital activities than the regional average, while those in Ecuador report fewer.

These differences are economically meaningful. Individuals with only basic skills struggle with managing data in spreadsheets, engaging in e-commerce, conducting online banking, or installing and configuring software. The large fraction of individuals in the region without intermediate and advanced skills will be slow to translate connectivity into more productive uses of digital technology.

This deficit in digital skills likely reflects deeper and more persistent deficits in foundational competencies. As Chapter 5 reports, current students also exhibit lower levels of foundational skills: Only 24 percent of 15-year-olds in Latin America and the Caribbean achieve a minimum math standard, compared with 69 percent of their counterparts in the OECD. Weaknesses in reading comprehension and quantitative reasoning constrain individuals' ability to navigate, interpret, and

Figure 4.6. Skills Required by the Digital Activities Individuals Undertake



Source: IDB staff calculations, based on data from the ITU DataHub, 2022–23.
Note: Digital skills indices are expressed in standard deviations relative to the average in Latin America and the Caribbean—that is, a value of one indicates the index is one standard deviation higher than the Latin American and Caribbean average. The indices are constructed using the most recent ITU country-level indicators (2022 or 2023) on the share of individuals who had recently undertaken basic, intermediate, and advanced digital tasks, based on the skills required to complete different tasks. Each country's index for each skill level is the average of the z-scores at that level. Each resulting index is then standardized relative to the Latin American and Caribbean mean and standard deviation. No country index is reported for basic or intermediate tasks if data are available for fewer than five tasks; no advanced index is reported if data are available for fewer than two tasks.

apply digital tools effectively. Those who lack these skills may struggle to design AI agents or even to provide AI with prompts that extract useful predictions from it. They may also be unable to use AI to compensate for their lack of other digital skills by, for example, using natural language assistants to create a formula in a spreadsheet, format a document, or navigate an unfamiliar government platform.

Infrastructure and Data

General-purpose technologies not only place unprecedented demands on existing infrastructure (for example, energy); they require the creation of whole new classes of infrastructure (connectivity, data centers, interoperability). Digitalization requires infrastructure to store, transport, and process digitalized data. Even more fundamentally, digitalization requires data. Without data, and particularly without local data, effective digital adoption and the training and adaptation of AI systems cannot even begin.

Data to fuel digital technologies only exist if organizations value them as essential to better decision making. Organizations that feel little pressure from competitors or voters to make data-driven decisions, however, are unlikely to prioritize investments in the digitalization and analysis of data. One indicator of an organization's interest in data is whether it acquires business enterprise software, which is central to the effective use of data in decision making. Unfortunately, relatively few firms in the region appear to use business enterprise software (see also Chapter 13). Uruguay is one of the most digitally advanced countries of the region and closely monitors digital adoption by its firms. In 2024–25, 23 percent of small firms, 27 percent of medium-size firms, and 47 percent of larger firms used enterprise resource planning (ERP) software (Jaccoud 2025). The percentages were lower for customer relationship management (CRM) software, at 14 percent, 12 percent, and 27 percent, respectively. Contemporaneous percentages for the European Union were much larger: 41 percent of small enterprises and 89 percent of large firms used ERP software, while 25 percent and 65 percent, respectively, used CRM software (Eurostat 2026).

Low-productivity countries also tend to lag in developing the infrastructure needed to take advantage of the data they collect. Latin American and Caribbean countries have been slow to invest in data storage and processing and in connectivity. OECD economies outside the region have seven data centers per million inhabitants, but the region only has one.[7] This paucity means that users in Latin America and the Caribbean are more likely to rely on distant data centers, often in other countries. Cross-border interconnection within the region remains limited, and connections to countries with more developed digital infrastructure

[7] This information is from the Data Center Map, a research tool that provides information on 12,259 data centers across 179 countries (see https://www.datacentermap.com).

are often poor. Submarine, terrestrial backbone, and inter-urban connectivity systems are both sparse and aging (García Zaballos et al. 2023; Wood 2024). Most of the region's submarine cable systems were deployed between 2000 and 2010 and are approaching or exceeding their 25-year design lifespan (Wood 2024).[8] As a result, even traffic between neighboring countries is frequently routed through external hubs, forcing countries to pay high costs and experience significant transmission delays (latency). The region also scores 4.6 out of 8 on the Broadband Development Index (García Zaballos, Iglesias Rodriguez, and Puig Gabarró 2023), compared with 6.3 for OECD economies. Median download speeds remain less than half the OECD average (García Zaballos, Iglesias Rodriguez, and Puig Gabarró 2023). In 2022, 79 percent of urban households had fixed broadband access, compared with 43 percent in rural areas (IICA 2022).

Institutional obstacles slow the modernization and expansion of data and digital infrastructure. Submarine cables, regional data hubs, and cross-border connectivity corridors require harmonized regulatory standards, streamlined permitting procedures, coordinated deployments, and joint spectrum management frameworks (Puig Gabarró et al. 2021). Uneven spectrum management and competition policies limit incentives for infrastructure sharing, co-deployment, and open access, especially in underserved areas (World Bank 2021).

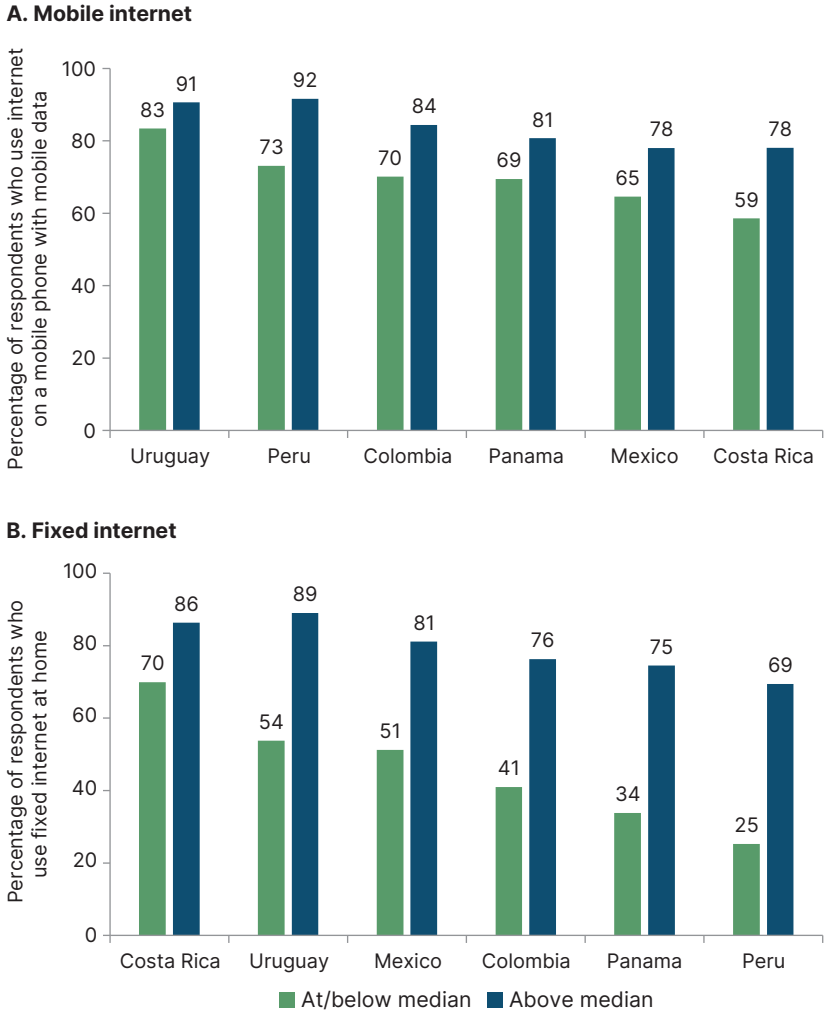
Data collected in 2025–26 by the Latin American Public Opinion Project (LAPOP) indicate that individuals in the region, particularly poorer ones, also lack the equipment they need to take advantage of digital technologies. Among those with below-median incomes, only 59–83 percent used the internet from a mobile phone with mobile data during the three months preceding the survey (Figure 4.7). The difference widens when looking only at fixed connections, which tend to be faster and have fewer data restrictions. Only 25–70 percent of below-median income individuals used fixed internet from their homes. A large fraction of lower-income individuals did not use the internet at all (16 percent) or used it only through mobile data (33 percent).

Computer ownership lags in the region (and, given differences in mobile and fixed internet access, is likely to lag even more among poor households). This is consequential, since computers are more productive than mobile phones for complex digital tasks, educational activities, and the use of government and firm platforms designed for larger screens. The share of households with computers is around 80 percent in the OECD, above 60 percent in emerging market economies, and just over 40 percent in Latin America and the Caribbean.[9] Public

[8] These are submarine systems with in-line repeaters, containing active electrically powered components along the cable that degrade over time.

[9] IDB staff calculations, based on the ITU DataHub. Estimates for Latin America and the Caribbean are based on data from Argentina, Brazil, Colombia, Costa Rica, Mexico, Paraguay, and Peru.

Figure 4.7. Mobile and Fixed Internet Use by Income Group



Source: IDB staff calculations, based on the LAPOP AmericasBarometer, 2025–26.
Note: The figure shows mobile and fixed internet use within the three months preceding the survey. Results are shown separately for two sets of respondents: those at or below the median income of the country and those above it. The sample includes adults ages 18 or older. Estimates use sampling weights for national representativeness. Panel A shows internet use on mobile phones with mobile data. Panel B shows fixed internet use at home, including Wi-Fi, broadband, fiber-optic, or cable.

policies, such as high tariffs on computers, may be at least in part responsible for the unaffordability of computers for poorer households. Even if these policies are changed, though, the ubiquity of mobile devices in the region, combined with lags in computer ownership, indicates the more important challenge is to optimize digital services for ease of use by those with limited bandwidth and small screens.

Many of the greatest benefits of digital technologies arise when government ministries and firms share and reuse one another's data, increasing productivity across institutions. The cost of financial transactions, for instance, plummets when payments from buyer to seller are instantly recognized by the buyer's and seller's financial institutions. These economies are lost, though, without system interoperability and governance standards to ensure both interoperability and data integrity.

Digital public infrastructure is one way to facilitate data sharing and interoperability.[10] Government investments in digital identity systems, interoperable registries, and secure data-sharing frameworks yield benefits across government (in, for example, taxation, social protection, health, and disaster response; see Chapter 7) at very low marginal cost. Digital public infrastructure can also significantly reduce transaction costs in the private sector, particularly those related to identity authentication and interoperable payment systems.

Argentina, Chile, Colombia, Panama, and Peru have centralized digital identity systems that not only reduce the costs of government transactions but are expected to be used by banks, fintechs, and telecommunications companies to authenticate customers. Chile has a common authentication layer for the public sector that enables interoperability across agencies and lowers the cost of delivering digital services (see Box 4.1). Argentina's digital identity infrastructure is widely used in fintech and banking.

Box 4.1. Investing in Interoperability: Chile's ClaveÚnica

Government investments in data and infrastructure do little to improve service delivery if users cannot easily access the system. Access, however, requires secure digital authentication, which, in turn, demands substantial upfront investment in cybersecurity, legal validation, identity verification, and fraud prevention. Unfortunately, individual agencies receive only a fraction of the benefits of these large investments. Hence, they invest too little and neglect to coordinate standards with other agencies, leading to underdeveloped and fragmented digital services.

ClaveÚnica centralizes the fixed investments and spreads their benefits across the entire public sector with a single digital identity and authentication system designed to provide a single, secure credential for accessing public digital services. Agencies focus on service delivery rather than identity management, and users interact with the state through a single, standardized authentication process. In the next phase of development, ClaveÚnica will be expanded for use in private sector authentication.

[10] Digital public infrastructure refers to shared digital systems that provide foundational services across the public and private sectors, such as identity verification, digital payments, and secure data exchange.

Lack of interoperability reduces the gains from digitalization in the private sector, as well, most notoriously in the case of payment systems. Ideally, the payments infrastructure of a country allows the instantaneous, low-cost settlement of claims and does so "universally," among banks, fintechs, payment institutions, merchants, and consumers. This demands interoperability so that any user, at any institution, using any payment instrument, can transact with any other through shared, standardized payment rails. Such infrastructure is difficult for the private sector to establish. Individually, for example, large banks are averse to interoperability because they can earn higher profits from proprietary, closed-loop payment systems.

Governments can address this market failure either by coordinating with banks to make their systems interoperable or by setting up a single payment system that banks are required to adopt.

Obstacles to Public and Private Sector Diffusion

Even if the foundations of effective digital adoption are in place, coordination and other market failures still inhibit the diffusion of digital technologies. Evidence reviewed in Chapter 3, for example, suggests that lack of connectivity cannot explain why governments and firms in Latin America and the Caribbean have made less progress in effective digital adoption than their counterparts in OECD countries outside the region. Other obstacles to diffusion loom larger. In addition to low levels of competition, resulting in part from regulatory policies, and to inadequate human capital, they include the focus of this section: market failures around information and coordination.

Because of the inherent uncertainty of general-purpose technologies, an important obstacle to their adoption is imperfect information. Organizations that are uninformed about the benefits of digital adoption and how to maximize them cannot assess the long-term payoffs of technological investments. Manufacturing firms, for example, especially if they are small or medium sized, perceive digital integration as complex, costly, and risky (Marzi et al. 2023). Firms hesitate to adopt digital technologies because they cannot assess their quality or the credibility of their vendors (Cirera, Comin, and Cruz 2022). Public sector agencies also struggle to estimate the benefits for households and firms of such complex reforms as digital transformation. This weakens their incentives to accelerate reforms.

Imperfect information plagues not only the organizations that could benefit from digital technologies but the investors and lenders who might finance their acquisition. Effective digital adoption requires substantial financing (Gorodnichenko and Schnitzer 2013). But transformational investments are often in intangible assets, such as new business processes, custom

software development, and specialized training. These are not suitable for use as collateral, and, in any case, credit institutions in Latin America and the Caribbean are often unable to appraise them (Cirera, Comin, and Cruz 2022; see also Chapter 12).

Uncertainty also deters adoption by customers. In a randomized informational campaign in Ghana targeting 15,000 microfinance clients, voice messages explaining the benefits and use of mobile banking increased the probability of using the service by 6 percentage points relative to a control group, from a baseline adoption rate of only 2.4 percent (Riley and Shonchoy 2025).

The experience of peers is an important source of information for organizations. Baumann et al. (2026) find that firms expect to invest 0.6 percentage points more in AI when they believe similar firms in their country will raise their investment in this technology by 1 percentage point. Unfortunately, organizations gain by waiting and learning from others; those who move first do not benefit from the valuable information their experience provides to the rest.

As the earlier discussion of digital public infrastructure makes clear, coordination failures also discourage adoption. Data sharing and interoperability require not only physical infrastructure to overcome coordination failure but the resolution of an institutional issue: the standards that govern data collection, storage, sharing, and access. Single-window systems in the public sector, for example, spare firms and individuals the burden of submitting their information to multiple agencies for independent verification and processing. They reduce errors and costs for both users and agencies. But single-window systems cannot exist unless agencies agree on the data they require and the format for the data, on the rules for sharing the data, and on the interoperability of agency systems.

Even within sectors, coordination failures are an obstacle to service delivery. Although more than 80 percent of criminal cases in Brazil are digitally processed (CNJ 2025), the digital systems of the different agencies involved—prosecutors, police, courts, prison administration, and financial intelligence units—are generally not linked. Hence, it is difficult to track cases as they move through the investigative, procedural, and sentence execution phases of the criminal justice system. Where Brazil has integrated digital systems in the criminal justice system (as recommended in Chapter 9), case backlogs and processing times in criminal and enforcement courts have dropped significantly (Kopittke and Ramos 2021; CNJ 2025).

Private sector firms face analogous challenges. The productivity gains associated with a firm's adoption of digital systems often rise when its suppliers and buyers adopt compatible systems (Forman and McElheran 2024). No single firm, though, has a strong incentive to coordinate the adoption decisions of the rest. Unfortunately, collective action mechanisms such as business associations or industry consortia remain weak in the region, limiting coordination and reinforcing

asymmetries of power and knowledge across and within supply chains (Cirera, Comin, and Cruz 2022; Delera et al. 2022).

The creation of an ecosystem that provides digital solutions tailored to local needs is a related coordination challenge analyzed in detail in Chapter 12. The lack of such an environment impedes diffusion because suppliers of localized digital solutions do not emerge until customers demand their services, but customers do not search for services until they exist. While foreign ecosystems may appear to be a convenient solution for this chicken-and-egg problem, firms and households in Latin America and the Caribbean may be less comfortable with the complex software solutions that developers in wealthy countries design for their home markets.

Conclusion

Turning digitalization and artificial intelligence into sustained productivity gains requires coordinated progress on several fronts. Latin America and the Caribbean needs institutions that promote investments, encourage competition, and manage digital risks; foundational, digital, and managerial skills that enable workers and organizations to adapt; and reliable infrastructure and data that can be securely shared and reused. These enabling conditions are complementary; weaknesses in one reduce the returns to investments in the others. Even where they are in place, information and coordination failures can delay adoption and prevent firms and public agencies from realizing its full benefits. The policy challenge is, therefore, to strengthen these enabling conditions while addressing specific barriers to diffusion and enabling the organizational changes through which technology raises productivity. The sectoral chapters that follow examine how this agenda can translate into better public services and more productive firms.

5

Improving Student Learning: The Role of Learning Platforms and AI

Education systems in Latin America and the Caribbean face a severe learning crisis. Although students are spending more years in school, many are still acquiring too few skills, reflecting weaknesses in instructional quality and effectiveness. Deep socioeconomic inequalities compound these challenges, leaving disadvantaged students far behind and limiting the region's prospects for inclusive growth and social mobility.

Digitalization and artificial intelligence (AI) can help address some of the factors that undermine learning. This chapter first reviews recent experimental evidence on digital learning platforms, showing how their effectiveness depends on how they are integrated into instruction and drawing lessons regarding their use at scale. It then examines how advances in AI could strengthen teacher effectiveness, from attracting and supporting prospective teachers to mentoring novices and supporting experienced teachers. Finally, the chapter considers the risks associated with the use of digital technologies in education and discusses how governments can mitigate them while preserving the potential of digital technologies to improve learning.

Improving Student Learning: An Urgent Matter

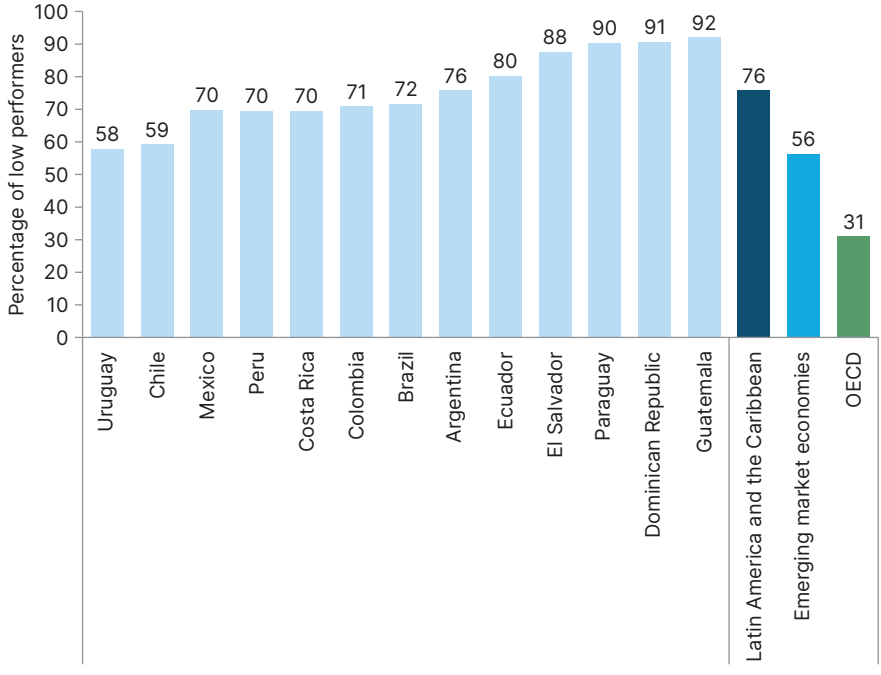
Improving student learning is essential to economic, social, and human development in Latin America and the Caribbean. Skills are a foundation of economic growth and equity. Higher-quality education can promote upward mobility, reduce poverty, and weaken persistent intergenerational disadvantage (Duncan and Murnane 2014), while gains in cognitive ability are associated with sizable increases in earnings (Hanushek and Woessmann 2008). Recent evidence also suggests educational investments have accounted for 45 percent of global economic growth since 1980 (Gethin 2025).

Over the past few decades, the region has made remarkable progress in expanding access to education, achieving near-universal primary enrollment

and substantial growth at the secondary and tertiary levels. Education spending has also increased, reaching an average of 4.2 percent of gross domestic product in 2023, compared with 4.8 percent among Organisation for Economic Co-operation and Development (OECD) countries (Arias Ortiz, Giambruno, and Karsaclian 2026). Yet greater access and spending have not consistently translated into learning.

Figure 5.1 documents the magnitude of the learning crisis. Among the 15-year-old Latin American and Caribbean students assessed by the OECD's Programme for International Student Assessment (PISA) in 2025, 76 percent did not reach a minimum math standard, compared with 31 percent in the OECD and 56 percent among emerging market economies with similar levels of economic development. The difference from these emerging market economies is particularly revealing. It shows that the region's poor learning outcomes cannot be

Figure 5.1. Secondary Students Failing to Achieve a Minimum Math Standard across Countries



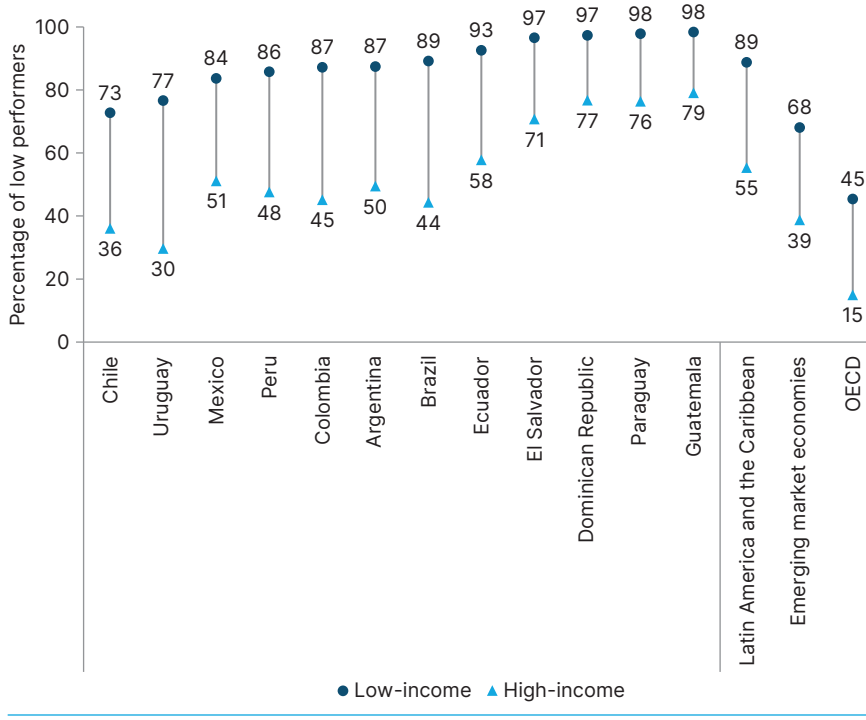
Source: IDB staff calculations, based on data from PISA 2025.
Note: The figure shows the share of 15-year-old students assessed by the 2025 PISA who did not reach at least performance level 2 (of six levels). Country-group values are unweighted averages across countries with available data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

explained by development levels alone and points instead to weaknesses in the effectiveness of its education systems.

As Figure 5.2 shows, large socioeconomic disparities compound these outcomes. On average, 89 percent of low-income students failed to reach the minimum math standard, compared with 55 percent of high-income students. Even in stronger-performing countries, such as Chile and Uruguay, the gaps remain large. Moreover, in the Dominican Republic, El Salvador, Guatemala, and Paraguay, virtually all low-income students failed to attain the standard. And high-income students in Latin America and the Caribbean performed worse, on average, than low-income students in OECD countries.

Taken together, these patterns underscore the urgent need for solutions that directly address the core constraints to learning in the region. The next sections examine the main obstacles to improved learning and how technology could help address them.

Figure 5.2. Learning Gaps by Socioeconomic Status across Countries



Source: IDB staff calculations, based on data from PISA 2025.
Note: The figure shows the share of 15-year-old students assessed by the 2025 PISA who did not reach at least performance level 2 (of six levels). Country-group values are unweighted averages across countries with available data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Why Students Learn Little, and How Technology Can Help

A broad set of system-level reforms is essential to improving education quality at scale, including sustainable financing, stronger teacher recruitment and professional development, and effective monitoring and quality assurance. But learning ultimately happens in classrooms, through the interaction among teachers, content, and students—the instructional core (City et al. 2009). When teachers struggle to provide instruction effectively, when instructional content is weak or poorly aligned, or when students are not engaged, learning suffers. Digital technologies can help strengthen each element of the instructional core.

Barriers to Learning

Three sets of barriers to student learning are particularly important in Latin America and the Caribbean. First, teachers are the primary in-school determinant of learning (Araujo et al. 2016), yet many in the region lack adequate content knowledge and pedagogical skills. About half score in the lowest two proficiency levels on the OECD's Survey of Adult Skills (PIAAC), a pattern not observed among other tertiary-educated workers or in high-performing OECD systems (Estrada and Lombardi 2023). Even strong teachers work in classrooms that are large and heterogeneous, making it difficult to tailor instruction, diagnose learning deficits, and provide individualized feedback (IDB and World Bank 2024).

Second, instructional content can itself limit learning. Effective teaching requires coherent curricula and high-quality materials aligned with clear learning standards (Reimers and Chung 2016; Bando, Näslund-Hadley, and Gertler 2018). Yet access to high-quality materials remains uneven across the region, and, in many classrooms, resources are scarce, outdated, or poorly aligned with curricula and students' learning needs (Bruns and Luque 2014; Elacqua et al. 2018).

And, third, students often lack sufficient opportunities—and motivation—to practice at an appropriate level. Building foundational reading and math skills requires repeated, structured practice and timely feedback (National Research Council 2000; Rosenshine 2012), but instructional time is often fragmented. Students within the same classroom differ widely in their learning levels, and many struggle to remain engaged. When instruction is poorly matched to what students already know, motivation can decline and learning can stall (Banerjee et al. 2017; World Bank 2018).

How Digital Tools Can Help Overcome the Barriers

Digital technologies can improve teaching, learning, and the content with which students engage. Figure 5.3 matches the main challenges affecting these three elements of the instructional core to the digital tools that can help address them.

Figure 5.3. Learning Challenges and Digital Solutions

	Main challenges	How digital tools can help	Key opportunity: learning platforms
Teachers	• Knowledge and pedagogical gaps • Difficulty differentiating instruction • Limited time for feedback	• Digital coaching and virtual training • Assessments with actionable dashboards • Curriculum-aligned lesson-planning tools	• Real-time insights and reports to aid in planning lessons, grouping students, and targeting support • Rapid identification of student needs
Materials	• Limited access to high-quality materials • Resources scarce or outdated or misaligned with curriculum	• Digital materials • Curriculum-aligned libraries • Interactive exercises and gamified practice	• High-quality, evidence-based exercises • Increased time on task
Students	• Large and heterogeneous classrooms • Low motivation and engagement	• Adaptive learning systems • Automated feedback tools	• Automatic, personalized feedback • Gamified, engaging content

Source: IDB staff, based on Arias Ortiz et al. (2025).

Regarding teachers, virtual training and coaching can strengthen content knowledge and pedagogical practice, while digital assessments and dashboards can provide timely information on which students are struggling and which skills need to be reinforced (Rodriguez-Segura 2022; Escueta et al. 2020; Banerjee et al. 2023). Digital lesson-planning tools can also help teachers identify curriculum-aligned resources, reduce time spent on preparation and grading, and free up more classroom time for instruction (Arias Ortiz et al. 2025).

Regarding content, digital tools can expand access to high-quality, curriculum-aligned materials at relatively low marginal cost. Digital textbooks, resource repositories, and curriculum-aligned libraries can make materials more widely available, while interactive exercises can provide structured practice and reinforce conceptual understanding. Unlike printed materials, digital content can also be updated continuously, and AI can recommend resources or adjust content to students' needs (Cho and Permzadian 2024).

Regarding students, digital technologies can expand opportunities for practice and feedback beyond whole-class instruction. Adaptive systems can adjust the sequence and difficulty of exercises to students' learning levels, while automatic feedback allows students to identify errors and try again in real time. Gamified features, such as points, badges, and progress indicators, can also help sustain engagement and motivation (Araya et al. 2019).

Among these technologies, learning platforms stand out because they can strengthen all three elements of the instructional core simultaneously. Platforms such as Khan Academy or Duolingo for Schools combine tools for teachers—such as assessments and dashboards, high-quality curriculum-aligned content, and structured student practice—with automatic feedback. They can help teachers identify learning deficiencies and target support, make high-quality instructional materials more readily available, and provide students with more opportunities to practice and receive individualized feedback. The following analysis examines how learning platforms can be used.

Using Learning Platforms to Improve Student Learning

A substantial literature provides experimental evidence on the effectiveness of learning platforms. Table 5.1 summarizes 21 interventions implemented in developing countries and evaluated using rigorous experimental methods. The evidence spans seven countries, includes both math and language applications, and covers grades from early primary through lower secondary school. Across these interventions, the average effect is 0.13 standard deviations in math and 0.09 in language.[1] These gains are sizable relative to other education interventions; Evans and Yuan (2022) report a median effect of 0.10 standard deviations across evaluations in low- and middle-income countries, while McEwan (2015) reports average effects of 0.12 for teacher training, 0.09 for performance incentives, 0.08 for instructional materials, and 0.06 for school management and supervision.

At the same time, impacts vary widely, from small negative effects in some interventions to gains above 0.30 standard deviations in others. This heterogeneity underscores a central lesson: Learning platforms are not inherently effective. Their results depend critically on how they are designed, implemented, and integrated into teaching and learning. This section examines the main implementation choices that appear to shape their effectiveness.

Should Learning Platforms Replace or Supplement Teacher Instruction?

An important implementation decision is whether learning platforms should replace part of regular teacher-led instruction or supplement it by adding practice time. Figure 5.4 shows a clear pattern: Interventions included in the analysis that replaced teacher instruction cluster around zero, with several negative effects,

[1] Effect sizes in standard deviations are the conventional metric for the impact of educational interventions on student achievement.

Table 5.1. Evidence on the Effectiveness of Learning Platforms

Intervention	Country	Subject targeted	Grade	Math effects	Language effects	Average	Platform supplements instruction
Ferman, Finamor, and Lima (2019)	Brazil	Math	5, 9	−0.02	–	−0.02	N
Araya et al. (2025)	Chile	Math	4	0.27	−0.01	0.13	Y
SUMMA and J-PAL (2023) (T1)	Chile	Math	4	−0.06	0.01	−0.03	N
SUMMA and J-PAL (2023) (T2)	Chile	Math	4	−0.04	−0.09	−0.06	N
SUMMA and J-PAL (2023) (T3)	Chile	Math	4	−0.08	−0.04	−0.06	N
Fafchamps and Mo (2018) (T1)	China	Math	3–6	0.17	–	0.17	Y
Fafchamps and Mo (2018) (T2)	China	Math	3–6	0.17	–	0.17	Y
Lai et al. (2012)	China	Language	3	0.22	0.19	0.21	Y
Lai et al. (2013)	China	Math	3, 5	0.12	–	0.12	Y
Lai et al. (2015)	China	Math	3	0.21	0.11	0.16	Y
Lai et al. (2016)	China	Both	3	0.06	0.10	0.08	Y
Ma et al. (2020)	China	Math	4–6	0.03	–	0.03	Y
Mo et al. (2014)	China	Math	3, 5	0.16	–	0.16	Y
Büchel et al. (2022) (T1)	El Salvador	Math	3–6	0.21	–	0.21	Y
Büchel et al. (2022) (T2)	El Salvador	Math	3–6	0.24	–	0.24	Y
Muralidharan and Singh (2025)	India	Both	1–8	0.22	0.20	0.21	N
Muralidharan, Singh, and Ganimian (2019)	India	Both	6–9	0.37	0.23	0.30	Y

(continued on next page)

Table 5.1. Evidence on the Effectiveness of Learning Platforms *(continued)*

Intervention	Country	Subject targeted	Grade	Math effects	Language effects	Average	Platform supplements instruction
Levesque, Bardack, and Chigeda (2020) (T1)	Malawi	Math	2	0.07	–	0.07	Y
Levesque, Bardack, and Chigeda (2020) (T2)	Malawi	Language	2	–	0.34	0.34	Y
Bettinger et al. (2022) (T1)	Russia	Both	3	0.1	0.05	0.08	Y
Bettinger et al. (2022) (T2)	Russia	Both	3	0.09	−0.02	0.04	Y
Average				0.13	0.09	0.12	

Source: IDB staff, based on sources listed in the table.
Note: The table includes 21 interventions meeting the following criteria: implemented in primary or secondary schools in developing countries (United Nations classification); consisting of software providing automatic feedback for math or language; effects measured at least 12 weeks after program start using experimental evaluations against a status quo control group; samples of at least 200 students and 20 randomized units; and results published after 2011. Reported effects are intention-to-treat (ITT) estimates in standard deviations. T1, T2, and T3 indicate specific interventions within a study that reports results for multiple interventions. A dash indicates the evaluation did not test that subject. When multiple follow-up measurements were available, the estimate closest to seven months was selected; when no preferred specification was indicated by the authors, the estimate with the most controls was used.

while all those that supplemented instruction produced positive effects, often of substantial magnitude.[2]

It is difficult to compare the effects of interventions in which learning platforms supplemented teacher instruction with those in which they replaced it because the underlying studies also differ in context, platform design, assessment, and implementation quality. But evidence from Santiago, Chile, provides a cleaner comparison. Araya et al. (2025) study students who used the same platform twice weekly, once replacing a math class and once adding instructional time, and find a gain of 0.27 standard deviations. By contrast, three interventions evaluated by SUMMA and J-PAL (2023), in which platform use only replaced teacher-led instruction, produced small negative effects. Because the studies hold context, software, assessment, and grade constant, they provide stronger evidence that supplementing teacher instruction produces positive effects, while replacing it does not.[3]

Part of this advantage could simply reflect the additional instructional time. Yet available evidence suggests time alone is not the full explanation. Büchel et al. (2022) find that supplementary instruction using technology generated gains 0.09 standard deviations larger than supplementary teacher-led instruction. Moreover, evaluations of extended school days generally find only small learning gains (Cerdan-Infantes and Vermeersch 2007; Arzola 2011; Hincapie 2016; Garganta, Pinto, and Zentner 2024). Together, these studies suggest that the productive use of additional time—rather than the additional time itself—is what drives the gains in supplementary platform interventions.

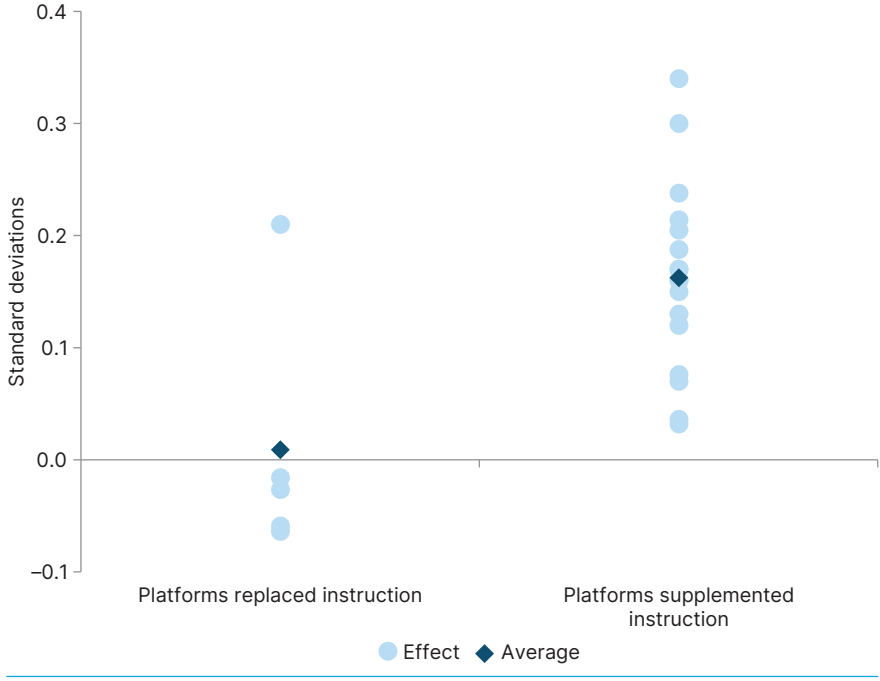
Why might replacing teacher instruction yield poor results? Platforms can displace activities that software is less able to replicate, including the introduction of new concepts, the diagnosis of misconceptions, and the development of conceptual understanding. Moreover, implementation can be hindered by unreliable internet service, faulty devices, or limited digital skills, which are common in developing country settings. These difficulties can reduce time spent on learning tasks, also resulting in more muted impacts. These findings

---

[2] The average effect of supplementary platform interventions is 0.16 standard deviations. Relative to an estimated annual learning gain of about 0.35 standard deviations in grades 3–8 in the United States (Hill et al. 2008), this is equivalent to 46 percent of a year's learning. Conservatively assigning zero effects to subjects not measured in the evaluations included in Table 5.1 lowers the estimate to 0.11 standard deviations, or about 31 percent of a year's learning.

[3] Linden (2008) found a similar pattern in India in two otherwise identical interventions: Replacing instruction produced large negative effects, while supplementing it generated substantial gains. Singh, Navarro-Sola, and Oreopoulos (2025) also highlight that whether platforms replace or supplement instruction is an important factor in explaining impact variation across studies.

Figure 5.4. Learning Platform Effects: Replacing versus Supplementing Instruction



Source: IDB staff calculations, based on sources listed in Table 5.1.
Note: Each point represents an evaluated intervention. Interventions are grouped according to whether the learning platform replaced regular teacher-led instruction or supplemented it. When a platform both replaced and supplemented instruction, it is categorized as supplementing. Effects are intention-to-treat (ITT) estimates in standard deviations.

may not apply, however, in settings where the quality of teacher-led instruction is especially low.

For policymakers, the implication is straightforward: Learning platforms should generally be used to add structured practice rather than displace teacher-led instruction. This can be done by adding in-school practice periods, after-school sessions, or structured homework. The approach is particularly relevant for countries extending the school day, where learning platforms offer one evidence-based way to use additional instructional time productively.

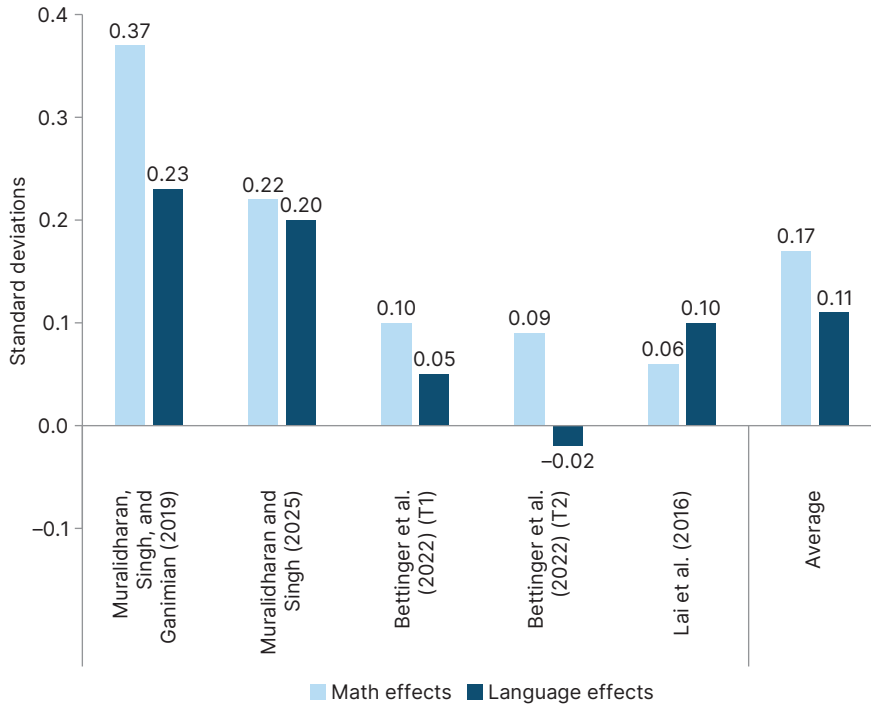
Which Subject Should Be Targeted: Math or Language?

A second implementation decision concerns which subject to prioritize when introducing learning platforms. Among interventions that targeted both math and language with similar amounts of instructional time, learning gains were

larger on average in math. As shown in Figure 5.5, average effects were 0.17 standard deviations in math compared with 0.11 in language—about 50 percent larger.[4]

The evidence base is also substantially stronger for math. Of the interventions in Table 5.1, 14 targeted math only, compared with just 2 targeting language only, while 5 targeted both subjects. Taken together, the evidence suggests that, from grade 3 onward, learning platforms generate larger and more consistently documented gains in math. For education systems facing capacity or budget

Figure 5.5. Effects of Learning Platforms Targeting Both Math and Language



Source: IDB staff calculations, based on the sources cited in the figure.
Note: Each pair of bars reports the math and language effects for an intervention that targeted both outcomes. The final pair reports the average effects across these interventions. Effects are intention-to-treat (ITT) estimates in standard deviations. The two interventions reported in Bettinger et al. (2022) are indicated by T1 and T2. More details are in the note to Table 5.1.

[4] One exception is the study by Levesque, Bardack, and Chigeda (2020), which found substantially larger effects for a language than a math intervention among second-grade students. This suggests the relative effectiveness of math platforms may differ in the earliest grades, when students are still developing foundational literacy skills.

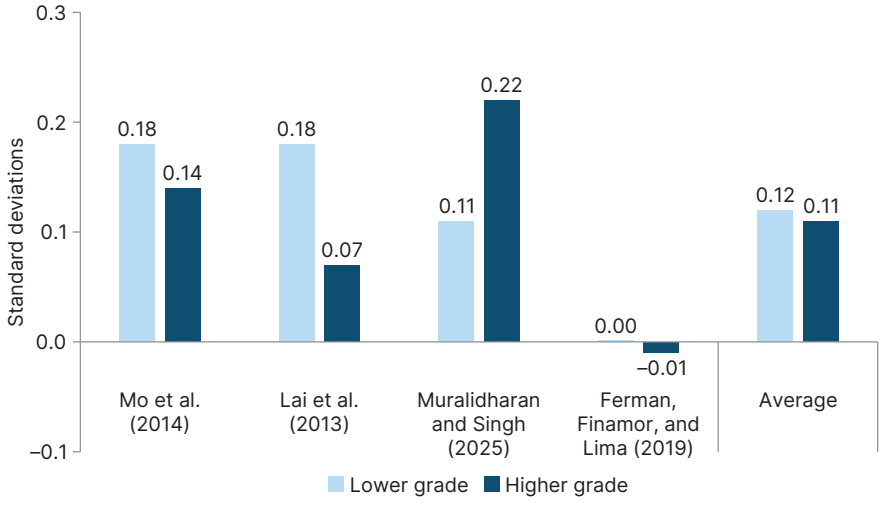
constraints, math may, therefore, be a natural starting point for implementation, particularly in upper primary and secondary grades.

Should Platforms Focus on Earlier or Later Grades?

A third implementation decision concerns which grades to prioritize when introducing learning platforms. Figure 5.6 summarizes evidence from studies that compare effects across grades under similar implementation conditions. On average, learning gains are very similar: 0.12 standard deviations in lower grades and 0.11 in higher grades.[5]

The evidence, therefore, does not point to a clear advantage for earlier or later grades. The reviewed studies also generally find similar effects for students with lower and higher baseline achievement, although Lai et al. (2012) report larger gains for lower-performing students. Hence, governments can choose which grades and student groups to prioritize based on broader policy objectives, such as strengthening foundational skills or addressing accumulated learning deficits.

Figure 5.6. Learning Platform Effects across Grades



Source: IDB staff calculations, based on the sources indicated in the figure.
Note: Each pair of bars represents a study reporting effects for lower and higher grades under the same implementation conditions. Muralidharan and Singh (2025) compare students in average grades 3 and 7; Lai et al. (2013) and Mo et al. (2014) compare grades 3 and 5; and Ferman, Finamor, and Lima (2019) compare grades 5 and 9. Effects are intention-to-treat (ITT) estimates in standard deviations.

[5] Because annual learning gains measured in standard deviations tend to decline as students progress through school, similar platform effect sizes may be equivalent to a larger percentage of annual learning in higher grades.

Most existing evaluations, however, focus on grades 3 to 6, so the evidence is less established for other grade levels.

Two Additional Decisions with Limited Evidence: Personalization and Weekly Dosage

A fourth implementation decision concerns whether platforms should personalize content to each student's learning level. Evidence is still limited. In India, De Barros and Ganimian (2024) compare students who received content personalized to their learning level with students who used the same platform but with nonpersonalized instruction (that is, targeted according to their grade level). After nine months, average learning was similar across groups, although lower-performing students did benefit from personalization. Whether newer AI-enabled systems can generate larger gains from personalization remains an open question.

A fifth decision concerns how much time students should spend using learning platforms each week. Greater use is associated with larger learning gains (Eames et al. 2026), suggesting educators who implement a platform should ensure sufficient practice time and monitor whether the students are using it. Experimental evidence on optimal dosage is scarce, however. Bettinger et al. (2022) find doubling weekly use from 45 to 90 minutes produced similar effects in math and slightly smaller effects in language. For policymakers, the priority is, therefore, to ensure sustained use while continuing to test how much practice time is needed to maximize learning. Learning platforms facilitate this task because they automatically generate data on student use, allowing schools to monitor engagement at very low additional cost and identify students who are not practicing enough.

Transformed Learning through AI

The evidence reviewed above provides clear guidance on how learning platforms can be integrated into instruction to improve student learning. Yet technology aimed directly at students addresses only part of the challenge. Teachers remain the primary in-school determinant of learning, making their effectiveness central to improving education outcomes, particularly as the teaching profession experiences shortages, low prestige, and high early-career attrition (Elacqua et al. 2018). AI could help strengthen the profession throughout the career cycle, from attracting candidates to supporting novice teachers during induction to assisting teachers throughout their careers, including in their own use of AI.

Education research has identified several effective interventions along this pathway. High-quality career mentoring can encourage high school students to pursue teaching (Ajzenman, Elacqua, et al. 2026), while induction and mentoring

programs can improve teacher well-being and reduce attrition (Keese et al. 2023). Instructional coaching is also among the most effective strategies for improving teaching quality and student learning (Kraft, Blazar, and Hogan 2018). These interventions, however, are human-intensive; they depend on skilled professionals who must themselves be recruited, trained, and supervised. This creates the risk of the "voltage drop" described by List (2022), whereby interventions lose effectiveness as they are scaled up. Indeed, instructional coaching programs serving more than 100 teachers have been shown to be about half as effective as smaller programs (Kraft, Blazar, and Hogan 2018).

Recent advances in AI—particularly large language models that can interpret and produce natural language—could help relax these constraints. By enabling teachers and students to interact with software through text or speech, AI can replicate or augment some forms of support traditionally provided by human specialists, potentially at much lower cost (Al-Ubaydli et al. 2017; Labadze, Grigolia, and Machaidze 2023). Rigorous evidence remains limited, however, and is concentrated primarily in high-income countries (Arias Ortiz et al. 2025). In Latin America and the Caribbean, the Inter-American Development Bank is helping build this evidence through pilots and large-scale experimental evaluations testing AI applications at different stages of teachers' careers.

At the recruitment stage, an experimental evaluation in Chile tested whether a generative AI chatbot called "Kai" could provide personalized career mentoring to high school students and encourage them to become teachers. Earlier work had found that a scripted chatbot expanded the program's reach at low cost but was less effective than human counselors (Ajzenman, Elacqua, et al. 2026). In a recent nationwide experiment, however, Kai increased the probability that students ranked an education major first by 1.4 percentage points, or 14 percent, while trained human counselors produced no statistically significant effect (Ajzenman, Del Toro Mijares, et al. 2026). More students responded to Kai than to human counselors (35 versus 28 percent), and its conversations were faster and more semantically coherent. Human counselors, by contrast, scored substantially higher on empathy and motivation. The results suggest that AI can help ease the implementer-quality constraint that limits conversation-based interventions at scale, while human and AI support may serve complementary functions.

At the induction stage, evidence comes from Chile's Profe Gabi, an AI-powered WhatsApp mentoring tool for novice teachers (Elacqua et al. 2025). In an eight-week pilot, the chatbot reached 550 teachers, 85 percent of whom reported being satisfied or very satisfied. Teachers mainly sought help with pedagogical practice, socioemotional well-being, and career guidance, with especially high demand for lesson planning, student assessment, and classroom management. Yet engagement fell sharply, from 79 percent of teachers in week 1 to 9 percent

in week 8. As with learning platforms, access alone is unlikely to ensure sustained use; dedicated time, monitoring, and follow-up may be needed. Profe Gabi is now being evaluated within Chile's official induction program through a large-scale experimental evaluation that expanded in 2026 to more than 7,000 novice teachers.

AI can also augment the work of professionals who mentor and support teachers. In Peru, an experimental evaluation involving 6,000 novice teachers and 365 mentors integrated AI into the Ministry of Education's mentoring platform while keeping human mentors at the center of the program. The AI assistant answers questions about course content, supports feedback on written assignments, and generates personalized practice, with promising preliminary findings (Del Toro Mijares et al., forthcoming). In Guatemala, the Ixmunané chatbot helps teachers identify students at risk of not advancing from primary to middle school and suggests personalized strategies for intervention (Del Toro Mijares et al., forthcoming). Additional studies are underway in Colombia and the Dominican Republic.

A final priority concerns teachers' own use of AI. Teachers across Latin America and the Caribbean are rapidly adopting these tools for planning lessons, preparing materials, and designing assessments. In Peru, more than three out of four first-year teachers report using AI in their work, with similar adoption rates in urban and rural areas (Del Toro Mijares et al., forthcoming). But rapid adoption does not guarantee effective use. Education ministries can provide training, practical guidance, and clear standards to ensure AI reduces time spent on routine tasks and improves instruction while teachers remain responsible for how the content it generates is used.

The emerging lesson is that AI's most promising near-term contribution may run through teachers, by strengthening recruitment and induction, providing ongoing support, and facilitating their own use of AI. High-quality evidence across a range of settings is still needed, but the rapid pace of technological change means education systems will need to experiment, evaluate, and adapt while building on the lessons already emerging.

A broader opportunity would be to combine these advances with a deeper redesign of how schools organize teaching and learning. As Chapter 1 emphasizes, realizing the full productivity potential of digital technologies requires reorganizing processes around their capabilities. Yet relatively few efforts in education have pursued this approach. Instead, many have followed a "plug and play" strategy, introducing technology into specific activities while leaving the surrounding instructional processes largely unchanged—a strategy that can limit the potential learning gains. An integrated approach would connect regular student practice on learning platforms with assessment, lesson planning, classroom instruction, and teacher support. Data generated by student practice on

a platform, for example, could guide AI-assisted recommendations on which topics teachers should revisit, which materials to use, and which students need extra help. Designing and rigorously evaluating such models is an important next step toward determining whether a deep redesign of educational processes can deliver large learning gains.

Managing the Risks of Digital Technologies in Education

Digital technologies can improve education, but more technology is not always better. The learning platforms and AI applications discussed above are designed to support specific educational activities, such as structured student practice and teacher mentoring. By contrast, unstructured access to smartphones, social media, and other digital technologies, including AI, can harm learning and well-being by competing for students' attention, displacing studying, sleep, and face-to-face interaction, and exposing them to harmful social comparisons (Haidt 2024).

A growing body of evidence documents these risks. In Italy, the expansion of broadband access has increased the prevalence of mental disorders among those exposed before age 20 (Donati et al. 2025). In Spain, broadband expansion increased diagnoses of mental health problems and suicide rates, particularly among girls, while reducing time spent sleeping, doing homework, and interacting with family and friends (Arenas-Arroyo, Fernandez-Kranz, and Nollenberger 2025). Evidence on social media points in the same direction. The staggered expansion of Facebook across U.S. colleges worsened student mental health, with unfavorable social comparisons appearing to be an important mechanism (Braghieri, Levy, and Makarin 2022). Experimental evidence further shows that temporarily deactivating Facebook and Instagram improved adults' emotional well-being (Allcott et al. 2025).

An increasingly important question is whether restricting smartphone use in schools can reduce these harms. Emerging evidence suggests such policies often improve education outcomes. Studies find positive effects of school smartphone bans on academic achievement in Brazil, England, Norway, and the United States (Beland and Murphy 2016; Figlio and Özek 2025; Abrahamsson 2026; Lichand et al. 2026). Other studies, however, find no effects on academic achievement in Sweden or the United States (Kessel et al. 2020; Allcott et al. 2026). The more limited evidence on student well-being points to benefits from school smartphone bans. In Norway, the use of psychological care services declined among girls, while in the United States, initially negative effects on well-being turned positive in the second year of implementation (Abrahamsson 2026; Allcott et al. 2026). Taken together, these emerging studies show school restrictions can improve outcomes, although effects are not universal.

As concerns have grown, governments have increasingly acted to impose limits on smartphone use in schools. By March 2026, national bans or restrictions were in place in 58 percent of countries worldwide and 57 percent of countries in Latin America and the Caribbean (UNESCO 2026). Australia has gone further by requiring age-restricted social media platforms to take reasonable steps to prevent children under 16 from holding accounts, although difficulties with age verification have complicated enforcement.

Generative AI introduces an important tradeoff. The same tools that can provide personalized explanations and feedback can allow students to forgo the cognitive effort required for learning, particularly when used for unsupervised schoolwork. This risk depends on how AI is designed and used. Tools that guide students through the reasoning process, provide hints, or ask students to explain their thinking may support learning, while those that simply produce answers may undermine it. Recent large-scale evidence from China suggests that rapid adoption of AI for homework among secondary students can significantly reduce how much they learn (Strömberg, Lei, and Wu 2026). Generative AI also complicates assessment because submitted work may no longer reliably reveal what students know and can do independently.[6]

Important uncertainties remain about how governments, schools, parents, and students should respond to these risks. Governments can set rules for smartphone and AI use in schools, regulate technology providers, teach students how to use digital technologies responsibly, and provide parents with practical guidance. Because these technologies are spreading faster than the evidence base is developing, policy cannot wait for definitive answers. Governments should act on the best available evidence while continuing to evaluate emerging risks and policy responses.

Policy Recommendations

Digital technologies can help education systems improve learning and expand access to high-quality educational support, but realizing these gains requires deploying them deliberately rather than simply expanding their use. Education ministries should prioritize three actions.

Deploy learning platforms to supplement teacher-led instruction. Education ministries should integrate learning platforms—prioritizing math from grade 3

[6] A separate emerging concern involves AI companions—conversational agents designed to simulate personal relationships. Among Australian children ages 10 to 17, 8 percent reported having used one in 2026. These tools may foster psychological dependence, displace human interaction, and expose children to inappropriate or misleading content (eSafety Commissioner 2026; Sun, Wang, and McDaniel 2026).

onward—into structured time blocks that add practice time rather than replace teachers' instruction. This requires dedicating time in the weekly schedule through targeted in-school practice slots, afterschool sessions, or structured homework that students can complete on smartphones. Teachers should receive the training, ongoing support, and real-time usage and performance dashboards they need to promote sustained use and monitor student progress. Ministries should ensure access to intuitive, reliable, curriculum-aligned platforms that provide students with immediate, actionable feedback and engage school principals to sustain schoolwide use. Used in this way, learning platforms can generate substantial improvements in foundational skills.

Explore AI to strengthen teachers' effectiveness at every stage in their careers. Building on emerging evidence from the region, education ministries should experiment with AI applications that support teachers at each stage of their careers, evaluating the results as they scale up use. AI-enabled tools can provide career guidance and mentoring to prospective teachers where experienced mentors are scarce, support novices during induction, and expand access to coaching and professional support, augmenting rather than replacing the professionals who provide it. At the same time, ministries should provide practical guidance on when teachers should use AI and how to use it effectively, including how to evaluate AI-generated educational materials and adapt them to students' needs while preserving their own essential role in instructional decisions.

Manage digital risks to protect student well-being. Education ministries should ban nonpedagogical smartphone use throughout the school day, with exceptions limited to instructional, accessibility, and medical purposes. They should also incorporate age-appropriate instruction on responsible use of smartphones, social media, and AI into the curriculum, making clear to students that the instruction is intended to protect their learning and well-being. Students should be taught to use generative AI effectively, emphasizing that developing skills requires sustained cognitive effort. Finally, ministries should provide parents with practical guidance on delaying smartphone ownership, setting limits on digital use, and guiding children's use of generative AI.

6

Connected Health, Controlled Diseases

Digital technologies could transform how health systems in Latin America and the Caribbean deal with noncommunicable diseases (NCDs), the region's most pressing and complex health challenge. Evidence suggests that, when integrated into redesigned care models, digital health technologies can help primary care systems respond more effectively (Bernal et al. 2022; Da Silva et al. 2024; Schwalm et al. 2025). Globally, this could save an estimated 2.1 million lives, avert 7.4 million hospitalizations, and generate about US$200 billion in economic benefits over the next decade (WHO 2024).

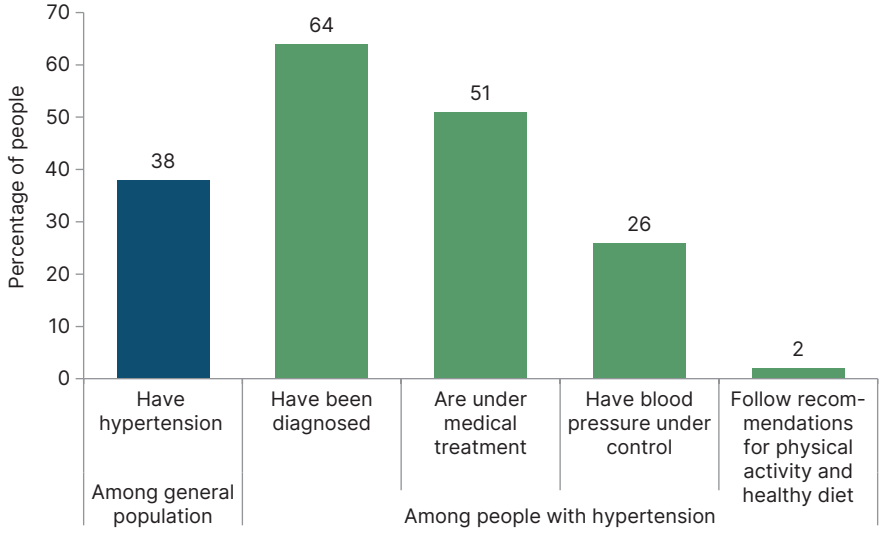
NCDs, including hypertension, diabetes, and cardiovascular disease, account for more than three-quarters of the region's disease burden and four out of five preventable deaths (Institute for Health Metrics and Evaluation 2025). They also impose substantial costs on households, health systems, and economies. Ineffective prevention and control may cost South American countries up to 4 percent of gross domestic product annually (PAHO 2025).

Hypertension illustrates the challenge. If untreated, it increases the risk of heart attacks, strokes, and other health problems, but early detection, medication, and lifestyle changes can substantially reduce these risks. As Figure 6.1 shows, many people with hypertension remain undiagnosed, and too few take medication or follow recommendations on physical activity and healthy diets. Only about one-quarter have their blood pressure under control.

This pattern extends to other cardiometabolic diseases, such as diabetes.[1] Because these conditions are lifelong, inadequate management can lead to disease progression and more complex care needs, costly specialized services, and avoidable hospitalizations. In Latin America and the Caribbean, NCDs cause

[1] Cardiometabolic diseases are a cluster of interconnected, often preventable health conditions, including obesity, type 2 diabetes, high blood pressure, and dyslipidemia, that significantly increase the risk of cardiovascular events, such as heart attacks and strokes.

Figure 6.1. Hypertension Care for Latin American and Caribbean People



Source: IDB staff calculations, based on the Data Portal on Noncommunicable Diseases, Mental Health, and External Causes, Pan American Health Organization (PAHO), 2019, and Bernal et al. (2026).
Note: Reported values are unweighted averages across countries with available data. Within each country, estimates use sampling weights for national representativeness. The sample includes adults ages 30–79. The prevalence of hypertension is defined as the proportion of people who have systolic blood pressure 140 mm Hg or greater or diastolic blood pressure 90 mm Hg or greater or are taking medication for hypertension. Estimates of hypertension prevalence, awareness, treatment, and control are based on data from PAHO and cover 26 Latin American and Caribbean countries. The indicator on adherence to physical activity and healthy diet recommendations among people with hypertension was derived from Bernal et al. (2026), using the World Health Organization's STEPwise approach to NCD risk factor surveillance (STEPS), and covers Argentina, Bolivia, Ecuador, Guyana, and Uruguay.

about 8.8 percent of hospitalizations (Bernal et al. 2025), most of which could be prevented with earlier treatment.

The statistics provided in Figure 6.1 reflect three structural mismatches between how health systems in the region were designed and what NCD care requires. First, most health systems are reactive rather than proactive. They treat people when they seek care instead of preventing, detecting, and managing disease across the population. As a result, care often begins only after the disease has progressed or complications emerge. About half of diabetes and hypertension cases are not diagnosed until complications appear (Arredondo 2014).

Second, care is episodic rather than continuous. People with NCDs need lifelong care from multidisciplinary teams but often rely heavily on specialists, limiting others' access to specialist care and helping to make the care of individual patients more fragmented. In Mexico, seven out of ten patients whose hypertension was initially controlled no longer had it under control seven years later (Mauer et al. 2022).

And, third, health systems offer only limited support outside health facilities. Physicians may recommend physical activity or weight loss but often provide neither a plan nor ongoing support. Patients must manage their conditions without access to their health data or tools to support medication adherence. As a result, only 2 percent of hypertension patients in the region follow lifestyle recommendations (Bernal et al. 2026).

To serve people with NCDs better, countries in Latin America and the Caribbean must transform primary care and shift toward population-based control models (Ordunez et al. 2024). This chapter examines how a digital health ecosystem integrated into redesigned NCD care can help health systems manage populations proactively, enable health workers to provide care more effectively, and help people with chronic conditions live longer, healthier lives.

Digital Health as a Strategic Enabler of NCD Care

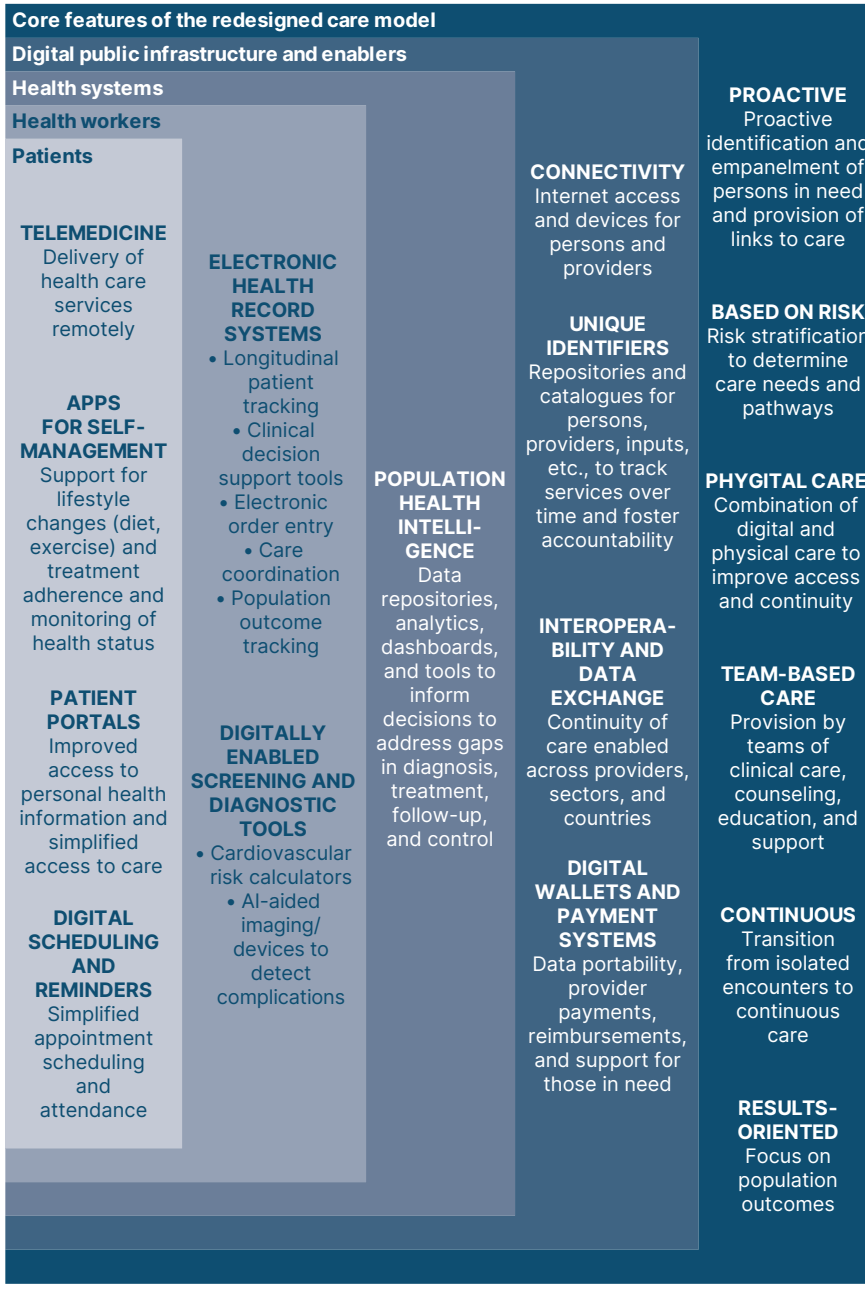
Harnessing the full potential of digital technology to meet the needs of patients with NCDs requires more than layering tools onto existing systems; it demands a fundamental redesign of the model of care. Digital tools are most useful when they are part of an integrated ecosystem that optimizes workflows to support a shift away from episodic, reactive, facility-centered care toward proactive, risk-based, continuous care centered on people's long-term needs (Figure 6.2). Realizing these gains requires organizational redesign, with digital tools first organizing information and AI building on that foundation to improve decisions and system management.

Care must be organized to identify patients early, stratify them by risk, link them to the right pathways of care, and provide ongoing follow-up rather than isolated encounters. Digital tools enable a "phygital" model that combines in-person and digital services, supports team-based care, and keeps the focus on population outcomes, continuity, and timely action.

Within this ecosystem, different digital interventions serve different actors. Population health intelligence combines data repositories, analytics, and tools to give managers and care teams the data they need to provide care proactively and address health system deficiencies. Electronic health record systems provide health workers with a platform for longitudinal tracking, clinical decision support, care coordination, and digitally enabled screening and diagnostics. Other tools, such as telemedicine, self-management apps, patient portals, and digital scheduling and reminders, transform patients from passive recipients into active participants in managing their own health.

As discussed in Chapter 1, achieving systemwide change and realizing the benefits of digital transformation at scale requires enabling factors across certain fundamentals, including institutions, governance, skills, and infrastructure. In the health sector, and specifically for the prevention and management of NCDs, this means having the following elements in place:

Figure 6.2. Digital Ecosystem for Redesigned NCD Care



Source: IDB staff, based on WHO (2024).

- *Connectivity*, including reliable internet access and devices, so both providers and patients can use digital services
- *Unique identifiers for people and providers*, which allow services and outcomes to be tracked over time and across settings
- *Interoperability and data exchange*, which allow information to follow patients across providers and levels of care, to ensure continuity
- *Digital payment systems*, which can support provider payments, reimbursement, and financial support for people in need

These are the enabling conditions that allow digital solutions to work as part of a coherent digital ecosystem. Where they are weak, even effective interventions will remain isolated and will generate modest gains.

This section reviews the components of the digital ecosystem for NCD care and the evidence for how digital tools can support a redesigned model of care. While most evidence covers individual interventions, the largest benefits come from their integration into a coherent ecosystem.

Patient Needs for NCD Care

People living with NCDs require continuous, reliable, and person-centered support that goes beyond facility-based episodic care and evolves as the disease progresses.

The starting point is diagnosis. NCDs, which affect mostly working-age adults, are often silent in their early stages, and timely access to preventive and diagnostic services is essential. People diagnosed with chronic diseases who do not have major complications can often control their conditions with medication and/or lifestyle changes. An integrated approach should include regular consultations with health workers and data to monitor patients' health status; education and support for adherence to the treatment plan; diagnosis of possible complications; and adaptations of treatment. Patients also need tools to manage their own health and adhere to treatment. At advanced disease stages, they require more frequent contacts, support from health workers and specialists, and close monitoring to stave off further complications.

Digital interventions can enable models of care that extend beyond physical health facilities. Telemedicine can allow patients (especially in remote or underserved areas) to receive timely clinical advice and follow-up without the costs and disruptions of in-person visits. Virtual consultations and digital communication tools, such as cell phones and text messaging, are particularly useful for services that do not require an in-person physical examination or diagnostic testing at a health facility. Studies have established that telemedicine performs

just as well as in-person consultations in managing diabetes, hypertension, and high cholesterol (Alfarwan et al. 2024; Mabeza, Maynard, and Tarn 2022). In some cases, it provides better health outcomes, reducing blood pressure in people with hypertension (Ma et al. 2022) and improving blood glucose in people with diabetes (Eberle and Stichling 2021). Efficacy has been demonstrated in low- and middle-income countries (Hoffer-Hawlik et al. 2021) and in modalities led by nurses, which can make the technologies more cost effective (Kappes et al. 2023).

Some modalities of telemedicine combine remote care with devices patients can use to monitor their health, an approach called telecare. Diabetic patients can measure their glucose levels at home with glucose meters and upload the data to a centralized platform for their care teams. Evidence from a meta-analysis found this type of digital intervention is associated with clinically significant improvement in the blood glucose of diabetic patients (Kerr et al. 2024).

Telecare can also help bridge the transition from hospital to home by allowing patients to transmit health data to providers and receive medication reminders, educational materials, and clinician feedback. Remote monitoring and telemedicine can reduce hospitalizations and urgent care needs, particularly among heart failure patients, and are associated with fewer cardiovascular-related hospitalizations and lower mortality (Kuan et al. 2022).

Digital tools can also help patients manage cardiometabolic disease. Interventions typically use apps, text messages, and phone calls for education and reminders and to enable patients to record and upload health data. Health care providers can review this information and offer personalized feedback.

Research shows these digital tools can improve blood glucose in patients with diabetes (De Souza Ferreira et al. 2023). They can also help patients manage blood pressure (Liu et al. 2023) and adhere to medication regimens (Mikulski et al. 2022) and self-care activities, such as healthy eating and exercise (Aminuddin et al. 2021).

In addition, individuals can manage their health care needs using web- or app-based patient portals. These technologies allow them to view personal health information, test results, and care plans; request refills; communicate securely with providers; schedule appointments; and gain access to educational materials. Although the evidence is mostly observational, reviews suggest portal use among people with chronic conditions is associated with better health care utilization, treatment adherence, and self-management (Brands et al. 2022), as well as greater patient engagement, particularly when the portal also provides access to electronic health records (Alomar et al. 2024).

Finally, digital scheduling and appointment reminders offer a low-cost way to improve follow-through with care, reduce missed appointments, and improve the take-up of screening services. Text reminders have improved the take-up of screening services for diabetes, hypertension, and cervical cancer (Marcus et al. 2024; Gallegos et al. 2023) and increased visit attendance for people with hypertension, particularly among patients who were overdue for care (Jubayer et al. 2024). In Argentina and Chile, automated reminders for chronic care patients enabled timely cancellations and rescheduling, allowing clinics to serve more patients (Boone et al. 2022; Esteban et al. 2026).

Together, these digital tools, telemedicine, self-care apps, patient portals, and automated appointment systems complement face-to-face services and support more flexible, proactive, and person-centered care pathways.

Health Workers' Needs for Providing NCD Care and Management

Caring for people with NCDs places sustained demands on health workers. Digital tools can help reduce administrative burdens, support better clinical decisions, and strengthen high-quality, person-centered care by providing access to comprehensive medical records and augmenting diagnostic capacity.

Managing NCDs requires sustained, coordinated care across multiple providers. Paper-based systems make it difficult to track patients over time, often resulting in fragmented or incomplete information. Because paper records are confined to facilities, they rarely ensure continuity of care when patients move across providers or levels of the health system.

Electronic health record (EHR) systems can address many of these issues. An EHR system comprises the software and supporting infrastructure used by health facilities to create, store, and share patients' clinical information electronically. Beyond digitizing records, these systems shape how care is delivered by placing and tracking orders, prompting clinicians with guideline-based reminders, exchanging information with other providers, and generating data on patient populations (IOM 2003; ISO 2005).

Since existing studies often evaluate specific functions rather than the effects of whole EHR systems, the evidence that follows pertains to three especially important aspects of these systems for NCD care.

Clinical decision support (CDS) systems are on-screen tools embedded within EHR systems that help clinicians deliver evidence-based care by prompting them to follow recommended processes, avoid nonindicated practices, optimize medication ordering, and improve documentation.[2] CDS systems can help

[2] CDS systems can also issue warnings about drug allergies, though attention must be paid to clinicians' responses and alert fatigue (Ancker et al. 2017).

health workers adhere to clinical guidelines (Kwan et al. 2020) and improve the detection and control of hypertension (Phadke et al. 2025; Lopez et al. 2019).

Computerized provider order entry (CPOE) refers to systems that allow clinicians to enter medical orders directly into an EHR and transfer them to a department or unit rather than having to handwrite them or give verbal instructions. These systems can be integrated with clinical decision support tools that flag potential errors. CPOE reduces transcription errors, enhances communication among care teams, and promotes safer and more efficient care (Nuckols et al. 2014).

Health information exchange (HIE) refers to the digital infrastructure that enables the secure sharing of clinical data across health care organizations. It is supported by *interoperability*, the ability of different EHR systems and software applications to communicate, exchange information, and make use of the data exchanged. With interoperability, digital health information—such as diagnoses, medications, test results, and care plans—can follow the patient across facilities and over time. Hence, interoperability enables continuity of care by reducing duplication, preventing information from getting lost during care transitions, and enabling health workers to make more informed decisions.

In addition to the capabilities provided by EHR systems, health workers can expand their diagnostic capacity by using AI-based algorithms to analyze images or other diagnostic information (Box 6.1). Such tools can, for example, improve early detection and treatment and make screening more accessible for diabetic retinopathy, a common complication of diabetes that can lead to vision loss or blindness. In Mexico, an AI-based algorithm has provided diagnoses based on retinal images that can be taken in primary care settings (Tejerina, Pérez Cuevas, and García Castro 2023). In Thailand, a deep-learning system detected diabetic retinopathy in community-based screening programs, with accuracy comparable to that of retina specialists (Ruamviboonsuk et al. 2022).

Box 6.1. Transforming the Digital Ecosystem for NCDs with GenAI

Most digital tools for self-management, such as apps and traditional chatbots, rely on predefined rules or algorithms. They can support treatment adherence, lifestyle changes, and access to information, but their responses are typically standardized and limited to predetermined pathways.

Generative artificial intelligence (GenAI), by contrast, can generate context-specific content and interact in conversational language rather than through fixed menus. This can make communication with chatbots more natural, adaptive, and responsive to individual needs, improving engagement and retention. GenAI can also process and generate audio, text, and video in multiple languages.

(continued on next page)

Box 6.1. Transforming the Digital Ecosystem for NCDs with GenAI
(continued)

GenAI tools to support patients are already being deployed and evaluated. India's Noora Health combines in-hospital caregiver training with cellphone-based GenAI tools that deliver real-time, personalized responses to caregiver questions. It reinforces appropriate care practices following hospital discharge by sending about 10,000 messages a day to patients in eight regional languages (Stanford Center for Digital Health 2024). Therabot, the first GenAI chatbot to provide mental health treatment, has been rigorously evaluated and shown to improve mental health (Heinz et al. 2025). Evidence from Mexico has shown that even short-term engagement with an AI chatbot providing therapy can improve mental health and reduce job absenteeism (Angelucci, Fabregas, and Vazquez 2026).

GenAI can also transform how health workers interact with EHR systems by automating such tasks as medical documentation (Bhuyan et al. 2025). It can draft and structure clinical notes from conversations for health workers to review. Commercial applications are already used at scale in clinical settings (Tierney et al. 2025). GenAI-generated responses to patient messages that physicians can revise have been found to be more empathetic and comprehensive than responses written from scratch (Garcia et al. 2024; Mandal et al. 2025; Ayers et al. 2023).

Despite its promise, GenAI poses substantial risks. It can "hallucinate," producing plausible but baseless information, and be sycophantic, reinforcing users' views rather than correcting errors. Its use, therefore, requires evidence-based deployment, strong governance and ethical safeguards, real-world evaluation, and sustained human oversight. GenAI should complement, not replace, clinical judgment or health system reform, and it should be implemented responsibly within redesigned models of care.

Health System Needs for NCD Care and Management

NCDs place sustained demand on health systems for proactive prevention, coordinated care, and long-term follow-up. Population health management offers a structured way to meet these demands by combining patient registries with risk stratification, standardized treatment protocols based on risk, team-based care, and continuous performance monitoring (WHO 2023). This approach is effective in improving the control of hypertension and diabetes at the population level (Jaffe et al. 2013; Jaffe and Young 2016) and has been adapted to Latin America and the Caribbean through HEARTS in the Americas, led by the Pan American Health Organization (PAHO). The effort is being implemented in about 10,000 primary care facilities across 33 countries, where it is improving hypertension control (Ordunez et al. 2024).

Digital health tools are essential to making population health management feasible at scale. Registries and dashboards built on data from EHR systems enable population-level tracking, performance monitoring, and quality improvement, while clinical decision support facilitates treatment standardization. Telemedicine and

digital communication channels support follow-up and adherence to treatment between visits, and apps support patients' self-management and lifestyle changes. Experiences from Brazil and Colombia (Box 6.2) show how treatment protocols, workforce organization, performance management, and digital tools can be aligned within a coherent population-based model to generate systemwide gains.

Box 6.2. Building a Model of NCD Care Enabled by Digital Tools

Two experiences from Latin America and the Caribbean illustrate how digital tools can be woven together to support a redesigned, "phygital" model of NCD care. One is taking place within a private insurer network in Colombia, the other in a public primary care system in São Paulo, Brazil.

In Medellín, Colombia, an integrated care model has reduced avoidable hospitalizations and complications from diabetes. SURA, a health insurer with its own provider network, manages approximately 177,000 people with diabetes. It organizes care around cohort and case management, with individualized care plans, active follow-up, alerts for missed appointments or clinical deterioration, and targeted interventions for high-risk patients. Population dashboards integrate real-time indicators and predictive alerts to guide decisions, enabling identification of care gaps. EHRs support structured data capture and longitudinal risk assessment, while clinical decision support standardizes guideline-based practice. Advanced analytics—including predictive models and risk scores—stratify patients by clinical risk, control status, and behavioral profiles, assigning them to structured care pathways led by nurses and supported by multidisciplinary teams. Digital channels, like WhatsApp, deliver education tailored to individual profiles, appointment reminders, and self-management support, improving adherence to treatment and continuity of care between visits.

In São Paulo, financing from the Inter-American Development Bank (IDB) helped build the foundational digital public infrastructure needed for a phygital model at scale. The cornerstone is a clinical data repository, integrating 84 information systems, processing over 1.5 billion health events for 27 million users, and enabling continuous patient tracking across the entire network. The municipality complemented this digital backbone by formally recognizing telemedicine as a mode of care and equipping primary care facilities to deliver these services. Patients in hard-to-reach areas can consult specialists through their local clinics, connecting remotely with providers elsewhere in the city while receiving support from onsite nurses. A telecare platform with nearly 20,000 registered professionals has produced over 2 million teleconsultations.

The e-saúdeSP app (with 3.4 million active users) serves as a patient portal for health data and scheduling and a digital urgent care pathway (Pronto Saúde) for acute, nonsevere cases. Health workers can access any electronic medical record administered by the municipality using a clinical viewer that lets them check appointments, services provided, and medication use. AI-powered dashboards support data-driven management.

These case studies showcase how care models can be reimagined to serve population needs at scale by integrating digital tools into redesigned care pathways, rather than deploying them as standalone applications.

Source: Schwarzbauer et al. (2026) and Borges Almeida Da Fonseca (2024).

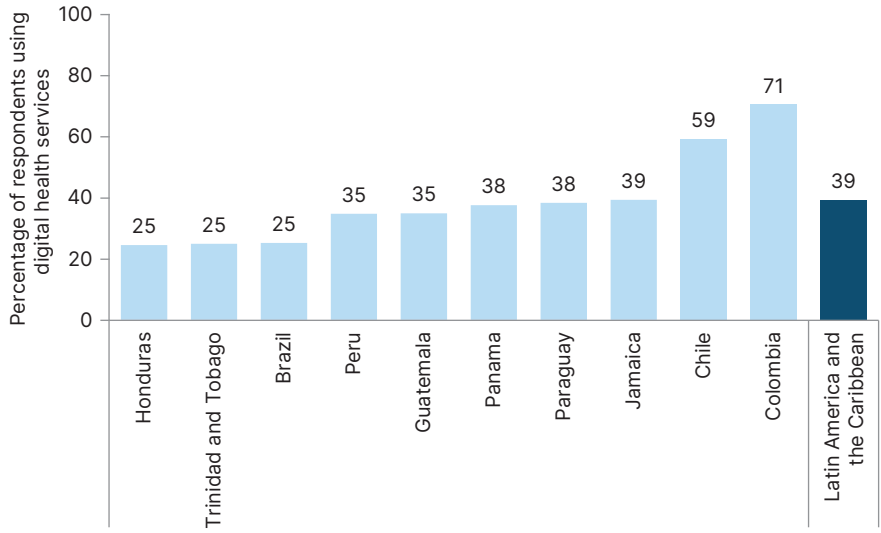
Barriers to Adoption of Digitally Enabled NCD Care

Digital interventions can help patients, health workers, and health systems address NCDs. But how much progress have health systems in Latin America and the Caribbean made in adopting them? Despite strong evidence of their benefits, adoption in the health sector remains uneven and often shallow, consistent with the broader pattern of digitalization in the region described in Chapter 1. This section reviews seven obstacles to adoption at scale by synthesizing recent data from four surveys conducted in the region.

Low Take-Up: Use of Digital Health Has Yet to Scale Up

The adoption of digital health services remains limited regionally in Latin America and the Caribbean and highly variable across countries. In the Encuesta Ciudadana sobre el Uso de Servicios Públicos Digitales, an in-person population survey conducted in 10 countries in 2023–24, only about 39 percent of respondents reported using at least one digital health service. The lowest use was in Honduras (24.6 percent) and the highest in Colombia (70.6 percent; Figure 6.3).

Figure 6.3. Population Use of Digital Health Services

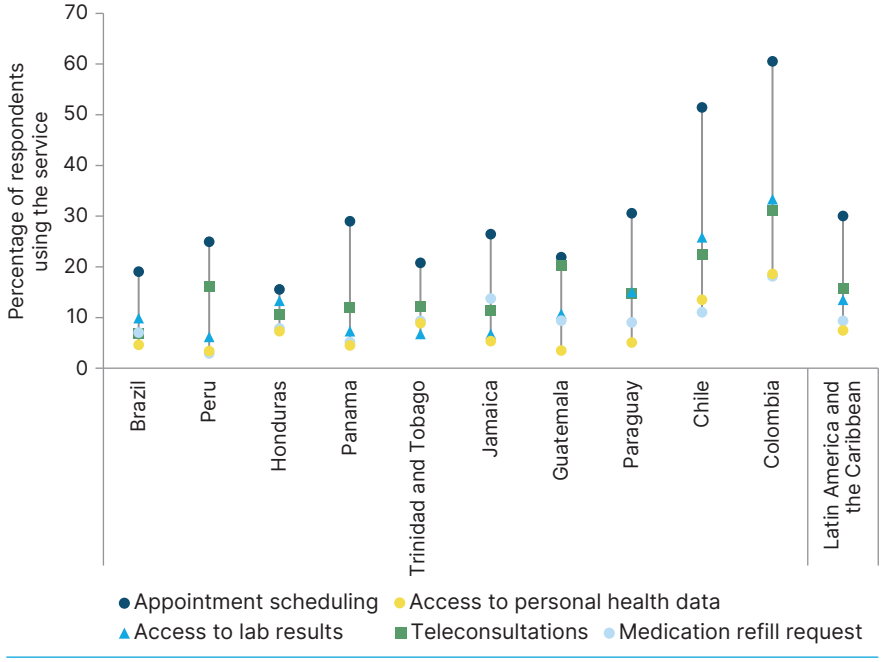


Source: IDB staff calculations, based on data from the Encuesta Ciudadana sobre el Uso de Servicios Públicos Digitales, 2023–24.
Note: The figure shows respondents' use of at least one of the following digital health services within the 12 months preceding the survey: appointment scheduling, teleconsultations, access to laboratory results, medication refill requests, or access to personal health data. The sample includes adults ages 18 and older. The estimate for Latin America and the Caribbean is the unweighted average across the countries included. Within each country, estimates use sampling weights for national representativeness.

As Figure 6.4 shows, appointment scheduling was the most widely used digital health service (30 percent), followed by teleconsultations (16 percent), access to laboratory results (14 percent), medication refill requests (9 percent), and access to other personal health information (8 percent). Only 19 percent of respondents used two or more services, indicating use remains concentrated in standalone services with limited integration across care pathways.

Digital health services are not more widely adopted for reasons concerning supply and demand. On the supply side, remote and rural areas lack adequate technology infrastructure (Nakayama et al. 2023; Pierce, Schroeder, and Suchecki 2021); national digital strategies are fragmented and underfunded (Capasso et al. 2024; Ribeiro, Gomes, and Gomes 2024); regulatory frameworks for remote care are inadequate (De la Torre, Diaz, and Perdomo 2024); and personnel lack sufficient digital health training (Curioso 2019). On the demand side, barriers are imposed by limited internet access, device and data costs, and lack of digital skills (Pombo et al. 2025). The principal constraint is, therefore, not the technology itself, but the conditions required for its effective diffusion.

Figure 6.4. Types of Digital Services Used



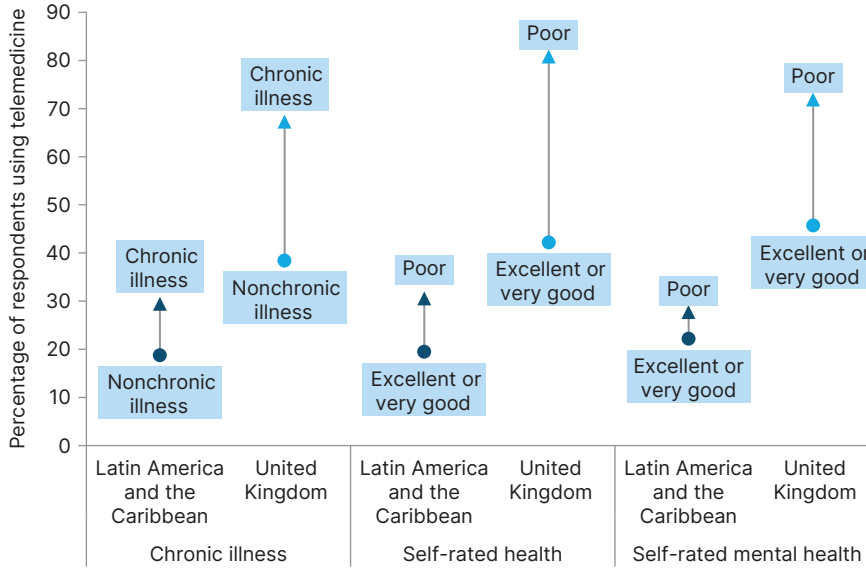
Source: IDB staff calculations, based on data from the Encuesta Ciudadana sobre el Uso de Servicios Públicos Digitales, 2023–24.
Note: The figure shows respondents' use of digital health services within the 12 months preceding the survey. As respondents could report using more than one service, the categories are not mutually exclusive. The sample includes adults ages 18 and older; values cover all respondents, not only those who need health services. Estimates for Latin America and the Caribbean are unweighted averages across the countries included. Within each country, estimates use sampling weights for national representativeness.

Limited Reach of Telemedicine

Although people with chronic conditions are more likely to use telemedicine in the region, access remains limited. According to the People's Voice Survey (PVS), conducted in five countries during 2022–23, around 30 percent of adults with a chronic illness reported using telemedicine in the past year, compared to 19 percent of those without one (Figure 6.5).

Even so, availability of this service remains a major constraint. According to the Encuesta Ciudadana, only a fraction of respondents reported their health care provider offered teleconsultations, with a regional average of 26 percent (Figure 6.6). The availability of such services varied significantly across countries, from 58 percent in Colombia to just 13 percent in Trinidad and Tobago and Honduras.[3]

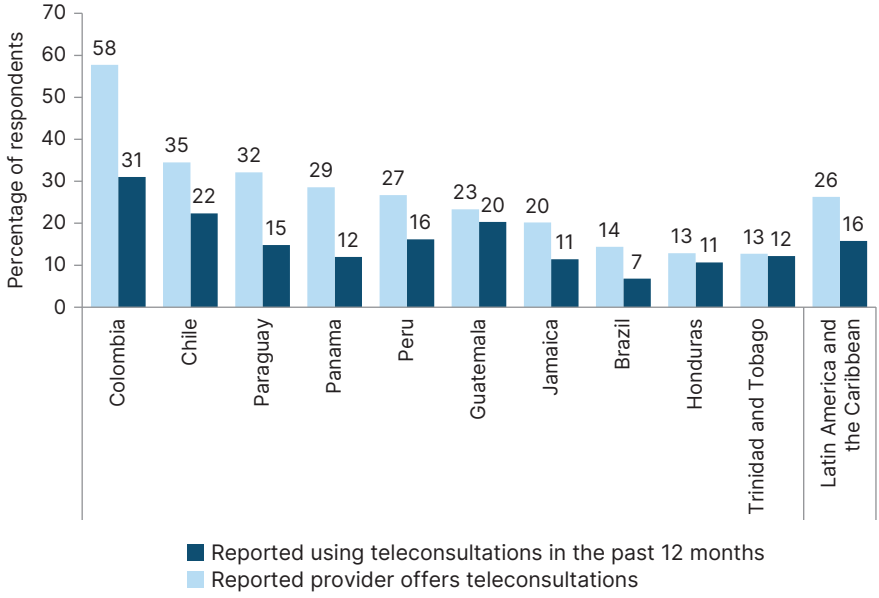
Figure 6.5. Use of Telemedicine by Health Status, Compared with the United Kingdom



Source: IDB staff calculations, based on data from the People's Voice Survey, 2022–23.
Note: The figure shows the use of telemedicine, defined as at least one virtual or telemedicine visit within the 12 months preceding the survey. Results are shown separately for both the lowest and the highest category by dimension of health status: people with a chronic illness versus those without one; and people reporting poor versus excellent or very good health, for both self-rated general health and self-rated mental health. The sample includes adults ages 18 and older. Estimates for Latin America and the Caribbean are unweighted averages across Argentina, Colombia, Mexico, Peru, and Uruguay. Within each country, estimates use sampling weights for national representativeness.

[3] Availability of teleconsultations may be higher, but these data rely on people's being aware that the service is offered by their health providers.

Figure 6.6. Availability of and Use for Teleconsultations



Source: IDB staff calculations, based on data from the Encuesta Ciudadana sobre el Uso de Servicios Públicos Digitales, 2023–24.
Note: Teleconsultations refer to medical consultations conducted via audio or video call. Availability of teleconsultations is self-reported by respondents. The sample includes adults ages 18 and older; values cover all respondents, not only those who need health services. Take-up may be slightly higher if conditioned on needing health services, but these data are not available. Estimates for Latin America and the Caribbean are unweighted averages across the countries included. Within each country, estimates use sampling weights for national representativeness.

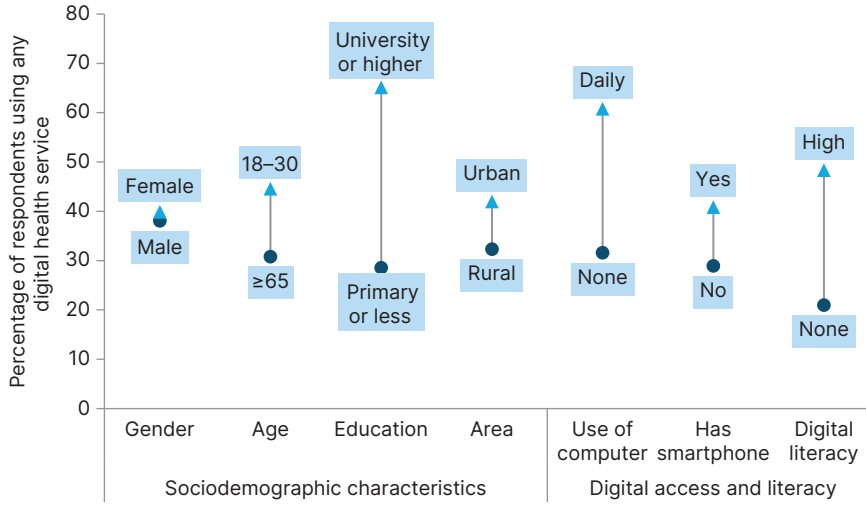
Unequal Access: Large Inequities Persist

Differences in age, education, residence, computer use, and digital literacy can create inequalities in digital health use. According to the Encuesta Ciudadana, the largest deficits are related to education, computer use, and digital literacy (Figure 6.7). On average, adults with university education or higher are 37 percentage points (pp) more likely to use digital health services than those with primary education or lower. Adults who use a computer daily are 29 pp more likely to use these services than those without computers, and people with greater digital literacy are 27 pp more likely to use digital health services than those with none. These disparities exceed those related to age (14 pp) and whether a person lives in a rural or urban area (10 pp).

Misaligned Models: Care Pathways Are Not Redesigned for Digital

Digital care is often implemented as a technological add-on rather than integrated into a redesigned model of care. This requires reorganized workflows, task triage, and referral pathways. Three interconnected barriers limit broader integration:

Figure 6.7. Average Inequities in Use of Digital Health Services



Source: IDB staff calculations, based on data from the Encuesta Ciudadana sobre el Uso de Servicios Públicos Digitales, 2023–24.

Note: The figure shows respondents' use of at least one of the following digital health services within the 12 months preceding the survey: appointment scheduling, teleconsultations, access to laboratory results, medication refill requests, or access to personal health data. The digital literacy gap compares people who had not used the internet within the three months preceding the survey with those in the highest tertile of confidence in the following digital skills: sending emails with attachments; scanning and sending documents; finding and installing mobile applications; adjusting privacy settings on websites or apps; selecting effective keywords for online searches; identifying true versus false information online; and recognizing what information is risky to share on the internet or on social networks. The sample includes adults ages 18 and older. Reported values are unweighted averages across Brazil, Chile, Colombia, Guatemala, Honduras, Jamaica, Panama, Paraguay, Peru, and Trinidad and Tobago. Within each country, estimates use sampling weights for national representativeness.

- Health workers often lack formal telemedicine training, while concerns about medical liability, quality of care, and the inability to conduct physical examinations contribute to clinician resistance (De la Torre, Diaz, and Perdomo 2024).
- Weak and inconsistent regulatory frameworks, including unclear rules on reimbursement, medical liability, e-prescription, and data privacy, prevent telemedicine initiatives from moving beyond small pilots (Garcia Saiso et al. 2021; Hechenleitner-Carvallo et al. 2025). Health system fragmentation and poor interoperability also hinder the establishment of integrated virtual care pathways.
- Limited connectivity and unreliable electricity impede telemedicine and platform integration in rural and low-income areas (Camacho-Leon et al. 2022), isolating primary care facilities from remote services.

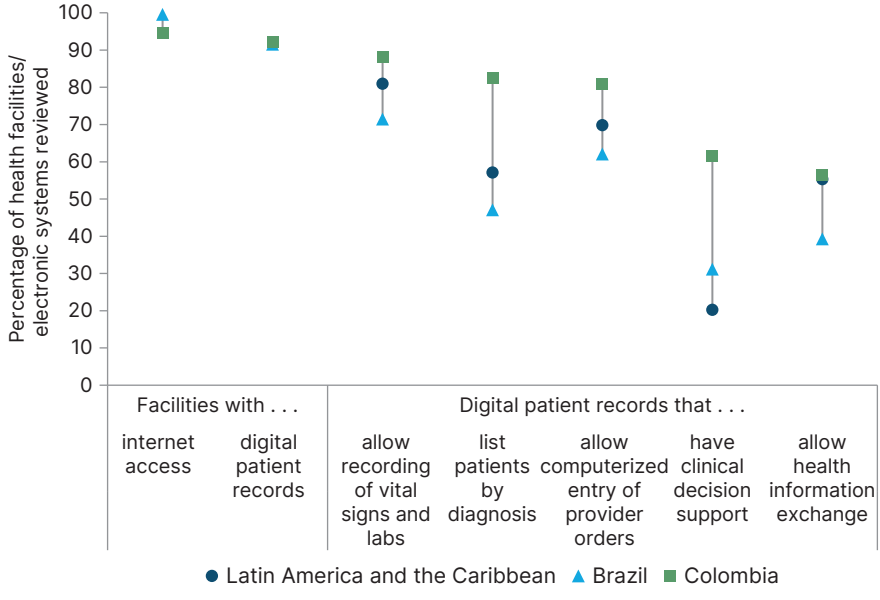
Digital Records Not Being Built for NCD Care

Facility surveys in Brazil and Colombia, together with a multicountry review of electronic systems, show that digital records are increasingly common but

still fall short of what is needed for effective NCD care (Figure 6.8). Around 92 percent of facilities in Brazil and Colombia use digital patient records, and nearly 98 percent have internet access. Yet the information captured and the functions available vary substantially. In the seven-country review, for example, only 81 percent of systems systematically recorded vital signs and laboratory results, and only about 55 percent allowed the exchange of health information.

Important functions for population health management also remain limited. In Brazil, only 47 percent of facilities could generate lists of patients by diagnosis, while clinical decision support was available in 31 percent. Fully functional systems are rarer still; even in Colombia, which performs best across most indicators shown in Figure 6.8, only 28 percent of facilities have access to digital systems covering the full set of EHR functionalities.

Figure 6.8. Data and Functions of Digital Information Systems for NCD Care



Source: IDB staff calculations, based on data from the CETIC Survey of Health Facilities for Brazil, 2024; on the Encuesta de Madurez TIC for Colombia, 2024; and on a scorecard review of electronic systems for Latin America and the Caribbean, 2021–25.

Note: The figure shows the share of health facilities and electronic systems that meet each criterion for digital capacity. For Brazil and Colombia, values come from nationally representative facility surveys that cover public and private providers and use similar questionnaires. When a criterion combines several indicators, the reported value is their average—for example, "recording of vital signs and labs" averages the vital signs and laboratory indicators—which keeps the two countries comparable, given that the Brazilian data are drawn from published results. Estimates for Latin America and the Caribbean are unweighted averages across Argentina, Brazil, Ecuador, El Salvador, Guatemala, Paraguay, and Suriname. Within each country, estimates are not nationally representative, as data come from a scorecard review of electronic systems.

Weak Analytical Capacity in Health Systems

Although digital information systems can make data timelier and more accessible for managing NCDs, data are valuable only if they are analyzed and used at different levels in the health system to improve care. This requires health practitioners and administrators to have the skills to transform data into action. A recent PAHO-IDB regional assessment of health workforce competencies in data analysis found large gaps (PAHO 2026). About 40 percent of health systems are at level two, out of five, in systematically analyzing health needs and applying advanced techniques for real-time decision making, while data skills remain basic.

Lagging Frameworks and Governance

Deficiencies in national legal and regulatory frameworks hinder the development of interoperable digital health systems (Campos Rivera et al. 2025). Although most countries have data protection laws, rules governing the sharing of NCD-related data, including sensitive information on chronic conditions, are not always suited to longitudinal care. Few countries legally require compliance with interoperability standards essential for continuity of NCD care, resulting in fragmented implementation that disproportionately affects patients with complex, multiple conditions. Governance responsibilities often overlap or are poorly defined, hindering coordinated NCD prevention and control. Unclear health data ownership further weakens NCD registries and surveillance systems, while inadequate telehealth regulation restricts access to care, particularly in underserved or geographically isolated communities (SPH-Digital 2022).

Policy Recommendations

When embedded in redesigned care models, digital tools can help shift NCD care from reactive to proactive, from episodic to continuous, and from facility-centered care to care delivered across settings. While these changes are especially urgent in the case of NCDs, the institutional foundations, data systems, and organizational capabilities they require to be implemented can strengthen health system performance more broadly. The following policies are recommended.

Use digital technologies to enable proactive, population-based NCD management. Health ministries and providers should organize NCD care around patient registries, risk stratification, standardized treatment protocols, and team-based follow-up. EHR data, dashboards, and predictive analytics should be used to identify people who are undiagnosed, uncontrolled, overdue for care, or at high risk and connect them to appropriate care pathways. Clear responsibilities should be established for care teams to act on this information and track outcomes over time. Management and financing arrangements should be aligned with continuous care and population health outcomes rather than isolated encounters.

Redesign care workflows around integrated digital tools. Health ministries and providers should combine in-person and remote care within redesigned workflows rather than simply digitalizing existing processes. Telemedicine, patient portals, self-management apps, digital scheduling and reminders, and AI-enabled support should be used to extend care between visits and help patients manage chronic conditions. Primary care facilities in rural and underserved areas should serve as digital access points, providing connectivity, devices, and onsite support for remote consultations. Digital services should be intuitive, available in relevant languages, and work reliably on older, lower-cost devices to avoid widening access deficits.

Build interoperable EHR systems and the governance to support them. Ministries should establish and finance EHR systems with minimum functional standards for NCD care, including structured capture of vital signs; clinical decision support; computerized entry of provider orders; patient registries; and the data needed to track outcomes over time. Interoperability and secure data exchange should be required across providers and levels of care, supported by common standards and clear rules and safeguards for authorized data access, privacy, cybersecurity, and the responsible use of AI. Clear institutional responsibilities for setting and enforcing these standards should be assigned, and implementation should be coordinated with government digital agencies.

Adapt the health workforce. Successful adoption of an integrated digital model requires development of the skills, roles, and regulatory conditions needed to use digital tools and translate data into clinical and managerial action. Priorities should include digital and data literacy across clinical and managerial roles, task shifting, remote care modalities and automation, and workflow optimization to free up time for patient care. Contracting and regulatory frameworks must also be updated to enable remote care.

7

Digital Technologies and the Future of Social Protection

Social protection systems are essential for promoting inclusive development and resilience, especially in regions marked by high inequality and vulnerability to economic and climate shocks. During the past two decades, governments in Latin America and the Caribbean established many noncontributory programs (financed from general revenue, regardless of prior contributions) to complement existing contributory ones (financed by and linked to prior contributions), reaching roughly 180 million individuals across the region by 2022 (Schwarz and Stampini 2025). Behind this progress, however, important structural challenges remain. On the one hand, social spending often gets into the wrong hands; in 2015, the resources from social programs delivered to high-income individuals represented around 0.5 percent of gross domestic product (GDP; Izquierdo, Pessino, and Vuletin 2018). On the other hand, social programs still miss many people who need assistance; by 2022, 31 percent of the region's extreme poor remained without access to cash transfer programs (Schwarz and Stampini 2025), and roughly 40 percent of individuals worked without contributing to old-age pension systems (Tapia et al. 2023).

Addressing these issues is a complex endeavor comprising at least four stages: *identifying* potential beneficiaries; *targeting* benefits to those who are eligible; ensuring *take-up* of benefits; and *delivering* those benefits effectively. Sources of friction at any stage—such as incomplete social registries, burdensome application or benefit-claiming processes, or logistical difficulties—can result in the exclusion of legitimate beneficiaries, weakening the effectiveness of these policies. In the context of cash transfers (a noncontributory program), Coady and Parker (2009) find that the administrative use of a proxy means test improves targeting, particularly when efforts are made to reduce the application frictions that low-income individuals face. This type of friction also affects contributory programs when, for example, both red tape and misperceptions of the importance of old-age pensions affect enrollment (Bosch, Melguizo, and Pagés 2013).

Since the beginning of the century, governments have gained access to a new generation of digital tools, including interoperable social registries, satellite imagery, targeting models powered by artificial intelligence (AI), digital platforms, and electronic payments. These novel technologies have great potential to help identify and verify beneficiaries, streamline enrollment, and deliver support more securely and rapidly. The use of many of these tools is proliferating in Latin American and Caribbean countries. Recent evidence, for example, shows that digital payments—such as transfers to bank accounts or digital wallets—are becoming increasingly common, with roughly 83 percent of beneficiaries of noncontributory programs receiving their payments this way. Such improvements can increase the efficiency of social spending and reduce fiscal pressure. They may also make social protection systems more adaptive, enabling governments to expand or tighten coverage as climate or economic conditions change.

Although digital technology can enhance social protection, it introduces new risks. Overreliance on digital systems may exclude populations with limited access to connectivity, devices, or digital skills. If not carefully designed, digital solutions can replicate or even amplify existing inequalities. But these limitations do not have to be an excuse for inaction; rather, they should be a call for taking these issues seriously. Governments must strike a balance between harnessing technology to improve service delivery and ensuring that digital systems are inclusive and accessible to all.

Moreover, many of the key challenges facing social protection systems cannot be solved simply by reducing frictions and enhancing key processes. In many cases, they require substantive reforms to program rules, incentives, and design. Digital technologies and AI can substantially strengthen governments' capacity to implement and monitor policies, reduce administrative frictions, and improve the targeting and delivery of benefits, but they cannot substitute for determining whether existing policies are appropriately designed to achieve their objectives.

This chapter explores three questions bearing on digital technologies and the future of social protection. First, how can governments use technology to build more efficient and inclusive social protection systems? Second, what unintended consequences may result from a shift toward digital service delivery? Third, where do social protection systems in Latin America and the Caribbean currently stand in their progress toward digital transformation?

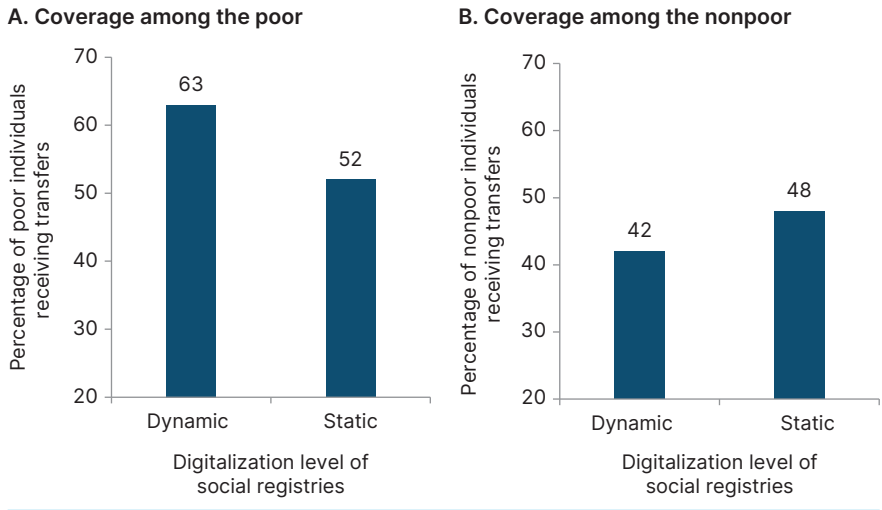
The Potential of Digital Tools

Figure 7.1 presents suggestive evidence for Latin America and the Caribbean on how, as social protection systems become more digitalized and dynamic, they can minimize exclusion errors. In the case of antipoverty programs, "exclusion" refers to the share of poor individuals who fail to receive benefits. The figure depicts the

relationship between the degree of digitalization of a social protection system—proxied by whether a social registry is dynamic or static (terms defined in the note to Figure 7.1)—and the coverage of social programs for two groups of interest: poor and nonpoor populations. Panel A shows that, in countries implementing dynamic social registries, the share of poor individuals who effectively receive benefits from social programs is 11 percentage points higher than in those using static social registries. Panel B shows that this higher coverage among the poor is not explained by greater overall coverage as, in countries with dynamic social registries, the share of nonpoor individuals who receive benefits is 6 percentage points lower than in those with static registries.

These patterns should not be read as causal. More efficient systems may simply be those that digitalize, and both efficiency and digitalization may reflect broader differences in state capacity. But they do suggest a strong link between digitalization and efficiency, with effects manifesting along the many layers of a social protection system.

Figure 7.1. Cash Transfer Beneficiaries, by Poverty Status and Digitalization Level



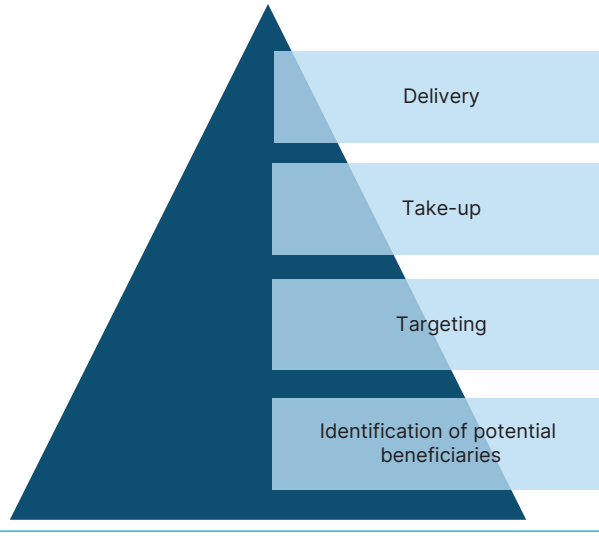
Source: IDB staff calculations, based on Guven, Yeachuri, and Almenfi (2025) and Stampini, Medellín, and Ibarrarán (2023).
Note: The figure shows the share of the population, above and below the poverty line, living in households that benefited from noncontributory cash transfer programs in 2019, based on tables 5 and 6 of Stampini, Medellín, and Ibarrarán (2023). Poverty is defined according to the international line of US$6.85 per day (adjusted for purchasing power), based on per capita income, net of noncontributory cash transfers. Reported values are unweighted averages across Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Mexico, Peru, and Uruguay. Within each country, estimates use sampling weights for national representativeness. Results are shown separately by digitalization level of social registries, based on Table B.5 of Guven, Yeachuri, and Almenfi (2025). A dynamic social registry allows continuous, on-demand updates and real-time interoperability with administrative data sources, while a static registry relies on infrequent, survey-based updates, which increases the risk of outdated information.

The Four Stages of Social Protection

The impact of a social program hinges on the government's ability to reach individuals who will benefit the most. In principle, noncontributory programs with universal coverage can ensure no one is left behind; they minimize exclusion error, defined as the share of targeted individuals or households (in this case, those living in poverty) who do not receive a benefit. With a fixed budget, however, universal coverage comes at the cost of reducing the per-beneficiary benefit amount or increasing inclusion errors, defined as the share of nontargeted individuals (that is, nonpoor households) who end up receiving a benefit. This tradeoff between exclusion and inclusion errors is exacerbated by economic shocks (Beuermann et al. 2025). With contributory programs, their impacts and sustainability crucially depend on their design and on how the cost of financing them is spread among beneficiaries, employers, and governments.

With limited public resources, many countries make important investments that enable their social protection systems to select beneficiaries carefully. A foundational investment is in datasets that support the first stage of social protection: the *identification* of the potential beneficiaries of social programs (Figure 7.2). In the second stage, *targeting*, government agencies combine the information in these datasets with additional sources of data to select from among the potential beneficiaries those who are eligible for benefits, based on characteristics relevant to the program at hand. For the third stage, *take-up*,

Figure 7.2. The Four Stages of Social Protection



Source: IDB staff.

some programs may require eligible beneficiaries to comply with certain conditions to gain access to their funds. These may include enrolling in a program, filing relevant paperwork, or agreeing to a minimal number of contributions. The final stage is *delivery*, when enrolled eligible beneficiaries receive their benefits.

This simple framework provides a way to think about how the use of digital tools at each stage can reduce exclusion and inclusion errors and, consequently, maximize the welfare derived from a given program. Of course, some stages may be more important than others, depending on the context and type of program. Likewise, a contributory program, which usually requires individuals to enroll with social security, may benefit less from investments in targeting but require substantial work to eliminate frictions in the enrollment or disbursement process.

While the approach above suggests a bottom-up order, it is important to emphasize that solutions and frictions at each stage can also have upstream effects. If the mode of delivery of a benefit is too cumbersome, for example, individuals may opt not to take up the benefit, enroll in the program, or even register in their country's social registry (Coady, Martinelli, and Parker 2013). Beyond potential upstream and downstream spillover effects of investments along the process, economies of scope may also be derived from these investments.[1] The digital public infrastructure—that is, foundational digital services such as digital identity and data-sharing systems—that enables targeting in one program can enable it in others, as well. Likewise, as shown by the case of single-window web portals for social protection (discussed later in the chapter), a web platform to provide information about one program can serve the same purpose for many others at virtually no additional cost. While the analysis below focuses on the direct effects of digital interventions at particular stages, it highlights cases in which those effects reverberate throughout the entire process.

Identification of Potential Beneficiaries

The foundation of a social protection system requires obtaining data on a country's population to define the set of potential beneficiaries. At the most aggregate level, many countries rely on statistical information from surveys or censuses to characterize the subnational regions or population groups likely to be a program's target population by, for example, constructing poverty maps. At the individual

[1] Economies of scope arise when producing several goods or services jointly costs less than producing them separately. In this context, a single investment in the development of digital public infrastructure can serve multiple programs at little additional cost. Economies of scope differ from economies of scale, which arise when the average cost per unit falls as the scale of production of a good or service increases.

level, they can invest in social registries to collect information on potential beneficiaries, particularly for noncontributory programs. In the case of contributory programs, relevant information on potential beneficiaries is derived from the contributions to social security, but the countries also can benefit from other information in social registries since, in many cases, contributory pension schemes are complemented by a noncontributory component (a minimum pension funded from general revenue rather than from contributions).

Governments acknowledge that some individuals are left behind by data collection efforts related to social registries. The high levels of informality in Latin America and the Caribbean also mean that many individuals do not appear in administrative records from contributory programs, such as pensions or unemployment insurance. For this reason, data from civil registries or vital records are often merged with existing datasets. Indeed, recent experimental evidence from Panama shows that encouraging the updating of basic identity documents increases the visibility of individuals with the government and, consequently, their likelihood of benefiting from social programs (Reyes, Roseth, and Vera-Cossio 2025).

Several countries in Latin America and the Caribbean have invested in digital public infrastructure to enable the secure integration of different sources of data with social registries. A review of thirteen social registry case studies in the region, conducted for this chapter, finds that in five cases (Brazil, Chile, Colombia, the Dominican Republic, and Guatemala), administrative records are combined with social registry data. In Chile, for example, the social information registry combines data from the Social Household Registry (Registro Social de Hogares)—the household survey tool traditionally used to target social programs—with civil registration (birth, death, marriage), employment, health, and education records. It also incorporates information about old-age pensions and financial data.

This approach not only expands the coverage of the information available in the social protection system; it enables multiple programs and government agencies to use one unified tool for implementation. A great example of the economies of scope that characterize digital technologies, this unified tool builds a bridge between the contributory and noncontributory components of social protection.

Novel digital tools and alternative data sources can provide governments with better information, enabling more precise targeting of social programs. One promising approach involves combining satellite images and census data (often used as a benchmark) with remote-sensing models (algorithms that turn raw satellite or drone pictures into useful information) to distinguish among different types of structures, such as warehouses and residential buildings. This method has proved relatively successful in predicting different dimensions of poverty (Jean et al. 2016).

The models can then be refined to recognize characteristics associated with low-income neighborhoods, using manually tagged images and complementary data, such as electricity bills. Cell phone use records can also provide useful information, as shown by Blumenstock, Cadamuro, and On (2015). When further combined with geolocated beneficiary databases, this technology allows governments to identify gaps in coverage and proactively reach out to households currently outside formal information systems, enhancing the inclusiveness and accuracy of social protection programs.

Some governments in Latin America and the Caribbean are already using these tools. In the Dominican Republic, IncluIA uses remote sensing to identify high-poverty areas and guide outreach; a pilot in Santo Domingo added nearly 30,000 previously missed individuals to the social registry (Monge and Chávez 2025). Brazil, Costa Rica, and El Salvador have adopted similar approaches.

The costs of increasing data coverage for the design and implementation of social programs are manageable. Interviews conducted for this chapter with public officials in several countries in the region that have modernized their social registries indicate that the initial investment ranges from US$4 million to US$14 million, depending on the size of the country. Annual operating costs range from US$1 million to US$4 million. These investments may pay off over time by improving targeting and reducing the share of funds allocated to high-income individuals, particularly as many payments are recurrent. To put these costs in perspective, resources from social programs delivered to high-income individuals in Latin America and the Caribbean have been estimated at around 0.5 percent of GDP (Izquierdo, Pessino, and Vuletin 2018). Better social registries can help reduce such misallocation by improving the identification and targeting of beneficiaries.

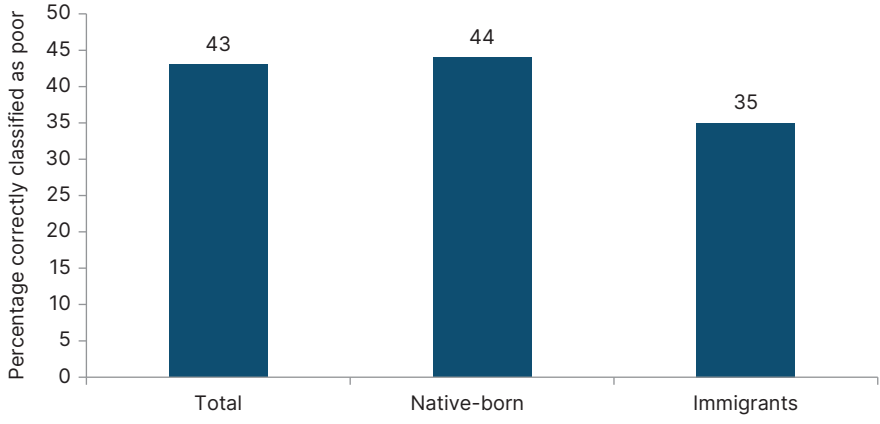
Digital public infrastructure does more than improve efficiency and transparency. By making it possible to bring together information seamlessly from multiple sources, it can prove vital for quickly adapting the coverage of social protection programs in response to aggregate, regional, or idiosyncratic shocks. Vera-Cossio et al. (2023) find that complementing the information in its social registry with multiple data sources enabled Colombia to expand the coverage of its safety net, which allowed vulnerable individuals to keep meeting their basic needs amid the COVID-19 pandemic. More broadly, Tesliuc and Fonteñez (2025) find that countries with stronger digital infrastructure for deploying social protection programs were better at expanding social spending during the pandemic. These capabilities are particularly relevant in a region characterized by substantial cross-border migration. Digital identification systems and interoperable information exchange can help governments identify and register migrants who may otherwise remain outside traditional administrative databases, reducing exclusion errors.

Targeting

Given the universe of potential beneficiaries, governments often need to define a target population for a given program. Antipoverty programs, for example, are designed to reach the poorest households and individuals. The fundamental problem is that neither income nor consumption is perfectly observable for the entire population—a crucial constraint in settings of high informality, such as Latin America and the Caribbean. Thus, many governments use other variables that can be observed (for example, place of residence, education, or housing characteristics) to predict income and consumption, an approach known as proxy means testing.

In practice, proxy means testing is used, above all, to establish eligibility; a household qualifies for a program when its predicted income or consumption falls below a defined threshold. One problem with proxy means testing is that some households are "data-poor"—that is, the government knows little about them—so their income or consumption cannot be predicted accurately. These households are often overrepresented among certain minority groups. Figure 7.3 exemplifies the problem. It depicts poverty-targeting accuracy for immigrants in Chile, who represent 8 percent of the survey sample, and for native-born residents, based on a proxy means testing approach that uses the traditional information available

Figure 7.3. Poverty-Targeting Accuracy in Chile, by Migration Status



Source: IDB staff calculations, based on Chile's National Socioeconomic Characterization Survey (CASEN), 2022.
Note: CASEN is Chile's official household survey, used to measure poverty, inequality, and socioeconomic conditions at the national and territorial levels. The estimates in the figure are based on a regression model trained on a randomly selected 50 percent subsample; the estimated coefficients are then applied to the remaining 50 percent testing subsample to generate out-of-sample predicted incomes. The sample includes adults ages 18 and older. Estimates use sampling weights for national representativeness. Household monthly incomes are compared to the poverty threshold of CLP 216,849 (about US$234), according to CASEN estimates for 2022.

in household surveys or social registries. It shows that this approach is more accurate in identifying poor individuals among native-born residents than among immigrants.

Novel data sources can improve accuracy by capturing subgroups that traditional datasets often represent poorly. Data sources such as satellite imagery, electricity consumption, or cell phone usage patterns not only help identify individuals missed by conventional surveys but predict wealth and other socioeconomic characteristics (see, for example, Blumenstock, Cadamuro, and On 2015; Blumenstock 2018). Evidence also indicates that gains in targeting can come not only from better data but from better methods. Using the same data, cutting-edge AI-based approaches can substantially improve targeting accuracy. Noriega-Campero et al. (2020) find that, relative to traditional methods, AI-based predictions could reduce exclusion errors by 17 percent in Colombia and 26 percent in Costa Rica, keeping the budget constant.

New digital tools can also make it easier for governments to keep information current. This is essential for seamlessly and transitorily expanding the coverage of safety nets, a task that becomes complicated when the data in a social registry are not updated periodically. Baez, Kshirsagar, and Skoufias (2019), for example, combine remote-sensed data with traditional household data to develop a drought-contingent targeting framework for Sub-Saharan Africa. Christian et al. (2025) provide evidence from Nepal that Forecast-Based Anticipatory Action—a framework that uses satellite data to trigger anticipatory financial aid when floods are forecast—enables the timely delivery of post-disaster aid, which has a larger impact than aid delivered months after the event.

Integrating updated data into targeting tools holds great potential beyond use in natural disasters. Beuermann et al. (2025) cite an important example in Colombia. They note that the targeting errors based on proxy means testing trained on the data traditionally available in social registries (dwelling characteristics, ownership of appliances, and basic socioeconomic characteristics) increased during the economic downturn produced by the COVID-19 pandemic. The reason for the increase was intuitive: The economic situation of households changed quickly, and this was unlikely to be represented in pre-crisis data. The study shows that keeping a statistical tool to select beneficiaries updated with current data on sectoral unemployment spells can achieve levels of welfare similar to those produced by an expansion in coverage of social programs, but at a fraction of the cost. It also suggests that data used in traditional targeting tools can quickly decay. Indeed, Aiken, Ohlenburg, and Blumenstock (2023) suggest that, to compensate for data decay, the underlying survey data used in proxy means testing should be updated every three years.

Take-Up

Incomplete participation in social protection programs is the norm rather than the exception. Even in programs with near-automatic enrollment and with benefits that are not contingent on complying with conditions, not all eligible beneficiaries end up receiving their benefits. Regarding an unconditional cash transfer program with near-automatic enrollment in Colombia, for example, Vera-Cossio et al. (2023) find that 10 percent of eligible individuals failed to receive their benefits. This issue is more salient when there are additional enrollment costs. Coady and Parker (2009) show that, among individuals deemed eligible for a cash transfer program in Mexico based on a poverty score, only 66 percent applied for the program, and only 47 percent ended up receiving benefits. These costs affect take-up overall as well as who benefits from social programs, and they can involve several layers of expense, from obtaining access to documents to acquiring information (Romero and Singh 2022).

Application requirements can reduce take-up when eligible individuals encounter paperwork, time, or information barriers (Finkelstein and Notowidigdo 2019). Digital tools can reduce these frictions by simplifying applications and, where administrative data permit, enabling automatic enrollment. Digital platforms can also streamline access across multiple programs. During the COVID-19 pandemic, Chile relied on its Social Household Registry to allow households to register, update socioeconomic information, and determine eligibility for a wide range of programs. The platform processed more than 800,000 applications in June 2021 alone (Tejerina and Vargas 2025).

In 2025, Chile built upon this technology by launching the Unified Social Portal (Ventanilla Única Social). The portal integrated social protection services, transforming the Social Household Registry from a system primarily focused on information registration to a single entry point where citizens can update their household data, apply for benefits, and manage interactions with multiple programs and institutions. The new platform is the gateway (that is, single-window web portal) for a variety of social programs, such as cash transfers, rent subsidies, education grants, and even subsidies for micro- and small firms. By consolidating procedures that were previously fragmented across different websites and offices, it streamlines access to social protection programs and likely reduces transaction costs for citizens.

For these types of portals to work, the public needs to be aware of them and, as discussed later in this chapter, to be able to work with them. As other countries, such as Colombia, work to implement similar portals (Zuluaga and Tejerina 2025),

it is important to understand whether these sophisticated e-government tools can be complemented with scalable information provision interventions. More broadly, evidence is needed on the impacts of systemwide interventions, such as single-window web portals, and key social protection metrics, such as exclusion errors and poverty rates.

Delivery

The impacts of any social protection programs ultimately depend on the extent to which beneficiaries can, indeed, receive the benefits to which they are entitled. Low-income individuals in rural areas may need to balance the benefits derived from cash transfers against the costs of traveling to collect them. Likewise, many beneficiaries may not be able to receive their full benefits after middlemen take their cut (Muralidharan, Niehaus, and Sukhtankar 2016). For implementing agencies, the costs of delivering benefits may consume parts of their budgets that could otherwise be allocated toward the transfers themselves, or they may lead to disbursement errors.

Perhaps one of the most substantial transformations in social protection systems in Latin America and the Caribbean is the move away from in-person to electronic delivery of benefits; the share of beneficiaries of social programs who received their benefits through direct deposit increased from roughly 47 percent in 2014 to 83 percent in 2024 (see Figure 7.4, Panel B). Experimental evidence from Colombia shows that encouraging beneficiaries with no prior links to the formal financial system to receive transfers through direct deposit reduced payment failures and collection time while lowering delivery costs for the government. It also expanded beneficiaries' access to bank accounts and formal credit (Hernández et al. 2024).

Table 7.1 summarizes how digital tools can be incorporated at each stage of social protection. At the identification stage, digital social registries, integrated administrative databases, and remote-sensing models define and update the pool of potential beneficiaries. At the targeting stage, proxy means tests, alternative-data models, and AI-based methods sharpen eligibility decisions. At the take-up stage, prefilled applications, digital outreach, and single-window portals lower the barriers to enrollment. And, at the delivery stage, digital payment systems and biometric authentication make transfers cheaper, faster, and more reliable. Taken together, these tools illustrate the substantial gains digitalization can deliver across the four stages of social protection, reducing exclusion and inclusion errors while lowering costs.

Table 7.1. Summary of Digital Tool Incorporation through the Four Stages of Social Protection

Stage	Policy/Innovation
Identification of potential beneficiaries	Digital social registries for identifying and updating potential beneficiaries
	Integration of administrative databases across government agencies (tax, employment, health, education)
	Remote-sensing models combining satellite imagery and census data to identify potential beneficiaries
Targeting	Proxy means tests implemented through digital social registries
	Targeting models using alternative data sources (e.g., electricity consumption, mobile phone usage, remote sensing)
	AI-based targeting models for predicting eligibility and reducing exclusion errors
Take-up	Prefilled digital application forms using administrative data
	Customized digital outreach through chatbots, digital assistants, and SMS or mail reminders to encourage enrollment
	Integrated "single-window" portals for social programs enabling application and beneficiary–government interactions
Delivery	Digital payment systems delivering transfers to bank accounts or digital wallets
	Biometric authentication for beneficiary verification in payment systems

Source: IDB staff.

Digital Technologies and Emerging Tradeoffs

As is usually the case with innovations, novel digital tools applied to social protection may work better for some individuals than others. One concern is that, with increasing use, the technologies may strengthen or create new tradeoffs for policymakers. Two relevant risks are discussed below: the extent to which the use of digital payments and customer service platforms can exclude some individuals and the extent to which the use of additional sources of data to identify and target beneficiaries may generate opportunistic behavior or transmit societal biases against low-income people.

The Efficiency–Exclusion Tradeoff

This chapter has provided examples of how e-government tools, such as websites, apps, and digital payments, can improve targeting outcomes for social programs. It has long been recognized, however, that these gains may not reach everyone.

Some people prefer to interact with the government through traditional channels, such as in-person offices, while others lack access to or do not have the skills to use the necessary technology.

Several studies document this pattern. In the case of digital payments, Hernández et al. (2024) show that individuals in Colombia with less education, who are older, and who are living in rural areas are less responsive to encouragements to switch from in-person to digital payments. In India, evidence indicates that, while using biometric technology to improve beneficiary verification increased the efficiency of social programs, it also excluded low-income beneficiaries who could not switch to this new technology (Muralidharan, Niehaus, and Sukhtankar 2025). Ongoing research on Brazil's debt renegotiation program, DESENROLA, which requires beneficiaries to apply using a government portal, finds that almost 89 percent of individuals have not even been able to access the platform. The difficulties have been particularly acute among older people and those with less education (Gagete-Miranda et al., forthcoming). As the region ages, it will be important to monitor whether digital tools remain a barrier in old age, or whether future cohorts reach old age with stronger digital skills than current ones.

The efficiency–exclusion tradeoff adds a new dimension for governments to consider when introducing digital technology to the administration of social protection programs: how to reap the benefits from greater efficiency without raising transaction costs on vulnerable and less digital-savvy groups. In practice, alleviating the problem entails choosing from a menu of combinations of digital and in-person channels. In the short run, governments may keep an in-person option to serve individuals who lack connectivity or for whom adopting technology is too costly or not preferred. A good example is provided by Chile, which modernized its social protection system and implemented e-government tools to interact with beneficiaries through its single-window portal but continues to accommodate requests for in-person interactions (Tejerina and Vargas 2025).

In the longer term, an alternative approach is to invest more resources in user experience. As has been demonstrated in private sector settings, interventions focused on, for example, intuitive app design, simplified onboarding, and frictionless payment flows reduce cognitive effort and make processes feel effortless. These concepts are put into practice by the most innovative firms in Latin America and the Caribbean, such as fintech firms, social media platforms, and online marketplaces, and even by some public institutions to ensure they reach traditionally marginalized segments of the economy, including beneficiaries of social programs. The intuition behind this approach is to make interactions with potential beneficiaries as easy as possible so that issues of digital literacy are not a particular limitation.

Targeting Algorithms and Misreporting

An important concern in social protection is that individuals may rely on hidden actions to manipulate their eligibility. Anecdotally, people have been said to hide their TVs or appliances to improve their scores on proxy means tests. The use of interoperable digital public infrastructure combining multiple data sources may help assuage some of these concerns. Traditionally, a social registry would only use information from a self-reported assessment of living conditions. With more data available to assess poverty in near-real time, poverty predictions can be refined, making it harder for users to manipulate their scores either by misreporting aspects of their living conditions (Camacho and Conover 2011) or by deciding to work off the books (Bosch and Schady 2019; Garganta and Gasparini 2015). In the context of contributory programs that are particularly prone to misreporting (Dean, Fleitas, and Zerpa 2024; Gerard and Gonzaga 2021; Vera-Cossio et al. 2025), additional data sources can support income verification. In other words, more data sources and better ways to identify beneficiaries may reduce the consequences of strategic misreporting.

Benchmarking the Region's Digitalization of Social Protection

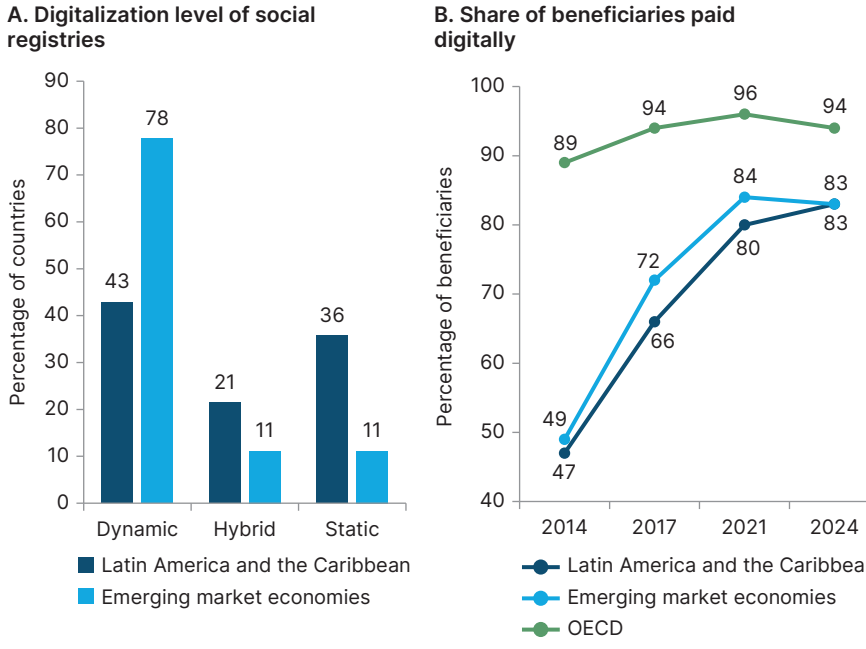
To characterize where countries in Latin America and the Caribbean stand with respect to digitalization of their social protection systems, this section examines two key dimensions: how regularly social registries are updated, and the share of beneficiaries who receive their benefits through electronic transfers.

Figure 7.4, Panel A, compares the share of dynamic social registries in Latin America and the Caribbean with that among other emerging economies. It shows that the region lags relative to other countries with similar incomes. This underscores the efforts needed to integrate different sources of data for better targeting, particularly in economies where labor market informality is more prevalent and income is harder to measure.[2]

Panel B of Figure 7.4 turns to the electronic delivery of social program transfers, where the picture is one of striking progress. In 2014, just 47 percent of beneficiaries in Latin America and the Caribbean received their transfers digitally, compared with 89 percent in the Organisation for Economic Co-operation and Development (OECD), a gap of more than 40 percentage points. By 2024 the region had reached 83 percent, cutting that gap to about 11 percentage points.

[2] Note that Panel A in Figure 7.4 does not include OECD countries, from which data on social registries are unavailable. Social registries may not, however, be necessary in the OECD, to the extent that informality is minimal, and governments already have interoperable data sources for other purposes—a feature more likely in higher-income countries, like those in the OECD.

Figure 7.4. Digital Social Protection: Dynamic Registries and Digital Transfers across Country Groups



Source: IDB staff calculations, based on Guven, Yeachuri, and Almenfi (2025) and the World Bank's Global Findex Database, 2025.

Note: Reported values are unweighted averages across countries with available data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A). Panel A results are shown separately by digitalization level of social registries, based on Table B.5 of Guven, Yeachuri, and Almenfi (2025). Dynamic registries allow continuous updates and real-time interoperability with administrative data, while static registries rely on infrequent survey-based updates. Estimates for Latin America and the Caribbean are based on Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Mexico, Peru, and Uruguay. Panel B reports the individuals who received government financial support in the previous 12 months deposited into a card, a bank or other financial institution account, or a mobile money account. The set of countries included varies by year, depending on data availability in each Findex round. Within each country, estimates use sampling weights for national representativeness.

This rapid convergence, shared with other emerging economies, reflects both policy efforts to modernize the state and investments in interoperable payment systems (Vera-Cossio 2025). A final step remains, as 17 percent of beneficiaries still collect their transfers in cash, but over the past decade the trajectory has been one of fast and sustained catch-up.

These two dimensions sit at different depths. Digital payments are the visible, delivery-facing layer, where the region has largely closed the gap with the OECD. Dynamic registries are the deeper, data-infrastructure layer—the layer on which AI-based targeting ultimately runs—and it is here that the region still lags.

The regional pattern, in short, is a digitized delivery interface resting on a data foundation that remains comparatively underdeveloped. This lag reflects broader institutional weaknesses—outdated regulation, immature data-governance arrangements, and limited technical capacity—reinforcing a central message of this report: The effectiveness of digitalization and AI depends critically on the strength of the institutions that support them.

Policy Recommendations

Digital technologies can substantially improve the efficiency, coverage, and adaptability of social protection systems in Latin America and the Caribbean. Achieving these gains requires four main policy actions.

Build dynamic, interoperable social registries. Social registries should be a shared public data layer that covers a broad segment of the population, identifies potential beneficiaries, and keeps the information used for targeting up to date. Links should be established among civil registration, tax, employment, pension, participation in public programs, health, education, and other relevant administrative records. These sources should be complemented, where appropriate, with information on household assets and living conditions, such as housing characteristics, and service consumption, such as electricity use, to improve the assessment of socioeconomic conditions and targeting. Targeted surveys and outreach should be used to include population groups who are poorly represented in existing data. A lead institution should be designated to coordinate the registry across government agencies, assign responsibilities for supplying and updating data, set interoperability and data-quality standards, administer access, and enforce privacy and cybersecurity safeguards. The resulting registry should support multiple programs and allow coverage and benefits to be adjusted as household economic conditions evolve or shocks occur.

Upgrade targeting with cutting-edge AI methods. Social protection agencies should regularly test whether advanced AI methods can be used to identify eligible beneficiaries more accurately than the statistical models currently in use, thereby reducing exclusion and inclusion errors without expanding program budgets. Rather than allowing incumbent models to persist by default, agencies should create competitive processes by which leading researchers and qualified external teams can develop and benchmark alternative methods using the same underlying data. This will require providing secure access to privacy-protected data, establishing transparent out-of-sample performance criteria, and comparing new models with existing targeting tools. Agencies should adopt clear performance metrics, implement methods that deliver meaningful improvements, and repeat these benchmarking exercises periodically so targeting performance continues to improve as data and analytical techniques evolve.

Develop comprehensive single-window portals for benefits. Procedures should be integrated across programs and agencies, so beneficiaries do not have to navigate multiple entry points. A single-window portal should be used as the main channel for citizens to obtain information, check eligibility, update their information, submit documentation, track decisions, and manage benefits across programs. Where eligibility rules can be codified and the underlying data are sufficiently complete and reliable, integrated data and advanced algorithms should be used to automate eligibility determinations and enroll beneficiaries without requiring a separate application. The portal should be complemented with AI-enabled chatbots and proactive digital communications, including behaviorally informed reminders and notifications, to help eligible individuals complete required steps and claim benefits. These measures can increase take-up, reduce exclusion errors and application costs, save citizens' time, and improve their experience of interacting with the state.

Advance digitalization without excluding beneficiaries. Digital interfaces should be designed to be intuitive and easy to use, including for people with limited digital skills and those using older devices. At the same time, in-person services should be maintained and strengthened for those who cannot or prefer not to interact through digital channels. Telephone assistance can provide an additional alternative with relatively low service-delivery costs and no transportation costs for beneficiaries, particularly when staff can guide them through digital procedures and help them learn to use digital channels. Governments should monitor completion rates across channels and population groups and adjust service design accordingly. This hybrid approach can capture the efficiency gains from digitalization without reducing access among the people most in need of social protection.

8

Beyond Adoption: Making Digital Tools Work for Infrastructure

Infrastructure services are essential for productivity, economic opportunity, and quality of life. They determine whether firms can produce reliably, workers can access workplaces efficiently, and households can obtain safe water, energy, and mobility services. Although Latin America and the Caribbean has made important progress in expanding access to infrastructure, significant challenges remain. Service providers continue to experience high losses and operational inefficiencies; many households still cannot get reliable, affordable, and high-quality services; environmental pressures are mounting; and increasingly frequent extreme weather events expose infrastructure systems to growing risks (Bagnoli and Cavallo 2025; Blackman et al. 2025). Improving infrastructure services is, therefore, central to addressing the region's productivity challenge, as discussed in Chapters 1 and 2.

The region's infrastructure challenge reflects both insufficient investment and weak performance of existing systems. Infrastructure investment remains below that of other emerging economies, while weaknesses in asset management, maintenance, and service delivery reduce the value obtained from existing resources (Brichetti et al. 2021; Brichetti et al. 2026). According to data from the Latin American and Caribbean Energy Information System, nearly 18 million people in the region still lacked access to electricity in 2024, while electricity losses averaged 14 percent of total supply. According to the Joint Monitoring Programme (JMP) global database, access to safely managed water stagnated at around 78 percent of the population, leaving approximately 142 million people without safe water services, while access to safely managed sanitation has been substantially below levels observed in high-income countries. Even where these infrastructure services are available, reliability, quality, and affordability remain persistent concerns (Pérez-Urdiales and Tojal Ramos Dos Santos 2024).

Traffic congestion is another significant challenge in a region with the highest levels of urbanization in the world. Average travel speeds in Latin American and Caribbean cities are typically between 15 and 25 kilometers per hour, compared

with 25 to 50 kilometers per hour in European cities. Commuters in Bogotá, Colombia, lose around 150 hours annually to congestion, and residents of Lima, Peru, and Mexico City close to 200 hours (Bagnoli and Stisman 2026).

These shortcomings disrupt economic performance and affect quality of life. Addressing them requires not only expanding infrastructure assets but increasing the efficiency, reliability, and quality of the services they provide. The potential gains of improving infrastructure are substantial. Cavallo, Powell, and Serebrisky (2020), for example, estimate that increasing infrastructure-sector productivity by about 5 percent from the baseline could raise average growth by 3.5 percentage points over a 10-year period in the countries analyzed. Extrapolating to Latin America and the Caribbean, this represents more than US$200 billion of incremental output over 10 years.

Digitalization and artificial intelligence (AI) offer new opportunities to improve productivity and service delivery related to infrastructure. Digital technologies such as sensors, smart meters, mobile applications, connected devices, and digital platforms generate large volumes of information about infrastructure systems and their users. AI and advanced analytics can then use these data to forecast demand, detect anomalies, optimize operations, identify maintenance needs, and support decision making. In some cases, automation can translate these insights directly into operational actions, such as adjusting network operations, dispatching repair crews, managing distributed energy resources, or optimizing traffic flows (Alarcón and Quiros-Tortos 2025; Galo et al. 2023).

The distinction between gathering and using information matters because much of the potential value of AI in infrastructure depends on the existence of digital systems capable of generating timely, reliable, and interoperable data. In infrastructure sectors, many digital technologies have been deployed for years, but the application of AI to support operations remains at an earlier stage (Álvarez Alonso et al. 2023). In practice, the transition from digitalization to AI in infrastructure sectors is less about adopting new technology than about moving from collecting information to using it effectively.

Technology alone, however, rarely improves infrastructure outcomes. Information only creates value when organizations have the incentives, capabilities, and governance arrangements needed to act on it. Infrastructure services in the region are often delivered by a combination of public agencies, private operators, concessionaires, and technology providers, making data governance, interoperability, regulatory frameworks, and institutional coordination essential complements to digital investments. The institutional capacity to transform information into action is particularly important in transportation, where responsibilities are frequently fragmented across many operators and authorities.

At the same time digital technologies support infrastructure systems, they can create new pressures on them (Box 8.1). The rapid expansion of data centers

and AI-related computing is raising the demand for electricity, water, and digital infrastructure worldwide. While this may create investment opportunities for Latin America and the Caribbean, it also highlights the need to ensure technological transformation remains consistent with broader infrastructure, sustainability, and development objectives (U.S. Department of Energy 2024; Bashir et al. 2024).

Box 8.1. Powering AI: The Infrastructure Demands of Data Centers

AI is rapidly expanding demand for data center capacity. Data centers require a great deal of electricity and water for computing and cooling (Xiao et al. 2025; World Economic Forum 2025; Spindler, Fisher, and Hahn-Petersen 2025). In the United States, existing data centers raised wholesale electricity prices by 2–6 percent between 2021 and 2025, with larger effects in areas where the centers are concentrated (Kay, Reaser, and Taylor 2026). Looking ahead, the magnitude of the impacts that continue to take place will depend heavily on infrastructure investment. Bogmans et al. (2026) estimate that, without investments in renewable generation and transmission, the AI-related demand shock could raise U.S. electricity prices by as much as 8.6 percent by 2030; with such investments, the increase may be only 0.4 percent. The key issue is, therefore, not only how much energy and water data centers consume but whether infrastructure can adjust to accommodate the growing demand.

In major developed markets, data center expansion is increasingly held back by limited power availability and environmental concerns (CBRE 2025). At the same time, some AI-related workloads, particularly model training, can be located farther from major end-user markets. The combination of capacity constraints in established data center hubs and less stringent requirements elsewhere may create opportunities for Latin America and the Caribbean, especially for locations with reliable electricity, sufficient connection capacity, clean generation sources, adequate water resources, strong digital connectivity, and regulatory credibility (García Zaballos et al. 2025).

Still, data centers create large, concentrated, and persistent loads that can require substantial investments in generation, transmission, distribution, and water systems. These pressures are particularly relevant in the region's four largest data center hubs—São Paulo, Brazil; Querétaro, Mexico; Santiago, Chile; and Bogotá, Colombia—where rapid growth is increasing demands on power and other infrastructure systems (CBRE 2026). Brazil illustrates the speed at which these pressures can develop; projected electricity demand by data centers associated with projects submitted to the Ministry of Mines and Energy increased more than fivefold between 2024 and 2025 (EPE 2024, 2025). In Chile, water scarcity has also increased scrutiny of the water requirements of cooling technologies (Tironi and Albornoz 2025). The policy challenge is, therefore, to coordinate the growth of data centers with timely electricity and water infrastructure investment so expansion does not undermine affordability, reliability, or environmental sustainability.

This chapter examines how digitalization and AI can improve the efficiency, equity, sustainability, and resilience of infrastructure systems for water, energy, and transportation. Drawing on international and regional evidence, it argues that the greatest gains are likely to emerge not from technology adoption alone but from combining digital tools with the institutional, regulatory, and organizational changes required to convert information into better infrastructure outcomes.

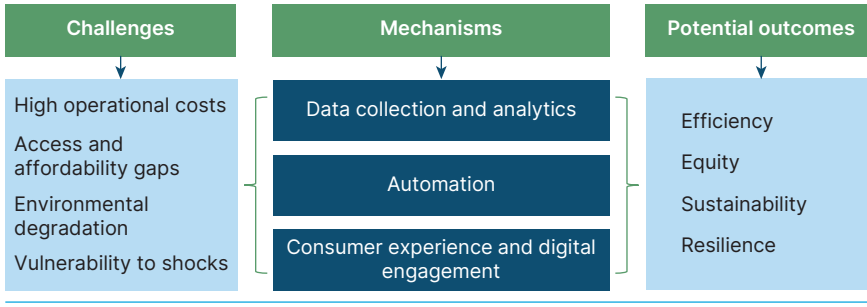
Theory of Change

How can digitalization and AI improve basic infrastructure across sectors in Latin America and the Caribbean? Briefly put, the impact of those tools depends on how they are adopted and integrated into infrastructure systems. Figure 8.1 presents an organizing structure for the chapter, grouping digital technologies according to the mechanisms through which they operate and the infrastructure outcomes they may affect with respect to four challenges: *high operational costs*, *access and affordability gaps*, *environmental degradation*, and *vulnerability to shocks*. This structure helps identify what technologies can do in principle and where adoption barriers, regulatory gaps, or contextual factors may prevent gains from materializing.

As the figure suggests, digital technologies, including AI, improve infrastructure outcomes through three mechanisms: *data collection and analytics*, *automation*, and *consumer experience and digital engagement*. Across these, digitalization generates the data, and AI-based methods extract value from the data.

In terms of *data collection and analytics*, sensors, smart meters, and connected devices generate continuous information on assets and service delivery. Analytics can use these data to forecast demand, detect losses and failures, prioritize maintenance, and improve planning across energy, water, and transportation systems.

Figure 8.1. How Digital Technologies Affect Infrastructure Outcomes



Source: IDB staff.

Automation involves linking digital monitoring and analytics to automated control systems that adjust operations in real time, reduce human error, and improve responsiveness to changing conditions. Applications include grid management, automated pumps and valves, and traffic management systems.

Consumer experience is shaped by digital platforms, mobile applications, and user interfaces that can make infrastructure services easier to access, more transparent, and more responsive. These can simplify billing and payment, provide users with information on consumption and service conditions, and generate additional data for planning and management. AI can further improve engagement by personalizing messages, recommendations, and customer support based on users' needs and behavior.

The use of these digital tools has the potential to affect four main outcomes for infrastructure: *efficiency*, *equity*, *sustainability*, and *resilience*.

Regarding *efficiency*, digital technologies can reduce the costs of providing services and enhance provider performance by improving measurement, reducing losses, optimizing operations, and automating routine tasks.

Digital tools can raise *equity* in access to infrastructure by reducing barriers to services and subsidies, improving targeting, identifying deficits in service quality, and making service delivery more responsive to underserved users. The equity benefits of digitalization are not automatic, however; they depend on deliberate efforts to design tools and platforms that are accessible and relevant to broad segments of the population.

Digital technologies can enable *sustainability* by using resources efficiently and by enabling the integration of renewable energy into the electricity generation matrix and facilitating the transition to circular infrastructure systems. In the energy sector, smart grids and demand response programs allow for the flexible integration of variable renewable energy. In water management, sensors and analytics can optimize the use of scarce resources, detect and prevent pollution, and support the reuse and recycling of water and nutrients. In transportation, digital platforms can promote shared mobility, reduce congestion and pollution, and support the shift to electric vehicles.

Real-time monitoring, predictive analytics, and automation can support *resilience* by helping infrastructure systems anticipate disruptions, respond more quickly, and maintain continuity of critical services. In the aftermath of disasters, digital platforms can support rapid damage assessment, resource allocation, and communication with affected populations (Cavallo, Cavallo, and Rigobon 2014).

Within this framework, rigorous empirical evidence, mostly from high-income countries, can inform strategies for the implementation of digital technology in basic infrastructure services in Latin America and the Caribbean. New research from the region can build on these insights to provide a better understanding of how local adoption patterns, consumer behavior, and regulatory frameworks shape the effectiveness of these technologies.

Evidence of Effectiveness

The discussion that follows is organized around the three mechanisms identified above—data collection and analytics, automation, and consumer engagement—and assesses how each contributes to efficiency, equity, sustainability, and resilience, first in water and energy and then in transportation. It examines where digital technologies have delivered measurable gains and where complementary investments, incentives, and institutional capacity have been necessary for those gains to materialize. The case studies in the accompanying boxes illustrate this central message, showing both the gains already realized by digital and AI-based tools in the region and the complementary conditions needed for them to deliver their full potential.

Water and Energy

Smart meters and the use of machine learning for fraud detection illustrate how digital technologies can improve infrastructure service delivery through better data and analytics, while also highlighting the need for complementary investments and incentives to realize their full potential.

Smart Meters: Data, Automation, and User Engagement Combined. Smart meters, which are among the most widely studied digital technologies in water and energy infrastructure, provide a concrete application of the analytical framework, accounting for all three of the transformation mechanisms it sets forth. First, the meters generate high-frequency consumption data and enable advanced analytics for forecasting demand, detecting losses, and planning operations; second, they facilitate automated grid and network management; and, third, they strengthen consumer engagement by providing real-time feedback and supporting digital billing platforms. Through these channels, smart meters can improve efficiency, sustainability, resilience, and, under the right conditions, equity, providing a useful illustration of how the three mechanisms can jointly influence all four framework outcomes.

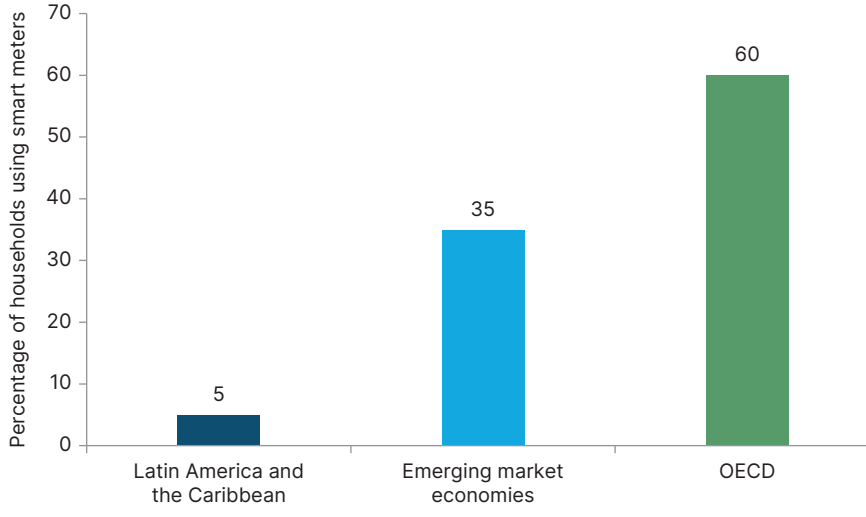
The empirical evidence broadly supports the efficiency gains from smart metering, though their magnitude depends on how the technology is implemented. Smart meters can improve measurement, reduce losses, lower operating costs, and enhance reliability. In the United States, their rollout increased utility revenues by 1–2 percent, reduced energy losses by 4–7 percent, shortened outage duration by 7–8 percent, and reduced employment in meter reading by 18 percent (Meeks, Pless, and Wang 2025).

Real-time feedback and personalized information can change household water and energy use by making consumers more aware of their consumption and providing actionable guidance. In the Canary Islands, online access to

water-use information reduced consumption by 2 percent (Daminato et al. 2021), while daily feedback through a mobile app reduced consumption by 6 percent in California. Among high-use households, the effects were larger when leak alerts were included (Nemati, Buck, and Soldati 2025). Similar effects have been documented for electricity; individualized messages reduced energy use among low-income households in Europe (Podgornik, Sucic, and Blazic 2016), while evidence from the United States and Japan shows responses depended on baseline consumption and how information was presented (Lynham et al. 2016; Matsukawa 2018). Together, these findings suggest digital engagement is most effective when information is timely, personalized, and linked to clear actions.

In Latin America and the Caribbean, water and energy utilities are still in the process of implementing smart metering systems. As shown in Figure 8.2, the rollout of these devices in the energy sector remains limited compared to other emerging market economies and to OECD countries. This gap reflects not the maturity of the technology but the conditions for its diffusion—namely, the regulatory frameworks, utility business models, and institutional and financial capacity to invest, which have yet to catch up with what is technically feasible.

Figure 8.2. Smart Meter Adoption



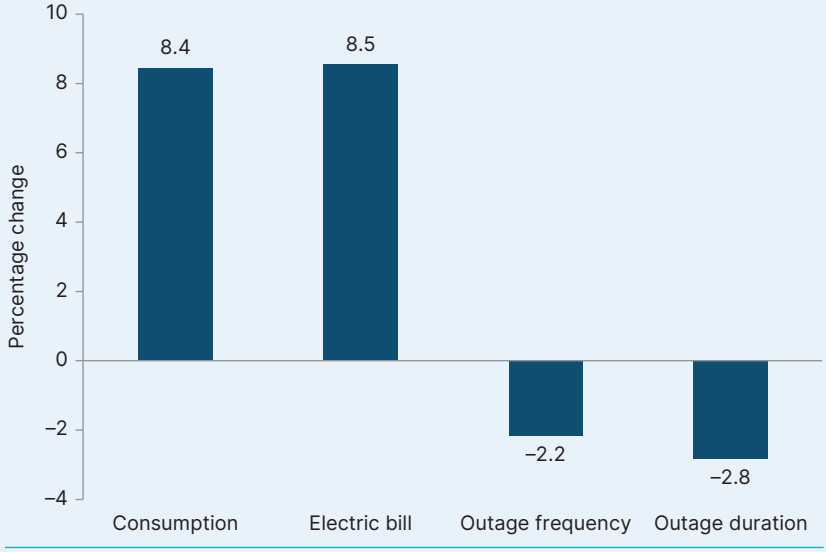
Source: IDB staff calculations, based on data from the International Energy Agency (IEA), 2021, and population data from the World Development Indicators, World Bank, 2021.
Note: The figure shows the use of smart meters as a proportion of total electric residential meters in 2021. Reported values are population-weighted averages across countries with available data. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Research in the region has focused primarily on the adoption of basic metering technologies. The existing evidence in Colombia and Ecuador shows that installing individual meters can substantially reduce household consumption (McRae 2024; Carrillo, Contreras, and Scartascini 2024). Box 8.2 extends this discussion by presenting new evidence on the effects on efficiency and reliability of energy smart meters in Brazil.

Box 8.2. Energy Smart Meters in Brazil

In the Brazilian electricity sector, the adoption of smart metering and other technologies needed to build a smart grid is relatively recent. Between 2021 and 2023, the share of smart meters among nearly 99 million residential electricity consumers increased from 0.8 percent to 2.6 percent.[a] The expansion was driven primarily by five distribution utilities operating in different Brazilian states, spanning the country from north to south. An analysis conducted for this book uses consumer-level data from the Brazilian regulator (ANEEL) to estimate the effects of smart meter deployment through an empirical methodology that exploits variation across households in the timing of deployment.

Figure B8.2.1. Causal Effects of Smart Meters on Measured Consumption and Outage Frequency



Source: IDB staff calculations, based on data from ANEEL in Brazil.
Note: Effects are estimated using a staggered differences-in-differences design exploiting variation in the timing of smart meter deployment across consumers between 2021 and 2023.

(continued on next page)

Box 8.2. Energy Smart Meters in Brazil *(continued)*

As presented in Figure B8.2.1, the results show that smart meter deployment increases recorded electricity consumption by 8.4 percent and, consequently, consumers' electricity bills. The increase may reflect more accurate measurement by smart meters, changes in household behavior, or both; the analysis cannot separate these channels.

In terms of resilience, as also shown in Figure B8.2.1, the estimated effects of smart meters on outage frequency and duration are negative but not significant. This result is explained largely by the physical location of smart meters at the distribution network's endpoint—inside or near consumers' premises. Most outages originate from failures in upstream infrastructure, particularly in the segments between substations and neighborhood feeders. As a result, smart meters by themselves are insufficient to mitigate outages.

As in the United States and Europe, the clearest documented impact of smart meters in Brazil has been improved measurement and billing. In contrast, the expected gains in sustainability, such as reductions in losses and overall consumption, and in resilience, such as fewer or shorter outages, have been limited or have not yet materialized. To influence consumption decisions, especially during peak hours, utilities must combine smart meters with dynamic pricing or other tariff designs that create clear incentives to shift or reduce electricity use. Reducing the frequency or duration of outages requires complementary investments in maintenance, field crews, and upgrades to the physical distribution network.

[a] Statistics computed by the authors, based on data from the Brazilian regulator (ANEEL).

Despite these promising results, the actual benefits of smart technologies often fall short of engineering expectations. Ultimately, user behavior and incentives determine whether the efficiency and sustainability gains from digitalization are realized. Brandon et al. (2022) find that smart thermostats, which were designed to optimize energy use automatically, did not lead to energy savings because users frequently overrode the preset temperature settings.

To ensure digital tools translate into tangible improvements, they must be complemented with appropriate pricing and policy mechanisms. Smart metering, for example, enables providers to introduce time-varying prices that reflect changes in supply and demand during the day. Experiments in the state of Connecticut in the United States and in Ireland show that combining dynamic pricing with real-time feedback reduces peak electricity demand (Jessoe and Rapson 2014; Carroll, Lyons, and Denny 2014).

Machine Learning to Detect Leaks and Fraud. In addition to smart meters for measuring usage, water utilities are increasingly using sensors and machine-learning algorithms to detect leaks and monitor network integrity. These technologies analyze flow and pressure data to identify anomalies that may indicate

water losses or infrastructure failures (Lee and Kim 2023; Romero-Ben et al. 2023). Water companies in Michigan, for example, are using machine-learning models to target maintenance efforts more efficiently and protect public health (Abernethy et al. 2018).

While this line of research stresses the operational promise and cost-saving potential of data-driven monitoring, most studies remain descriptive, focusing on technological capabilities rather than providing rigorous evidence of their effectiveness once they have been implemented. These applications do, however, represent an extension of the data collection and analytics mechanism of the framework, with expected benefits concentrated in efficiency and resilience. To illustrate how these tools are being deployed in practice and the difficulties of integrating them into existing systems, Box 8.3 examines the use of machine learning by a water utility to detect fraud in Quito, Ecuador. The case illustrates a central lesson of this chapter: AI can change how utilities prioritize inspections, but analytical improvements produce operational gains only when they adapt field procedures, feedback loops, and enforcement practices.

Box 8.3. AquaData: Machine Learning versus Water Fraud

Fraud is a big problem for utilities. In Latin America and the Caribbean, water utilities report that approximately 30 percent of water fails to generate revenue because of leaks, inaccurate metering, unauthorized consumption, and other losses. Reducing fraud, therefore, can free resources to expand the coverage and quality of water services while easing tariff pressure on paying customers (Fay et al. 2017).[a]

AquaData is an initiative of the Inter-American Development Bank (IDB), piloted with EPMAPS, the water utility in Quito, Ecuador, to curb fraud and related irregularities using machine learning. The model uses historical billing and inspection data to estimate the probability of irregularities for each connection. Before AquaData, EPMAPS already targeted inspections based on digitalized billing records, relying primarily on traditional indicators such as zero consumption and other evident anomalies. AquaData expands this approach by applying a broader set of consumption patterns to rank accounts according to predicted fraud risk.

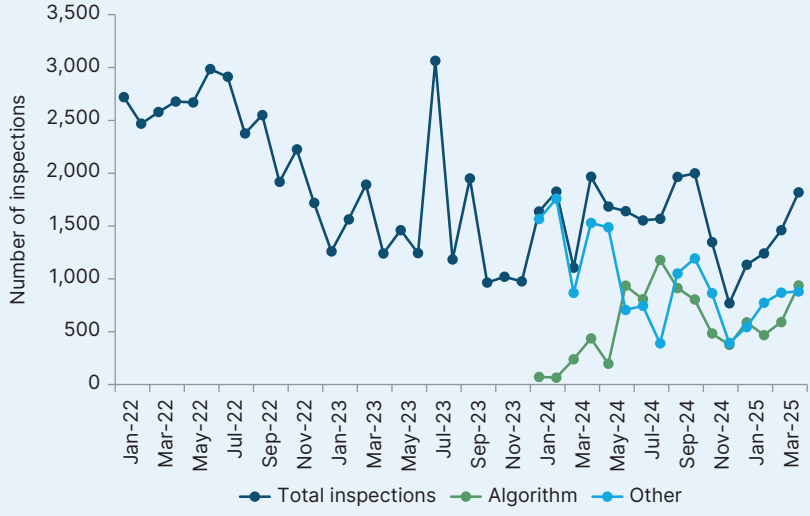
Figures B8.3.1 and B8.3.2 compare inspections selected using AquaData ("Algorithm") with inspections selected through these traditional methods ("Other").

Algorithm-guided inspections have increased since AquaData was introduced, but they have not yet produced a higher rate of confirmed infractions than traditional targeting, as shown in Figure B8.3.2. The algorithm does identify a different set of cases, including higher-consumption accounts and a greater share of meter-damage infractions, but these differences have not yet translated into higher infractions per inspection. Possible explanations include the continued parallel use of legacy targeting, conservative thresholds during early deployment, operational frictions in the field, and greater difficulty verifying irregularities among some high-consumption accounts.

(continued on next page)

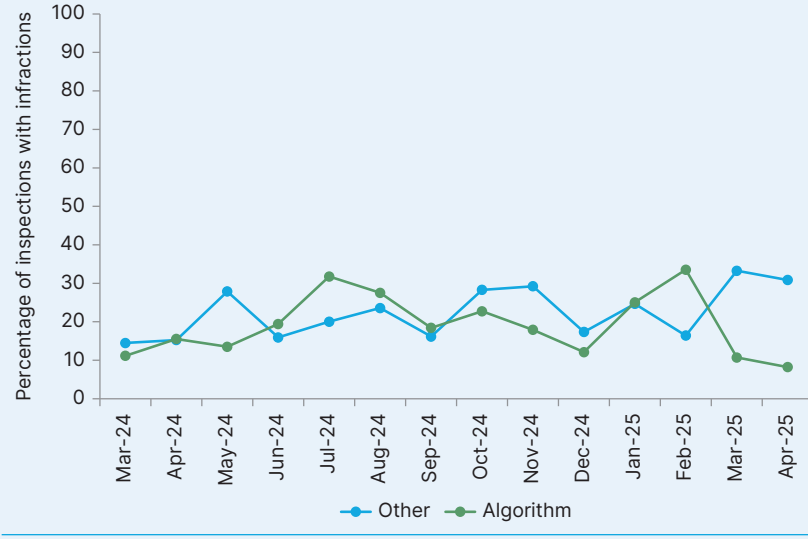
Box 8.3. AquaData: Machine Learning versus Water Fraud *(continued)*

Figure B8.3.1. EPMAPS Inspections using AquaData versus Other Methods



Source: IDB staff calculations, based on EPMAPS data.
Note: EPMAPS is the public water utility serving Quito, Ecuador. "Algorithm" refers to inspections selected using AquaData, a machine-learning model that ranks customer accounts based on their predicted probability of irregularities. "Other" refers to inspections selected using EPMAPS's traditional targeting methods.

Figure B8.3.2. Infractions per Inspection



Source: IDB staff calculations, based on EPMAPS data.
Note: EPMAPS is the public water utility serving Quito, Ecuador. Legend categories are as defined in the note to Figure B8.3.1.

(continued on next page)

Box 8.3. AquaData: Machine Learning versus Water Fraud *(continued)*

In sum, the digitalization of billing records provides a foundation for the systematic detection of fraud. Realizing the full benefits of this digital transformation, however, requires adjustments in operational routines, coordination between analytical and field teams, and continued fine-tuning of the algorithm.

[a] As mentioned above, fraud is also pervasive among energy consumers. In Rio de Janeiro, Brazil, research documents stolen energy equivalent to more than half of the formal market's size, and simulations show that, by eliminating theft, utilities could reduce billed prices by 18 percent (Resende et al. 2025).

Transportation

Evidence from smart cards, digital sensors, AI, and mobility platforms shows how digital technologies can improve transportation efficiency, planning, and subsidy targeting. It also highlights the importance of complementary policies and institutional capacity to translate information into better outcomes.

Smart Cards for Pricing, Subsidies, and Planning. In the transportation sector, rapid digital transformation is increasingly powered by two major sources of data: urban sensors and mobile applications (Selod and Soumahoro 2020). Urban sensors include technologies such as smart cards, digital toll systems, and cameras that capture information on vehicle movements and public transportation use. Mobile applications collect data directly from users' devices, generating real-time information on travel demand and mobility patterns. Together, these tools provide continuous, high-frequency data that enable authorities to address congestion, accidents, fare evasion, and the overall performance of transportation systems. Although the causal evidence remains more limited than in water and energy, a growing literature has begun to identify the effects of digital technologies and AI on transportation outcomes.

Smart cards have evolved from fare-collection tools into rich data systems for subsidy administration, demand analysis, and transit operations. Personalized cards can automatically apply discounted fares to eligible users, while transaction data can be used to estimate fare elasticities and responses to price changes (Kholodov et al. 2021; Guzman et al. 2021). Smart card data can also support operational and security analysis by, for example, allowing the identification of unusual travel patterns associated with theft and accounting for fare evasion to improve origin–destination matrices (Gu et al. 2019; Munizaga, Gschwender, and Gallegos 2020). Box 8.4 discusses how smart cards have enabled monitoring of ridership patterns, fare collection, and subsidy targeting in Bogotá's Bus Rapid Transit (BRT) system, resulting in gains in both efficiency and equity through the mechanism of consumer experience and digital engagement.

Box 8.4. Smart Cards and Bogotá's Bus Rapid Transit System

The deployment of smart card technology in the BRT system in Bogotá, Colombia, has enabled detailed monitoring of ridership patterns, fare collection, and subsidy targeting. Analysis of publicly available data illustrates two important roles played by smart card technology in the system.

First, smart cards enable precise and automatic subsidy targeting. By September 2025, 69 percent of passengers used personalized cards, which are required to receive transportation subsidies, and 17 percent of all users paid a subsidized fare. Among subsidy recipients, 48 percent were older adults, 43 percent qualified through SISBEN, and 9 percent were people with disabilities.[a] The system applies the appropriate discounted fare automatically at entry, reducing paperwork and administrative intervention and making targeted subsidy delivery easier to implement at scale.

Second, the technology provides granular data to monitor the effects of policy changes. In February 2025, the government implemented a fare increase alongside a reform of subsidy eligibility, which raised the share of users paying the standard rate from 79 percent in January to 87 percent in February. The smart card data allowed the tracking of these shifts in real time and showed broadly stable ridership patterns in subsequent months. This kind of evidence is valuable for evaluating policy reforms and informing future decisions on fare structure and subsidy design.

Using smart card data, Guzman and Hessel (2022) show that a 2017 subsidy for low-income users substantially increased ridership among beneficiaries, although the effect eventually faded. Guzman et al. (2025) reports results from an experiment that randomized monthly travel vouchers delivered through personalized smart cards to low-income riders. They find that the benefit increased BRT use, reduced reliance on regular buses, and, ultimately, shortened travel times.

Smart cards can streamline subsidy delivery and generate granular information on system use, but their impact depends on the policies and institutions surrounding the technology. Eligibility rules must determine who benefits, access channels must accommodate users with limited digital literacy, and service providers must have the analytical capacity and procedures to translate transaction data into better planning and service delivery.

[a] SISBEN (Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales) is Colombia's official system for classifying individuals and households according to their socioeconomic status. It is used to determine eligibility for social programs and subsidies, including transportation discounts, by assigning a score based on such factors as income, living conditions, and vulnerability. As discussed in Chapter 7, integrated digital systems that link rich individual-level data can improve the targeting of social programs, including utility subsidies, to disadvantaged populations.

Digital Sensors, AI, and Mobility Platforms. Digital sensors can improve traffic management by generating real-time information on vehicle flows, congestion, and enforcement. In the United States, electronic toll collection in New Jersey and Pennsylvania reduced pollution exposure and improved birth outcomes, including an 11 percent decline in premature births and a 12 percent decline in low-birthweight births (Currie and Walker 2011). Digital monitoring alone may be insufficient to change behavior, but it can strengthen the effectiveness of complementary policies. While traffic cameras in Texas did not lower accident rates (Gallagher and Fisher 2020), speed-limit reductions in São Paulo did produce reductions in accidents on roads monitored by speed cameras (Ang, Christensen, and Vieira 2020).

At the same time, data from Global Positioning System (GPS) devices and sensors embedded in public transportation fleets are being used to evaluate the efficiency of dedicated bus lanes and optimize route planning, as shown by González Ramirez and Silva (2025) in their analysis of bus operations in Chile. Video data combined with machine-learning methods have also been used to identify pedestrian safety risks around BRT stations and bus stops in Mexico City (Perez Villasenor et al., forthcoming). Box 8.5 discusses how digital technologies and AI are being applied in Bogotá's TransMilenio BRT system to improve efficiency and safety.

Box 8.5. TransMilenio: AI for Operations, Safety, and Maintenance

TransMilenio, S.A., the operator of Bogotá's Bus Rapid Transit system, has adopted a range of digital and AI-based tools to enhance operational efficiency, safety, and user experience (see Box 8.4 for a discussion of its use of smart cards). Through its fleet control and data management centers, TransMilenio's system collects extensive data—including GPS coordinates, trip details, and real-time operational events and alarms—based on sensor readings from 18 devices aboard each bus. The information is used to process a range of 23 operational events, from ignition at the beginning of the day to shutdown at the end. It also records alarms, such as sudden acceleration or braking. These data streams are used for real-time safety monitoring, regulatory compliance, predictive maintenance, incident investigation, and targeted safety campaigns.

TransMilenio's analytical models include monitoring of real-time speed and brake wear, detection of anomalous driver behavior (including microsleep events), and automated verification of buses' adherence to routes. For the electric fleet, energy management models supervise battery charging and project battery lifespan. Computer vision models, based on YOLO, a widely used real-time object detection algorithm, are used to analyze passenger flows and station access times, in turn supporting queue management and resource allocation.[a] Rapid response and corrective actions are enabled by automated reporting systems that generate daily operational summaries

(continued on next page)

Box 8.5. TransMilenio: AI for Operations, Safety, and Maintenance
(continued)

and send critical alerts to concessionaires via WhatsApp. Geofencing technology refines the tracking of vehicles, stations, and depots based on satellite GPS data.[b]

Implementation of these technologies has presented several challenges, notably the need to manage operational costs within public sector budgets. TransMilenio has sought to address these obstacles by adopting scalable cloud infrastructure, developing analytical models and messaging services internally, and optimizing existing monitoring platforms through contract renegotiation and internal expertise. According to TransMilenio, these strategies reduced costs and allowed the company to reinvest resources in further system improvements.

[a] YOLO stands for "You Only Look Once." TransMilenio uses YOLO models to detect and count passengers automatically and measure access times at stations by analyzing video feeds, enabling efficient monitoring and management of passenger flows.
[b] Geofencing refers to the creation of virtual geographical boundaries using GPS or similar technologies. When a vehicle enters or exits these predefined zones, the system triggers alerts or actions. In public transportation systems like TransMilenio, geofencing is used to monitor fleet location, ensure route compliance, and improve operational control.

The growing use of mobile and ride-share applications has introduced other forms of digitalization to urban mobility. Platforms such as Uber, Lyft, Waze, and Google Maps that generate real-time data on individual trips and traffic conditions allow both users and policymakers to make better decisions. Empirical evidence indicates the applications can influence congestion patterns in both positive and negative ways. On the one hand, navigation apps have been shown to help dissipate congestion in urban areas, as documented in California (Bagabaldo et al. 2024). On the other, Uber and Lyft decreased traffic speed in Texas by 2.3 percent (Tarduno 2021).

Because take-up and use remain unequal, not everyone reaps the same benefits from mobile and ride-share applications. Studies of Medellín, Colombia, and Mexico City show that ride-hailing adoption varies with age, education, income, and concerns about personal security on public transportation (Bedoya-Maya et al. 2022; Sabogal-Cardona et al. 2021; Oviedo, Sabogal-Cardona, and Scholl 2025). These technologies can produce measurable efficiency and resilience gains for users and operators, but their broader environmental and equity effects depend on whether cities embed them in effective planning, regulation, pricing, data governance, and service delivery systems.

Policy Recommendations

Digital technologies can help infrastructure providers deliver more and better services with existing resources. By reducing losses, enhancing asset utilization,

strengthening reliability, expanding access, improving affordability, and supporting more sustainable resource management, use of these tools can raise the productivity of infrastructure systems and lower costs for households and firms. The evidence reviewed in this chapter also shows that these gains do not emerge automatically from technology adoption alone, however. Realizing their full potential requires complementary policies, incentives, institutional capacity, and organizational changes that allow the information and analytical capabilities generated by digital technologies to translate into better decisions and operational improvements. Three policy actions should, therefore, be prioritized.

Deploy smart meters as part of integrated water and energy systems. Utilities and regulators should deploy smart meter programs as part of broader operational reforms rather than as isolated technology investments. Utilities should use meter data to improve billing, reduce losses, manage demand, and strengthen grid operations. They should provide customers with digital interfaces that offer timely feedback on consumption and prices and use AI tools to personalize alerts and recommendations. Utilities should also coordinate smart meter deployment with maintenance and upgrades to distribution networks so that better information translates into fewer and shorter outages. Regulators should establish interoperability, cybersecurity, and data-access standards before large-scale deployment and approve time-varying tariffs that encourage consumers to shift or reduce consumption during high-cost periods. They should also incorporate efficient smart meter investments into cost-recovery frameworks to give utilities incentives to deploy and maintain the technology.

Benchmark AI applications for water and energy operations before scaling up their use. Water and energy utilities should use AI as a decision-support tool rather than assume algorithmic solutions automatically outperform existing practices. They should test AI models against existing targeting approaches using operational metrics such as detections per inspection, losses recovered, repairs completed, and maintenance costs avoided. Before deploying AI models, utility managers should ensure data are standardized and continuously updated. Utilities should combine billing records, meter data, and network sensors to identify leaks, fraud, abnormal consumption, and other losses and to prioritize inspections and maintenance. Managers should design workflows that assign high-risk cases to field teams and ensure field outcomes feed back into the models. Regulators should require human review before AI-generated flags trigger fines, disconnections, or other enforcement actions.

Integrate data for transportation operations. Transportation authorities should treat data integration as core infrastructure rather than a technology project. They should use AI and advanced analytics to forecast demand, identify underserved areas, optimize routes and service frequencies, predict maintenance needs, detect incidents, and improve the timing of traffic signals. They should

pilot new applications, evaluate them against outcomes such as travel times, reliability, safety, congestion, and operating costs, and scale up their use only when they generate measurable improvements. Metropolitan transportation agencies, transit operators, and traffic management authorities should integrate data from smart cards, fare collection systems, vehicle fleets, GPS devices, traffic sensors, cameras, and mobility platforms. They should connect predictions to predefined operational responses, such as dispatching additional vehicles, adjusting schedules, reallocating maintenance crews, or modifying signal plans. Governments should invest early in staff capacity, cybersecurity, interoperability standards, and safeguards for passenger and location data.

9

Digital Tools for Safer Societies

Beyond its direct human costs, crime discourages investment, erodes trust in institutions, and weakens state legitimacy (Besley and Mueller 2018; Brown et al. 2019; Pinotti 2015).[1] Increasingly, governments in Latin America and the Caribbean have turned to digital technologies to strengthen crime prevention and improve public safety. The hope is that these technologies will allow the security sectors in the region to leapfrog (as Chapter 1 puts it) toward more efficient and equitable performance by accelerating administrative processes, helping agencies with limited resources do more, and enabling more precise targeting of enforcement and prevention efforts. Yet their adoption has often outpaced both the evidence on their effectiveness and the institutional conditions they require to deliver results. The results can be costly: investments that fail to improve public safety and, where safeguards are weak, intrusive surveillance and discriminatory enforcement.

This chapter reviews evidence concerning numerous digital technologies intended to support crime prevention, policing, justice, and the penal system in Latin America and the Caribbean. It assesses the causal evidence on their effectiveness, examines patterns of adoption across the region, and identifies the institutional conditions under which these tools are most likely to deliver results. It also considers the governance arrangements needed to limit misuse, protect individual rights, and ensure technological capacity translates into better public safety.

Three conclusions stand out. First, the strongest causal evidence is concentrated in a narrow set of applications, particularly technologies that

[1] The Inter-American Development Bank Group's Institutional Strategy 2024–2030 identifies three core strategic objectives (reducing poverty and inequality, addressing climate change, and fostering sustainable regional growth), with institutional capacity, rule of law, and public safety as cross-cutting focus areas. Evidence shows that crime and violence directly undermine the three objectives (Perez-Vincent et al. 2024).

increase the certainty of detection in high-crime places and those that mitigate the negative consequences of incarceration by replacing it with community supervision. Second, adoption in Latin America and the Caribbean has systematically favored visible, hardware-intensive investments over the foundational information systems—such as interoperable case management, data governance, and investigative infrastructure—on which many of those investments depend. And, third, technology has the greatest impact when it complements capable institutions rather than when it is used as a substitute for them. Where institutional foundations, governance safeguards, or accountability mechanisms are weak, the same tools that succeed elsewhere can be expensive, underused, ineffective, or harmful.

The chapter closes with policy recommendations that echo the primary message of this book: that technological adoption should be accompanied by investments in data quality, institutional coordination, transparency, accountability, privacy, and safeguards against misuse. Specifically, countries should prioritize the development of interoperable justice information systems, use local data to direct prevention and enforcement resources toward the places and populations where they can have the greatest effect, and deploy more advanced tools where the evidence suggests they can address specific problems, such as excessive pretrial detention and incarceration. The returns to digitalization, therefore, depend not only on which technologies governments adopt but on how they are embedded in the institutions that use them.

Obstacles to Crime Control and the Role of Technology

Crime can be reduced by preventing individuals from engaging in criminal activity (prevention), increasing the probability that crimes are detected and offenders are identified (deterrence), and restricting the ability of offenders to commit further crimes (incapacitation; Chalfin and McCrary 2017). Digital technologies can strengthen these institutional functions by improving the information available to decision makers, increasing operational efficiency, and enabling more precise targeting of scarce resources. The discussion that follows examines the main impediments encountered by crime control institutions in the region and the scope for technology to overcome these challenges.[2]

[2] This discussion is schematic and should not be read as a set of independent problems. Prevention, policing, courts, and penal systems are embedded in an interconnected institutional chain. Weaknesses in one part affect performance in others. Weak investigations, for instance, produce thin case files that courts struggle to process, while court congestion contributes to pretrial detention and prison overcrowding. Interventions at one stage may be undermined—or reinforced—by conditions elsewhere in the system.

Prevention: Reactive Spending and Weak Targeting

Compared to police, courts, and prisons, prevention receives only a small share of the public money that is spent on security in Latin America and the Caribbean (Serrano-Berthet 2018). Evaluations of large-scale prevention interventions show that those that are government supported have mixed or null results (Martinez Palomares 2019; Sanchez et al. 2021). Flawed program design and limited funding may partly explain this, but weak targeting may also reduce the effectiveness of the interventions.

Crime tends to be highly concentrated in both place and population. A large share of incidents occur in a small fraction of locations (Chainey, Serrano-Berthet, and Veneri 2021), and violence is disproportionately prevalent among high-risk groups (De Lima Friche et al. 2023; UNODC 2023). Yet prevention programs in the region are typically widely applied rather than directed toward the places and individuals where the marginal returns to prevention spending are likely to be highest. Targeting resources effectively requires timely and granular information on where risks are concentrated and who is most exposed—information that can be costly to assemble, update, and process, particularly when administrative records are fragmented. Digitalization can improve access to information and make more precise targeting feasible at scale by creating and integrating administrative data, identifying high-risk populations and locations, and helping tailor outreach and access to education, training, or social services for hard-to-reach groups. Tools that classify individuals or neighborhoods by risk, however, can also reproduce biases in the underlying data or be used in ways that stigmatize particular groups. Avoiding such bias requires safeguards, transparency, and institutional oversight.

Policing: Low Investigative Capacity

Policing in Latin America and the Caribbean is characterized by an inability to resolve violent incidents by identifying suspects, building viable cases, and securing convictions. In Chile, prosecutors recorded a known suspect in around 61 percent of 2023 homicide cases, a share that fell to 43 percent for homicides linked to organized crime (Fiscalía Nacional de Chile 2024). In Brazil, 36 percent of homicides committed in 2023 had led to formal charges by the end of 2024 (Instituto Sou da Paz 2025). And in Mexico, state prosecutors identified a suspect in only 17 percent of investigations of intentional homicide between 2010 and 2022 (HRW 2025).

Part of this deficiency can be attributed to low public trust in police, which cripples efforts to clear cases by reducing crime reporting and witness cooperation. In surveys conducted in Latin America and the Caribbean, 61 percent of respondents say they have little or no trust in the police (Lupu et al. 2023).

In contrast, 67 percent of respondents in Organisation for Economic Co-operation and Development countries outside the region report that they *trust* police (OECD 2022). Case clearance in the region is also undermined, however, by institutional weaknesses related to information collection, sharing, and processing, including fragmented information systems, limited forensic capacity, and lack of coordination between police and prosecutors (HRW 2025).

Technology can help by strengthening the information base on which investigations depend, specifically by linking incident records to suspect identifiers, consolidating forensic and digital evidence, and enabling data-driven deployment of patrol resources. Surveillance systems, biometric tools, digital evidence management, crime mapping, and analytical systems can all improve suspect identification and the construction of viable cases. These may reduce crime through deterrence and incapacitation.

Courts: Structural Congestion and Pretrial Detention

Congestion in its justice institutions impairs the speed and perceived fairness of legal sanctions in Latin America and the Caribbean. Data from the Centro de Estudios de Justicia de las Américas (CEJA) show that, between 2022 and 2024, the regional judicial resolution rate—defined as the ratio of cases resolved to cases initiated—was around 0.92, below the threshold of 1.0 required to prevent a backlog (CEJA 2025). While the regional congestion rate—the ratio of active cases to resolved cases within a specific year—declined from 2.81 in 2022 to 1.98 in 2024, it remained well above the range of 1.0 to 1.5 associated with manageable caseloads.

One effect of congestion is to extend periods of pretrial detention, thereby increasing the number of pretrial detainees at any given time. Greater congestion in regional justice institutions compared to those in Europe can account for data from the UNODC (2025) showing that approximately 33 percent of prisoners in the region are in pretrial detention, compared with 17 percent in Europe. Lengthy periods of pretrial detention have adverse consequences: Detained defendants are more likely to plead guilty, even when innocent, and acquire criminal records, reducing subsequent formal-sector employment and increasing future offending (Domínguez and Lazcano 2025; Dobbie, Goldin, and Yang 2018).

The use of digital technologies is promising for improving the administration of justice. Digital case management and electronic filing, scheduling systems, and structured records may increase efficiency by reducing delays and facilitating case flow, thereby diminishing both the need for and duration of pretrial confinement. Risk assessment tools can also inform pretrial and sentencing decisions, helping courts impose custodial measures more selectively. To the extent that these tools reduce delays in the application of judicial sanctions, they strengthen deterrence; to the extent that they improve the targeting of detention, they support more effective incapacitation.

Penal Systems: Overcrowding and Other Conditions

Conditions in penitentiary systems across much of Latin America and the Caribbean prevent rehabilitation and can perpetuate rather than reduce crime. World Prison Brief data from 2025 show prison occupancy rates of 113 percent in Mexico, 136 percent in Brazil, 163 percent in El Salvador, 248 percent in Peru, and 274 percent in Bolivia. Overcrowding is compounded by staffing shortages. Whereas European prison systems average approximately 1.6 inmates per staff member, Brazil, Central America, and Mexico operate with ratios of around 6 inmates per staff member (Aebi and Cocco 2024; INEGI 2024). Such conditions have consequences inside and outside prisons. Data collected by the UNODC indicate that the number of intentional homicides per 100,000 prisoners is more than twice as high in Latin America and the Caribbean (5.8) as in Europe (2.5), while Tobón (2022) and Jaramillo (2026) find that former prisoners and their peers are more likely to engage in criminal activity than others in their neighborhoods.

Although digital technologies cannot directly reduce overcrowding or expand prison capacity, they can enhance the identification and management of prisoners by supporting better prisoner classification, improving access to rehabilitation resources, and facilitating alternatives to incarceration. Better classification and access to appropriate rehabilitation can contribute to lower recidivism (Tobón 2022), while alternatives to incarceration, such as electronic monitoring, can preserve labor-market and family ties that make reoffending less likely (Di Tella and Schargrodsky 2013; Williams and Weatherburn 2022).

A Cross-Cutting Constraint: Weak Information Infrastructure

The challenges confronting prevention efforts, policing, justice, and penal institutions are compounded by weak information infrastructure. Fragmented case management systems, incomplete digital records, poor interoperability across agencies, and limited analytical capacity make it difficult to allocate resources strategically and coordinate across the criminal justice system, and to identify where cases or processes break down.

While digital technologies can help by making information more complete, accessible, and usable across institutions, as discussed above, having better information does not by itself improve crime control. Institutions must be able to incorporate that information into their operations—to allocate resources, for example, coordinate cases across agencies, or identify and respond to delays. New systems introduced without this underlying capacity may simply add technological complexity without improving performance (Andrews, Pritchett, and Woolcock 2017).

What the Evidence Says

The chapter so far has pointed to areas where digital tools have the *potential* to improve crime control institutions. This section surveys evidence about whether they work. It looks at their success in improving targeting and program delivery in social prevention, raising the certainty and speed of detection in policing, reducing delay and improving the quality of decision making in courts, and strengthening community supervision and prison management in the correctional system.[3]

Rigorous quantitative studies on the effectiveness of many of these technologies remain scarce in Latin America and the Caribbean and, for some newer applications, particularly those involving artificial intelligence (AI), are largely absent. In cases where no evidence from the region is available, therefore, the discussion that follows introduces relevant evaluations from other regions. This evidence does not mean that similar effects will necessarily arise in Latin America and the Caribbean, given differences in institutional capacity, legal frameworks, data quality, and patterns of crime. Rather, it provides a reference for identifying promising interventions, understanding the mechanisms by which they may operate, and prioritizing reforms and technologies for adaptation and rigorous evaluation in the region.

The available evidence is also uneven across technologies. Some applications—particularly hotspot policing, closed-circuit television (CCTV), and electronic monitoring—have been evaluated repeatedly using credible causal designs. Others, including integrated command centers and broad justice digitalization programs, have been widely deployed but rarely evaluated against crime outcomes, partly because their effects operate through longer and more complex causal chains.

Table 9.1 summarizes the evidence that is discussed in greater detail below, as well as the extent of adoption across the region of the technologies discussed here. As the table and discussion make clear, the strongest evidence supports the use of tools that raise the certainty of detection, deterring crime, or that provide alternatives to incarceration. Less evidence is available on tools that improve administrative efficiency.

[3] The chapter concentrates on conventional crime control technologies and the institutions that use them rather than examining technology-enabled crimes, such as cyber-enabled fraud, ransomware, and AI-assisted scams, which require distinct enforcement capabilities and regulatory approaches.

Table 9.1. Evidence on Technology and Crime in Latin America and the Caribbean

Technology	Available evidence		Adopted in the region?	Key limitations
	Global	Regional		
CCTV	Yes (18–57% crime reduction in some settings)	Yes	Most major cities	Possible crime displacement
CCTV + facial recognition	Only correlational	No	Pilots	Demographic bias risk
DNA databases	Yes (Denmark, United States)	No	13 countries	Requires forensic capacity and legal frameworks
Hotspot policing	Yes (65+ evaluations; 8–16% crime reduction)	Yes	Multiple countries	Displacement possible
Body-worn cameras	Mixed	No	Limited	Uncertain conduct effects; data governance needs
Communication/ response centers	None	No	Most countries	High cost; crime impact undemonstrated
Electronic case filing	On efficiency only	No	Limited	Faster case processing; crime link untested
AI in legal processes	None	No	Pilots	Bias and due-process risks
Electronic monitoring	Yes (Argentina, Sweden, United States)	Yes	Most countries	Requires supervision

Source: Reviewed throughout the section on evidence.
Note: "Causal evidence" refers to studies using credible identification strategies, such as randomized trials and quasi-experiments.

Prevention Technologies

A large body of causal evidence shows that education and employment opportunities can reduce criminal involvement. Quasi-experimental studies link additional schooling to reductions in arrest and incarceration, while improvements in employment opportunities reduce recidivism among former offenders (Britto, Pinotti, and Sampaio 2022; Cook et al. 2015; Deming 2011; Galbiati, Ouss, and Philippe 2021).

With respect to education, for example, the challenge for crime prevention is to ensure, with limited budgets, that at-risk youth remain in school and receive

educational support suited to their needs. Technology can expand the reach of these services to populations that traditional programs may struggle to serve. For example, students in areas affected by organized crime are both less likely to attend school and more likely to be recruited by criminal organizations. Online education can substitute for attendance and reduce vulnerability to these recruitment efforts. Dinarte et al. (2025) show that online platforms can sustain learning and tutoring at scale when in-person education is disrupted, in this case during the war in Ukraine.

Technology can also improve the targeting of prevention interventions. Machine-learning tools can use administrative and incident-history data to identify individuals at high near-term risk of serious violence, including shooting victimization (Heller et al. 2026). The tools allow agencies to direct scarce preventive services toward populations with the greatest need.[4]

Policing Technologies

The strongest evidence on policing technologies pertains to operational tools that support police deployment and criminal detection, such as CCTV, hotspot policing, and forensic applications, such as biometric databases. Less rigorous evidence is available on system-level technologies, including integrated command platforms, and technologies intended to increase police accountability, such as body cameras.

CCTV and Place-Based Deterrence

One of the most studied policing technologies is closed-circuit television. By raising the perceived risk of detection in monitored areas, CCTV discourages people from committing crimes. A meta-analysis finds it associated with a statistically significant reduction in crime. Effects are larger and more consistent in settings such as parking lots and when CCTV images are actively monitored (Piza et al. 2019).

[4] Better economic opportunities also reduce crime. Digital labor platforms, for example—app-based services that connect workers with flexible, on-demand jobs, such as taxi driving and food delivery—can raise the opportunity cost of offending by expanding access to legal employment. Evidence from Brazil links the rollout of a major delivery platform to a decline of roughly 10 percent in reported crime. The reductions were largest in the low-income areas where delivery workers reside. Crime was not displaced to the areas served by delivery workers (Frankenthal 2025). Similar results are found in France, where the effect is concentrated among youth newly eligible for platform work (Allouard et al. 2024). The digitalization of transfers and payments can also reduce street crime by lowering cash exposure; a quasi-experimental study of electronic benefit transfers in the United States estimates an overall crime reduction of 9 to 10 percent (Wright et al. 2017).

An evaluation of targeted camera deployment in Medellín, Colombia, finds reductions in reported crime in areas that were monitored, with no evidence that criminal activity was displaced to other locations (Gómez, Mejía, and Tobón 2021). On the other hand, an evaluation of the MiCalle CCTV program in Mexico City, which was geographically less focused and did not systematically locate CCTV cameras in high-crime areas, finds no evidence of crime reduction (Vilalta, Lopez-Ramirez, and Fondevila 2023). Together, these results suggest camera coverage alone is insufficient. Effectiveness depends partly on concentrating surveillance where crime risk is highest.

Hotspot Policing and Data-Driven Deployment

Hotspot policing addresses low detection rates directly by concentrating patrol resources in the places where crime is most prevalent. Meta-analytic evidence indicates it reduces crime by 8 percent based on conventional standardized effect sizes and 16 percent based on incidence-rate measures (Braga et al. 2019; Braga and Weisburd 2022). In Latin America and the Caribbean, hotspot programs have generally reduced targeted crimes when patrols are tightly focused, at the level of street segments rather than broad zones. As with CCTV, studies find that although displacement of criminal activity to neighboring areas is a potential concern, it is usually not detected in practice (Chainey, Alvarado, and Serrano-Berthet 2024; Chainey, Serrano-Berthet, and Veneri 2021). The main exception is a citywide randomized evaluation conducted in Bogotá, Colombia, which finds direct reductions in treated locations offset by increases in nearby areas (Blattman et al. 2021).

Also, like CCTV, the deployment of hotspot policing depends on identifying where crime is concentrated. Machine learning could improve this targeting by generating forecasts automatically or at lower cost, but causal evidence on whether it outperforms conventional crime analysis remains scarce. A 2015 randomized trial found that algorithm-guided patrols, using older machine-learning tools, produced a small but significant reduction in crime volume, while analyst-guided patrols did not (Mohler et al. 2015).

Forensic and Biometric Databases

Forensic identification databases, particularly DNA databases, are among the identification technologies for which causal evidence is the strongest. Biometric databases accelerate post-crime identification, directly addressing the problem raised earlier that suspects are identified for only a small fraction of homicides.

While evidence on these technologies is limited in Latin America and the Caribbean, studies from other settings signal their effectiveness. Doleac (2017),

for example, finds that DNA database expansions across U.S. states reduce crime rates and can be more cost effective than traditional enforcement tools. Evidence from Denmark exploits a large expansion of the national DNA database to estimate the effect of DNA registration on subsequent offending. In the year after registration, individuals whose DNA was added to the database were less likely to reoffend than comparable individuals whose DNA was not registered (Anker, Doleac, and Landersø 2021). Together, these studies indicate that increasing the probability of identification can deter offending and reduce recidivism.

Advanced Surveillance Technologies

The use of surveillance raises concerns about privacy and the potential for abuse that are heightened for advanced technologies, such as facial recognition and license plate readers. This makes evidence on whether they improve public safety particularly important. To justify the collection of data on a large population that includes only a few potential offenders, these technologies should generate information that can significantly improve the identification of offenders relative to existing police tools.

As with forensic and biometric identification, evidence on the effectiveness of advanced surveillance technologies is sparse in Latin America and the Caribbean. In the United States, however, the deployment of facial recognition technology is associated with reductions in violence because of faster and more certain identification (Johnson et al. 2024).

There are few studies on automated license plate readers, whether from the region or globally. They are generally limited and inconclusive. License plate readers are intended to increase the probability of detection by helping police identify and track vehicles associated with criminal activity, but the available evidence does not establish a consistent effect on crime. A quasi-experimental study of license plate readers deployed at roadblock locations in Buffalo, New York, produced inconsistent estimates of their effect on violent crime (Wheeler and Phillips 2018).

Body-Worn Cameras and Accountability

Body-worn cameras have been widely adopted. Unlike the technologies discussed above, cameras worn by law enforcement officers are designed mainly to improve accountability, although they may also facilitate the collection of evidence. A systematic review synthesizing 70 studies, though none from the region, finds that the cameras reduce citizen complaints about police conduct (Lum et al. 2019).

Integrated Command-and-Control Platforms

Integrated command-and-control platforms are information systems that help organizations coordinate, monitor, and direct operations. In the context of criminal justice, they help overcome the bottleneck that is created by weak information infrastructure. They accelerate response, improve coordination, and strengthen investigation by combining data from sources such as CCTV, gunshot detection, and officer deployment records. Although the effectiveness of command-and-control platforms is much more difficult to evaluate than that of the digital policing interventions already discussed, emerging quasi-experimental studies suggest measurable investigative benefits. An evaluation of Chicago's Strategic Decision Support Centers, for example, reports an increase in clearance rates for violent and property crime following implementation (Arietti 2024). The results suggest these platforms provide investigative benefits, but evidence that they ultimately reduce crime remains limited.

Court Technologies

Studies on digital technologies and the justice system have focused on administrative inefficiency and the quality of judicial decision making, mainly looking at intermediate outcomes, such as case processing, transparency, and risk prediction. Little is known about their downstream effects on crime.

Court Digitalization and Case Management

Court digitalization aims to reduce congestion and delay by improving document flow, case tracking, electronic filing, and access to remote hearings. Introducing digital systems is unlikely to generate substantial efficiency gains, however, without complementary changes in staffing, procedures, and management (Maroz, Popova, and Satizabál Acosta 2023). This finding echoes a central message of the book, emphasized in Chapter 1: Organizational redesign is crucial to realizing large productivity gains from digital technologies.

The COVID-19 pandemic accelerated the adoption of digital technology in court systems, particularly in upper-middle-income countries. Maroz, Popova, and Satizabál Acosta (2023) report that 43 percent of these economies introduced at least one new digitalization feature in 2020, rising to 89 percent in 2021, alongside adoption of remote hearings and e-filing. They find a strong positive association between digitalization and judicial transparency. Whether these systems also improve court efficiency, however, is less clear.

The limited causal evidence suggests efficiency gains in courts may take time to materialize. An evaluation of an electronic case management system in the Philippines found no significant reduction in case duration during the first year

of implementation but detected improvements in the second (Orbeta, Paqueo, and Siddiqi 2021). This pattern is consistent with the idea that digitalization requires institutions to adapt workflows and learn to use new systems before measurable gains emerge.

Algorithmic Decision Support

Algorithmic tools address problems associated with the quality and consistency of decisions regarding defendant detention. Analysis from Colombia indicates assignment to pretrial detention under existing practices is suboptimal, with low-risk defendants frequently detained and some high-risk defendants released (Mejía 2025a; see Box 9.1).

Box 9.1. PRiSMA: Colombia's Risk Assessment Tool for Pretrial Detention

Fear of bias is a significant obstacle to the use of algorithms for making sensitive decisions. Human bias is also known to permeate these decisions, though. Evidence from a tool for predicting recidivism risk in Colombia suggests ample potential for algorithms to generate decisions about pretrial detention that are fairer and more efficient than those made through human judgment alone.

Colombia's Office of the Attorney General developed PRiSMA (Perfil de Riesgo de Reincidencia para la Solicitud de Medidas de Aseguramiento [Recidivism Risk Profile for Requests for Pretrial Detention Measures]) to support prosecutors' and judges' decisions on pretrial detention. PRiSMA integrated arrest records from the Policía Nacional, case records from the Attorney General's case management system, and incarceration records from prison authorities to produce risk assessments at the individual level based on the likelihood of reoffending within two years.

The analysis finds that prosecutors requested detention for about 56 percent of individuals whose predicted risk of reoffending was low and failed to request it for about 39 percent of those with high predicted risk. Judges exhibited similar patterns. Counterfactual simulations indicate that correcting these errors could have reduced recidivism by up to 25 percent for overall crime, 45 percent for property crime, and 21 percent for violent crime without increasing intramural detentions.

PRiSMA is not in use today. Its utility depended on having interoperable data linking police, prosecution, and the prison system, which most jurisdictions in the region still lack. Furthermore, its eventual abandonment illustrates the institutional friction such tools encounter. Scaling them up requires at least two conditions: First, such an algorithm must be evaluated empirically to observe how prosecutors and judges respond to its use in practice. Second, a governance framework, including auditing, transparency, and independent evaluation, needs to be developed alongside the rollout. These conditions could not be met in the case of PRiSMA.

Source: Mejía (2025a).

Machine-learning models can improve the prediction of defendants' risk relative to unaided human judgment. Kleinberg et al. (2018), for example, show such models can rank defendants more accurately by risk, and policy simulations indicate better predictions could reduce detention without increasing crime. These results demonstrate the potential of algorithmic tools to improve the tradeoff between public safety and unnecessary incarceration.

Evidence from actual implementation is more cautionary, however. For example, mandatory pretrial risk assessment reform in Kentucky produced only a small increase in releases and was accompanied by more failures to appear in court and more pretrial crime (Stevenson 2018). Judges retained discretion and frequently did not follow recommendations to release defendants classified as low risk. The case illustrates how a tool can improve the information available to decision makers without changing outcomes if institutions do not incorporate that information into practice.

Taken together, the evidence suggests court technologies are most effective when embedded in complementary institutional reforms. Digital case management requires changes in workflows and administrative practices, while algorithmic decision support requires clear rules governing how predictions are used. In high-stakes settings, these systems must also be transparent, auditable, and subject to safeguards against discriminatory or arbitrary decisions.

Correctional Technologies

In correctional systems, evidence shows that the most effective technologies are those that replace incarceration with structured community supervision, directly addressing the concern that overcrowded, violent prisons can generate more crime. Di Tella and Schargrodsky (2013) find that individuals assigned to electronic monitoring rather than prison in Argentina were less likely to reoffend—a finding consistent with the capacity of monitoring to maintain labor market and family ties while avoiding prison exposure.

More recent quasi-experimental research from Sweden based on the results of a sentencing reform similarly shows that electronic monitoring reduces criminal recidivism while increasing labor supply. It documents better outcomes for children, as well, pointing to broader social benefits of replacing incarceration with home-based supervision for eligible cases (Grenet, Grönqvist, and Niknami 2024). Systematic review evidence is broadly consistent with these findings. It indicates electronic monitoring can reduce reoffending under specific conditions, particularly when paired with supervision practices and support services (Belur et al. 2020).

Cross-Cutting Lessons

Across all the evaluations of the different technologies and stages of the criminal justice system, three cross-cutting lessons emerge. First, technology is most effective when it complements, rather than substitutes for, institutional capacity. Across the interventions reviewed above, information and analytical tools generate value only when agencies have the routines, incentives, and authority to use them. "Management-by-results" models, inspired by New York City's CompStat program, illustrate this complementarity by combining timely crime data with territorial accountability and sustained managerial attention. Parfitt, Pantaleão, and Kopittke (2026) report significant reductions in homicide following the adoption of such models in several Brazilian states and emphasize integrated databases and performance routines as key enabling conditions. More generally, the evidence reviewed in this chapter suggests that better information alone is unlikely to improve clearance rates, case processing, or deterrence if institutions cannot translate it into operational decisions.

A second lesson is that the evidence becomes thinner as technologies become more complex and systemic. Although command centers, broad digital justice platforms, and AI-based analytical and decision-support tools feature prominently in current policy discussions, rigorous evaluations of their effects remain scarce, in part because they are inherently difficult to construct. Command centers should improve coordination, situational awareness, and access to information for many police officers and across a broad geographic area, and cannot be randomly assigned to some neighborhoods or police units and not others. Digital justice platforms often combine multiple reforms across institutions, making it difficult to isolate the contribution of any individual component.

A final lesson is that effectiveness is only one consideration for technology adoption; another is implications for rights and institutional legitimacy. While technologies that increase the capacity to identify, monitor, or classify individuals can strengthen deterrence and improve decision making, they can also magnify existing biases or enable misuse when governance is weak.

Does Adoption Follow the Evidence?

Latin American and Caribbean countries have made substantial investments in crime-related technology over the past two decades. Adoption has focused most on technologies that increase the probability of detection and management of data by police. CCTV networks have proliferated, including Mexico City's 30,000-camera C5 and Smart Sampa in São Paulo, Brazil. Many jurisdictions have introduced centralized command centers and data-driven policing dashboards

(Chainey, Alvarado, and Serrano-Berthet 2024; da Silva et al. 2020). DNA databases exist in 13 of 15 surveyed countries in the region (Muggah and Szabó de Carvalho 2018). The region has also used technology to expand alternatives to incarceration. For example, electronic monitoring programs cover over 120,000 individuals in Brazil alone (SENAPPEN 2025).

Countries in the region have been slower to adopt foundational systems that integrate all aspects of the criminal justice system. End-to-end interoperable case management allowing case-level information to be tracked across institutional boundaries—linking police, prosecutors, courts, and the penal system—is partial in most countries. Even when they introduce technologies to allow for such tracking, standardized identifiers, structured data entry, and performance monitoring systems are absent. Hence, agencies cannot integrate, analyze, or act on the data that they have in their systems.

The pattern of technology adoption in the region reveals a mismatch with the challenges of criminal justice. Low clearance rates, court congestion, poor prison conditions, and other impediments to criminal justice point to weaknesses in investigative infrastructure, case management, and correctional governance. Yet investment has largely been in surveillance hardware and command infrastructure. These tools can help deter crime but do not resolve the upstream failures in investigation, prosecution, and case processing that determine conviction and punishment.

This mismatch partially reflects the political incentives governments have to invest in visible, hardware-intensive technologies, such as cameras, command centers, and patrol vehicles, rather than less visible but more foundational systems, such as case management and data governance (Flom 2018). Surveillance infrastructure is procurable within election cycles and apparent to voters; back-office information systems are neither. Manning (2008) documents how technology adoption is shaped by organizational culture and vendor marketing rather than by evidence, a pattern confirmed by Lum, Koper, and Willis (2017).

This is not a critique of all infrastructure investment. Credible evidence supports the implementation of CCTV networks and electronic monitoring. But the absence of foundational systems and reliable and integrated information across the justice chain limits what any downstream technology can achieve.

Prerequisites for and Risks of Technology Adoption

The evidence reviewed above suggests that the effectiveness of digital technologies in Latin America and the Caribbean depends not only on the tools themselves but, as Chapters 1 and 4 emphasize, on the institutional environments in which they are deployed, and that the region's investments have not been aligned

with the highlighted challenges. These considerations point to a set of prerequisites and safeguards for implementation that should accompany technology adoption.

Implementation Prerequisites

Three prerequisites recur across the technologies reviewed in this chapter and are aligned with the three foundational areas—institutions and regulations, people, and data and infrastructure—described in Chapter 1 as needing to be strengthened for digital transformation to take place:

- *Governance, oversight, and evaluation.* Technologies should be accompanied by mechanisms to assess both their effectiveness and their correct use. This is particularly important for tools that influence enforcement, surveillance, or judicial decisions. Independent evaluation can determine whether operational improvements translate into better outcomes, while auditing, transparency, and human review can help identify errors, bias, or misuse before they become embedded in institutional practice.
- *Human capital and change management.* Introducing technology does not automatically change institutional behavior. Officials must be able to interpret new information, incorporate it into decisions, and adapt existing workflows accordingly. Training, workflow redesign, and clear assignment of decision-making responsibilities are, therefore, central to implementation.
- *Data quality and interoperability.* Many digital and analytical tools depend on administrative data, which often provide an incomplete representation of crime. In Latin America and the Caribbean, victimization surveys show that a large share of crimes are never reported (Perez-Vincent et al. 2024; Lupu et al. 2023), while official records can also suffer from misclassification and inconsistent reporting. These limitations are particularly important with respect to predictive tools, because models trained on incomplete or biased historical data may reproduce those patterns in their predictions. In terms of interoperability, many of the data-driven tools described here depend on seamless connectivity among police, courts, and correctional facilities. Institutional information technology (IT) systems in the region are often fragmented, with limited server capacity and outdated software.

Risks across the Technology Spectrum

The risks associated with technology vary according to the function of the tool. Place-based technologies, such as hotspot policing, can shift rather than reduce criminal activity. Electronic monitoring can expand formal supervision to individuals who otherwise would not have been incarcerated or monitored.

Technologies that identify or classify individuals create additional risks. Predictive systems reproduce patterns contained in historical enforcement data (Ensign et al. 2018; Lum and Isaac 2016). These risks become important when algorithmic outputs affect high-stakes decisions, such as police deployment, pretrial detention, or sentencing. Furthermore, surveillance technologies present governance risks, relying as they do on information collected from a large population of non-offenders to facilitate the detection of offenders.

As other chapters note (especially Chapter 1 and Chapter 10 on tax administration), AI-based tools add a further challenge because their complexity can make decisions more difficult to understand and contest. The evidence reviewed in this chapter remains particularly limited on whether such systems improve downstream crime or justice outcomes. Their adoption should, therefore, distinguish between predictive performance and demonstrated policy effectiveness and should be accompanied by mechanisms for transparency, auditing, human review, and independent evaluation.

In Latin America and the Caribbean, these risks are acute. As mentioned, surveys reveal little trust in judicial institutions (Lupu et al. 2023), and technologies introduced without transparency or oversight can reinforce the perception that the justice system is arbitrary. The result may be a deepening of legitimacy deficits that already depress cooperation. Although emerging regulatory frameworks signal a growing recognition that governance must accompany deployment, digital regulation is, as Chapter 4 notes, still in its infancy in terms of quantifying social harms and efficient regulatory responses to reduce them. Most countries in the region have not considered regulations to ensure algorithmic accountability in criminal justice, where the potential for social harm is high, as are the potential benefits in terms of legitimacy and trust of using explainable AI systems subject to independent review.

Policy Recommendations

This chapter shows that digital technologies can strengthen crime prevention and control, but the returns depend as much on institutional capacity as on the technology adopted. Countries in Latin America and the Caribbean can take the following evidence-based policy actions to produce benefits and lay the groundwork for further technological investment. Cutting across all of them is the broad recommendation that technological adoption should be accompanied by investments in data quality, institutional coordination, transparency, accountability, privacy, and safeguards against misuse.

Build interoperable justice information systems. Fragmented case management and limited data sharing among police, prosecutors, courts, and penitentiary systems reduce the effectiveness of nearly every other digital tool covered in this

chapter. Justice and public safety institutions should, therefore, establish end-to-end digital case management with unique person identifiers, creating linkages that allow every case to be tracked from incident report to conviction, release, or incarceration. Countries should designate or create a lead institution with authority to assign responsibilities across agencies for supplying and updating records, to administer access, and to enforce privacy and cybersecurity standards. They should also standardize data fields, identifiers, and reporting protocols across institutions and establish procedures that allow managers to monitor clearance rates, case duration, court congestion, and prison occupancy. Countries should prioritize interoperability and data quality before introducing more advanced analytical tools.

Target crime-control resources with local data. The evidence is unambiguous that policing is significantly improved through the gathering and use of local data. Police and prevention authorities should establish integrated crime-analysis and targeting units that combine spatial crime data with information on victimization and access (or lack of it) to social services to identify high-risk places and populations. Police should use these systems to concentrate hotspot patrols, CCTV, and investigative resources in high-crime areas, while prevention agencies should use them to direct interventions toward populations and places with the greatest need. Countries should maintain shared data systems so targeting decisions can be updated as local conditions change and resources can be coordinated across prevention and enforcement.

Use predictive algorithms to reduce incarceration. Excessive pretrial detention and prison overcrowding remain among the region's most costly bottlenecks. As available evidence indicates predictive tools can improve the accuracy of risk assessment, attorneys general and judiciaries should deploy predictive algorithms to support better pretrial detention decisions and identify individuals eligible for alternatives to custody. These tools should be embedded within clearly defined decision-making routines that preserve judicial and prosecutorial discretion and responsibility, with the understanding that model performance is contingent on the quality and consistency of the underlying judicial and administrative records. Implementation should be accompanied by a robust governance framework, including transparency regarding model inputs, mandatory bias testing, independent audits, and periodic rebenchmarking as data and methods evolve. For individuals assessed as low risk, authorities should expand alternatives to incarceration, such as electronic monitoring.

10

Unleashing Digital Technologies on Tax Administration

Persistent, widespread evasion, high compliance costs, and low progressivity characterize taxation in Latin America and the Caribbean. These challenges are rooted in information frictions that the region's tax administrations could overcome through the effective use of digital technologies, including artificial intelligence (AI). They could make accurate tax assessments and identify exactly the firms and individuals engaged in tax avoidance behavior. They could simplify compliance with prefilled returns, automated processes, and fewer reporting requirements. And they could use transaction-level data to support broader public objectives, including targeted transfers, better access to finance for firms, and greater market transparency. The result would be more efficient and equitable socioeconomic outcomes.

The success of the digital transformation of tax administrations, however, depends on trust in data governance, the ability of policymakers to overcome resistance from those who benefit from information asymmetries, and the removal of structural sources of information frictions, such as informality. It also depends on institutional capacities within tax administrations, including infrastructure, interoperability, enabling legal frameworks, and the capabilities needed to translate data into effective compliance strategies.

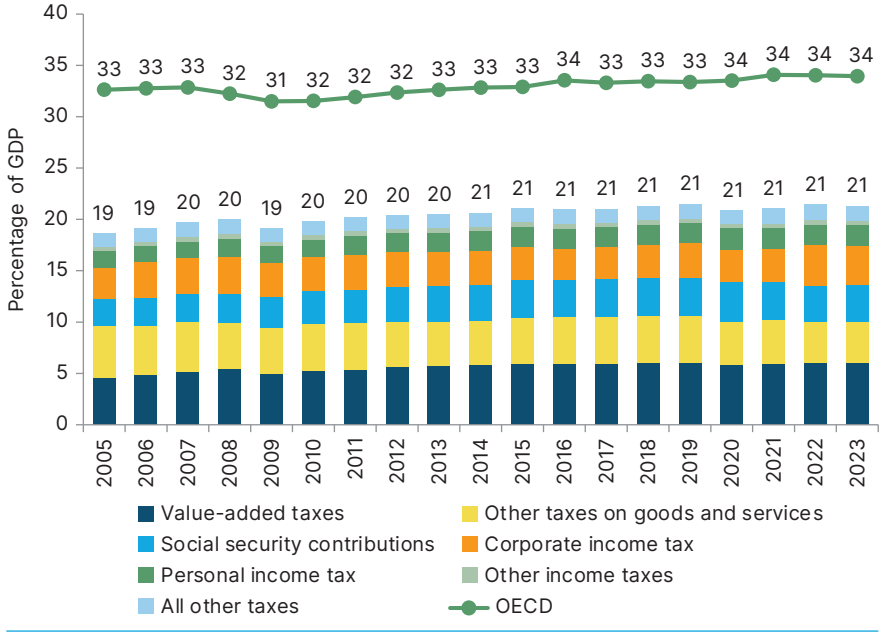
Taxation Challenges and Low Revenue

A central function of taxation is to raise sufficient and timely revenue to finance public expenditure, minimizing compliance costs and economic distortions that undermine investment, employment, and productivity (Musgrave 1959). Improving tax capacity, therefore, requires making tax systems simpler and more predictable, equitable, neutral, and administratively efficient (Beuermann et al. 2021). The effects of greater tax capacity reverberate far beyond tax collection, though. They include stronger state institutions, deeper financial markets, and faster economic growth (Baer et al. 2025).

In many Latin American and Caribbean countries, tax administrations struggle to achieve these objectives. With respect, for example, to the narrow goal of simply collecting revenues, ratios of tax to gross domestic product (GDP) remain well below those observed in the Organisation for Economic Co-operation and Development (OECD). In 2023, three-quarters of countries in the region collected less than 25 percent of GDP in taxes (see Figure 10.1). Personal income taxes yielded 2.2 percent of GDP versus 8.2 percent in the OECD (OECD et al. 2026). A more direct indicator of administrative capacity is on-time payments. In Latin America and the Caribbean, these also lag, particularly in the case of the personal income tax (see Figure 10.2).

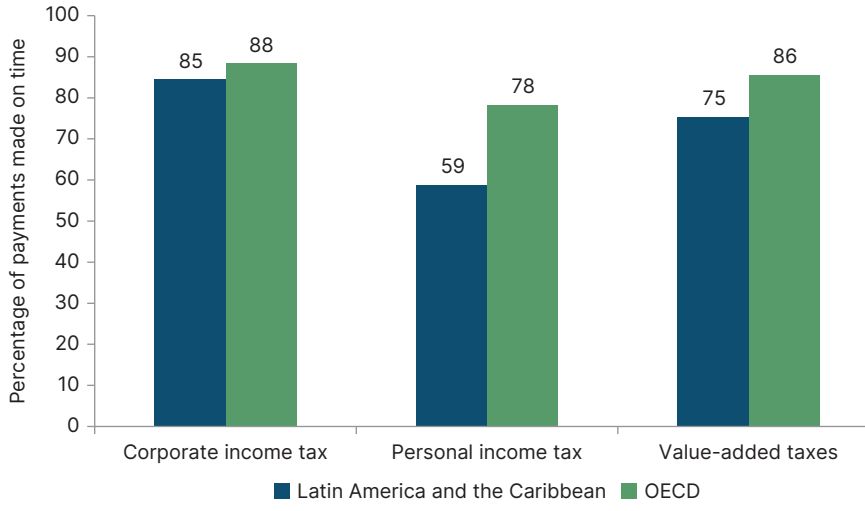
Low revenues reflect inefficiencies in both tax policy and administration. On the policy side, exemptions, preferential regimes, deductions, and rate structures narrow the effective tax base. Administrative weaknesses are manifested in underreporting, nonregistration, limited monitoring capacity within tax administrations, and the broader consequences of administrative weakness: informality

Figure 10.1. Regional Tax Burden and Revenue Composition



Source: IDB staff calculations, based on data from OECD et al. (2025).
Note: The bars in the figure show the tax burden and revenue composition for Latin America and the Caribbean; the line shows the tax burden for OECD countries. Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 26 countries. OECD excludes Latin American and Caribbean countries.

Figure 10.2. On-Time Payment Rate across Country Groups



Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 18 countries. OECD excludes Latin American and Caribbean countries.

and low tax morale, the intrinsic motivation to pay tax (Hutton 2010).[1] Even well-designed systems cannot achieve their intended yield without effective administration (Reyes-Tagle, Ruprah, and Baca Campodónico 2024). Indeed, one might say tax administration *is* tax policy.

Disentangling the respective roles of tax policy and tax administration in accounting for lower revenue collections in Latin America and the Caribbean versus in OECD countries is difficult. An alternative approach is to compare revenues countries actually collect with those they could have collected in the absence of policy and compliance distortions and then estimate the separate contributions of such distortions to the difference. Peláez Longinotti (2026) reports results from such an exercise based on revenues from value-added tax (VAT) in 18 Latin American and Caribbean countries. The study reveals that most of the difference between actual and potential VAT collections—28 percentage points—is the product of compliance distortions. The remainder, 15 percentage points, can be explained by policy distortions, such as exemptions.

[1] According to the International Monetary Fund's Revenue Administration Gap Analysis Program (RA-GAP) for the Dominican Republic (2018–23), the compliance deficit—attributable to lack of enforcement capacity and taxpayer noncompliance—is an estimated 37 to 42 percent of potential revenue. The resulting shortfall, such as the cost to tax collection of preferential tax regimes, is about 6 to 7 percent of GDP. See IMF (2025a).

Information Frictions and Revenue Shortfalls

Effective enforcement discourages evasion by increasing the perceived probability of detection, while low compliance costs and administrative burdens encourage voluntary compliance (Slemrod 2019). Both depend on overcoming three information frictions: insufficient available data, inaccurate and incomplete data, and limited capacity to integrate and analyze the data that are available. Without adequate information, tax administrations may be unable to identify who should be in the tax net, obtain a comprehensive view of taxable income and transactions, verify declarations, or transform data into effective enforcement and taxpayer services (Okunogbe and Tourek 2024; Motta Café, Yarygina, and Escalante 2024).

Deficiencies in data quality and coverage emerge because of incomplete taxpayer registries, limited third-party reporting, and inaccurate declarations (Carrillo, Pomeranz, and Singhal 2017). Even when data are available, tax administrations often lack the capacity to manage and analyze them. Fragmented data flows and weak interoperability prevent effective cross-checking across institutions and administrative functions, while limited analytical and operational capacity prevents the transformation of available data into actionable insights (Reyes-Tagle et al. 2021; Okunogbe and Tourek 2024; Jensen and Weigel 2026).

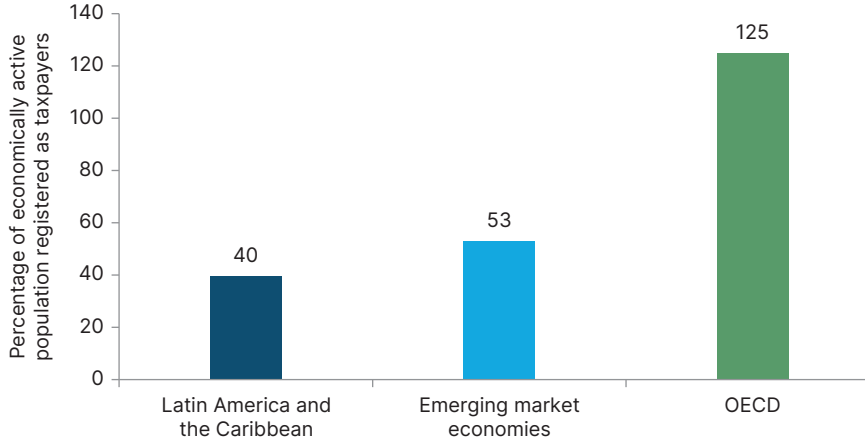
Under these circumstances, tax administrations cannot rely on taxpayer self-assessments because incentives for accurate reporting are weak, and the likelihood of evasion and underreporting increases. At the same time, poorly integrated filing systems can shift administrative costs to taxpayers through duplicative reporting requirements and the need for repeated interactions with officials (Okunogbe and Pouliquen 2022). As detailed below, all of these encourage evasion, discourage voluntary compliance, and undermine progressivity.

Tax Evasion

In 2018, tax noncompliance in Latin America and the Caribbean was an estimated 6.1 percent of GDP, including 3.8 percent from income tax evasion and 2.3 percent from evasion of value-added tax (United Nations 2020). Tax obligations are easier to evade if tax administrations lack reliable information to identify taxable bases accurately, verify declarations, and enforce compliance.

Accurate and complete tax registries, in particular, are an essential building block of tax enforcement. In Latin America and the Caribbean, however, registration data are incomplete and inaccurate. Registries contain fewer than 50 active personal income taxpayers per 100 people in the labor force—well below OECD levels and also under the average for other emerging market economies.

Figure 10.3. Active Personal Income Taxpayers across Country Groups



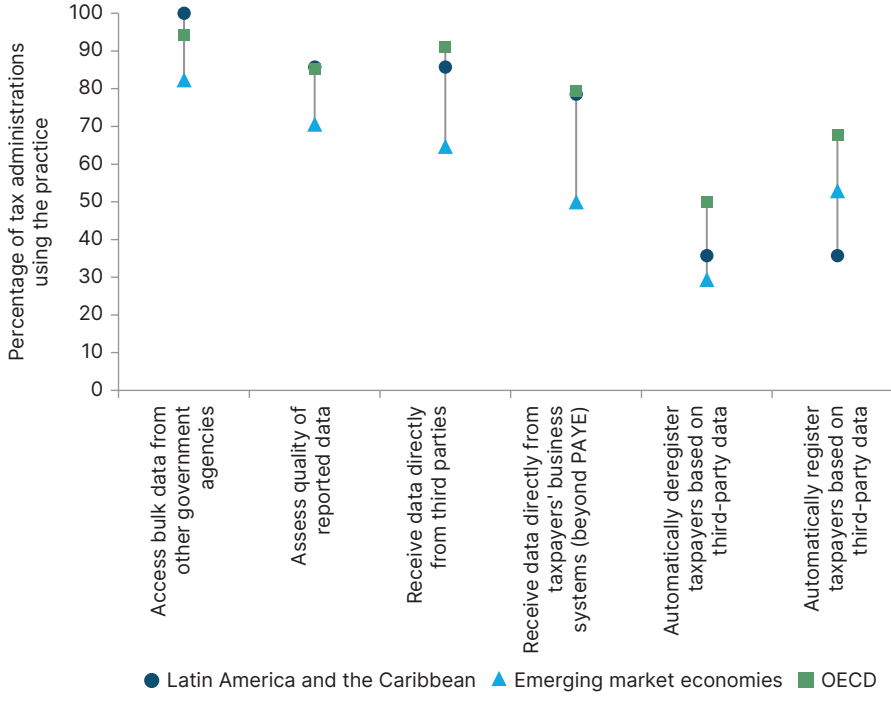
Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 23 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A). In OECD countries, values may exceed 100 because active personal income taxpayers can include individuals outside the labor force, particularly retirees, and people who register to claim tax credits or social benefits. See Crandall et al. (2026) for more details.

Incomplete or outdated registries continue to limit coverage of the personal income tax base (see Figure 10.3). Digitalization can help; electronic registration (e-registration) and electronic filing (e-filing) systems tend to improve the coverage and accuracy of taxpayer registries.

Even if digitalization facilitates the construction of tax registries with taxpayer-provided information, tax administrations must still verify the accuracy of that information, and they must rely on third-party reporting. Most tax administrations in the region report systematic practices for assessing the quality of the data they receive (86 percent, in line with the OECD), but few use third-party information to register or deregister taxpayers automatically (see Figure 10.4). Here again, digitalization can help, through electronic invoicing, digital payroll reporting, and financial information exchange, yielding structured data that allow systematic cross-checking of declarations (Bellon, Dabla-Norris, and Khalid 2023; Motta Café, Yarygina, and Escalante 2024). At the same time, interoperable platforms and automated data exchange improve information flows across institutions, and advanced analytics support risk-based audit selection and continuous compliance monitoring (OECD 2025c).

With digitalized third-party data, tax administrations can target taxpayers with low-cost enforcement and compliance interventions. In Costa Rica, for

Figure 10.4. Adoption by Tax Administrations of Selected Best Data Practices across Country Groups



Source: IDB staff calculations, based on data from the Inventory of Tax Technology Initiatives, OECD, 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on Argentina, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Paraguay, Peru, and Uruguay. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

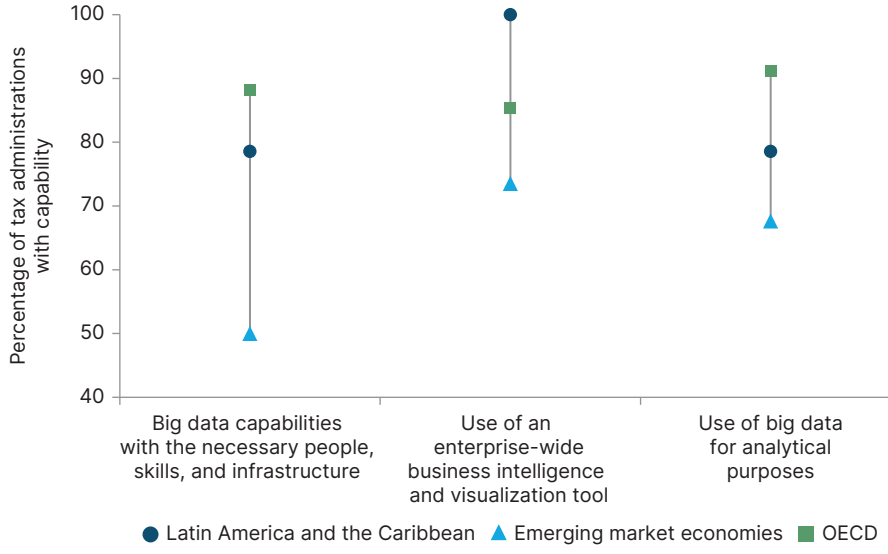
example, enforcement emails increased payment probabilities by 3.1 percentage points, rising to 3.7 percentage points when they included information about third-party transactions (Brockmeyer et al. 2019). In an experiment conducted in Colombia in 2013, emails combining information on outstanding liabilities, penalties, and payment methods increased the probability of payment by 15 percentage points and the share of arrears paid by 13 percentage points (Ortega and Scartascini 2015). Evidence from Brazil likewise shows that digital notifications of detected discrepancies produce larger reporting gains when accompanied by guidance on self-regularization—that is, on how the taxpayers can correct the discrepancies themselves (Motta Café, Yarygina, and Escalante 2024).

Legal and procedural frameworks in many countries are a significant bottleneck, not only for the digitalization of third-party reporting but in the implementation of administrative reforms, such as providing the opportunity for

self-regularization.[2] Similarly, while automating taxpayer registration and deregistration is technically straightforward, legal requirements often mandate that taxpayers formally initiate registration and complete documentary or identity verification procedures (Reyes-Tagle, Dimitropoulou, and Rodríguez Peña 2023; OECD 2025c). In some countries, the access of tax administrations to financial data is encumbered by bank secrecy provisions, deficient interagency data-sharing frameworks, or lack of interoperability between public systems (Reyes-Tagle, Dimitropoulou, and Rodríguez Peña 2023).

Finally, inadequate analytical capacity hinders the use of available data for detection purposes. As shown in Figure 10.5, Latin America and the Caribbean lags relative to the OECD in big data capabilities and in the use of big data for analytical purposes, although it is ahead in the use of enterprise-wide business intelligence tools. Because many administrations still lack advanced risk

Figure 10.5. Data Analytics Capabilities across Country Groups



Source: IDB staff calculations, based on data from the Inventory of Tax Technology Initiatives, OECD, 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on Argentina, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Paraguay, Peru, and Uruguay. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

[2] A randomized experiment by the Inter-American Development Bank (IDB) in Brazil used large-scale information cross-checking to identify discrepancies in the declarations of micro- and small firms. Auditor-assisted self-regularization increased reported monthly income by 20 percent, nearly closed the estimated evasion gap, and reduced declaration inconsistencies by 67 percent (Motta Café, Yarygina, and Escalante 2024).

segmentation tools and automated error detection systems, audits often remain manual, costly, and resource intensive. Third-party data are used mainly for ex post verification rather than integrated into continuous risk monitoring. This denies countries an opportunity to offset the high costs of audits by detecting compliance risks before evasion materializes, using data-driven risk models to prioritize cases with the highest impact on revenue and automated compliance checks and strategies to facilitate voluntary compliance in low-risk cases (OECD 2004).

Compliance Costs

Tax compliance rises with deterrence and ease of filing and payment (Bergolo, Londoño-Vélez, and Tortarolo 2023; Antinyan and Asatryan 2025). Firms in Latin America and the Caribbean, however, spend approximately 147 hours annually complying with tax requirements, compared with 98 hours spent by firms in OECD economies (World Bank 2025a).[3] Complexity of the requirements accounts for a large part of these compliance costs, but tax administrations could do more to reduce the information frictions that exacerbate them. Administrations often, for example, restrict data exchange across fragmented systems. This shifts the burden of providing information to taxpayers, who must repeatedly submit documentation, reconcile inconsistencies, and interact with the different institutions (Alm, Soled, and Thomas 2023; OECD 2022b).

In short, digitalization reduces compliance costs by automating data exchange and processing. E-filing and payment systems eliminate the need for physical submissions, while tools such as electronic invoicing, automated withholding, and expanded third-party reporting embed "compliance by design" into economic transactions (OECD 2014). By generating reliable data when activity occurs, these systems reduce the need for ex post verification and lighten administrative burdens. The use of prefilled returns based on third-party data reduces redundancy in reporting requirements and errors in reporting. Integrated digital portals can consolidate registration, filing, and payment processes within a single interface, and automated reminders and digital communication channels can support timely compliance (OECD 2025c).

Digital tools are not a panacea, however. If poorly designed or implemented, they impose large costs on firms with limited technological capacity, expanding the digital divide and perhaps discouraging formalization as well as compliance (Azmi et al. 2016).

[3] The nine Latin American countries covered by the survey are Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, and Uruguay.

Progressivity

Information frictions also stand in the way of tax system progressivity. For income taxes, the redistributive impact of statutory progressivity depends on the tax administration's ability to observe income accurately, detect avoidance strategies, and enforce compliance among higher-income taxpayers and complexly structured corporations. In practice, large firms and high-income taxpayers have access to sophisticated tax-planning and concealment strategies that increase the demands on tax administration capabilities (Chen and Lin 2017; Carrillo, Pomeranz, and Singhal 2017; Alstadsæter, Johannesen, and Zucman 2019; Guyton et al. 2023; Bustos et al. 2026). Handicapped in their efforts to monitor them by limited data sharing, fragmented registries, and the opacity of capital income, wealth, and cross-border financial flows, the administrations concentrate their enforcement efforts instead on wage earners and formal-sector firms, whose income is easier to verify through payroll reporting and withholding systems. The result is a corresponding decline in the effective progressivity of the tax system (Bergolo, Londoño-Vélez, and Tortarolo 2023).

Digitalization reduces these information frictions by expanding third-party reporting and allowing the integration and analysis of large volumes of financial, corporate, and cross-border data (Kitsios, Tovar Jalles, and Verdier 2020). The digitalization and formalization of tax laws can also enable analytical tools and AI to identify inconsistencies or loopholes that facilitate tax avoidance (Yadamsuren, Platt, and Diaz 2026; Blair-Stanek, Holzenberger, and Van Durme 2026). As always, though, their impact depends on complementary legal frameworks that provide access to relevant data, coherent tax policy that cuts down on avoidance opportunities, and institutions that can translate analytical insights into effective enforcement.

Digital tools can also improve the progressivity of indirect taxes, such as VAT, which is often considered regressive, as poorer households tend to spend a larger share of their incomes on consumption. Typically, to promote progressivity, countries reduce rates or place exemptions on the basic goods and services that make up a large fraction of poor households' consumption basket. These measures have modest effects on regressivity, however, as higher-income households receive a large share of the benefits, and those modest effects come at a high cost, as the measures significantly reduce tax revenues. A better approach is a personalized VAT, which combines a broad base and uniform rate with refunds targeted to poor households. Such an approach cannot be targeted without digitalization, however. Transaction-linked refunds, for example, require reliable consumption data, which could be provided by electronic invoicing and digital payments, as well as integrated reporting systems that link purchases to taxpayer identifiers.

IDB simulations for several Latin American countries indicate the ability of this approach to reduce inequality while preserving or increasing revenue (Barreix et al. 2022; Cavallo et al. 2022; Kotlikoff, Lagarda, and Marin 2023; Pessino et al. 2023). In Argentina, refunds are linked to debit-card purchases; Bolivia calculates them using electronic invoices; Colombian authorities use the SISBEN registry and existing transfer infrastructure to provide a fixed compensation; Ecuador requires invoices for eligible purchases; and Uruguay applies relief at the point of sale through government social cards (Rasteletti 2021; Barreix et al. 2022). A program implemented in Rio Grande do Sul in Brazil provided quarterly refunds of the state consumption tax to low-income families, while Brazil's national VAT reform has also incorporated a cashback mechanism (Barreix, Rocha, and Tostes 2025).

Digital Technologies and Taxation: The Evidence

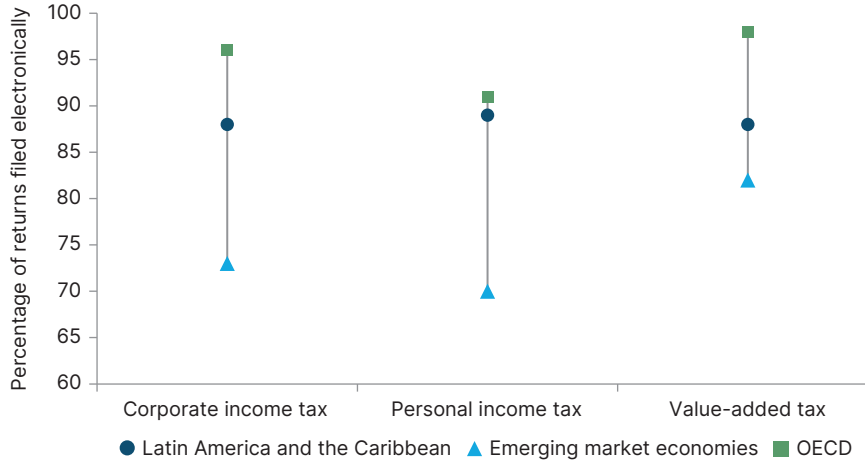
Evidence has accumulated regarding the effects of four of the most widely used digital tools: electronic filing and payment systems, electronic invoicing, prefilled returns, and, more recently, AI. Through case studies and cross-country comparisons, studies have provided largely correlational, but also some causal, evidence linking these tools to lower evasion, lower compliance costs, or greater progressivity.

E-Filing and E-Payment

Electronic filing and payment systems allow taxpayers to submit returns and pay liabilities through digital platforms, without having to visit tax offices or banks. In Latin America and the Caribbean, e-filing rates are above those found in other emerging market economies—close to 90 percent for corporate income tax, personal income tax, and VAT. For personal income tax, rates approach OECD levels (Figure 10.6). Cross-country evidence from Central Asia and Eastern Europe shows that when both e-filing and payment systems are used, the time filers need to comply with their tax obligations declines by about 8 percent in the first year, 12 percent in the second, and up to 27 percent after five years (Kochanova, Hasnain, and Larson 2020). Experimental evidence from Tajikistan similarly indicates that e-filing reduced firms' tax-compliance time by 40 percent (Okunogbe and Pouliquen 2022).

Although e-filing facilitates the collection of taxpayer-reported information, it does not necessarily improve the coverage or accuracy of that information. Hence, tax collections may not increase without broader reforms related to verification and enforcement. Evidence from Senegal shows that mandatory e-filing and payment reduced missing declaration data by over 90 percent. The effects

Figure 10.6. Global Comparison of E-Filing of Tax Returns across Country Groups



Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 18 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

on filing and payment were limited, however, because the system largely replicated paper procedures and lacked prefilling, automated checks, reminders, and stronger enforcement (Czajka, Diouf, and Santoro 2026). This experience illustrates the distinction highlighted in Chapter 1 between front-end digitalization and back-end transformation: Moving a tax form online changes the interface with the taxpayer, but realizing larger gains requires redesigning the processes and data systems behind it so information can be integrated, reused, and acted upon automatically.

Still, e-filing seems to increase compliance when it creates the perception that electronic records make evasion easier to detect. Data from Eswatini, a country in Southern Africa, indicate that, when mandatory e-filing was instituted during the COVID-19 pandemic, taxpayers were 60 percent less likely to file nil returns, reported 32 percent higher sales and 50 percent higher taxable income, and were 47 percent more likely to file on time. Higher reported income did not, however, translate into higher final tax liabilities, reflecting limits in enforcement capacity (Santoro, Amine, and Magongo 2022). More recent evidence from Eswatini finds that mandatory digital payments reduced late payments and improved payment accuracy, but the effects were heterogeneous: Companies paid more but less accurately, while individuals became more likely to pay in full (Santoro, Masuku, and Magongo 2026).

E-filing makes the biggest difference in countries with sufficient internet penetration, digital skills, and income levels. Compliance costs fall when the number of internet users exceeds 0.12 per capita, secondary enrollment surpasses 56 percent, or GDP per capita reaches roughly $2,700 in purchasing power parity (PPP; Kochanova, Hasnain, and Larson 2020). While users in Rwanda reported saving travel and queuing time through electronic filing and payment, unreliable connectivity and system congestion disrupted submissions and sometimes led to late-filing penalties. When confirmation messages failed to arrive, users of the mobile declaration service still had to visit government offices to obtain proof of filing and payment (Santoro et al. 2023). Nose and Mengistu (2023) present noncausal evidence suggesting that moving from low to high adoption of online filing is associated with an increase in nontrade tax revenues of up to 3.7 percent of GDP in countries with strong digital accessibility, administrative capacity, and investment in information and communications technology (ICT). In countries with weak digital infrastructure or limited administrative capacity, however, the association is less positive and can even be negative.

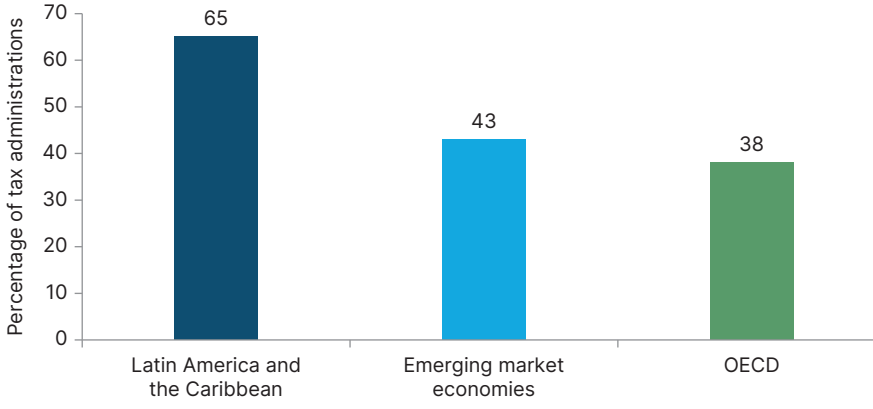
E-Invoicing

E-invoicing has expanded rapidly (Figure 10.7). It operates directly at the transaction level, with firms issuing standardized electronic invoices, often validated or cleared by the tax authority. This creates structured records of sales and purchases at the moment economic activity occurs. E-invoicing expands the tax base by capturing previously unreported transactions; improves data quality through the use of standardized formats; enables automatic matching between buyers and sellers; and provides transaction data in real or near-real time. The digital records of transactions are cross-linked across counterparties, reducing opportunities for underreporting (Barreix and Zambrano 2018; Bellon, Dabla-Norris, and Khalid 2023; OECD 2024, 2026a).

In Ecuador, firms adopting e-invoicing reported 19 percent higher VAT liabilities in 2015, rising to 28 percent in 2016 and generating approximately US$132.6 million in additional VAT revenue (Ramírez-Álvarez, Oliva, and Andino 2022). Following the staggered rollout of mandatory VAT e-invoicing in Peru, VAT payments increased by around 5 percent, after firms offset higher liabilities with accumulated VAT credits (Bellon, Dabla-Norris, and Khalid 2023).

Generating transaction data alone does not guarantee revenue gains. In Rwanda, the improved transaction "paper trail" produced by e-invoicing strengthened audit outcomes by allowing auditors to detect inflated input VAT claims more accurately. But without complementary risk-analysis systems and enforcement capacity, the impact on compliance was slight (Kotsogiannis et al. 2025). In general, without adequate ICT infrastructure, risk-based audit systems, VAT credit governance, and the capacity of tax administrations to manage large volumes of transaction-level data, e-invoicing systems yield data but not tax revenues (Barreix and Zambrano 2018).

Figure 10.7. Tax Administrations Requiring E-Invoices across Country Groups



Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 23 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

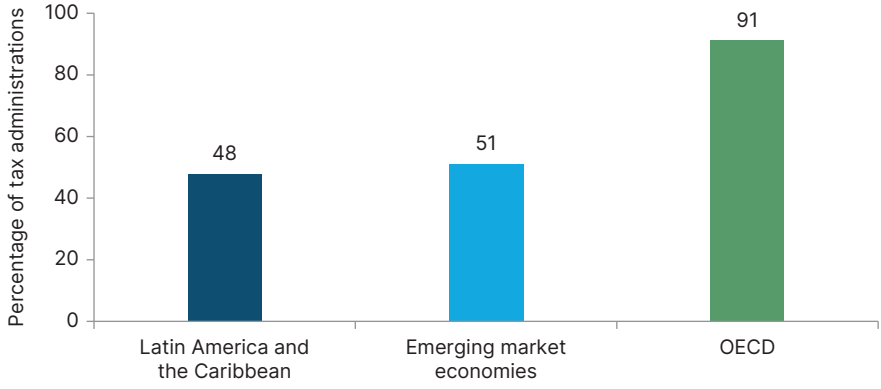
Prefilled Returns

Prefilled tax returns are declarations populated with information already available to the tax administration, such as employer payroll reports, financial institution data, or electronic invoices. Early uses of prefilling concentrated on personal income tax regimes with limited deductions and credits and access to reliable third-party information. Advances in information reporting systems, rule-based technologies, and data analytics have since extended its application to more complex tax systems (OECD 2025c). While a few countries—including Brazil, Chile, and Uruguay—have implemented prefilled systems for many personal income tax declarations, adoption across the region remains well below OECD levels and slightly below those of other emerging market economies (Figure 10.8).

Where reliable third-party information exists, prefilled returns can significantly reduce compliance costs and reporting errors. Using administrative data, Jenkins et al. (2023) estimate that, over 10 years, the net present value of savings from Chile's prefilled VAT system amounted to US$5.66 billion, of which US$1.73 billion accrued to taxpayers through reduced compliance costs and faster refunds and US$3.93 billion to the government from improved compliance and corporate income tax receipts.

Not surprisingly, however, the effectiveness of prefilled returns depends on the accuracy of the data used to prefill them. Inaccurate values signal weaknesses in administrative information systems, particularly when they underestimate liabilities. This lowers the perceived probability of detection, encouraging evasion (Van Dijk et al. 2020; Fonseca and Grimshaw 2017).

Figure 10.8. Tax Administrations Prefilling Personal Income Tax Declarations across Country Groups



Source: IDB staff calculations, based on data from the International Survey on Revenue Administration (ISORA), 2024.
Note: Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 23 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

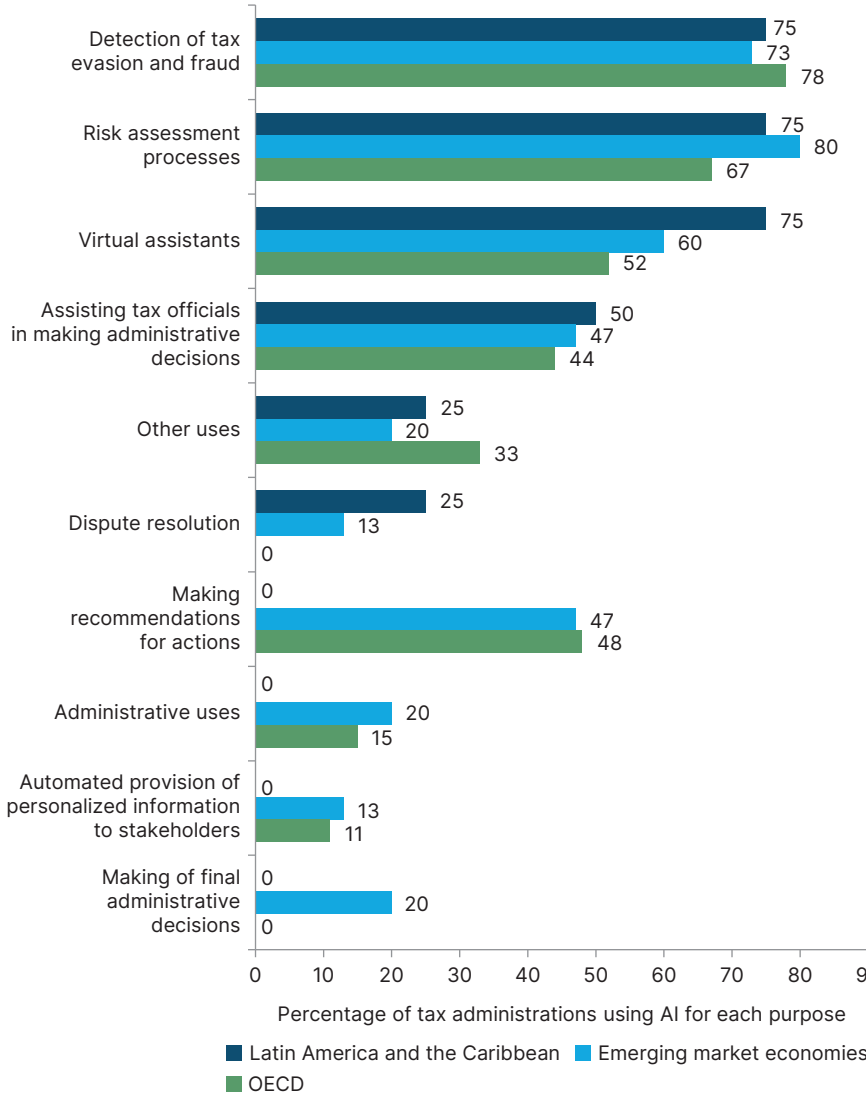
Use of Artificial Intelligence by Tax Administrations

Tax administrations increasingly employ AI and advanced data analytics to process large volumes of information and support data-driven decision making. These applications illustrate the relationship between digitalization and AI described in Chapter 1. E-filing, e-payment, and e-invoicing digitalize transactions and generate structured information; integrated data systems and prefilled returns allow that information to be reused; and AI can then extract additional value from these digital foundations through risk prediction, fraud detection, and taxpayer assistance.

According to the OECD, more than 70 percent of tax administrations report using AI tools to support at least some operational functions. Early applications have focused on rule-based systems and data analytics. More advanced machine-learning models lend themselves to fraud detection, audit selection, and taxpayer service automation (OECD 2025a). Fully automated services and integrity monitoring (a security practice that checks continuously for unauthorized modifications to data) remain limited and, in most Latin American and Caribbean countries, are often still at the pilot stage (see Figure 10.9).

AI can improve data quality and coverage by detecting inconsistencies across datasets and extracting information from unstructured sources, such as scanned documents, images, or text records. Its biggest potential, however, lies in its analytical capacity. Machine-learning algorithms can process large volumes of data, identify patterns associated with fraud or underreporting, and improve audit targeting and compliance management (OECD 2025c).

Figure 10.9. Use of Artificial Intelligence by Tax Administrations across Country Groups



Source: IDB staff calculations, based on data from the Inventory of Tax Technology Initiatives, OECD, 2024.
Note: The figure shows the percentage of tax administrations using AI for each reported purpose, among those that use AI. Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on Brazil, Colombia, Costa Rica, and Ecuador. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Ample evidence indicates machine-learning and AI tools can significantly improve the efficiency of auditing. Machine-learning models run on Italian Revenue Agency data, for example, suggest that replacing the 10 percent least

promising audits with algorithm-selected cases could increase detection of tax evasion by 39 percent and revenue recovery by 29 percent (Battaglini et al. 2025). In Brazil, machine-learning models trained on administrative and transactional data more reliably identify high-risk taxpayers. Using data from roughly 390,000 taxpayers, the AI tool reduced the pool of potentially relevant audit cases to 12.6 percent of total taxpayers and identified for prioritized scrutiny a high-risk subgroup representing around 1 percent of the original population. The models significantly improved prediction accuracy relative to baseline approaches (Pires 2024). In Mexico, Zumaya et al. (2021) analyze the application of AI tools to data from the electronic invoicing system (CFDI), covering around 80 million taxpayers and nearly 7 billion monthly invoices. Combining machine learning with network analysis, tax administrators were able to detect complex evasion schemes, such as fictitious invoicing loops. Accuracy levels exceeded 90 percent.

Although AI systems can improve the consistency, objectivity, and accuracy of enforcement decisions by reducing discretionary assessments and detecting complex evasion patterns, the decision-making processes AI uses to reach targeting conclusions are often opaque. This can raise concerns about transparency in administrative assessments, the explainability of algorithm-supported decisions, and taxpayer procedural rights, including access to information and the ability to challenge administrative actions. These concerns are attenuated when human officials remain responsible for reviewing, validating, and authorizing enforcement actions.

Concerns about due process in tax administrations' use of AI to target their enforcement actions could be resolved by adopting "explainable" AI systems, which allow taxpayers to review the reasons they were targeted. Technological constraints seem to limit the capacity of such systems, however. In an analysis of whether existing explainable AI techniques can meet Argentine legal requirements for administrative decision making, Górski et al. (2025) conclude that more interpretable models may be less accurate and that, even when generated by explainable AI systems, the explanations are often difficult for taxpayers to understand without expert support.

Moreover, while meaningful explanations are necessary for taxpayers to understand and challenge adverse decisions, excessive disclosure of operational details could make risk models easier to circumvent. AI can help compliant taxpayers interpret rules and reduce errors, but it could also help those who are more sophisticated infer detection patterns, identify loopholes, or devise aggressive tax-minimization strategies.

The laws in the region regarding explainability are also largely unsettled (Faúndez-Ugalde, Mellado-Silva, and Aldunate-Lizana 2020). At least in Chile,

however, the legal evolution is toward greater explainability. Reyes-Tagle, Dimitropoulou, and Rodríguez Peña (2023) describe a case in which a taxpayer requested access to the information used to evaluate their tax situation. The tax authority initially refused to disclose it, arguing that revealing the criteria and methodologies underlying the system could compromise the effectiveness of compliance risk management and audit selection processes. The Chilean Council for Transparency ultimately ruled in favor of disclosure.

As little evidence exists to help policymakers resolve such tradeoffs, it would be important to generate evidence on how taxpayer behavior might change if authorities are required to share more information about the AI models used to detect risk (Fratrič, Holzenberger, and Restrepo Amariles 2025). The goal for policymakers should be to introduce legal frameworks that protect taxpayer rights without requiring disclosure that materially facilitates evasion.

Another benefit of using AI in tax administration is its capacity to reduce compliance costs. Research on the Estonian Tax and Customs Board shows that AI-based language models and chatbots can help taxpayers navigate complex tax obligations by directing users to relevant guidance and explaining legal provisions in clearer language. The effectiveness of these tools, however, depends on the accuracy and continuous updating of the underlying legal information, as well as governance mechanisms ensuring transparency and the reliability of automated responses (Künnapas et al. 2025).

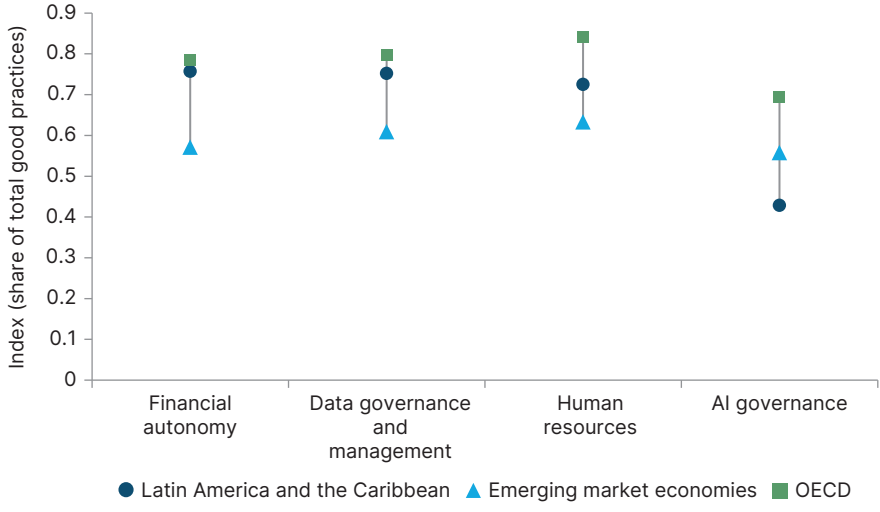
With respect to tax policy, agent-based models can identify inconsistencies and loopholes in legislation, allowing policymakers to detect policy gaps and anticipate avoidance strategies. This is only possible, however, when laws are codified in structured formats, and interdisciplinary collaboration between legal experts and data scientists enables accurate interpretation of regulatory frameworks (Fratrič, Holzenberger, and Restrepo Amariles 2025).

Complementary Factors and Where the Region Stands

Digital technologies offer important opportunities to improve tax collection in Latin America and the Caribbean. As the foregoing discussion makes clear, however, their effectiveness in reducing information frictions ultimately depends on complementary institutional, legal, and administrative conditions. This section summarizes these and compares the region with others in terms of readiness to use digital technologies in tax administration.

Figure 10.10 compares selected institutional conditions associated with digital transformation in tax administrations across Latin America and the Caribbean, emerging market economies elsewhere in the world, and OECD countries. Based on self-reported information from the International Survey on Revenue

Figure 10.10. Institutional Conditions for Digital Transformation across Country Groups



Source: IDB staff calculations, based on data from the Inventory of Tax Technology Initiatives, OECD, 2024, and the International Survey on Revenue Administration (ISORA), 2024.
Note: The indices are based on binary indicators, coded as 1 when a specific institutional practice, governance arrangement, capability, or policy is reported as present and 0 otherwise. Values represent the share of "good practices" reported within each category. The categories include (1) financial autonomy, capturing administrative and budgetary discretion, ICT expenditure, and operational flexibility; (2) data governance and management, including data management strategies, data quality assessments, cybersecurity, access controls, and data ethics frameworks; (3) human resources, covering staffing autonomy, recruitment and capability planning, and the use of specialized skills such as data science, behavioral science, and user-interface design; and (4) AI governance, including the existence of ethical frameworks, oversight mechanisms, testing procedures, and monitoring practices for AI systems. Reported values are unweighted averages across countries with available data. The estimates for Latin America and the Caribbean are based on 22 countries. OECD and emerging market economies exclude Latin American and Caribbean countries. Emerging market economies follow the International Monetary Fund classification (IMF 2025b, Table A).

Administration (ISORA)[4] and the OECD's Inventory of Tax Technology Initiatives, the figure suggests that many Latin American and Caribbean administrations report formal digital transformation strategies, governance arrangements, and data management practices at levels relatively close to those of OECD countries, although areas related to AI governance remain less developed.

These indicators mainly capture the formal existence of institutional arrangements rather than their implementation quality, operational maturity, or effectiveness in practice. Comparable cross-country evidence on these dimensions

[4] The Asian Development Bank (ADB), the Inter-American Center of Tax Administrations (CIAT), the Fiscal Affairs Department (FAD) of the IMF, the Intra-European Organisation of Tax Administrations (IOTA), and the Organisation for Economic Co-operation and Development (OECD) jointly administer the International Survey on Revenue Administration.

is unavailable, however. The preceding discussion makes clear, for example, that important deficiencies persist in interoperability, data quality, analytical capacity, operational integration, and the effective use of information for enforcement and compliance management. Compliance is disrupted and trust eroded by fragile systems—such as those unable to handle peak filing volumes—while lack of analytical capacity leaves large volumes of data underutilized (World Bank 2025b).

To address these deficiencies, access to third-party information and effective legal and governance frameworks are essential. These include legal frameworks that govern the access to and use of data by tax administrations and build public trust in how the data are used. A lack of clear legal mandates to access and require third-party information, along with poor coordination frameworks, can restrict data sharing across agencies and limit effective cross-checking (World Bank 2025b; Okunogbe and Santoro 2023). These constraints may also limit the use of digital records and automated outputs as valid evidence for tax enforcement.

Even when data are used not only for enforcement but to improve taxpayer services, insufficient safeguards for transparency, accountability, taxpayer rights, and due process can undermine trust and reduce participation in digital systems (Reyes-Tagle, Dimitropoulou, and Rodríguez Peña 2023). High levels of informality also impede the digital transformation of tax administrations, as informal firms and workers produce little data on their economic—and taxable—activities. Informality keeps large segments of economic activity outside the reach of tax authorities, inherently limiting the coverage of digital systems, while low tax morale weakens incentives for accurate reporting even in the formal economy, further reducing the impact of digitalization. As discussed in Chapter 2, this is part of a broader relationship between informality and digital transformation: Informality limits the reach and diffusion of digital technologies across the economy, while eroding the tax base that finances digital infrastructure and e-government.

Policy Recommendations

Three information frictions underlie high evasion, high compliance costs, and limited effective progressivity in Latin America and the Caribbean: incomplete and unreliable taxpayer information; fragmented and legally constrained access to data; and limited capacity to transform available data into administrative action. While digital transformation can address all of these, it will require the following four priority actions.

Build a 360-degree taxpayer view across the taxpayer life cycle. Tax administrations should expand and update registry coverage by continuously identifying individuals and businesses engaged in potentially taxable activity

but absent from the tax net. Where reliable data and legal authority permit, administrations should register them automatically; otherwise, targeted communications and assistance should encourage registration and self-regularization. This requires the authority and interagency agreements to access and link third-party and transaction-level data, including data from e-invoices, payment systems, payrolls, customs authorities, property registries, corporate and beneficial-ownership registries, and financial institutions. Common identifiers, secure interoperable interfaces, and automated cross-checks should be used to reconcile records, reveal missing or inconsistent information, and verify declarations. Dedicated technical and data-governance capabilities should be developed to enforce quality, access, privacy, and cybersecurity standards. These systems should be complemented by behaviorally informed interventions tailored to taxpayer profiles and risks, with clear reminders, guidance, and simplified corrections facilitating compliance and credible information about available third-party data, detection, and consequences deterring persistent misreporting. Together, these measures should make taxpayers and taxable income more visible, reduce evasion, strengthen effective progressivity, and lower reporting costs.

Embed compliance by design through digital tools. Tax administrations should redesign the compliance architecture by integrating e-invoicing, e-filing, e-payment, and prefilled returns into end-to-end processes that generate and reuse information throughout the compliance cycle. Jurisdictions where adoption is low should phase in these tools only after systems are tested, accessible payment channels are established, and small and medium-sized enterprises have received affordable tools and support and been granted realistic transition periods. Services should work on mobile devices and low-bandwidth connections. Administrations with established systems should link invoices and returns with customs, payroll, payments, and taxpayer registries. Returns should be prefilled with reliable third-party data and automated matching and AI tools used to identify discrepancies, fictitious invoices, abnormal VAT credits, and evasion schemes. These systems should reduce reporting costs and rates of underreporting while enforcing high-risk transactions.

Enable responsible AI deployment across tax functions. Tax administrations should establish a responsible-AI adoption program, assign clear institutional responsibility, and recruit multidisciplinary teams with tax, legal, data-science, and cybersecurity expertise. They should invest in robust technology platforms and secure environments for developing and testing AI tools and models. The teams should rank potential AI applications by expected value and risk, initially piloting initiatives related to data-quality checks, e-invoice and fraud-network matching, risk-based audit selection, prefilling, and taxpayer assistance. Administrations should not deploy AI models in enforcement until rules have been

set to define permitted data and applications, accountability for automated outputs, documentation and audit-trail requirements, accuracy testing, understandable explanations, human review, and effective appeals. They should benchmark against existing methods using predefined performance criteria. And they should scale up only those applications that improve detection, oversight of high-income individuals and complex businesses, or taxpayer services, conditional on maintaining privacy and due process.

Do not neglect the distortions embedded in tax policy. Digitalization and AI cannot compensate for the economic distortions that result from large tax expenditures, special tax regimes, and high corporate tax rates, nor the adverse effects on equity of heavy reliance on value-added taxes. As digitalization and AI make enforcement increasingly effective, governments should review whether the rules being enforced remain aligned with revenue mobilization, equity, formalization, and growth objectives and reform those that are not.

11

From Red Tape to Real Time: Digitalizing Government Transactions

From paying taxes and obtaining social benefits to renewing driver's licenses, government transactions pervade people's lives. Such transactions are not mundane; through them, citizens exercise their rights and fulfill their civic obligations. Problems in government transactions, therefore, undermine the social contract between citizens and government. If transactions impose high costs on citizens, they limit efficient and equitable access to services. Opacity and the abuse of administrative discretion breed corruption. And, of course, problematic transactions, such as those that rely excessively on manual processing, also result in elevated costs for governments.

This chapter addresses factors that increase the costs of government transactions and the extent to which digitalization can meaningfully address them—that is, the extent to which it can lower transaction burdens on individuals, vulnerability to corruption, and the costs of administering government services. It shows, however, that the adoption of digital channels across Latin America and the Caribbean has remained limited.[1] The chapter diagnoses the underlying causes of this limited take-up, distinguishing between demand and supply factors. Finally, it offers recommendations to increase take-up of digital channels and to fulfill the transformative potential of digitalization in strengthening the relationship between citizens and government.

Unlike Chapters 5 to 10 in this book, which examined digitalization in specific public sectors ranging from education and health to citizen security and taxation, this chapter looks across sectors at the transactions themselves—the concrete interactions through which individuals and firms request information from, or provide it to, government. These interactions recur in every sector discussed so far, and the same demand- and supply-side barriers to digital take-up—that

[1] This chapter uses the results of the IDB's Citizen Survey on Government Transactions and Equity, 2023–24, for 11 Latin American and Caribbean countries (Brazil, Chile, Colombia, Guatemala, Honduras, Jamaica, Panama, Paraguay, Peru, Trinidad and Tobago, and Uruguay); see Pombo et al. (2025).

is, limited connectivity and digital skills among users, low awareness of available digital channels, incomplete or poorly designed digital services, and weak coordination across government agencies—appear repeatedly, regardless of the sector. Treating transactions as a subject makes it possible to draw out these common challenges and the lessons that follow from them.

These challenges also connect directly to the broader argument developed in Chapter 1: that the productivity gains from digital technologies depend on more than adoption alone. The same principle applies to government transactions. Moving a form or procedure online can reduce some costs for users, but the largest gains arise when digital channels are combined with shared infrastructure, interoperable data, and changes in the underlying procedures and workflows by which services are delivered. As in the other, more specific sectors, digitalization can raise public-sector productivity when it moves beyond a digital front end toward deeper organizational and back-end transformation.

Why Do Government Transactions Matter?

Through government transactions, rights are exercised, policies are implemented, and obligations are fulfilled. These transactions comprise the set of requirements, steps, or actions through which individuals can demand information from, or provide information to, a public entity, with the aim of obtaining a right or fulfilling a duty. Examples include registrations, certifications and verifications, obligations, services, and permits (Roseth, Reyes, and Santiso 2018).

These requirements, steps, and actions determine who interacts with the state and how. Some procedures are universal, such as obtaining an identification document. Others are specific to certain groups, such as application for social subsidies for low-income households, tax compliance for businesses, or documentation for migrants. Some carry mandatory fees, while others are free. Low government transaction costs boost access to services and improve compliance with civic obligations, thereby fostering trust, transparency, and effective government. High transaction costs exclude people from services, increase distrust in government, and raise transaction costs for governments struggling to implement public policy.

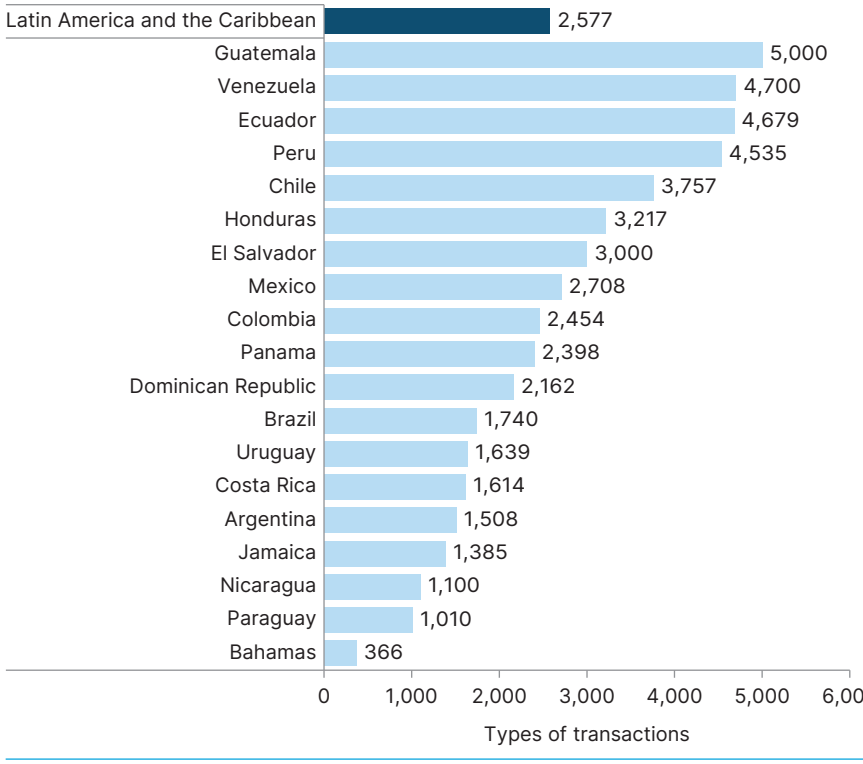
The Importance of Government Transactions

According to Douglass North (1984), transaction costs rise when transacting parties mistrust each other and are poorly informed about each other's actions. When institutions increase trust and resolve information asymmetries, they reduce uncertainty and transaction costs, increasing economic activity. Government transactions are often costly because they rely on extensive verification requirements for identity, eligibility, and compliance, creating multiple checkpoints among citizens, public employees, and supervising institutions. Mistrust prompts

governments to impose onerous rules, even though it is possible to design institutional rules that reduce transaction costs without jeopardizing transaction integrity. Governments often lack effective frameworks, however, to create such rules and instead impose excessive bureaucracy.

Figure 11.1 shows that in 2017, the central governments of most Latin American and Caribbean countries managed between 1,000 and 5,000 distinct types of transactions. In the aggregate, governments process millions of procedures per year. In 2020, for instance, Chileans conducted more than 261 million transactions with their government (Gobierno de Chile 2020), while in 2025, Mexicans conducted around 402 million.[2]

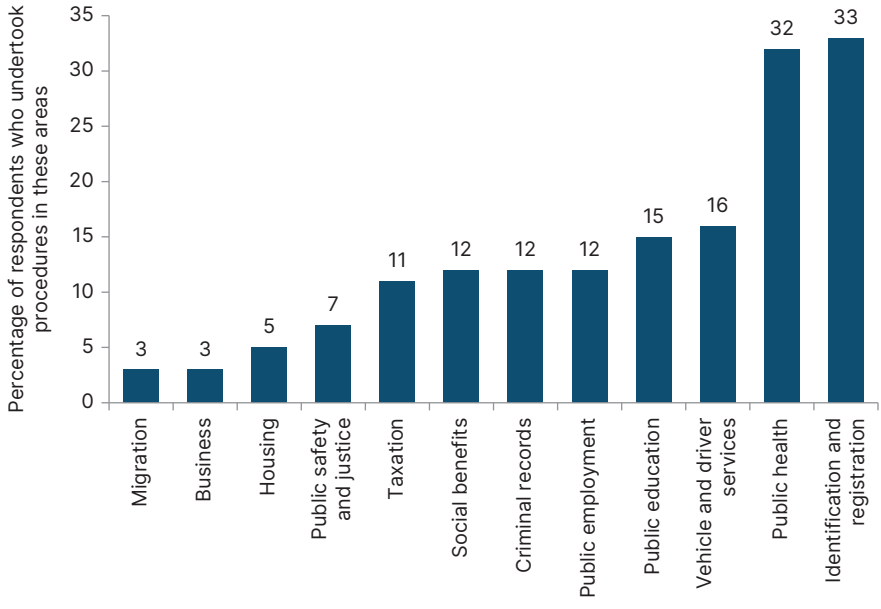
Figure 11.1. Transactions Administered by Central Governments across Countries



Source: IDB staff calculations, based on Roseth, Reyes, and Santiso (2018).
Note: The estimate for Latin America and the Caribbean is the unweighted average across the countries included.

[2] Data are from INEGI (National Institute of Statistics and Geography), Encuesta Nacional de Calidad e Impacto Gubernamental [National Survey on Government Quality and Impact], 2025.

Figure 11.2. Most Common Transactions



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: The figure shows the fraction of respondents who reported completing a procedure related to the listed areas (such as migration or business) within the 12 months preceding the survey. Reported values are unweighted averages across Brazil, Chile, Colombia, Guatemala, Honduras, Jamaica, Panama, Paraguay, Peru, Trinidad and Tobago, and Uruguay. Within each country, estimates use sampling weights for national representativeness.

The government transactions most frequently carried out in Latin America and the Caribbean are related to basic rights, such as civil registration, identification, and public health (see Figure 11.2). A central challenge for the region and its public administrations is to streamline these transactions by eliminating unnecessary steps or procedures that raise administrative costs and discourage citizens from seeking access to services.

Transaction Costs and Corruption in Public Procedures

Institutional arrangements regulate the transactions through which people gain access to government services, exercise their rights, and demonstrate compliance with civic obligations. These arrangements must balance two competing objectives: minimizing the burden procedures place on individuals while ensuring services and authorizations reach those who are eligible and not those who are not. To achieve this, governments establish rules and procedures that define how people can gain access to services, including the steps they must follow,

the information they must provide, the offices they must contact, and the requirements they must meet. By clarifying and enforcing these rules, the institutional framework helps ensure eligible individuals can apply for and receive the services to which they are entitled.

Transaction Costs and Access

The formal rules surrounding government transactions, however, can impose either small cognitive, monetary, and temporal burdens or large burdens that deter participation and suppress access. They can, for example, include modest or extravagant information requirements and interaction with one public office or many. The larger the costs relative to expected benefits, and the less information governments provide about them, the more such requirements suppress the take-up of services. When individuals easily find information about programs and eligibility, can quickly complete their applications, and can receive accurate, timely information about when and how they will receive benefits, take-up is high.

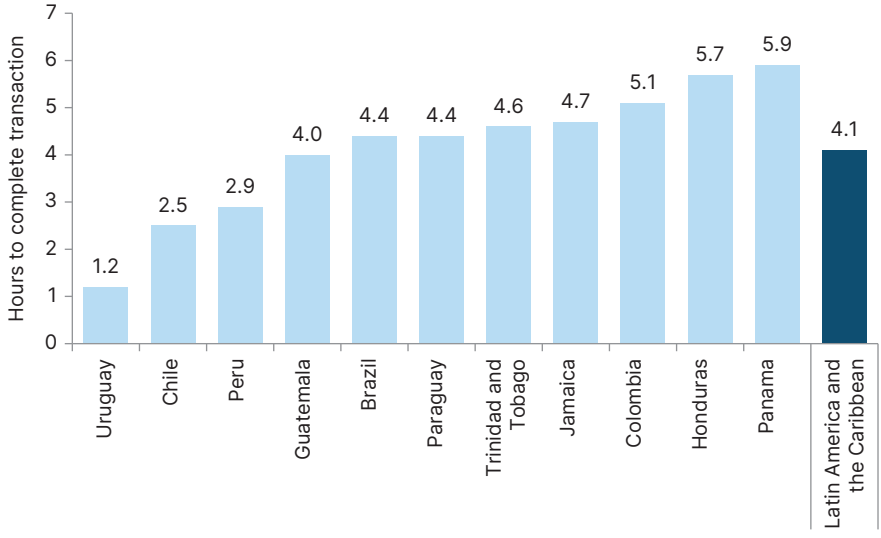
Even when each step or requirement appears to be trivial, users perceive transaction costs as cumulative and experience them as a bundle that includes travel time and expenses, compliance burdens, learning costs, and even the psychological costs associated with interacting with public officials (Masood and Azfar Nisar 2021; Moynihan, Herd, and Harvey 2015; Mohsin Ali and Altaf 2021). According to Kyle and Frakt (2021), nearly one in four nonelderly insured adults in the United States reported delaying care because of an administrative task that was required to obtain access to it.

Pombo et al. (2025) find these transactional challenges can be significant in Latin America and the Caribbean. As Figure 11.3 shows, users in the region spend an average of about four hours to complete a single transaction; the time ranges from more than five hours in Panama, Honduras, and Colombia to roughly one hour in Uruguay.

This pattern is driven by in-person transactions. On average, completing an in-person procedure in the region takes around six hours, including travel time and waiting at government offices.[3] Additionally, half of users need more than one visit to the relevant offices to complete the same procedure: 29 percent of in-person procedures require two visits, and 21 percent require three or more (Pombo et al. 2025).

[3] Traveling to and from a government office to complete a procedure can take up to an hour and 35 minutes, while waiting for service there can take about an hour and 21 minutes (Pombo et al. 2025).

Figure 11.3. Average Time to Complete Government Transactions across Countries



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: The estimate for Latin America and the Caribbean is the unweighted average across the countries included. Within each country, estimates use sampling weights for national representativeness.

Transaction Costs and Corruption

Corruption in government transactions is pervasive. According to Transparency International (2019), one in five individuals—almost 56 million people—in Latin America and the Caribbean who received public services such as water and electricity paid a bribe to secure access. But sometimes, the requirements intended to reduce corruption may be counterproductive. An analysis of nearly 25,000 survey responses in Mexico indicates that increases in the compliance and psychological costs of administrative burdens are associated with a higher likelihood of bribery (Nieto-Morales, Peeters, and Lotta 2024). This correlation may arise because burdensome requirements are introduced precisely where risks of corruption are greatest. Efforts to reduce fraud can raise transaction costs, prompting people to resort to informal approaches to gain access to services or obtain certification of their compliance with legal requirements.

Governments and programs vary widely in how they balance these competing objectives. In the United States, for example, some state Medicaid programs that have placed greater weight on preventing abuse have imposed burdensome administrative requirements that can restrict the access to benefits for eligible individuals (Moynihan, Herd, and Rigby 2016). In Ecuador, high-cost procedures

intended to reduce fraud have instead been associated with lower compliance and increased reliance on informal channels to obtain access to services (Méndez Reátegui et al. 2023).

Where digitalization comes in is by helping governments meet the objective underlying many burdensome procedures: generating and using the information they need to validate beneficiary eligibility. If governments already have such information, they can accurately identify eligible households, reducing both transaction costs and fraud. Presently, governments often ask for information with no bearing on eligibility, unnecessarily increasing transaction costs to beneficiaries. Drawing on evidence from a field experiment with the Earned Income Tax Credit program in California, Bhargava and Manoli (2015) find that merely simplifying needlessly complex program materials and processes could have increased the claiming rate from 14 to 23 percent.

On the other hand, governments may rely too heavily on insufficient information, reducing the costs of determining access or compliance at the expense of significant mistargeting. Soares, Ribas, and Osório (2007) find that in Brazil's Bolsa Família cash transfer program, authorities adopted a less precise targeting method to avoid the high cost of verifying the income of roughly 11 million households. Under this method, 59 percent of poor households were deemed ineligible to receive the benefit. At the other extreme, governments may prioritize accurate targeting and compliance even when verification is costly. Caldés and Maluccio (2005) estimate that, in Nicaragua, the pilot cash transfer program, Red de Protección Social, incurred US$0.63 in administrative costs for every US$1 transferred to beneficiaries (although this figure includes substantial upfront design, evaluation, and other fixed costs).

Digitalization can improve on these approaches by enabling governments to verify eligibility and compliance at lower cost to both governments and beneficiaries. By reducing administrative burdens, it can lower transaction costs and expand access to services. When well designed and widely adopted, digital public services can also improve government performance and strengthen the relationship between citizens and the state.

The Benefits of Digitalizing Government Transactions

Digitalization can accelerate administrative processes, broaden access to public services, and strengthen citizen participation by enabling more convenient and effective channels of interaction with government (Ibrahim et al. 2025). Compared with in-person procedures, digital channels are generally faster, less costly for users and governments, and less susceptible to corruption (Roseth, Reyes, and Santiso 2018).

Reductions in Transaction Costs for Individuals and Firms

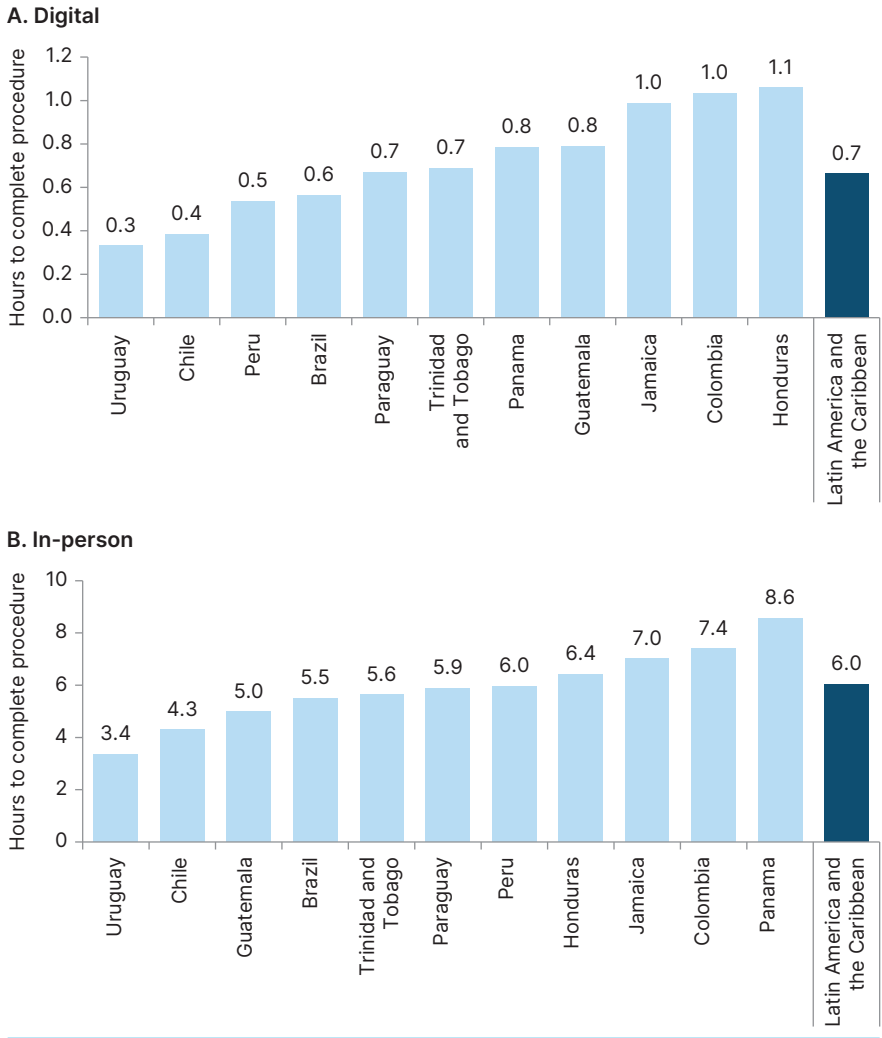
In Latin America and the Caribbean, in-person procedures can take, on average, nine times longer than digital procedures. Figure 11.4 disaggregates the data presented in Figure 11.3 to distinguish the two. According to Panel A of Figure 11.4, digital procedures in the region take an average of approximately 40 minutes, while, as Panel B shows, in-person procedures take approximately six hours. The difference varies considerably across countries, but digital procedures are consistently much faster than in-person ones.

Case studies reinforce the country-level data. Colombia introduced ¡ADenunciar!, a virtual platform to report crime. It reduced average reporting times from 90 to 40 minutes. Within 18 months of its 2017 launch, it received 17 percent of all complaints filed in the country. Consistent with the notion that lower-stakes crimes are more sensitive to reporting costs, reports of theft increased by 27 percent in the first month (National Police of Colombia 2019). In Bolivia, applicants randomly assigned to a digital identification renewal process completed the procedure 40 percent faster and were 23 percentage points more likely to complete it successfully than those assigned to the standard process (Chong, Velásquez, and Yáñez-Pagans 2022). Outside the region, in Tajikistan, experimental evidence indicates electronic tax filing reduced the time firms spent on tax-related activities by about 40 percent (Okunogbe and Pouliquen 2022). A study of tax compliance costs using cross-country evidence points in the same direction: The adoption of e-filing systems with electronic payment functionality reduced the time firms spent preparing and paying taxes by 27 percent five or more years after adoption (Kochanova, Hasnain, and Larson 2020).

Evidence from Hungary illustrates the gains from digitalization at the municipal level. Szedmák, Varga, and Szabó (2025) analyze the digital transformation of services, ranging from urban planning and municipal transportation to waste management and education, across more than 3,000 municipalities. By the end of 2022, electronic case management was 32 days faster than paper-based case management and 14 days faster than hybrid systems. An open government data initiative in 315 Chinese cities reduced overtime work by public officials by 10 percent by improving information management, reducing the number of manual tasks, and strengthening interdepartmental coordination (Wu 2026).

Firms also benefit from digitalization efforts in administrative areas other than taxation. In São Paulo, Brazil, for example, the Empreenda Fácil program streamlined and digitalized the process for registering firms engaged in low-risk activities, cutting the time required to open a business from more than 100 days

Figure 11.4. Average Time for Procedures using Digital versus In-Person Channels across Countries



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: The estimate for Latin America and the Caribbean is the unweighted average across the countries included. Within each country, estimates use sampling weights for national representativeness.

to 5 and reducing the number of in-person visits from four to one (Pizzolato Gonçalves and Venijio Maggion 2022). The Electronic Business Registration Form in Jamaica consolidated 13 forms into 1 and enabled entrepreneurs to interact with multiple agencies through a single digital window. Registration times fell from five days to one or two (Roseth, Reyes, and Yee Amézaga 2021).

Savings in Government Administrative Costs

The fiscal returns to governments of digitalization are as compelling as the reductions in transaction costs for individuals and businesses. Using digital procedures to process requests for services reduces costs to governments in Latin America and the Caribbean by 40 to 98 percent compared to in-person procedures (Pizzolato Gonçalves and Venijio Maggion 2022; Roseth, Reyes, and Santiso 2018). In São Paulo, the government's unit cost of processing public service requests fell by an average of 40 percent following the digital transformation of the services analyzed. In just the first 12 months following digitalization, the estimated savings amounted to US$27 per US$1 invested in digital transformation (Pizzolato Gonçalves and Venijio Maggion 2022).

Colombia's Ministry of Telecommunications documented similarly large savings: Digitalizing nine local government procedures reduced administrative costs by 53 to 90 percent relative to in-person delivery (MinTIC 2014). Comparative data from Australia, Mexico, Norway, and the United Kingdom indicate that in-person transactions cost the government between US$9 and US$15, compared to about US$0.50 for a digital transaction (Roseth, Reyes, and Santiso 2018).

Corruption Prevention

Digitalization can also reduce opportunities for corruption by replacing discretionary, face-to-face interactions with transparent, rule-based digital channels. Digital channels can record each step, send automatic notifications, and create auditable electronic records. In India, Karnataka's Bhoomi project placed rural property records online and thus eliminated officials' ability to solicit bribes for access to land records; the project saved an estimated 7 million farmers 1.32 million working days and Rs. 806 million in informal payments (Bertot, Jaeger, and Grimes 2010; Transparency International 2003).

These anticorruption gains can be amplified when digitalization is combined with reforms to payment and verification systems. When India's Mahatma Gandhi National Rural Employment Guarantee Scheme replaced advance payments with digital "just-in-time" disbursements, it reduced program expenditure by 24 percent, decreased the incidence of "ghost workers," and cut the personal wealth of program officials by 10 percent (Banerjee et al. 2020). The introduction of biometric smartcards for wage and pension payments reduced leakage by nine times the program's cost. Combined returns from time savings and reduced leakage reached almost ten times the program's cost. Nearly all beneficiaries (90 percent) preferred the new system (Muralidharan, Niehaus, and Sukhtankar 2016).

Finally, the anonymity of digital procedures can advance equity by reducing stigma and exposure to discriminatory treatment. This benefit may be particularly relevant for historically marginalized groups, including Indigenous peoples, Afro-descendants, people with disabilities, and victims of conflict, for whom in-person interactions with public officials can carry significant social and personal risks (Chen and Chen 2024). These benefits may not be universal, however; evidence from other settings shows that anonymization can sometimes disadvantage marginalized groups (Behaghel, Crépon, and Le Barbanchon 2015). More research is needed in the region to assess how digital procedures affect access and take-up among these populations.

Why Digital Public Services Remain Underused

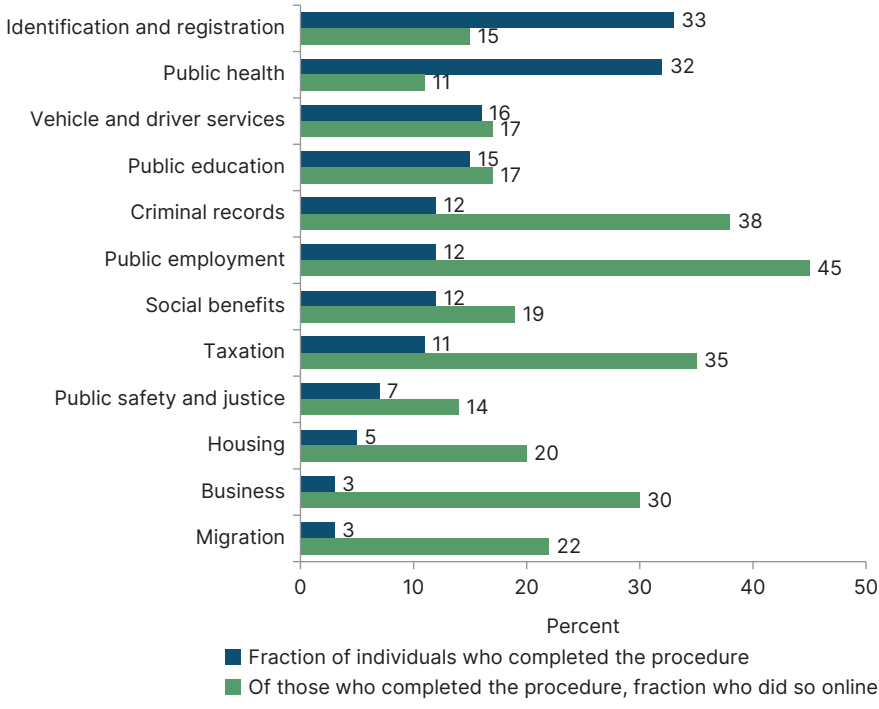
Digitalization of government transactions remains incomplete across Latin America and the Caribbean. As shown in Chapter 3, 83 percent of adults in the region use the internet, only 10 percentage points below the average for countries in the Organisation for Economic Co-operation and Development (OECD); yet just 26 percent interact with government online, compared with 70 percent in OECD countries (Global Findex Database 2025; LAPOP AmericasBarometer, 2025–26; Barbados Digital Literacy Survey, 2026; Eurostat, 2025; ITU DataHub, 2022–25). Broad internet access has, therefore, not yet translated into widespread use of digital government services.

Moreover, the savings in transaction costs and government spending are greatest when governments digitalize the services most heavily used by groups (often socially vulnerable populations) subject to the highest transaction costs, and those groups do adopt the digital channel. Yet the most frequently used government services tend to have relatively low rates of digital take-up, either because no digital option is available or because users continue to rely on in-person channels.

Figure 11.5 summarizes comprehensive survey data on citizen-reported government transactions and channel use in Latin America and the Caribbean in 2023–24 (Pombo et al. 2025). The most common transactions—identification and civil registration, reported by 33 percent of citizens, and public health–related procedures, reported by 32 percent—have relatively low digital adoption rates of 15 percent and 11 percent, respectively. By contrast, less common transactions, such as business permits and procedures, reported by just 3 percent of the population, have considerably higher digital adoption rates, at 30 percent.

On the demand side, gaps in broadband access, low digital confidence, and lack of awareness can prevent citizens from using available digital services. On the supply side, governments may fail to provide digital options or may offer services that are incomplete, unreliable, or difficult to navigate. Both sets of constraints can help explain the patterns shown in Figure 11.5.

Figure 11.5. Most Common Transactions versus Digital Channel Use



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: The figure shows the fraction of respondents who reported completing the procedure within the 12 months preceding the survey. The percentage of people who completed a given procedure digitally is the number of respondents who completed the procedure online divided by the total number of respondents who reported completing the procedure within the 12 months preceding the survey. Reported values are unweighted averages across countries. Estimates are based on the same countries as in Figure 11.2. Within each country, estimates use sampling weights for national representativeness.

Demand-Side Factors

Demand-side barriers to the use of digital public services are not evenly distributed across the population. They are often greatest among people who incur high costs when seeking access to government services through traditional channels and could, therefore, benefit most from a convenient digital alternative. The goal is not to shift everyone online, but to ensure that citizens who could benefit from digital services have the resources, skills, knowledge, and confidence to use them.

Resources and Skills to Use Digital Public Services

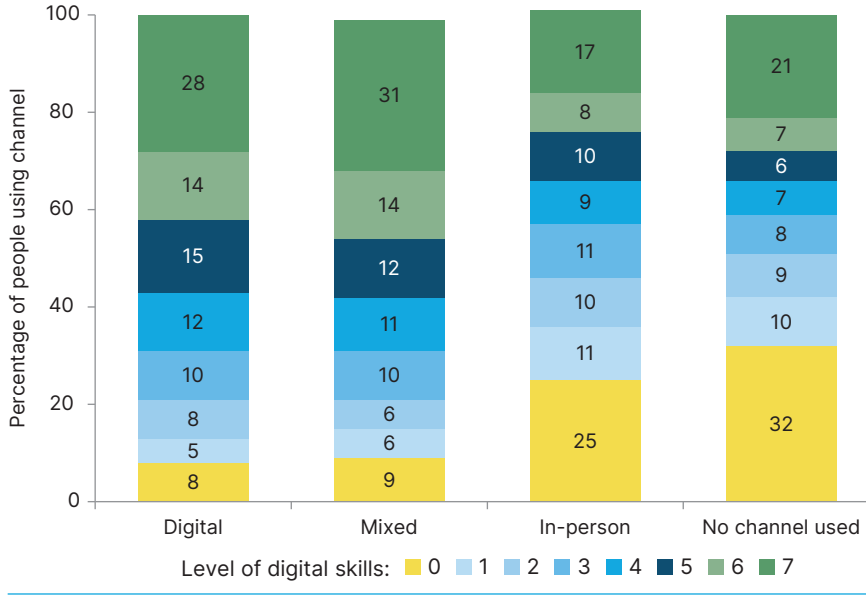
As Chapter 4 observes, factors that constrain citizen take-up of digital channels in Latin America and the Caribbean include limited connectivity; lack of appropriate

devices; weak digital skills; low trust in government and/or digital processes; and limited awareness of online options.

Most citizens in the region have access to broadband connectivity and digital devices, but for some digitalization is out of reach. Among citizens who completed their last government transaction in person in the past 12 months, only 25 percent had computers at home, compared to 54 percent of those who used digital channels.

The lack of digital skills, as well as the lack of confidence in digital skills, discourages the use of digital channels. About 20 percent of citizens in Latin America and the Caribbean report being unable to perform any of seven basic digital tasks, rising to 43 percent among older adults. Only 28 percent report a high level of confidence (Pombo et al. 2025). Figure 11.6 shows a clear association between individuals' confidence in their digital skills and their use of digital channels. Of those who used only the digital channel, more than a quarter reported the greatest confidence in their digital skills, compared to 17 percent of those who used only in-person channels.

Figure 11.6. Level of Digital Skills in the Last Procedure, by Channel Used



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: The survey asked respondents to assess their skills regarding these seven tasks: identifying keywords in internet searches, installing mobile applications, sending emails with attachments, scanning documents, modifying privacy settings on websites, identifying truthful information online, and recognizing risky information before sharing it online. The question was, "Now I am going to read you a list of activities you could carry out on the Internet. Please tell me whether or not you feel confident in your ability to perform these tasks independently with minimal difficulty, using one of the following options: confident, somewhat confident, not at all confident." Reported values are unweighted averages across countries. Estimates are based on the same countries as in Figure 11.2. Within each country, estimates use sampling weights for national representativeness.

Skills and digital confidence are, like connectivity, correlated with other characteristics that are often associated with disadvantaged groups. Skills vary across education levels, age groups, and disability conditions, for example. Digital procedures are considered difficult by 26 percent of low-education users in the region, compared with 14 percent of high-education users; by 32 percent of people with disabilities, compared with 19 percent of people without; and by 27 percent of older adults, compared with 15 percent of younger users (Pombo et al. 2025). These gaps are concerning because many programs target precisely these socially and economically vulnerable groups, who could stand to benefit most from the large-scale adoption of digital public services.

Awareness

When citizens lack access both to technology and digital skills, the potential of digitalization to reduce transaction costs, generate government savings, and reduce corruption in service delivery is significantly constrained. But even when citizens have access and skills, the widespread use of digital public services is influenced by another factor: awareness that these services exist.

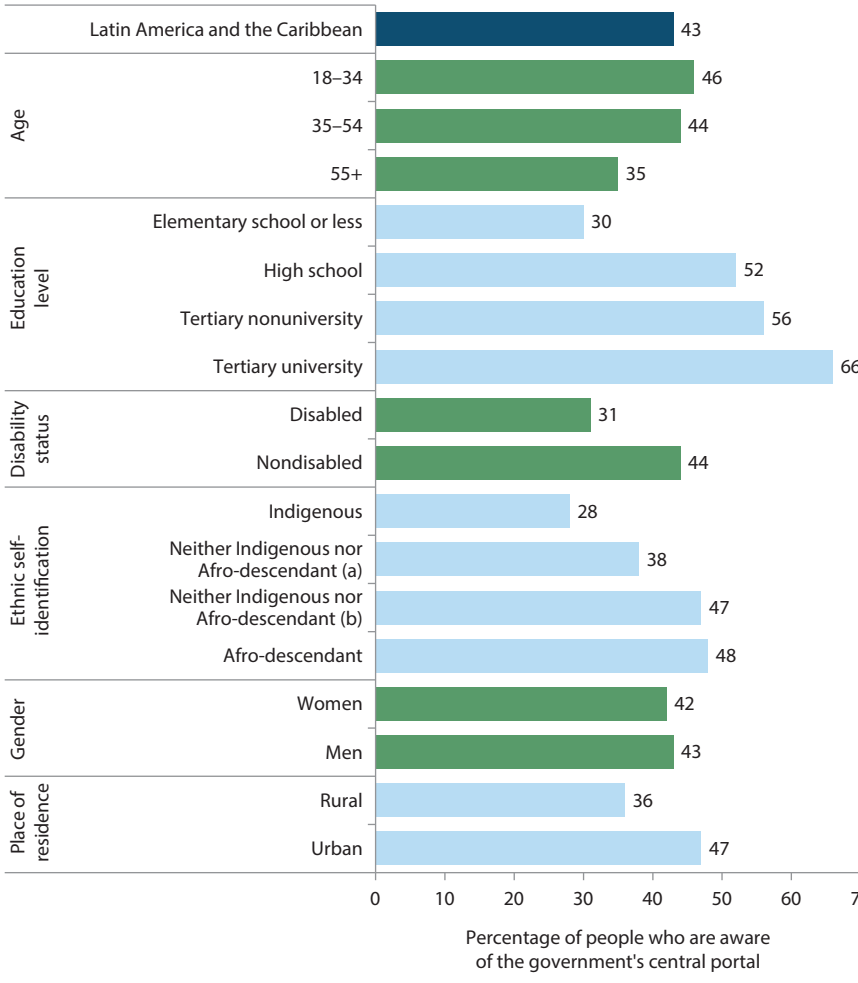
Firms and individuals typically gain access to digital services through their country's main central government portal or domain. Awareness of the portal, however, remains low among people across the region and is highly correlated with whether they report using digital channels. Only 32 percent of individuals who did not undertake a government transaction in the preceding 12 months are aware of their country's single domain; the share rises to 38 percent among in-person users of government services, 60 percent among mixed-channel users, and 65 percent among those who completed their procedure fully online (Pombo et al. 2025).

Awareness is lowest precisely among those who stand to benefit most. Only 30 percent of citizens with elementary education or less, 31 percent of people with disabilities, 35 percent of adults ages 55 or older, and 36 percent of rural residents are aware of the main central government portal, compared with 66 percent of the highly educated, 44 percent of people without disabilities, 46 percent of adults ages 18–34, and 47 percent of urban residents (see Figure 11.7).

Supply-Side Limitations

Naturally, digital adoption also depends on the quality of the services governments provide. From the supply side, the challenge is not simply to offer services online but to ensure they are reliable, widely accessible, and easy to use. User-centered design that minimizes frictions is essential if digitalization is to reduce administrative burdens and deliver meaningful efficiency gains.

Figure 11.7. Awareness of the Main Central Government Portal across Demographic Groups



Source: IDB staff calculations, based on data from the Citizen Survey on Government Transactions and Equity, 2023–24; see Pombo et al. (2025).
Note: Reported values are unweighted averages across countries. Estimates are based on the same countries as in Figure 11.2. Within each country, estimates use sampling weights for national representativeness. Two averages are presented for the non-Indigenous and non-Afro-descendant population: (a) without Brazil; and (b) without Guatemala, Honduras, and Paraguay. Because of reduced sample sizes in the surveys, Brazil is excluded from the mean of the Indigenous population, and Guatemala, Honduras, and Paraguay are excluded from the mean of the Afro-descendant population.

A basic obstacle is that not all public service procedures are available online. Many procedures are entirely offline or only partially digitalized, a situation that limits the potential benefits of digital transformation. In this regard, Table 11.1 illustrates the cases of Mexico and Brazil; for the former, few services can be initiated and completed online (except those related to taxation), whereas in the latter, almost all public services are digitalized.

Table 11.1. Available Digital Public Services in Mexico and Brazil

	Mexico			Brazil		
Type of procedure	Number of procedures	Percentage that can be started online	Percentage that can be completed online	Number of procedures	Percentage that can be started online	Percentage that can be completed online
Taxation	63	71	65	315	100	100
Public education	131	47	21	1,525	87	78
Migration	163	42	2	53	100	100
Identification and registration	30	33	13	42	100	98
Social benefits	156	28	24	158	93	87
Vehicle and driver services	29	28	28	102	94	94
Public health	171	24	6	715	82	80
Public employment	52	23	13	86	98	95
Business	333	16	15	1,391	97	94
Housing	76	16	14	83	95	93
Public safety and justice	146	2	1	425	94	89
Other	341	10	7	91	97	95

Source: Pombo et al. (2025).

Poor design also suppresses take-up. Confusing user interfaces and unresponsive servers lead individuals to give up on digital channels and seek in-person assistance. Some populations with disabilities can use only those digital services that accommodate the specific challenges they confront. Few government portals in the 20 countries included in this analysis largely comply with web accessibility standards, however; they fall short in accommodating users with visual impairments and other physical challenges, who might benefit from keyboard navigation, alternative text for screen readers, mobile-responsive layouts, or simple language that is easily understood by all (see Table 11.2).

As a result, users with visual, motor, or cognitive disabilities, as well as those with low literacy, can face barriers built into the design of digital platforms, which often assume an "average user." Addressing these barriers requires incorporating

Table 11.2. Accessibility Analysis of Latin American and Caribbean Governments' Websites

Country	Accessibility criteria										
	Simple language	Website language	Website title	Zoom 200%	Alternative text	Color	Structure and headings	Landmarks	Screen reader	Keyboard	Aggregated score (max 10)
Argentina	●	●	●	◑	●	◑	◑	◑	◑	◑	7
Barbados	●	●	○	◑	○	◑	○	◑	◑	○	4
Bolivia	●	○	◑	●	◑	◑	○	○	◑	○	4
Brazil (a)	●	●	●	◑	○	●	●	◑	◑	◑	7
Brazil (b)	●	●	●	●	○	◑	●	●	◑	○	7
Chile (c)	●	●	○	●	○	◑	◑	◑	○	○	4.5
Chile (d)	◑	●	○	○	●	◑	●	○	◑	◑	5
Colombia (e)	●	●	●	●	○	◑	○	○	◑	●	6
Colombia (f)	◑	●	●	◑	○	●	◑	○	◑	◑	5.5
Costa Rica (g)	●	○	○	●	○	◑	○	○	○	◑	3
Costa Rica (h)	●	○	○	●	○	○	○	○	◑	◑	3
Dominican Republic	●	○	●	◑	◑	◑	◑	◑	◑	◑	5.5
Ecuador	●	●	●	◑	●	◑	◑	●	●	◑	8
Guatemala	●	○	●	◑	●	◑	◑	◑	◑	◑	6
Honduras	●	○	○	◑	○	○	○	○	◑	◑	2.5
Jamaica	◑	●	○	◑	◑	◑	◑	○	○	◑	4
Mexico	●	○	◑	◑	◑	◑	◑	◑	◑	◑	5
Panama	◑	○	◑	◑	○	◑	◑	○	◑	◑	3.5
Paraguay	●	●	○	●	○	◑	◑	◑	◑	◑	5.5
Peru	●	●	●	●	–	◑	◑	◑	◑	◑	6.5
Suriname	◑	○	●	◑	◑	◑	○	○	◑	◑	4
The Bahamas	◑	○	◑	○	○	◑	○	◑	○	◑	2.5
Trinidad and Tobago	●	●	●	●	○	●	○	◑	◑	◑	6.5
Uruguay	●	●	●	◑	●	◑	◑	◑	◑	◑	7

● Fully accomplished ◑ Partially accomplished ○ Not accomplished

Source: Pombo et al. (2025), citing Pallero and Marquez (2023).
Note: (a) Services and Information of Brazil; (b) CadÚnico; (c) School Admission System; (d) National Service of Disability; (e) System for Identifying Potential Beneficiaries of Social Programs; (f) Portal of Procedures; (g) National Information System and Unified Registry of Beneficiaries; (h) Pura Vida Digital. The "-" symbol indicates the criterion could not be assessed because data were unavailable. For Peru, the aggregate score (6.5) was calculated over 9 of the 10 criteria, as "Alternative text" was not assessed.

universal design principles from the outset so that digital public services are accessible to a wider range of users.

Policy Recommendations

Digitalization can reduce the time and monetary costs of government transactions, lower administrative costs, and reduce opportunities for corruption. Realizing these gains requires deliberate changes in how governments design and deliver services. Four policy actions stand out.

Empower lead digital institutions to coordinate digitalization efforts and explore uses of artificial intelligence (AI). The digitalization of transactional services is technically demanding and has significant economies of scope, as Chapters 1 and 4 emphasize. Governments should, therefore, formally designate a digital-government institution as the lead coordinating body for service digitalization that can deploy shared infrastructure, such as a single government domain, digital identification, and interoperability platforms that let agencies exchange data without duplicating requests to citizens. Because transaction reform changes how public agencies operate, investments in technology should be accompanied by investments in organizational capacity. This institution should also monitor emerging AI uses in government transactions, such as specialized agents that help citizens get access to services, and support small-scale, well-evaluated exploration, given how limited the evidence base still is, addressing such risks as data breaches and cybersecurity vulnerabilities.

Prioritize end-to-end digital transformation of high-demand transactions using mobile-first, inclusive design. Expanding the number of services available online remains important, but putting up forms and procedures is not enough. Governments should prioritize high-demand and high-burden services and redesign them from end to end, simplifying requirements, integrating back-end data, and reusing shared digital infrastructure so citizens are not repeatedly asked for information the state already holds. Digital channels should be optimized for mobile phones and designed from the outset to be accessible to users with different levels of digital skills and connectivity.

Redesign procedures to reduce discretion and close corruption loopholes. Where transactions currently depend on case-by-case official judgment, replace discretionary steps with automated, rules-based processing wherever eligibility criteria can be clearly codified, and require digital audit trails for any remaining manual decisions. Sector ministries and anticorruption agencies should jointly identify which procedures carry the highest corruption risk and prioritize those for automation. This reduces the opportunities for the bribery and informal payments that arise when officials retain unchecked discretion over service access.

Improve in-person services for underserved populations. Many people in Latin America and the Caribbean will not be able to or will not choose to use digital channels for public services in the near term given gaps in connectivity, device access, and digital skills and awareness, along with persistent preferences for in-person or phone interactions. Governments must, therefore, maintain and strengthen nondigital delivery by drawing on global best practices, like consolidating services from multiple agencies under one roof; ensuring physical, linguistic, and cognitive accessibility; and expanding proximity through widespread service centers, mobile units, or temporary service fairs that bring the state closer to citizens.

12

Removing Barriers to the Technology Sector

Digital technologies are reshaping production, consumption, and public service delivery, with the potential to improve welfare, firm productivity, and government efficiency. Other chapters of this book examine the ways in which they do. But digital services do not emerge on their own. They are the product of firms that invest in developing solutions and bringing them to market, a process that, as Chapter 2 explains, artificial intelligence (AI) can transform. This chapter, accordingly, takes a supply-side perspective, examining the barriers standing in the way of firms that provide digital services in Latin America and the Caribbean.

Consistent with the International Monetary Fund's approach, the chapter defines digital service providers broadly to include information and communications technology (ICT) services, online platforms, and platform-enabled services, collectively referred to as the tech sector (IMF 2018).

Before proceeding, it is useful to ask why a country should seek to develop a domestic tech sector. One motivation is structural transformation. Technology-intensive sectors tend to have higher productivity and faster growth, so their expansion could raise aggregate productivity. Yet high productivity alone may not justify promoting the sector if its activities generate limited spillovers. The broader relevance of tech sectors stems from their role in expanding the technologies and services available to firms, thereby enhancing economy-wide efficiency (Acemoglu, Akcigit, and Johnson 2026).

A complementary argument concerns absorptive capacity. Local technology firms, skilled workers, and specialized providers adapt foreign technologies to local conditions. By lowering adoption costs, the adaptation helps other domestic firms—particularly those at early stages—take up these technologies (Choi and Park 2025) and speeds diffusion and digital transformation. This can, in turn, contribute to higher productivity and output (Chapter 2).

This chapter does not argue that every country should develop a large domestic tech sector or seek to replicate Silicon Valley. Policies forcing specialization have often yielded disappointing results. At the same time, consistent evidence of cross-sector spillovers clearly suggests the benefits of some domestic

technological capability. The discussion presented here is grounded in a nuanced perspective. It sees benefits for countries in cultivating targeted technological competencies that complement existing comparative advantages but does not view tech sector development as an end in itself.

Understanding the Tech Sector in Latin America and the Caribbean

To understand better the barriers encountered by suppliers of digital services, it is useful to characterize the sector both across several aggregate indicators and in terms of firm attributes.

Tech Sector Aggregate Indicators

The digital sector accounts for a smaller share of economic activity in Latin America and the Caribbean than it does in other regions. Computer programming and information services represent 3.2 percent of output in Organisation for Economic Co-operation and Development (OECD) countries (excluding Latin America and the Caribbean), compared with 1.1 percent across seven Latin American countries.[1] The share is highest in Costa Rica (2.2 percent), followed by Argentina (1.6 percent), Brazil (1.5 percent), Chile (1.3 percent), Colombia (0.8 percent), Peru (0.2 percent), and Mexico (0.1 percent).

The prevalence of digital service providers can also be assessed using Crunchbase, a platform that aggregates funding information on technology companies and startups.[2] Figure 12.1, constructed using Crunchbase data, shows digital sector firms in Panel A and the subset engaged in AI-related activities in Panel B. In both panels, most countries in the region fall below the trend line, indicating fewer digital firms than their economic size would predict.

The same data can be used to compare the prevalence of firms in subsectors such as agtech, fintech, edtech, greentech, and govtech. Relative to OECD countries, digital firms in Latin America and the Caribbean are less prevalent across all categories. The region lags in fintech (gap of 4.3 firms per million people), in edtech (5.6 firms per million people), in agtech (3.9 per million), and in greentech (2.6 per million). These deficits persist even after controlling for differences in country size and income levels.[3]

---

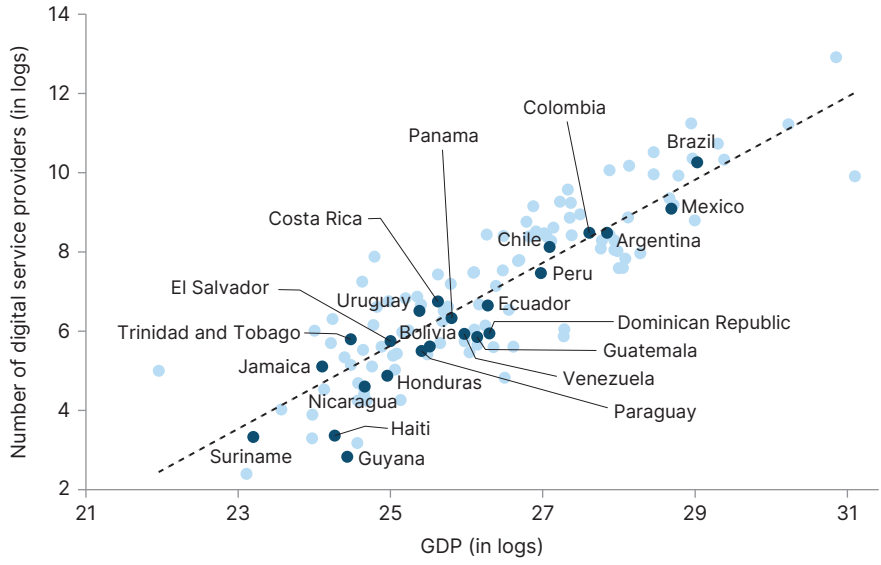
1 IDB staff calculations, based on the 2025 edition of the OECD Trade in Value Added (TiVA) dataset. Figures refer to 2022, the latest year available. Shares are calculated as sector gross output relative to total gross output. The sector comprises computer programming, consultancy, and information service activities (ISIC Rev. 4 codes 62 and 63).

2 The Crunchbase data should be interpreted with caution. The data provide an indication of the entrepreneurial ecosystem in the country rather than a comprehensive account of the full universe of firms.

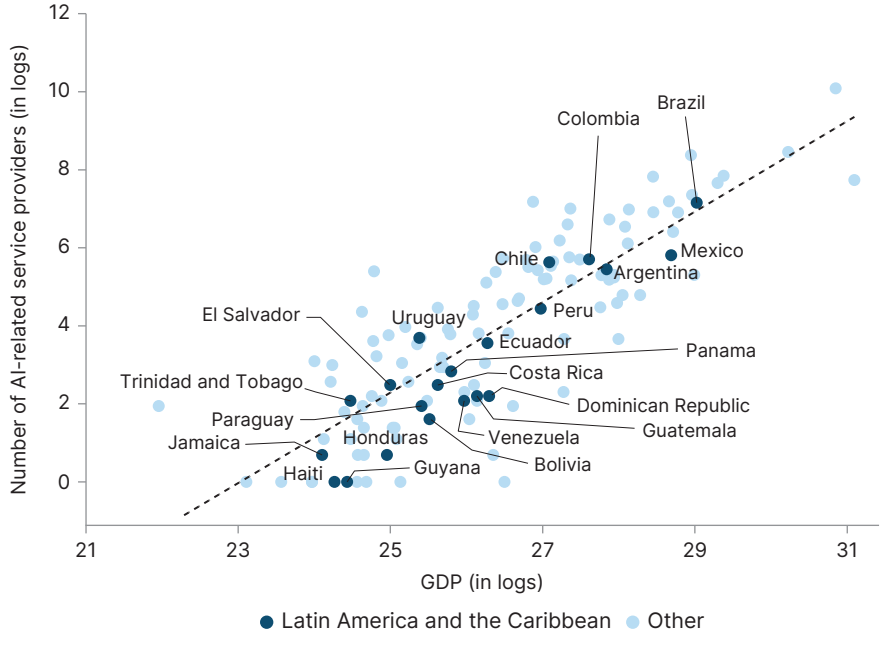
3 After controlling for GDP and GDP per capita, the difference between OECD and Latin American and Caribbean countries remains in all subsectors except govtech, where it is no longer statistically significant.

Figure 12.1. Prevalence of Digital Firms

A. Digital service providers



B. Companies providing AI-related services

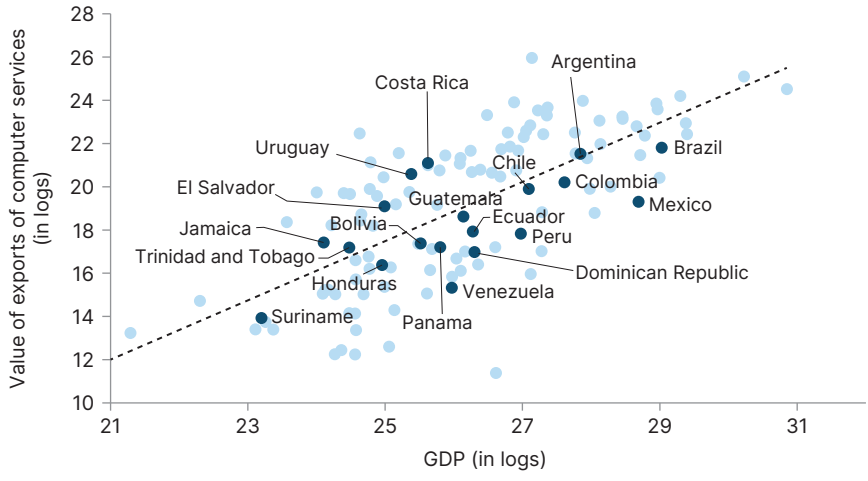


Source: IDB staff calculations, based on data from Crunchbase, 2025.
Note: The dashed lines show the linear fit. "Other" covers countries and economies outside Latin America and the Caribbean with available data. Panel A shows digital sector firms—those providing software, information technology, internet services, data and analytics, and platforms. Panel B shows the subset of firms offering AI-related solutions.

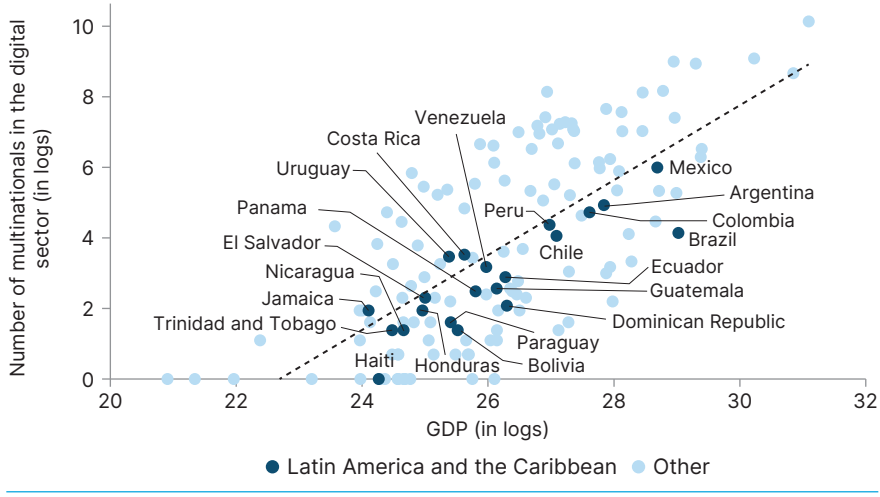
Exports of digital services and multinational presence provide two further perspectives (Figure 12.2). Most Latin American and Caribbean countries fall below the trend line in both dimensions, indicating underperformance relative to economic size.

Figure 12.2. Exports and Multinational Activity

A. Exports of computer services



B. Multinationals in the digital sector



Source: IDB staff calculations, based on data from the World Trade Organization–UN Trade and Development (WTO-UNCTAD) annual trade in services database for Panel A (2018–23) and Dun and Bradstreet for Panel B (2022).

Note: The dashed lines show the linear fit. "Other" covers countries and economies outside Latin America and the Caribbean with available data. Panel A export data correspond to computer services, averaged over 2018–23. Panel B data correspond to multinationals in 2022 in the following North American Industry Classification System (NAICS) sectors: 518 (computing infrastructure providers, data processing, web hosting, and related services) and 5415 (computer systems design and related services).

In sum, the region's digital sector is small relative to other regions across several dimensions—specifically, output share, firm counts, trade, and multinational presence.

Profile of Digital Firms

Beyond these aggregate outcome indicators, the profile of digital firms in the region should also be understood. This section examines some of the most relevant attributes of digital firms identified in the literature.

A primary characteristic of digital service providers is their reliance on research and development (R&D). The intangible products they develop require rapid updates to avoid obsolescence (Varian 2019). Because innovation is essential for competitiveness, these firms tend to be among the most R&D-intensive firms across countries (OECD 2020). A second characteristic of digital firms is the high skill level of the labor force; designing algorithms, software platforms, or machine-learning models requires deep expertise and often an advanced degree. A third characteristic is reliance on alternatives to traditional bank financing, as digital firms often lack the tangible assets required as collateral for bank loans.

The analysis that follows employs national innovation surveys to examine the extent to which digital service providers in Latin America and the Caribbean exhibit these characteristics. The analysis uses sectoral classification to separate digital service providers (referred to as "tech firms") from firms in the rest of the economy (referred to as "nontech firms").

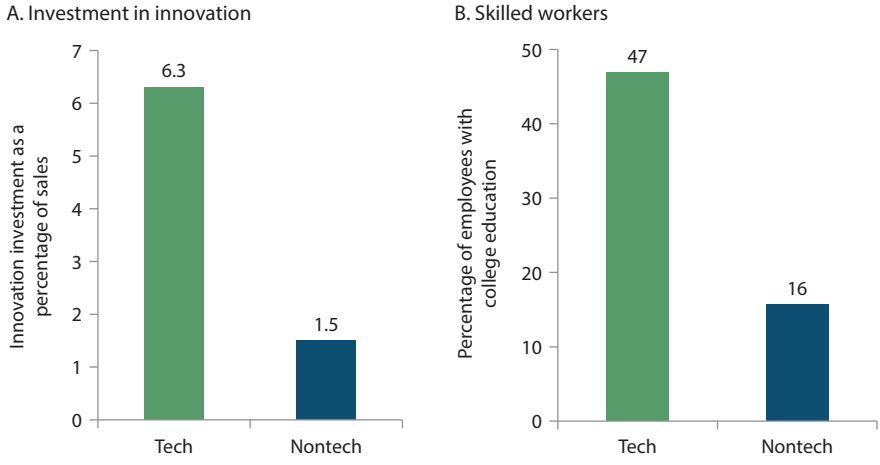
Figures 12.3 and 12.4 confirm that tech firms in the region exhibit the characteristics mentioned above.[4] They have an innovation-to-sales ratio about four times higher than nontech firms, and the share of skilled workers is also about three times greater. Regarding finance, the share of nontech firms using bank financing is more than twice that of tech firms. These differences persist after controlling for firm size and export orientation.[5]

Significant performance differences relative to firms in other regions remain, however. On innovation intensity, for example, OECD data show an average R&D-to-sales ratio of 5.3 percent among digital sector firms in 23 OECD countries outside of the region; the share for Latin American and Caribbean countries is

[4] This exercise first calculates each measure for every country and then computes the simple average across countries.

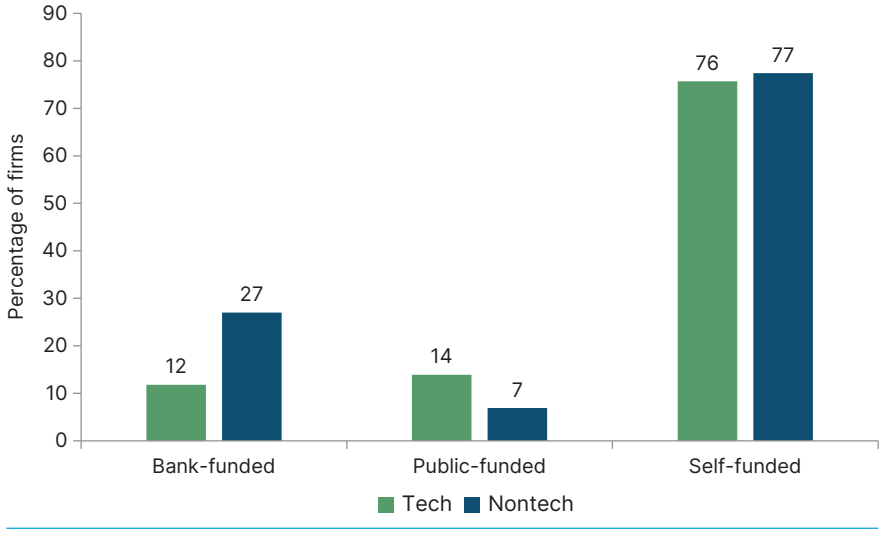
[5] Regressions controlling for firm size and export status indicate that, relative to nontech firms, tech firms have a 4.6-times higher innovation ratio, a 24-percentage-point higher share of skilled workers, and a 12-percentage-point lower probability of obtaining bank credit.

Figure 12.3. Innovation Intensity and Skill Level



Source: IDB staff calculations, based on microdata from the Harmonized Latin American Innovation Surveys Database, IDB, 2015–20 (Crespi et al. 2022).
Note: Sectoral classification is used to separate digital service providers (referred to as "tech firms") from firms in the rest of the economy (referred to as "nontech firms"). The following sectors are used as proxies for ICT firms: ISIC Rev. 4 codes 62 (computer programming, consultancy, and related activities) and 63 (information service activities). Reported values are unweighted averages across Colombia, Ecuador, Panama, Paraguay, Peru, and Uruguay.

Figure 12.4. Sources of Funding for Investment in Innovation



Source: IDB staff calculations, based on the Harmonized Latin American Innovation Surveys Database, IDB, 2015–20 (Crespi et al. 2022).
Note: Sectoral classification is used to separate digital service providers (referred to as "tech firms") from firms in the rest of the economy (referred to as "nontech firms"). The following sectors are used as proxies for ICT firms: ISIC Rev. 4 codes 62 (computer programming, consultancy, and related activities) and 63 (information service activities). Reported values are unweighted averages across Colombia, Ecuador, Panama, Paraguay, Peru, and Uruguay.

only 0.6 percent.[6] Digital firms in the region thus invest substantially less in R&D than their OECD peers.

On skilled labor, U.S. Bureau of Labor Statistics data show that high-skill workers account for 63 percent of employment in the computing services sector in the United States—16 percentage points above the share in Latin American and Caribbean countries (see Figure 12.3, Panel B).

On funding, Crunchbase data show Latin American and Caribbean companies significantly behind OECD peers. Figure 12.5 shows that digital service providers in the region raise an average of US$1.7 million per firm, compared to US$2.1 million in OECD countries and US$7.2 million in the United States. The contrast is sharper for AI-related firms. The funding gaps persist after controlling for country size and income level and are particularly pronounced for companies providing AI-related services.[7]

Barriers Faced by Digital Service Providers

The previous section shows weaker outcomes for the digital sector in Latin America and the Caribbean relative to international peers, suggesting firms in the region face barriers to growth. These barriers are explored below.

The analysis again uses national innovation survey data. Table 12.1 presents the shares of tech firms and nontech firms reporting various factors as obstacles, as well as the difference between the two shares.

The largest share of responses points to small market size as a constraint, suggesting part of the region's underperformance may stem from insufficient demand. This challenge is not unique to the digital sector, however. More revealing are the obstacles identified by a larger share of tech than nontech firms, indicated by the higher numbers in the third ("Difference") column.

The largest difference between tech and nontech firms concerns intellectual property rights. Because information-based services are costly to develop but cheap to reproduce, intellectual property protection is particularly important for tech firms to capture returns on their investments (Varian 2019). Another notable difference is the shortage of skilled human capital. Since skilled workers

[6] The analysis combines OECD data on sectoral sales and research and development investment to calculate R&D-to-sales ratios, using ISIC Rev. 4 codes 62 and 63 as a proxy for ICT firms. Countries covered are Australia, Belgium, the Czech Republic, Germany, Denmark, Estonia, Finland, France, Greece, Hungary, Israel, Italy, Korea, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Spain, Slovakia, Slovenia, and Türkiye. The figure for Latin America and the Caribbean comes from the six national innovation surveys used in Figure 12.3.

[7] After controlling for GDP and GDP per capita, average funding per company in OECD countries remains 3.4 times higher than in Latin America and the Caribbean for AI-related firms, while the gap for digital service providers falls to 0.3. Thus, funding deficits remain but are considerably larger for AI-related firms.

Figure 12.5. Average Total Funding per Company



Source: IDB staff calculations, based on data from Crunchbase, 2025.
Note: Country-group values are unweighted averages across countries with available data. OECD excludes Latin American and Caribbean countries. Panel A shows digital sector firms—those providing software, information technology, internet services, data and analytics, and platforms. Panel B shows the subset of firms offering AI-related solutions.

Table 12.1. Share of Firms Reporting Given Factor as an Obstacle to Innovation

Obstacle	Tech	Nontech	Difference
Small market size	0.647	0.676	-0.029
Lack of science, technology, and innovation policies	0.631	0.607	0.024
Lack of infrastructure	0.617	0.610	0.007
Lack of skilled human capital in the firms	0.598	0.555	0.043
Lack of internal financial resources	0.577	0.579	-0.002
Lack of external financial resources	0.526	0.499	0.027
Intellectual property rights system	0.526	0.425	0.101

Source: IDB staff calculations, based on the Harmonized Latin American Innovation Surveys Database, IDB, 2015–20 (Crespi et al. 2022).
Note: The table reports the difference between tech and nontech firms. Differences are statistically significant at the 10 percent level for lack of science, technology, and innovation policies, at the 5 percent level for lack of skilled human capital in firms and for small market size, and at the 1 percent level for lack of external financial resources and for intellectual property rights system. Sectoral classification is used to separate digital service providers (referred to as "tech firms") from firms in the rest of the economy (referred to as "nontech firms"). The following sectors are used as proxies for ICT firms: ISIC Rev. 4 codes 62 (computer programming, consultancy, and related activities) and 63 (information service activities). Reported values are unweighted averages across Colombia, Ecuador, Panama, Paraguay, Peru, and Uruguay.

represent a larger share of employment in technology, a limited pool of qualified workers poses an important constraint.

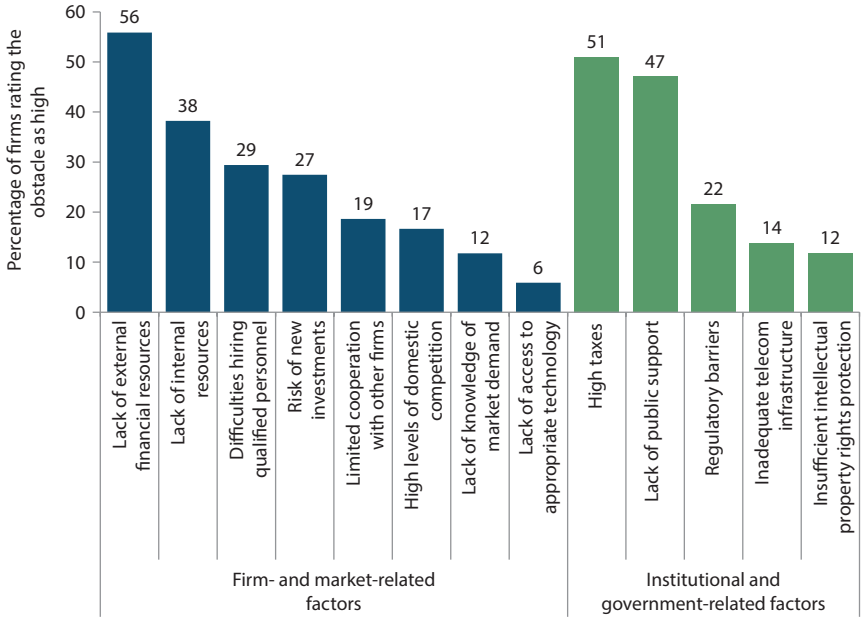
Differences are also notable for two other obstacles. The first is the lack of external financing; since digital firms' intangible assets make traditional loans difficult to secure, underdeveloped venture capital markets pose an important barrier. The second is limited public support, reflected in the lack of science, technology, and innovation policies.

An Inter-American Development Bank (IDB) survey of 102 Latin American and Caribbean tech companies from the Crunchbase sample provides complementary insights (Figure 12.6). The most cited firm-level obstacles are limited financing, insufficient internal resources, and difficulty finding qualified personnel. Among government-related factors, high taxes and lack of public support are most prominent.[8]

The factors identified as major obstacles by tech firms in the IDB survey—and as greater obstacles for tech than nontech firms in national innovation surveys—are limited access to finance, difficulty finding qualified personnel, and insufficient public support.

[8] The results are consistent with another survey, in which firms in the region also identified the lack of financing and access to venture capital as the main obstacle for startups developing AI; see Stubrin et al. (2026).

Figure 12.6. Obstacles to Growth Faced by Digital Service Providers



Source: IDB staff calculations, based on an IDB survey of tech firms drawn from Crunchbase, 2025.
Note: The sample includes 102 digital sector firms—those providing software, information technology, internet services, data and analytics, and platforms—from Latin America and the Caribbean. Reported values are unweighted averages across countries with available data.

The challenge of obtaining skilled human capital can be examined further using additional datasets. LinkedIn data on AI talent provide an indication of the scale of this constraint. These data show negative or near-zero net AI talent flows in most Latin American and Caribbean countries, but OECD countries consistently attract AI talent (see Figure 12.7, Panel A).[9] The domestic stock of advanced AI talent is also very limited, with most countries in the region showing talent concentrations well below those of their OECD peers (see Figure 12.7, Panel B).[10]

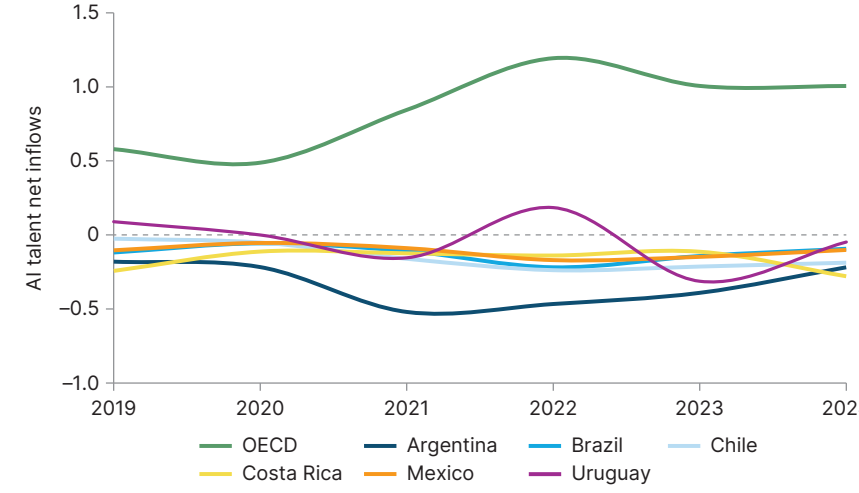
An additional barrier associated with talent scarcity is a weak local knowledge base. Knowledge-intensive firms benefit from proximity to universities, research centers, and skilled professionals (Audretsch, Lehmann, and Warning 2005; Feldman and Kogler 2010). Figure 12.8 shows that locations with greater AI research activity also tend to have more AI startups, across Latin America and the Caribbean and OECD countries (Panel A), as well as Argentinean cities (Panel B).

[9] AI talent net flows refer to the arrivals minus departures of LinkedIn members with AI skills or AI occupations in each country over a specific period, normalized by the number of LinkedIn AI members in the country at the end of the period and multiplied by 10,000.

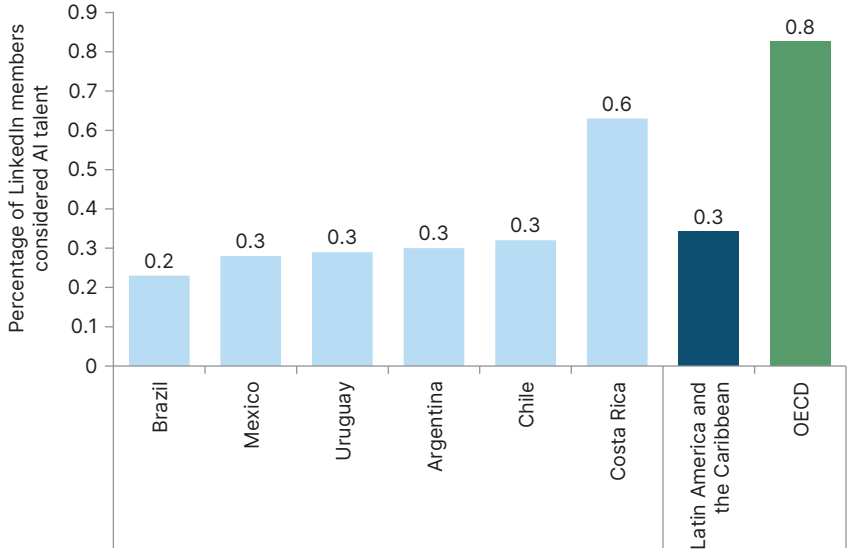
[10] AI talent concentration is calculated by dividing the counts of AI talent by the total number of LinkedIn members in a country.

Figure 12.7. AI Talent Flows and Concentration

A. AI talent net flows



B. AI talent concentration

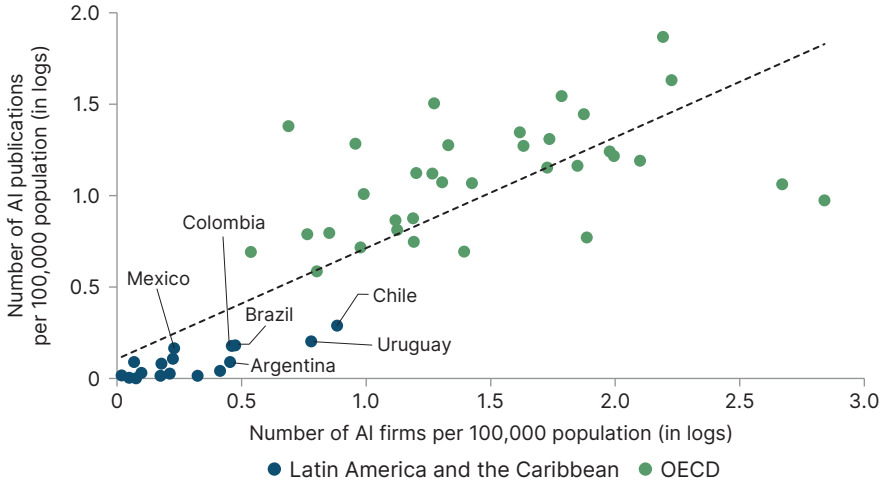


Source: IDB staff calculations, based on LinkedIn AI skills data, 2019–24, obtained through the Development Data Partnership.

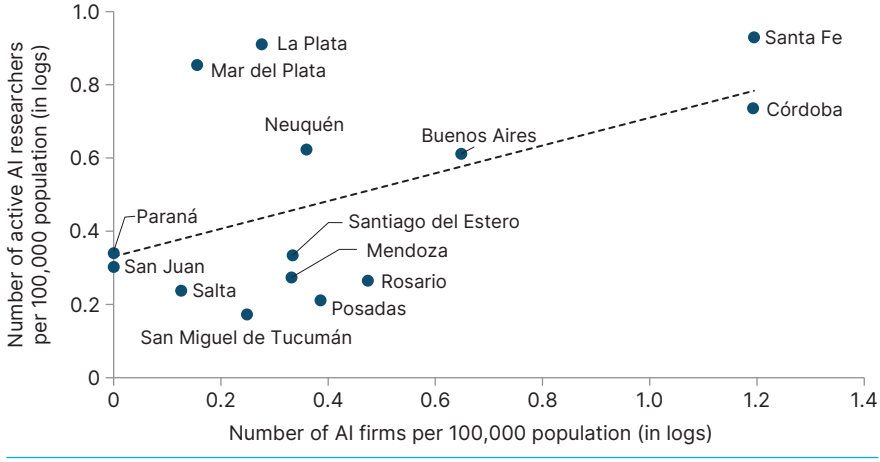
Note: Since LinkedIn data cover platform users rather than the full labor market, changes may reflect both labor market dynamics and variations in platform use, as well as coverage across sectors, occupations, and countries. Results should, therefore, be interpreted with caution. LinkedIn members are considered AI talent if they explicitly include at least two AI skills in their profiles or if they are or have been employed in AI jobs. For the definition of AI skills and methodological guidance, see Hood, Kaura, and Carpanelli (2025). Country-group values are unweighted averages across countries with available data. OECD excludes Latin American and Caribbean countries. In Panel A, AI talent net flows refer to the arrivals minus departures of LinkedIn members with AI skills or AI occupations in given countries over specific periods, normalized by the number of LinkedIn AI members in the country at the end of the period and multiplied by 10,000. In Panel B, AI talent concentration is calculated by dividing the counts of AI talent by the total number of LinkedIn members in a country at the end of 2024.

Figure 12.8. Relationship of AI Research Activity to AI Firms

A. Latin America and the Caribbean versus OECD



B. Argentinean cities



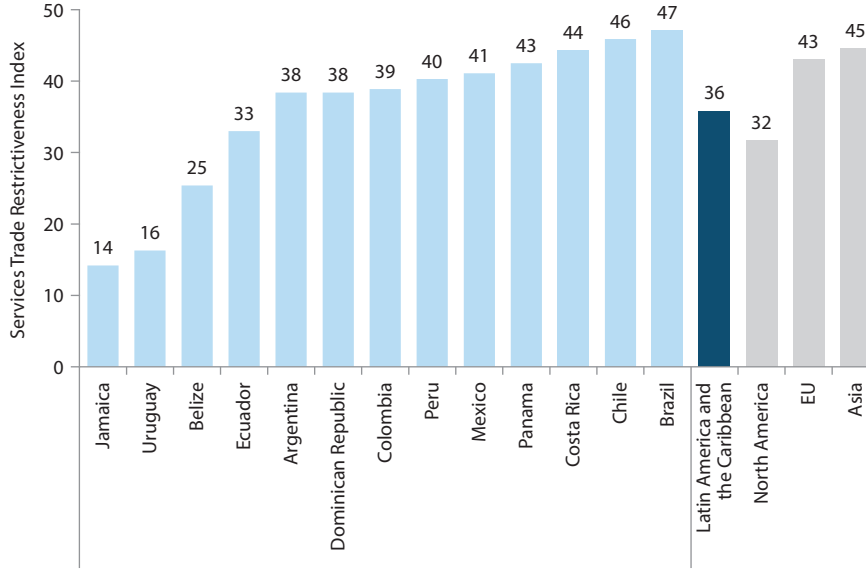
Source: IDB staff calculations, based (for Panel A) on data from Crunchbase, 2025, and the OECD.AI dataset, 2024, which combines documents from OpenAlex and Scopus; and (for Panel B) on data from Crunchbase and OpenAlex.
Note: Variables are measured per 100,000 inhabitants and expressed in natural logarithms using the transformation ln(x + 1) to retain observations with zero values. The dashed lines show the linear fit. In Panel A, each point represents a country with available data. Latin America and the Caribbean covers Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Trinidad and Tobago, and Uruguay. In Panel B, the sample includes only Argentinean cities with more than 200,000 inhabitants.

Regulatory barriers can also significantly hinder the creation and growth of digital service providers. More than 20 percent of the firms surveyed by the IDB identified this factor as a major obstacle to growth (see Figure 12.6).

Market access restrictions on foreign digital service providers reduce competition and service availability while limiting domestic firms' opportunities to learn from global competitors and raising input costs. Figure 12.9 shows these restrictions in Latin America and the Caribbean, using the Services Trade Restrictiveness Index (STRI) for computer and related services.[11] The region falls in the middle of the regional distribution, although some countries remain highly restrictive. Reducing these barriers would increase competition and diversify the supply of computer services.

Finally, a lack of public support emerges as a constraint on innovation and growth in both the national innovation surveys and the IDB survey. The next section discusses the rationale for public interventions in this sector (many of which are designed to address the obstacles identified above), proposes a framework for classifying these measures, and reviews empirical evidence on their effectiveness.

Figure 12.9. STRI in Computer Services



Source: IDB staff calculations, based on the Services Trade Policy database, the World Trade Organization's Integrated Trade Intelligence Portal (I-TIP). Data for most countries are for 2022.
Note: Country-group values are unweighted averages across countries with available data. North America refers to Canada and the United States. Asia refers to the Asia-Pacific region and encompasses the members of the Regional Comprehensive Economic Partnership (RCEP) agreement for which data are available. EU refers to European Union members.

[11] The STRI is based on the WTO I-TIP Services Trade Policy Database. It aggregates regulatory measures, scored by their level of restrictiveness, into an index.

Policy Discussion

Tech firms are subject to well-known market failures throughout the innovation process (discussed in Chapter 4). Digital services rely on knowledge that is costly to produce but easy to reproduce, creating a gap between private and social returns. Knowledge spillovers limit firms' ability to capture the benefits of R&D (Griliches 1992; Bloom, Schankerman, and Van Reenen 2013), particularly in digital sectors where technologies diffuse rapidly. These problems may be more severe in emerging economies with less mature innovation systems and weaker intellectual property protection (Stiglitz 1989; Cirera and Maloney 2017). Firms themselves identify weak intellectual property regimes as a major barrier to innovation.

A second challenge is access to finance. Digital firms rely heavily on intangible assets, which are difficult for lenders to value and create uncertainty for investors (OECD 2020; Demmou and Franco 2021). While venture capital can reduce this shortfall, it remains limited in Latin America and the Caribbean. Indeed, the innovation surveys and the IDB survey identify lack of external financing as a major barrier to growth.

A third constraint is the shortage of advanced digital skills. Firms may underinvest in training because skilled workers are highly mobile, creating human capital externalities and limiting the supply of qualified workers (Crespi et al. 2024; Rao 2015). Innovation surveys and the Crunchbase sample identify skill scarcity as a common obstacle to digital firms' growth.

Beyond firm-level factors, technology development depends on the quality of the ecosystem. The region hosts fewer digital and AI firms than its size would suggest and has weaker global linkages (Bakker et al. 2024; IDB 2024). These patterns may partly reflect coordination failures. As highlighted in Chapter 4, digital innovation requires complementary investments in broadband, data governance, and cybersecurity, whose absence can discourage investment in subsectors such as fintech, edtech, or generative AI.

Finally, scale matters. As discussed in Chapter 1, digital business models rely on network effects and economies of scale, and markets in Latin America and the Caribbean are relatively small and fragmented (ECLAC 2018). Firms' frequent identification of small market size as an obstacle reflects the difficulty they have in building the user bases needed for cost recovery and growth.

Taken together, these mechanisms suggest market forces alone may not be sufficient to generate the level of investment, experimentation, and scaling required to develop a dynamic digital sector, particularly in contexts where regulatory frameworks and supporting institutions remain incomplete or uneven. Innovation in digital services is shaped by a combination of structural externalities, intangible assets, information gaps, coordination failures, and scale economies

that influence firms' incentives across their life cycles. Thus, individual market failures may compound each other, amplifying barriers to firm entry, innovation, and scaling.

The tendency of constraints to reinforce one another suggests that isolated interventions are unlikely to be sufficient. When multiple constraints simultaneously affect firms' incentives to innovate and scale up, effective responses often require coordinated policy approaches that address several bottlenecks at once.

These conceptual insights provide a rationale for an active public role. The task of public policy is not to substitute for market processes or to "pick winners" but to correct the misaligned incentives that prevent firms from investing, innovating, and scaling up at levels consistent with their technological potential. Because constraints interact, effective responses require a combination of policy tools that reshape incentives, expand capabilities, and strengthen the operating environment.

The policy response outlined below draws on a framework developed by Crespi, Fernández-Arias, and Stein (2014). It distinguishes public goods from market-oriented instruments and horizontal from vertical measures. Horizontal public good interventions address economy-wide constraints with limited distortion risk, while vertical market interventions—subsidies or targeted tax incentives—directly affect firm profitability and require stronger institutional capacity and transparent selection criteria. For the digital sector, the notion of public goods is expanded to include nonrival digital enablers, such as data governance frameworks, cybersecurity standards, and digital identity systems, while vertical instruments are intended to target specific subsectors, such as fintech, edtech, and AI.

Using this modified framework, the available policy tools (presented below and in Table 12.2) can be connected directly to the failures highlighted in the analysis presented above:

- *Horizontal public good interventions*, such as digital governance frameworks covering data protection, cybersecurity, and intellectual property, reduce uncertainty and facilitate product development. Talent programs address skill shortages, while open platforms, such as digital identity systems, reduce fixed costs and alleviate coordination failures.
- *Horizontal market interventions* correct incentive problems at the firm level. R&D grants, innovation vouchers, and tax incentives counteract underinvestment in intangible assets, while accelerators and capability-building programs help firms overcome information asymmetries.
- *Vertical public good interventions* target specific digital subsectors. Regulatory sandboxes enable supervised experimentation where

Table 12.2. Public Policies to Promote Digital Service Providers

Type of policy	Public goods	Market interventions
Horizontal (applies across all digital firms)	National digital infrastructure (e.g., broadband backbones)	R&D tax credits that explicitly cover software and IT services
	Digital governance frameworks (e.g., intellectual property protection for software, open data, cybersecurity standards)	Competitive grants for software product development
	Talent pipelines (e.g., coding schools, advanced programs in AI)	Startup acceleration programs with funding and mentoring for digital entrepreneurs
	Open digital platforms (government application programming interfaces, or APIs, interoperability standards) accessible to firms	Seed funds or voucher schemes for early-stage digital startups
Vertical (targeted to specific digital subsectors, e.g., fintech, edtech)	Regulatory sandboxes to test new business models safely	Co-investment schemes with private venture capital in digital subsectors
	Sector-focused innovation districts or digital parks with shared labs, testing facilities, and incubators	Public procurement of innovative software solutions
	Certification and quality standards for specific industries	Export promotion tailored to digital firms (trade missions, digital market access support)

Source: IDB staff.

regulatory uncertainty is high.[12] Sectoral testbeds and domain-specific datasets provide the infrastructure to develop frontier applications in financial services, education, or health.

- *Vertical market interventions* mobilize resources toward niches where social returns are high but private incentives remain weak. Co-investment schemes involving venture capital can catalyze investment in emerging digital activities; export promotion and soft-landing programs help firms enter larger markets; and public procurement for innovation creates early demand, enabling firms to validate technologies and attract follow-on investment.

Empirical evidence on the impact of these measures remains uneven. Most rigorous evaluations focus on advanced economies and specific instruments.

[12] A good example is the UK fintech sector, where firms participating in a regulatory sandbox increased access to finance, innovation activity, and survival. These results underscore the role of regulatory clarity in supporting tech sector development (Cornelli et al. 2024).

While the evidence base is thinner for Latin America and the Caribbean, some impact evaluations offer useful insights.

In Mexico, for example, evaluations of PROSOFT (Program for the Development of the Software Industry) found positive impacts on revenues, job creation, and export readiness (Secretaría de Economía 2009), with related evidence also available for Argentina (Pereira, Barletta, and Yoguel 2016). These results highlight the role of matching grants, certification support, and cluster initiatives in addressing coordination failures and capability gaps that hold back the development of domestic tech sectors.

Evidence from entrepreneurship and accelerator programs in the region also points to the importance of combining financial support with mentoring, networks, and ecosystem services. The experience with Start-Up Chile, the Chilean government's seed accelerator, shows that structured acceleration schemes significantly increase venture fundraising and early scaling, suggesting that reducing information asymmetries and strengthening signals to investors are critical mechanisms for supporting technology-based startups (Gonzalez-Uribe and Leatherbee 2018). These results also suggest that access to finance alone is insufficient and that complementary nonfinancial inputs play a decisive role in enabling tech firms to grow.

Moreover, descriptive and program-level assessments suggest that weak foundational enablers (such as fragmented regulatory frameworks, skill shortages, and limited shared infrastructure) remain binding constraints that raise entry costs and slow scaling (OECD 2019; Crespi, Fernández-Arias, and Stein 2014).

The evidence indicates that narrowly focused programs tend to have limited impact, whereas coordinated approaches can generate larger effects by exploiting synergies across interventions. Innovation and firm growth, for example, depend on the joint presence of such complementary capabilities as access to finance, skilled human capital, knowledge infrastructure, and supportive regulatory conditions (Flanagan, Uyarra, and Laranja 2011; Cirera and Maloney 2017; Guerzoni and Raiteri 2015), which in turn require a combination of policy instruments rather than isolated interventions.

Policy Recommendations

A stronger digital sector can support innovation, technology adoption, and productivity across Latin America and the Caribbean. This does not require building a large tech sector everywhere but, rather, finding ways for digital capabilities to complement existing strengths and generate broader spillovers. Four policy actions are particularly important.

Modernize regulatory frameworks and expand market access. Governments should strengthen the regulatory frameworks that enable digital markets to

function effectively. This includes establishing balanced and predictable intellectual property frameworks that preserve incentives for innovation while facilitating knowledge diffusion, as well as implementing clear rules for data protection and cybersecurity to build trust and reduce uncertainty. Governments should also reduce unnecessary regulatory barriers that impede the entry and growth of digital firms—including foreign firms—and limit their ability to compete alongside established providers.

Support the development of digital talent and the knowledge base. Public support should be directed toward expanding digital skills where firms underinvest in training. Programs should be demand driven, designed with employers, adaptable to changing needs, and evaluated before scaling up. Governments should also strengthen advanced education and research in science, technology, engineering, and mathematics (STEM) fields, particularly in areas such as AI, and foster connections among researchers, skilled professionals, and firms to translate knowledge into new technologies and applications.

Improve access to finance and support innovation. Governments should address underinvestment in innovation and financing constraints using instruments tailored to firms' needs. R&D grants, innovation vouchers, and appropriately designed tax incentives can encourage firms to invest in innovation, while credit guarantees and other risk-sharing mechanisms can facilitate access to debt financing without replacing private lenders. For younger and higher-risk firms, seed funds, accelerators, and public–private co-investment can help mobilize equity and venture capital, particularly when combined with mentoring and other capability-building services. Public support should target financing gaps and catalyze private investment rather than substitute for market financing.

Coordinate policies to address interrelated constraints. Effective support should combine complementary instruments to address the many bottlenecks firms run into as they enter, innovate, and scale up. Policies for talent and knowledge creation should be connected with innovation financing, credit, and risk capital and aligned with appropriate regulatory frameworks and digital infrastructure. Where relevant, sector-specific instruments, such as sandboxes, testbeds, and public procurement, together with export promotion, can help firms develop new solutions and reach larger markets.

13

Firms' Adoption of Digital Technologies: Drivers and Effects

Latin America and the Caribbean faces a persistent productivity challenge. As was discussed in Chapter 2, weak long-run growth largely reflects slow growth in total factor productivity (TFP)—that is, the economy's ability to generate income from inputs—rather than systematically slower capital accumulation or labor force growth (IDBG 2025). Even accounting for sector composition, the region's average firm productivity is significantly lower than in Asia's emerging economies and roughly four times lower than in countries in the Organisation for Economic Co-operation and Development (OECD). And its TFP distribution lies markedly to the left of both groups (Figure 13.1, Panel A).

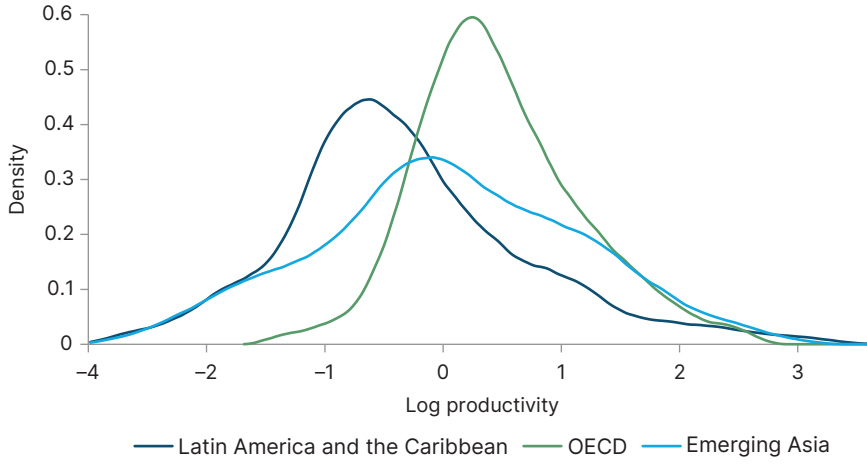
Latin American and Caribbean firms also lag their OECD counterparts in the adoption and effective use of digital technologies across the full digital chain (Cirera, Comin, and Cruz 2022). This gap persists after controlling for firm size, age, and sector. Firms in the region are less likely to maintain an online presence. They transact smaller shares of sales and payments electronically at higher costs, interact less with the public sector digitally, and use less reliable and more expensive internet infrastructure (Figure 13.1, Panel B). Alongside firms' more limited online presence, individuals in the region are also less likely to transact online than those in OECD countries, as documented in Chapter 3. And these deficits are systematically wider among smaller firms.

Against this background, this chapter presents three main messages. First, the adoption of digital technology is highly uneven across technology types (basic versus advanced), firms (small versus large), and business functions (internal functions focused on coordination versus outward-facing functions focused on innovation). Basic, less integrated technologies are more common. Larger firms tend to adopt more advanced technologies, particularly artificial intelligence (AI), for internal, scalable, and coordination functions.

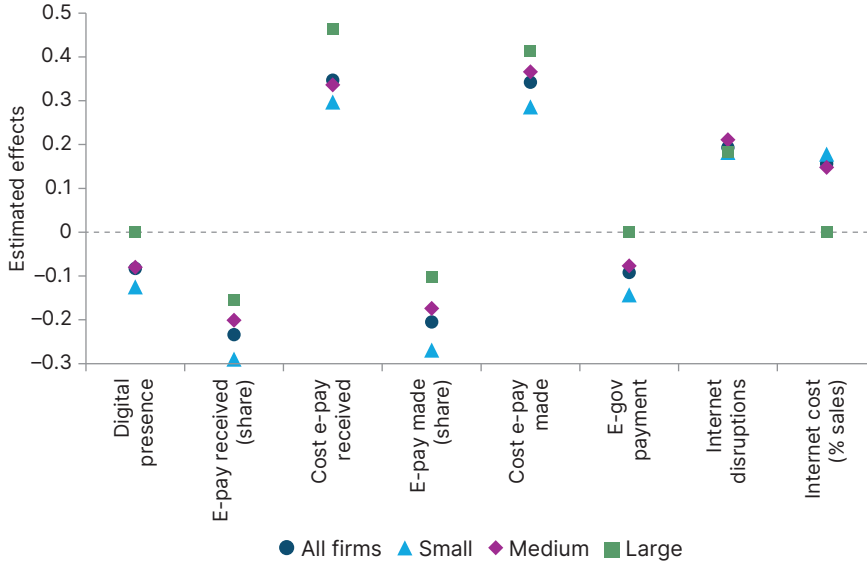
Second, digital technologies display systematic coadoption patterns. More sophisticated, data-intensive applications and AI are concentrated among firms that also use a broader set of basic technologies, while the reverse is much

Figure 13.1. Productivity and Digital Technology Adoption Gaps

A. Firm-level total factor productivity distributions



B. Latin American and Caribbean adoption gap relative to OECD



Source: IDB staff calculations, based on data from the World Bank Enterprise Surveys (WBES), 2020–26.
Note: Both panels use the most recent survey wave per relevant country, 2020–26. Panel A reports revenue-based total factor productivity (TFPR) for manufacturing firms, estimated following Francis et al. (2020). The estimate for Latin America and the Caribbean is based on Barbados, Belize, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Jamaica, Mexico, Paraguay, Peru, Suriname, Trinidad and Tobago, and Uruguay. OECD excludes Latin American and Caribbean countries. The estimate for emerging Asia covers China, Hong Kong SAR, Indonesia, Korea, Malaysia, Singapore, and Thailand. Panel B includes sector fixed effects. The reference group comprises OECD countries, excluding Latin America and the Caribbean. Results are shown separately by firm-size groups: small (fewer than 20 employees), medium (20–99), and large firms (100 or more). The "all-firms" series controls for firm age and size; size-specific series control for age only and are benchmarked against OECD firms of the same size. Standard errors are clustered at the country-year level. Effects not statistically significant at the 95 percent level are shown as zero.

less common. This pattern suggests that more advanced adoption requires firms to build capabilities cumulatively. Barriers also vary with the sophistication of firms' digital use. Entry-stage constraints (information and cost) differ from the "second-generation" barriers (data, organization, governance) that impede more sophisticated adoption.

Third, as highlighted in Chapters 1 and 4, policy should address both the enabling conditions and the firm-specific determinants of digital technology adoption and effective use, reflecting the different constraints associated with the sophistication of firms' adoption. This requires a differentiated mixture of policy instruments, including scalable entry-stage support to reduce information and cost barriers and more intensive, implementation-oriented assistance for firms capable of integrating data-intensive technologies and AI.

A New Perspective on Firms' Adoption of Digital Technologies

Digital adoption is often measured by whether firms use a particular technology, but this binary view masks important patterns. Firms vary in how broadly they deploy technologies across business functions, how intensively they use them, and how deeply they integrate them into their operations. Understanding these differences is essential for assessing their readiness to benefit from advanced applications such as AI and for explaining why digitalization translates into productivity gains for some firms more than others.

What Official Surveys Show—and What They Miss

Official firm-level surveys from Chile, Colombia, and Ecuador show that the diffusion of advanced digital technologies in Latin America and the Caribbean remains incomplete and stratified. Cloud computing—the storage of data and running of software on remote servers accessed over the internet—varies substantially. Advanced applications have diffused far less than mature digital technologies, with larger firms systematically more likely than smaller ones to use advanced tools (Gutiérrez, Gallego, and Herrera Giraldo 2025). While evidence on AI is thinner, it points in the same direction. In Colombia, AI adoption rates among large firms are up to nearly three times those among micro-, small, and medium-sized enterprises (MSMEs). About 14 percent of service firms use AI, compared with less than 7 percent of firms in manufacturing or retail (Gutiérrez, Gallego, and Herrera Giraldo 2025). These levels are low by the standards of advanced adopters but in line with early-stage technology diffusion (Rogers 1983).

Even in OECD economies outside the region, the diffusion of cloud computing, enterprise software—that is, integrated business systems that manage a firm's operations, resources, and customer relationships—analytics, and AI is incomplete (Calvino and Fontanelli 2023; Dahlke et al. 2024; Dinlersoz, Dogan,

and Zolas 2024). The relevant benchmark is not universal adoption; it is, rather, the speed and breadth at which firms move from early experimentation to systematic use.

Official adoption indicators rarely reveal the business functions for which firms use AI, whether they rely on standardized or customized tools, how intensively they use them, or how technologies are combined. This matters because the productivity effects of digitalization depend not on whether a technology is present but on how deeply it is embedded in workflows and organizational routines.

How Digitally Engaged Firms Use Digital Tools and AI

To complement official sources, this analysis uses a detailed survey on digitalization and AI adoption conducted through ConnectAmericas, an online business platform created by the Inter-American Development Bank (IDB). An important caveat is that ConnectAmericas' membership is not representative of the region's firm population. Members tend to be larger, more digitally connected, and more likely to be engaged in cross-border trade than the typical firm.[1] The evidence should be read as characterizing the digitalization experience of these firms.[2]

On average, about 48 percent of firms report their core business functions as predominantly digital, but this masks three dimensions of unevenness. First, breadth varies. Approximately 67 percent have digitalized at least one business function, but only around 22 percent have digitalized all functions.

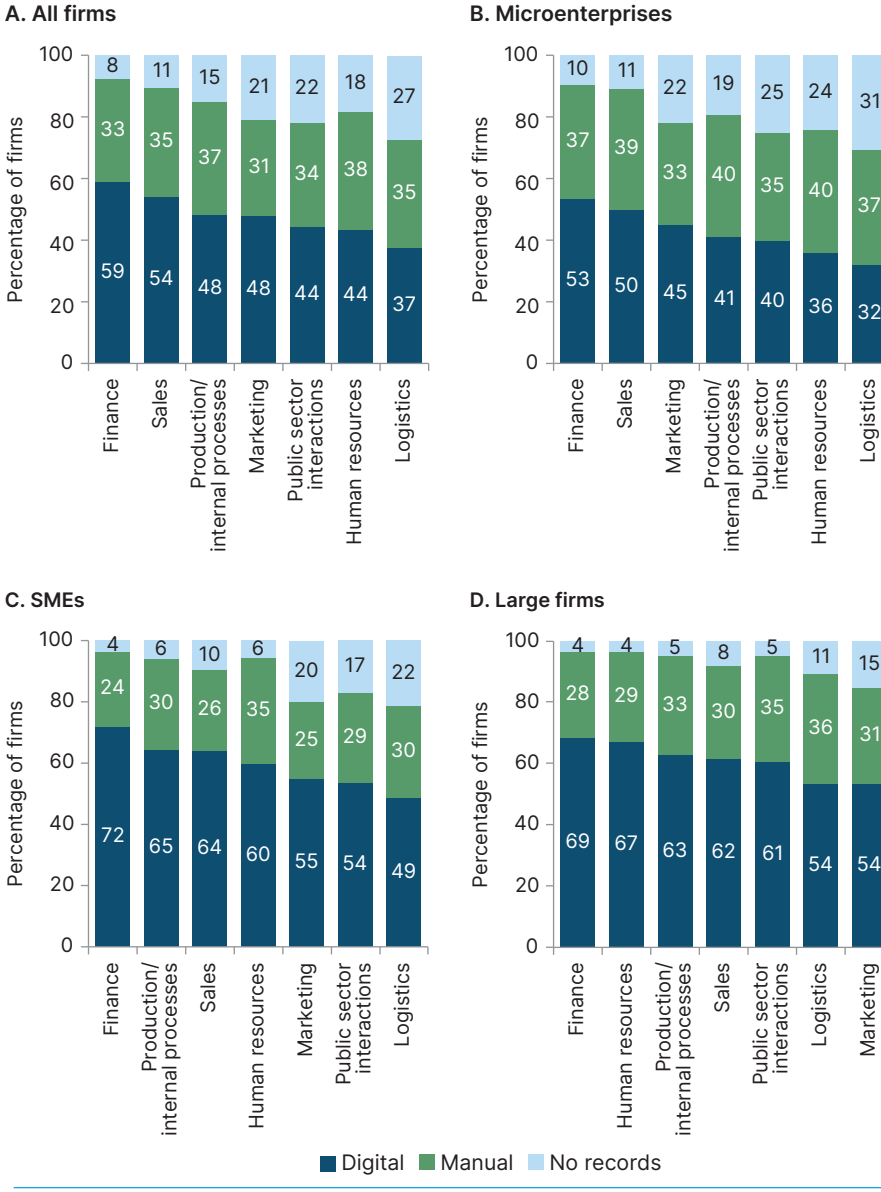
Second, digitalization varies across functions. It is highest in finance and sales (59 percent and 54 percent, respectively) and lowest in logistics (about 37 percent). Human resources, marketing, and public sector interactions fall in between (44–48 percent; Figure 13.2, Panel A).

And, third, there is a pronounced firm-size gradient (Figure 13.2, Panels B–D). Averaged across functions, 43 percent of microenterprises report predominantly digital processes, versus roughly 60 percent of small and medium-sized

[1] A benchmarking exercise for Uruguay, matching ConnectAmericas members to formal firms, confirms this. ConnectAmericas members have roughly 10 times as many employees (about 40 employees, compared with 4) and are far more likely to export (10 percent versus 0.7 percent) and import (27 percent versus 5 percent). Manufacturing firms are also overrepresented among members (16 percent versus 9 percent).

[2] The voluntary ConnectAmericas survey on digitalization and AI adoption covers 1,549 firms in 25 countries. Roughly 70 percent have up to 10 employees, about 25 percent have between 11 and 250 employees, and 5 percent have more than 250 employees. Among firms reporting their sector, about 63 percent are in services. The sample is skewed toward larger, more digitally engaged firms, so reported adoption rates likely overstate those among the region's firms overall. Country coverage is uneven, with most respondents from Argentina, Colombia, Ecuador, Mexico, and Peru, and Brazil markedly underrepresented, limiting cross-country comparisons.

Figure 13.2. Extent of Digitalization across Business Functions and Firm Size



Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: The figure shows the share of firms that keep records of each business function digitally, manually, or not at all. Results are shown separately by firm-size groups: microenterprises (fewer than 11 employees), SMEs (11–250), and large firms (more than 250). The sample covers 1,549 firms in 25 Latin American and Caribbean countries.

enterprises (SMEs) and large firms. Microenterprises are especially likely to operate with manual or nonexistent records in core functions such as production, human resources, and logistics. These patterns show that firms can be digital in

one function and highly manual in others, raising questions about their ability to exploit economies of scope across complementary functions.

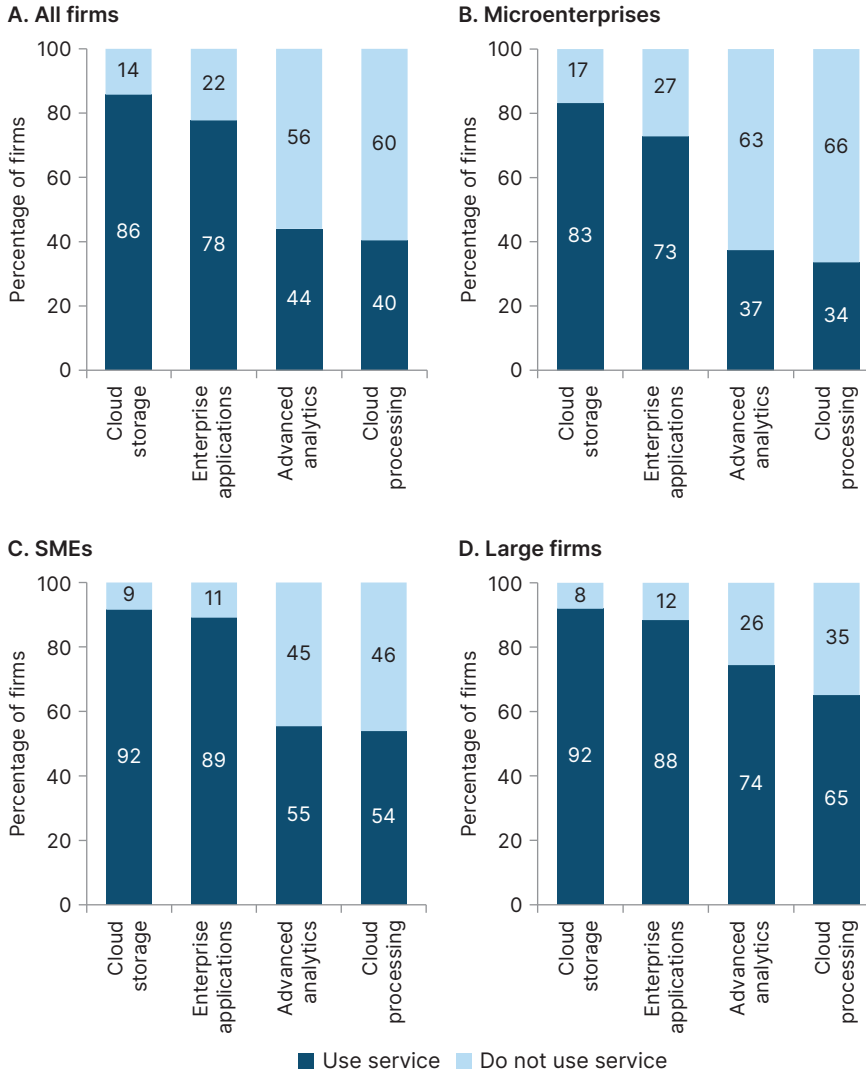
The use of cloud-based services is a key indicator of AI readiness and one of the strongest predictors of AI adoption, as these services provide much of the data and computing infrastructure AI applications require (Gutiérrez, Gallego, and Herrera Giraldo 2025). Around 85–90 percent of firms use cloud storage and close to 80 percent cloud-based enterprise applications, but only about 40–45 percent report using cloud processing or advanced analytics. The size gradient is again pronounced. Adoption of these advanced services remains below 40 percent among microenterprises, rises above 50 percent for SMEs, and reaches two-thirds for large firms (Figure 13.3). The difference is starkest for advanced analytics, used by about 37 percent of microenterprises and 74 percent of large firms. Basic cloud services are near universal, while data- and computation-intensive layers remain concentrated among larger firms.

Generative AI applications, which create new content—text, code, images, audio, or video—have quickly moved from niche tools to widespread use among firms in the region, although adoption remains largely superficial. GenAI adoption rose sharply, from around 9 percent of survey respondents in 2022 to about 19 percent in 2023 and almost two-thirds by 2025. Among adopters, use also became progressively more sophisticated. Basic, "out-of-the-box" use grew first and was increasingly complemented by light adaptations or fully customized solutions embedded in firms' workflows (Figure 13.4). Even so, basic use remains the dominant mode. Some 82 percent of adopters rely on off-the-shelf tools or light adaptations rather than solutions deeply integrated into production, decision making, or customer management. This is in line with the technology's low entry cost, as chat-based tools require little prior investment in data systems.

The familiar size gradient in AI adoption reverses for generative AI. Microenterprises report the highest GenAI use (around 70 percent, compared with about 60 percent among SMEs and 55 percent among large firms), but larger firms are more likely to use specialized nongenerative applications (Table 13.1).[3] These patterns are in line with the two adoption margins discussed above: Smaller firms enter mainly through standardized, off-the-shelf generative tools with low entry costs, while larger ones more often combine generative and nongenerative AI in production-oriented uses.

[3] The comparatively high adoption of generative AI among microenterprises may partly reflect the ConnectAmericas sample composition, as members are more digitally connected and outward oriented than their counterparts in the general firm population. The reversed size gradient should, therefore, be interpreted with caution.

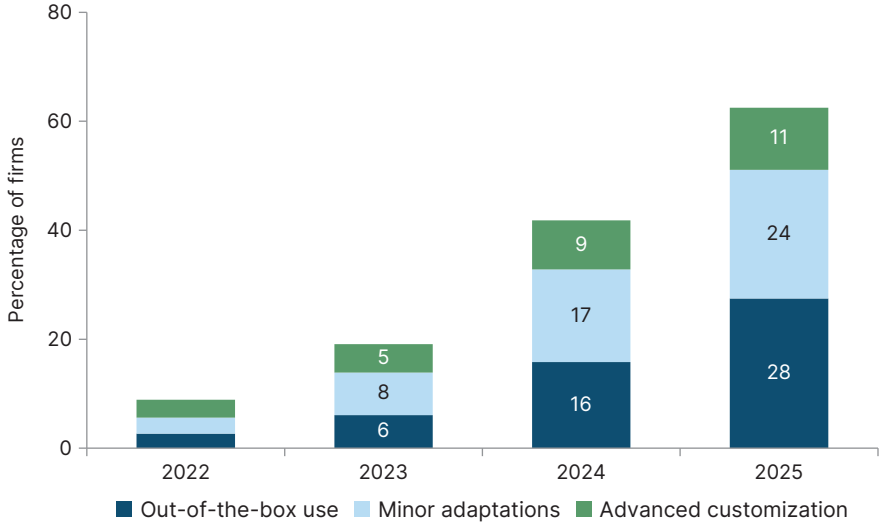
Figure 13.3. Use of Cloud Services, by Type and Firm Size



Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: Firm-size groups are defined as in Figure 13.2. The sample covers 1,549 firms in 25 Latin American and Caribbean countries.

The differences in AI adoption by firm size persist even when comparing firms of similar age operating in the same country and sector (Figure 13.5, Panel A). Compared with microenterprises, SMEs are less likely to adopt generative AI but more likely to use predictive analytics and intelligent robotics. Large firms show even greater advantages in adopting these specialized technologies and are also more likely to automate decision making.

Figure 13.4. GenAI Adoption over Time by Usage Mode



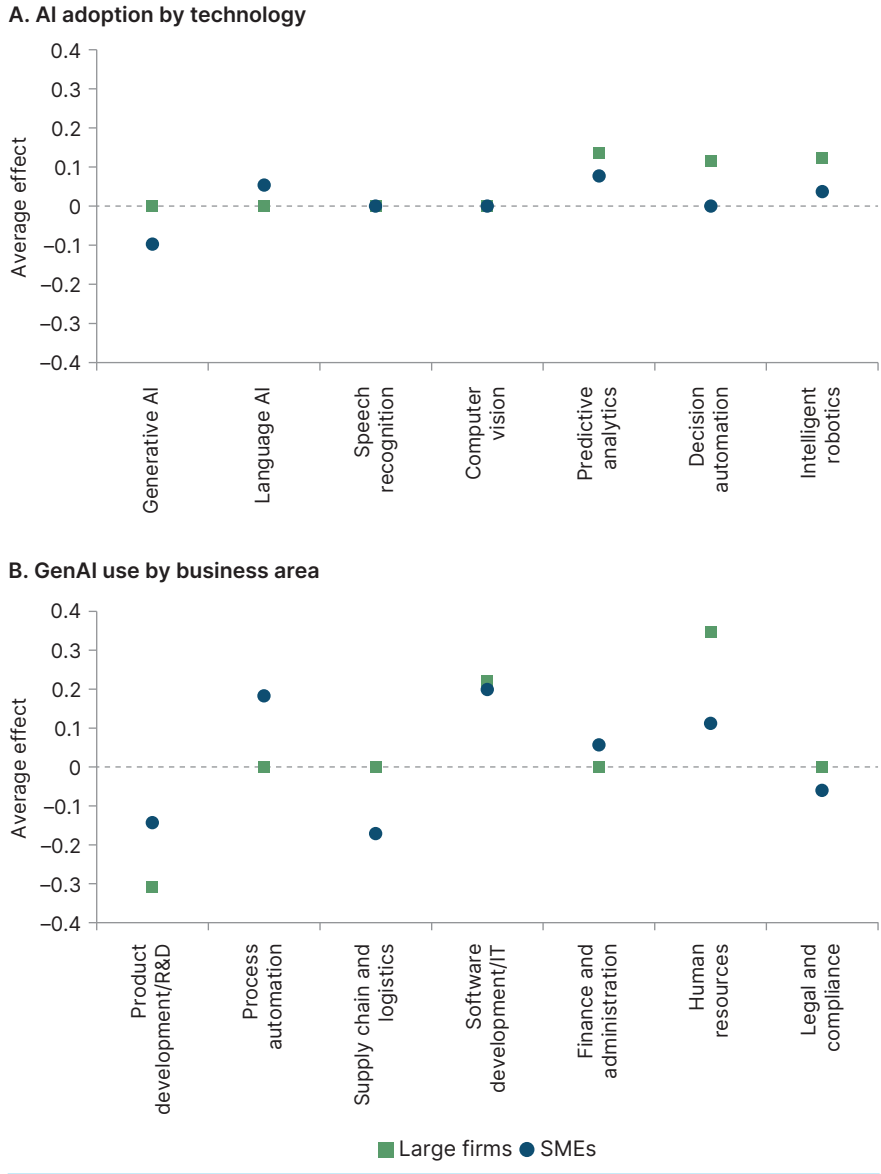
Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: The figure shows the cumulative share of firms reporting generative AI use by year of first adoption and usage mode (direct/out-of-the-box, minor adaptations, advanced customization). The sample covers 1,549 firms in 25 Latin American and Caribbean countries.

Table 13.1. AI Adoption, by AI Type and Firm Size

Type of AI adoption	Share of firms using each AI type (percent)		
	Micro (<11 employees)	SMEs (11–250 employees)	Large (>250 employees)
Intelligent robotics	4.9	7.3	12.8
Decision automation	19.6	17.9	22.1
Predictive analytics	19.0	22.0	27.9
Computer vision	21.0	19.7	27.9
Speech recognition	24.4	21.5	23.3
Language AI	53.5	54.1	53.5
Generative AI	69.4	58.1	55.1

Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: Generative AI creates new content. Other categories are nongenerative applications that process, recognize, or analyze existing information: language AI (text processing, chatbots, translation); speech recognition (voice commands, transcription); computer vision (image analysis, facial recognition); predictive analytics (forecasting, pattern detection); decision automation (rule- or model-based automation of decisions); and intelligent robotics (AI combined with physical automation). The sample covers 1,549 firms in 25 Latin American and Caribbean countries.

Figure 13.5. Firm Size and AI Adoption: Effects by Technology and Business Area



Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: The figure shows average effects from linear probability models. The sample covers 1,549 firms in 25 Latin American and Caribbean countries. Models include size-group indicators for SMEs and large firms (base category: microenterprises), the natural logarithm of firm age, and country–industry fixed effects. Firm-size groups are defined as in Figure 13.2. Standard errors are clustered at the country level. Effects not statistically significant at the 95 percent level are shown as zero.

Firm size is also related to where generative AI is used (Figure 13.5, Panel B). SMEs are more likely than microenterprises to use GenAI in process automation and internal operations, while both SMEs and large firms are more likely to use it in software development and information technology. Both groups, particularly large firms, are more likely to apply GenAI in human resources. Conversely, both are less likely to use it in product development and research and development. Use in supply chain and logistics is significantly lower only among SMEs.

These patterns indicate GenAI use in larger firms is oriented toward internal, scalable coordination functions rather than outward-facing innovation activities. This orientation reflects the economics of firm organization. As firms grow, coordination and communication absorb a rising share of resources, making technologies that reduce these costs more valuable (Garicano 2000; Bloom, Garicano, et al. 2014).

Scale is not associated with greater generative AI use, which diffuses broadly across firm sizes, but is more strongly related to nongenerative, application-specific technologies, such as predictive analytics, decision automation, and intelligent robotics, and to GenAI use in internal, scalable, and coordination-intensive functions. This pattern mirrors organizational and capability-related complementarities: Larger firms are better positioned to integrate AI into core processes, combine different AI applications, and deploy them in ways that require data infrastructure, specialized skills, and organizational coordination. Standalone generative AI diffusion should not, however, be read as broad transformation. Advanced tools, including integrated AI applications, remain concentrated among firms with more sophisticated digital portfolios.

Coadoption and Digital Technology Sophistication

Evidence from the United States shows that digital technologies are coadopted in a hierarchy of increasing sophistication, with firms using advanced tools, such as AI and robotics, also tending to use more widely diffused digital technologies (Zolas et al. 2020; McElheran et al. 2024). While comparable evidence for Latin America and the Caribbean is scarce, this analysis finds a similar pattern using official firm-level survey data from Argentina and Colombia.[4] Technologies cluster into three broad groups that can be interpreted as foundational, intermediate, and advanced. Foundational

[4] The coadoption analysis is descriptive. It identifies technologies that tend to appear together but neither establishes causal complementarities nor reveals adoption sequences.

technologies include communication-oriented tools, enterprise resource planning, basic customer-management tools, and related systems that allow firms to formalize and digitalize core records and transactions. Intermediate technologies support more integrated forms of digitalization, including cloud use, supply-chain and logistics systems, decision-support tools, and other data-handling applications. Advanced technologies comprise big data analytics and integrated AI applications embedded in data infrastructure and production or decision-making workflows rather than occasional standalone use of general-purpose generative AI tools.

In Argentina, 2021 data from the National Survey of Employment and Innovation Dynamics (ENDEI) on 3,254 firms show that 90 percent use at least one foundational technology, compared with 48 percent for intermediate technologies and 8 percent for advanced tools. In Colombia, data for 2020 from the Survey of Information and Communication Technologies (ENTIC), with 21,630 firms, exhibit a comparable gradient, with 95 percent of firms using foundational technologies, 13 percent using intermediate technologies, and only a small share using advanced tools, such as AI (8 percent) and big data (4 percent).[5]

These technology groups also form an ordinal measure of digital sophistication. The resulting pattern suggests that advanced technologies are concentrated among firms with broader digital technology portfolios rather than being adopted in isolation. This matters for policy because firms may appear partially digital while lacking the data quality, systems integration, or internal routines needed to benefit from advanced tools. The relevant policy question is not only why firms adopt a given tool, but what enables some to develop broader, more sophisticated digital portfolios while others remain concentrated in basic uses.

Drivers of Digital Technology and AI Adoption

What enables firms to move from basic digital tools to more advanced technologies, including AI? Evidence points to the importance of workforce skills, management practices, and investment in innovation. Firms also report factors that can hold back adoption, from limited information and financing to deficits in connectivity, data quality, and technical expertise. Understanding how

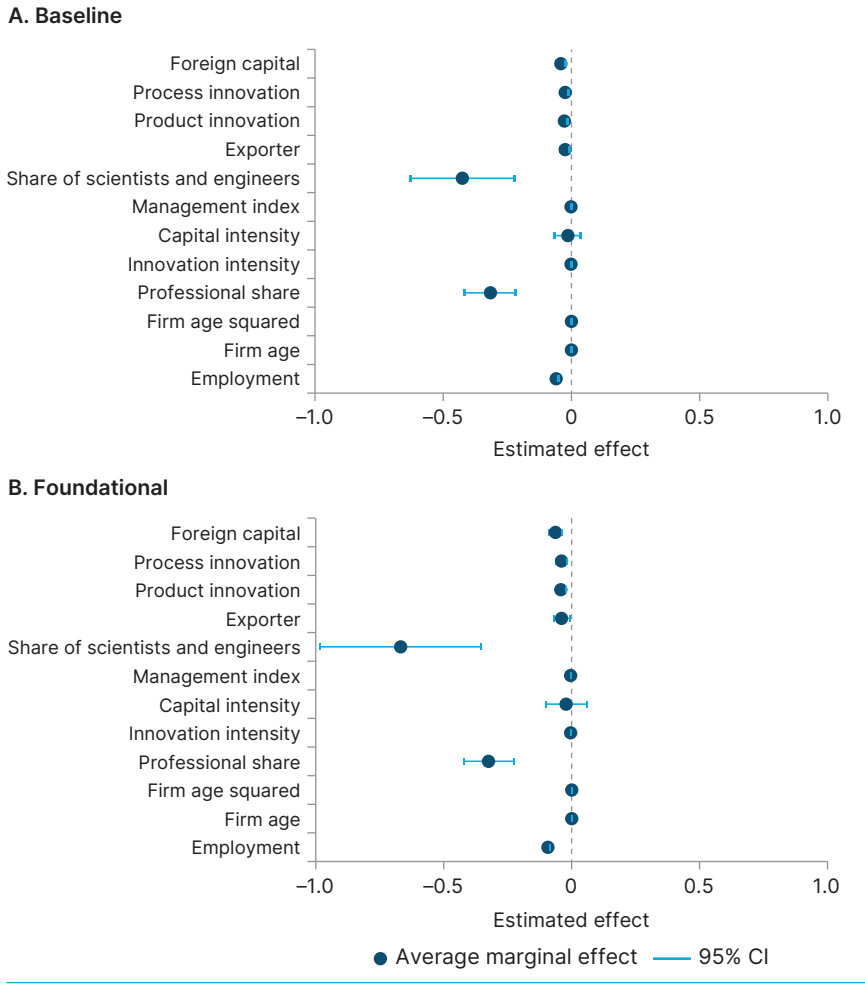
[5] The lower measured prevalence of intermediate technologies in Colombia should not be interpreted as evidence of weaker capability accumulation. ENTIC covers a much richer set of technologies classified as foundational (about 30, versus 10 in ENDEI), mechanically widening the foundational group and shrinking the intermediate one.

these obstacles vary across firms and stages of adoption can help identify where public support could be most useful.

Firm-Level Determinants of Adoption

An official survey in Argentina allows examination of how digital portfolio sophistication relates to firm characteristics (Figure 13.6). The estimates are correlations, not causal effects; they show how firm characteristics relate to digital adoption profiles without identifying exogenous drivers of more sophisticated adoption. This caution applies particularly to workforce composition,

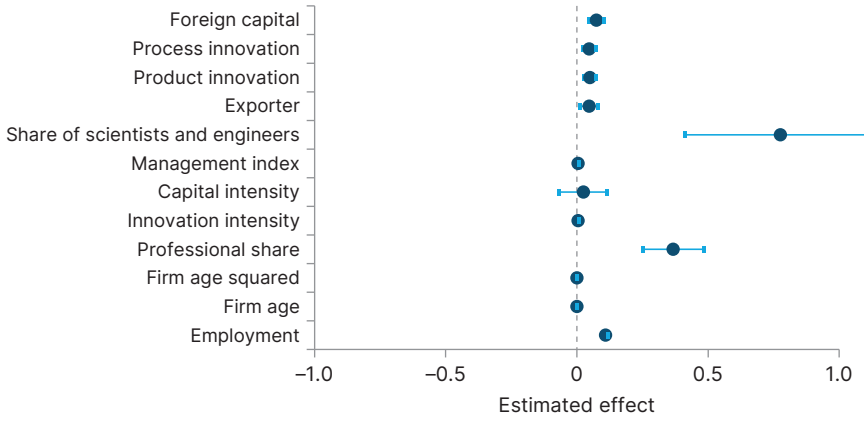
Figure 13.6. Firm Characteristics and the Sophistication of Digital Portfolios



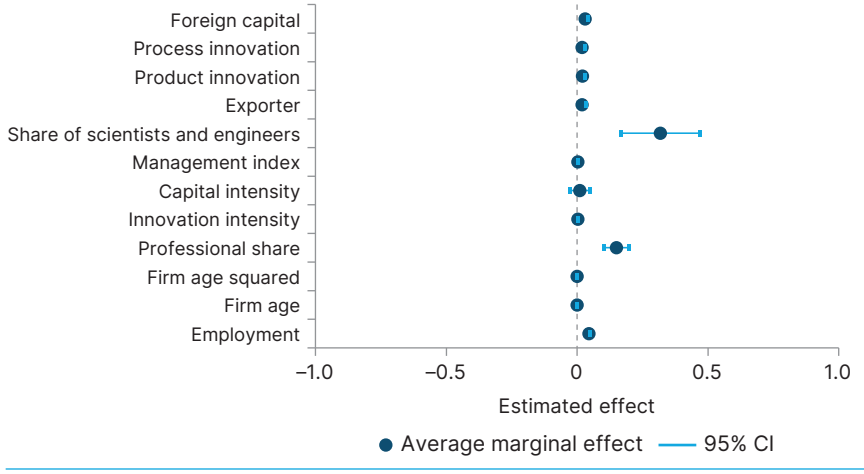
(continued on next page)

Figure 13.6. Firm Characteristics and the Sophistication of Digital Portfolios
(continued)

C. Intermediate



D. Advanced



Source: IDB staff calculations, based on data from Argentina's ENDEI III survey, 2019/2021.
Note: The figure shows average marginal effects, along with 95 percent confidence intervals (CI), from an ordered logit on firm size, age, workforce composition, management practices, innovation inputs, export status, and foreign ownership. Employment and innovation intensity enter in natural logarithm; capital intensity is the capital-to-sales ratio; and the share of scientists and engineers captures workforce skill composition. The ordered outcome ranks firms' digital portfolios from no adoption through three groups (foundational, intermediate, advanced). Sector and region fixed effects and robust standard errors are included. Estimates are descriptive associations, not causal effects.

as a high share of employment related to information and communications technology (ICT) may reflect reverse causality—that is, firms that choose more digital ways of organizing production also hire workers with the skills required.

More sophisticated digital adoption is associated with a combination of factors rather than any single dominant one (Figure 13.6). In addition to larger firm size, greater innovation intensity, better management quality, and a workforce with higher shares of ICT-related and professional employees are all associated with lower probabilities of no or foundational adoption and higher probabilities of intermediate and advanced adoption.

ICT-related employment has the highest correlation, underscoring the association between digital skills and more sophisticated adoption. This is most pronounced for intermediate adoption. As was discussed in Chapter 4, this suggests human capital is especially relevant for integrated and data-intensive applications rather than basic digital tools. Other characteristics show weaker associations. This is the case with export status and innovation output, which are associated with higher probabilities of intermediate and advanced adoption; with firm age, which is statistically insignificant across categories once other characteristics are accounted for; and with foreign ownership, which is positively associated with advanced technology use, consistent with greater access to complementary resources.

The correlation of observable characteristics does not rise systematically with technological sophistication. Several covariates are positively and significantly associated with advanced technology adoption, but their estimated relationships are no stronger than for intermediate adoption. This suggests advanced adoption is not simply a more intensive version of intermediate adoption. Although observable firm characteristics are strongly correlated with digital portfolio sophistication, adoption of such advanced technologies as big data or AI also appears to depend on factors not captured by these data, including data assets, organizational readiness, and managerial focus.

What Prevents Firms from Adopting Digital Technologies?

If observable characteristics only partly account for advanced technology adoption, what obstacles do firms perceive? The ConnectAmericas survey asked firms to identify the single most important obstacle to adopting AI.[6] Their responses inform policy design, particularly for the larger, more digitally connected, and more outward-oriented firms included in the survey sample.

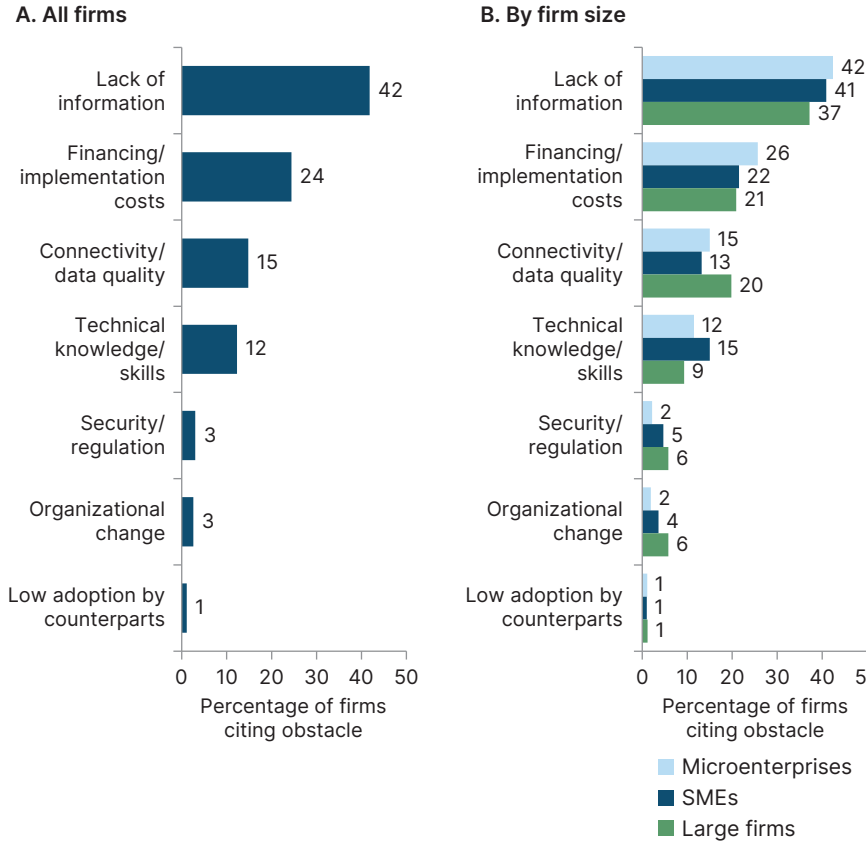
The responses indicate that the main perceived barriers to AI adoption are informational and financial rather than regulatory or organizational.

[6] Self-reported obstacles need not coincide with binding constraints. Firms may identify proximate rather than fundamental barriers, and those that have not seriously considered adoption may not yet perceive the obstacles they will encounter.

About 42 percent of firms report lack of information as their primary obstacle, followed by financing and implementation costs (24 percent), connectivity and data quality (15 percent), and technical knowledge or skills (12 percent). Concerns about security and regulation, organizational change, or low adoption by counterparts jointly account for the remaining 7 percent (Figure 13.7, Panel A).

Perceived barriers vary with firm size as digital engagement deepens (Figure 13.7, Panel B). Lack of information and financing difficulties are particularly pronounced among microenterprises. For SMEs, skill shortages become more salient, consistent with human capital constraints at intermediate stages of digitalization. Larger firms are more likely to report connectivity

Figure 13.7. Main Obstacles to AI Adoption



Source: IDB staff calculations, based on data from the ConnectAmericas survey, IDB, 2025.
Note: The figure is based on a nonrepresentative sample of digitally engaged firms. Each firm reports its single most important obstacle to adopting AI. Panel A reports results for all firms and Panel B shares by firm-size group, defined as in Figure 13.2.

and data quality problems, along with security, regulatory, and organizational challenges, the "second-generation" barriers that emerge with advanced and data-intensive applications.

Barriers also appear at different stages of adoption. Information or financing difficulties are typically known ex ante and may prevent adoption, while organizational challenges, data quality, or implementation difficulties often emerge only after firms begin experimenting with or deploying AI. Their importance may, therefore, be understated in cross-sectional evidence, which pools firms at different stages. The shift in reported obstacles across firm sizes reflects both organizational complexity and a learning process in which firms discover new bottlenecks as digital use becomes more integrated. Policy interventions, therefore, need to be stage specific, addressing entry barriers before adoption and implementation challenges once adoption is underway.

The Role of Public Policies

Government support for firm digitalization can be justified by several interacting market failures. Chapter 4 highlights two of them: knowledge spillovers and network externalities. With knowledge spillovers, early adopters cannot fully reap the value of what they learn through experimentation, since part of that knowledge flows to other firms. With network externalities, the returns to adopting a technology depend on how many other firms also adopt it. Both lead firms to underinvest in digital technologies, so adoption falls short of the socially desirable level.

Other market failures can restrain diffusion by limiting firms' ability to build the capabilities adoption requires. Restricted access to credit may prevent firms from financing intangible investments, such as training and organizational change. Information asymmetries can make it hard for firms to identify suitable technologies and judge the quality of technical advice, which weakens the markets for services that support capability building. Coordination failures between firms and training providers can also restrict the supply of relevant skills and retraining opportunities. Together, these failures tend to perpetuate capability shortfalls and hold back further adoption and learning. Because these barriers vary systematically by technology, degree of integration, and firm size, interventions need to be carefully designed and tailored. Otherwise, the firms that encounter them are likely to fall further behind (see, for example, Gal et al. 2019).

Public programs address these obstacles through technological diagnostics, training, and grants, often delivered in partnership with chambers of commerce or business associations. This section reviews evidence from available impact evaluations.

What We Know about Public Programs Supporting Firms' Digital Adoption

Rigorous evidence on the effectiveness of public digitalization programs is scarce. European Digital Innovation Hubs (EDIHs)—one-stop shops that help SMEs adopt advanced digital technologies—illustrate this evidence gap. Existing program assessments report substantial improvements in the digital maturity of participating firms, but they rely on noncausal methods and do not examine effects on productivity, competitiveness, and employment (Carpentier et al. 2025; Wintjes and Vargas 2023).

Limited evidence available from Peru points to mixed results for the Centros de Innovación Productiva y Transferencia Tecnológica (CITE)—public and private centers providing training, technical assistance, and technology transfer—in promoting firms' digital adoption. Valcarcel Pineda (2023) finds no statistically significant effect of CITE training on e-commerce adoption and significant reductions in firms' use of the internet and social networks. This is interpreted as firms—mostly micro and small—redirecting limited resources toward other productive areas, such as labor and human capital, rather than digital tools.

Identifying which program designs work, for which firms, and at what cost requires causal evaluations, which are often hampered by limited data. New evidence from a voucher-based program for smaller firms in Uruguay helps address this problem.

New Evidence: The Effects of Uruguay's Modo Digital Program

Uruguay's Modo Digital, implemented by the National Development Agency (ANDE) since 2021, supports the digital transformation of MSMEs through instruments promoting the adoption and effective use of digital technologies. Its most intensive form of support and largest instrument in terms of budget is the Vouchers de Transformación Digital. These vouchers cofinance projects seeking to increase firms' productivity through digital technologies that improve business management, operational efficiency, and production and organizational processes. The vouchers have two independent application phases: Phase 1 supports diagnosis of firms' needs and preparation of a customized digital transformation plan, while Phase 2 finances its implementation. Firms may enter Phase 2 after Phase 1 or with an independently prepared plan. The program provides a nonreimbursable grant covering up to 60 percent of total project costs, with a maximum subsidy equivalent to approximately US$20,000 across both phases.

Baptista, Gonzáles, and Hernández (forthcoming) find significant positive short-run effects of Phase 2 vouchers across eight digitalization indicators: overall digital maturity, digital technology use, technologies and digital skills, communication and sales channels, organization and people, processes, data and analytics, and strategy and digital transformation. Estimated improvements range from roughly 15 to 40 percent relative to the comparison group, with the largest effects in organization and people, processes, and data and analytics—dimensions closely aligned with the investments the vouchers support. Effects are larger for firms starting at the novice level of digital maturity and for microenterprises. Small firms are the only size group with significant gains across all eight indicators. Results also suggest larger gains when firms had previously completed Phase 1 or included training and workforce reskilling, but direct comparisons between the relevant subgroups are generally not statistically significant. Higher financing does not generate uniformly larger effects across outcomes.

The Uruguay evidence shows that targeted financial support, combined with diagnostics and implementation assistance, can generate significant short-run improvements in the digital maturity of MSMEs.

Effects of Digital Technology and AI Adoption on Performance

The adoption of digital technologies and AI can reshape firm organization, employment, innovation, and performance. As discussed in Chapter 2, these technologies affect firms in several ways. They reduce search and coordination costs, helping firms reach more consumers (Goldfarb and Tucker 2019), and they allow firms to use data more systematically in decision making (Brynjolfsson and McElheran 2016). They also interact with organizational design, shifting where decisions are made (Bloom, Garicano, et al. 2014). Within the workforce, they change the mixture of tasks and skills firms need, prompting adjustments in hiring (Acemoglu and Restrepo 2019; Agrawal, Gans, and Goldfarb 2019; Acemoglu et al. 2022), while automation reallocates tasks between labor and capital (Acemoglu and Restrepo 2019, 2022). Finally, AI can improve products and production processes and, by serving as a new general-purpose method of invention, reshape the innovation process itself (Cockburn, Henderson, and Stern 2019).

Empirical studies suggest that management software, cloud services, e-commerce, and analytics can improve sales, exports, product upgrading, and, in some cases, employment (Cirera, Comin, and Cruz 2022; Fernandes et al. 2019; Wu, Hitt, and Lou 2020; DeStefano, Kneller, and Timmis 2025). In the United States, AI investment is associated with faster growth in sales, employment, and market valuation, primarily through increased product innovation (Babina et al. 2024).

Yet these gains do not arise automatically. Digital technologies are strongly complementary to managerial quality, organizational capital, and human capital (Bresnahan, Brynjolfsson, and Hitt 2002; Schivardi and Schmitz 2020). Chapter 4 argues that, because of these complementarities, they generate larger productivity increases when embedded in broader transformations of firms' production processes and workplace organization (Bartel, Ichniowski, and Shaw 2007; Brynjolfsson, Rock, and Syverson 2021). Because these transformations take time, measured productivity gains often lag adoption as firms invest in new processes, business models, and skills, giving rise to the "Productivity J-Curve" identified by Brynjolfsson, Rock, and Syverson (2021) and examined in Chapter 2. Where these complements are missing, adoption may yield only modest gains, and where firms differ in their ability to use them, performance gaps may widen (Schivardi and Schmitz 2020; De Ridder 2024).

The question, therefore, is whether firms can integrate digital technologies into their operations in ways that improve performance. As explained in Chapter 4, this depends on structural conditions, including regulations and the availability and quality of digital infrastructure and skills, as well as firms' incentives and capabilities. Managerial practices are particularly relevant. World Management Survey data, which score firms on monitoring, target setting, and incentive practices, place emerging economies such as Brazil well below the United States and other advanced economies (Bloom and Van Reenen 2010; Bloom, Lemos, et al. 2014). Much of this gap reflects a large share of poorly managed firms in developing countries, in contrast with the unusually small share of poorly managed firms in the United States (Scur et al. 2021). Differences in management practices account for about 30 percent of TFP differences both across and within countries, although the proportion is smaller in less developed economies (Bloom, Sadun, and Van Reenen 2016). Weak managerial capabilities also help explain why firms in developing countries, including those in Latin America and the Caribbean, invest little in innovation and technology adoption despite high potential returns, since these capabilities are needed to reap those returns (Cirera and Maloney 2017).

New Evidence from Colombia: Digitalization Support and Firm Performance

The evidence reviewed so far suggests a causal chain from program participation to technology adoption and deeper digitalization, and from there to improved firm performance. The preceding discussion established the first link, but rigorous evidence on performance effects remains scarce. New evidence from Colombia's Business Digital Transformation Centers (Centros

de Transformación Digital Empresarial—CTDE) examines the relationship between program participation and firm performance through reduced-form estimates.

The CTDE program was a public initiative supporting Colombian MSMEs in their digital transformations, implemented in coordination with chambers of commerce, business associations, universities, and other regional stakeholders. It guided firms along a staged adoption path that included awareness, digital-maturity diagnostics, personalized transformation plans, tailored training, ICT implementation—for example, customer relationship management (CRM) systems—and follow-up technical assistance. Its design combined entry-stage support addressing information barriers with deeper, implementation-oriented assistance.[7]

Participation in the CTDEs is positively associated with income growth among firms that received the most intensive support, namely training and assistance in technology adoption processes, although the differences become statistically significant only in later post-participation years. Relative to the comparison group, these firms' income was about 50 percent higher four years after participation and about 55 percent higher in the fifth year (Figure 13.8).[8] For firms that received lighter support, such as diagnostics, awareness activities, and technology adoption plans, the associations were smaller and short-lived; their income was about 30 percent higher four years after participation, but this difference was statistically significant only in that year.

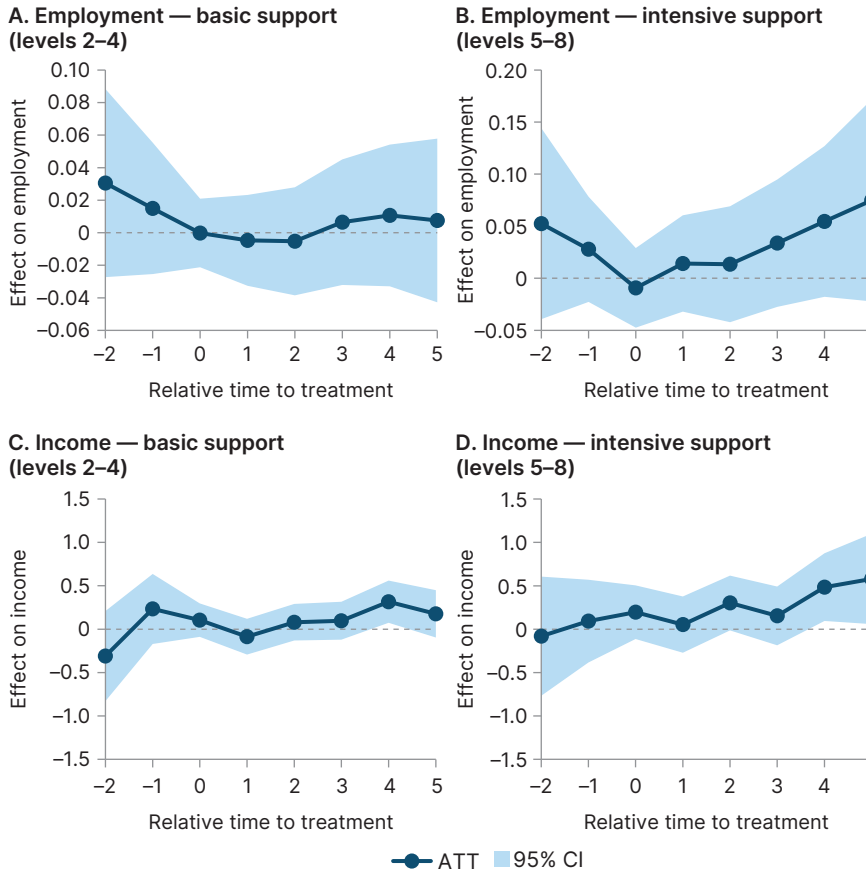
For employment, no measurable differences are observed among firms that received lower-intensity support. For those that received the most intensive support, the estimates are rough, but they suggest a positive employment pattern that becomes stronger over time. This pattern would be consistent with employment responding with a lag, as firms expand their workforces only after initial increases in income or business activity. It is also in line with recent U.S. evidence showing that, although labor demand falls for tasks more exposed to AI, firms that adopt AI tend to increase employment as they become more productive and grow faster, so that overall employment changes are modest rather than negative (Hampole et al. 2025).

---

7 The program was demand driven and open to all MSMEs nationwide. Rolled out in 2017–18, it expanded from 18 to 24 centers and was later succeeded by the ZASCA initiative, a network of government centers supporting the reindustrialization of micro- and small firms.

8 These estimates should be interpreted as descriptive evidence rather than causal, as progression to later stages of the program is itself an endogenous firm choice.

Figure 13.8. Effects of CTDE Participation on Firm Performance



Source: IDB staff calculations, based on data from Colombia's Business Digital Transformation Centers (CTDE) administrative records merged with the firm registry (RUES).
Note: The figure shows event-study estimates (ATT), along with 95 percent confidence intervals (CI), from a staggered difference-in-differences design (Callaway and Sant'Anna 2021) with inverse-probability weighting. Treatment levels 2–4 denote basic support to firms (diagnostics, awareness, plan design) and levels 5–8 intensive support (training and assistance with technology adoption).

Policy Recommendations

Digitalization and AI can raise firm productivity when firms integrate them into production, decision making, and other core business processes while building the required skills, data, and organizational capabilities. A business climate that enables this transition requires four firm-level policy actions.

Mobilize finance and implementation capabilities for business digital transformation. Financing should be combined with the diagnostic, project-design, and technical capabilities firms need to implement digital transformation

projects effectively. Public support should target identifiable market failures and attract, rather than substitute for, private finance. Financing terms and the public contribution should reflect project risk, expected spillovers, and repayment capacity, while implementation support should help firms identify the technologies, data, skills, and organizational changes required for effective digital transformation.

Align digitalization instruments with firm heterogeneity. Firm heterogeneity in digital capabilities, constraints, and project needs calls for managing digitalization instruments as a coordinated portfolio rather than isolated programs. Common diagnostics and shared program information can help identify gaps and overlaps, match firms to appropriate support, and facilitate referrals across instruments. Where data permit, government agencies could also test whether AI-assisted diagnostics and matching improve targeting. As technologies, firms' needs, and underlying market failures evolve, instruments should be added, adapted, consolidated, or discontinued accordingly.

Foster specialized digital implementation networks. Coordination failures can limit firms' access to the complementary expertise required for digital transformation. Public support can help address these failures by supporting networks that link business organizations, technology centers, universities, and private providers. Private providers should remain central to commercially available solutions, while public support can facilitate coordination, referrals, and access to capabilities that individual providers have limited incentives to supply. A public agency or specialized intermediary can coordinate, depending on institutional capacity, and a common entry point may simplify firms' access. Experiences such as Colombia's CTDEs and the European EDIHs provide useful design references for multi-actor delivery, but existing evidence does not isolate the effect of any particular coordination model. Institutional arrangements should, therefore, remain flexible and be adapted to local capacities, costs, implementation quality, and firm outcomes.

Track progression from technology adoption to effective use. A common framework should be established for measuring firms' digital capabilities and the depth of digitalization and AI integration across programs, allowing program-specific modules where needed. The framework should draw on available program, survey, and administrative information, with common firm identifiers used to link data on digital capabilities to firm performance, subject to appropriate data-protection safeguards. This information will allow policymakers to track capability accumulation, assess program effectiveness, and compare how different forms of support relate to firm outcomes. Periodic updates should inform adjustments to the policy portfolio and support rigorous evaluation.

14

Facilitating and Promoting Trade and Investment through Digital Technologies

As shown in Chapter 2, the growth performance of Latin American and Caribbean countries has been remarkably weak over the last six decades. This weakness, and the resulting failure of the region to converge with developed economies, are primarily attributable to low growth in aggregate total factor productivity (IDBG 2025).

Both trade and foreign direct investment (FDI) can raise productivity and economic growth through several channels. At the aggregate level, trade generates static productivity gains, as less productive firms exit the market and more productive ones expand (Melitz 2003); trade also generates dynamic gains, as resources are reallocated toward sectors with greater learning potential and as access to the global capital stock widens (Young 1991; Grossman and Helpman 1991). At the firm level, trade raises productivity through several means: by granting access to a broader set of inputs (Ethier 1982; Goldberg et al. 2010; Halpern, Koren, and Szeidl 2015), by transmitting new knowledge through interactions with sophisticated foreign buyers (Westphal 1990; Atkin, Khandelwal, and Osman 2017), and by enlarging the market and, thus, the returns to innovation (Lileeva and Trefler 2010; Bustos 2011).

FDI can raise host-country productivity through two broad channels: reallocation, as competition and selection shift resources toward more productive firms, and knowledge spillovers, transmitted both within and across industries (Blomström and Kokko 1998; Markusen and Venables 1999; Alfaro 2017).[1] Via the latter channel, domestic firms interacting with locally operating multinational firms gain access to a wider variety of higher-quality goods and services, better technologies and managerial and production practices, and

[1] These gains are far from automatic. Their realization depends on firms' absorptive capacity, the depth of local supplier networks, and complementary investments in skills and institutions (Alfaro 2017; Cusolito and Maloney 2018).

relevant commercial information. These spillovers arise through labor mobility (Balsvik 2011; Muendler, Rauch, and Tocoian 2012; Poole 2013; Setzler and Tintelnot 2021) and through vertical linkages with local input suppliers (Aitken, Hanson, and Harrison 1997; Aitken and Harrison 1999; Javorcik 2004; Alfaro and Rodríguez-Clare 2004; Alfaro-Ureña, Manelici, and Vasquez 2022).

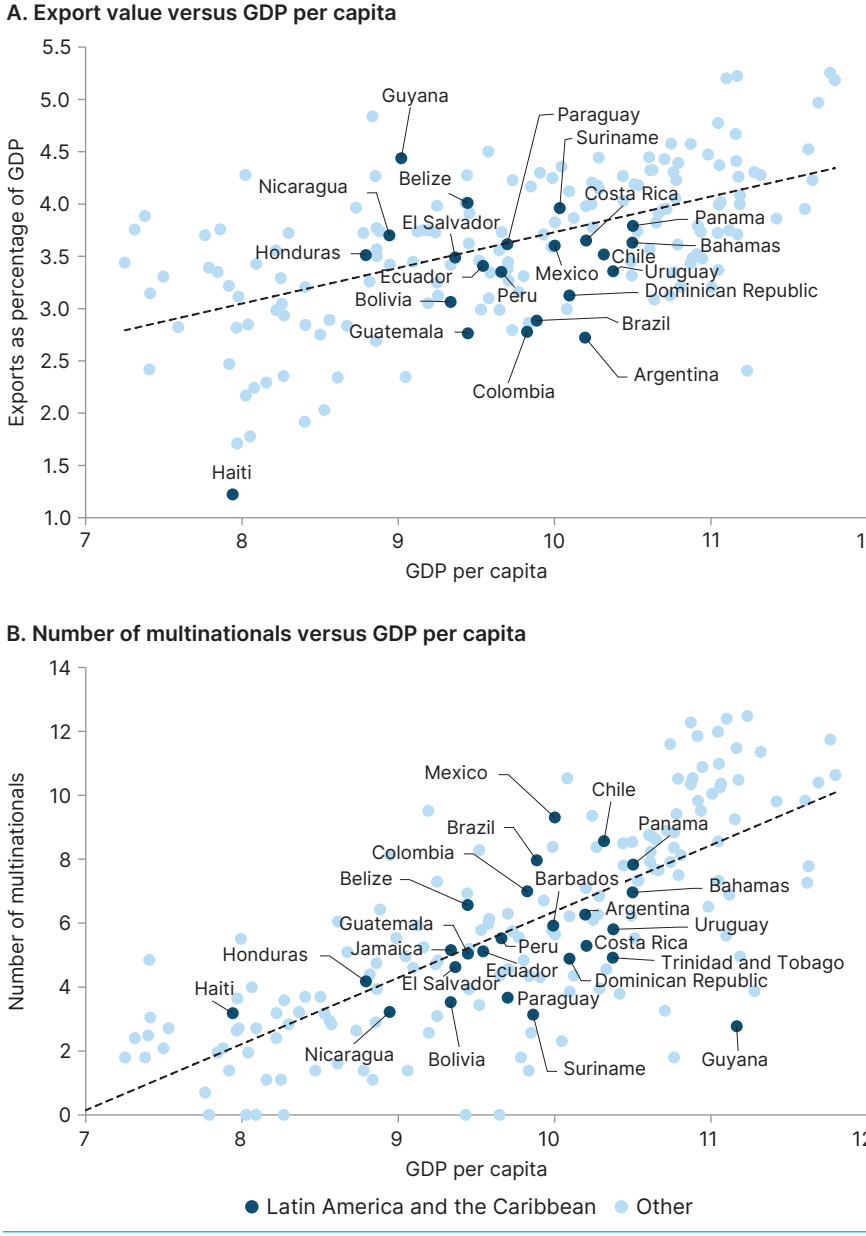
Evidence for Latin America and the Caribbean consistently indicates that trade and FDI are key growth and productivity drivers. The opening of the region to international trade helped accelerate growth and led to a gain in average income per capita of up to 16 percent in 20 years—a payoff hardly seen in other public policies (Mesquita Moreira and Stein 2019). The region's situation is still far from satisfactory, however. In many Latin American and Caribbean countries, export levels remain below their potential. The same is true for countries' participation in multinational production (Figure 14.1).

This situation can be traced back to several factors, high trade costs prominent among them (Mesquita Moreira and Stein 2019). The evidence in this chapter makes clear that digital technologies in general and artificial intelligence (AI) in particular can effectively help reduce these trade costs across their sources, which include regulatory compliance, administrative border processing, and information frictions. These technologies thus favor trade and FDI expansion, specifically increased firm participation in international trade and multinational production. Trade and FDI gains from digitalization are far from automatic, however; they require both precedent and concomitant actions in order to materialize. Digitalization of trade and investment procedures makes a significant difference in outcomes only when preceded by process reengineering and optimization, and when accompanied by incentives for effective adoption and use and conducive change management. Furthermore, these gains are larger when digital-related policy initiatives fully consider network externalities. Thus, indiscriminately supporting firms' participation in already congested online platforms is unlikely to produce the expected sales gains, as entry will further intensify competition for buyers' attention.

The Impact of Digital Technologies on Trade and FDI

Digital technologies affect *what* is produced, *how* production is carried out, and *who* produces. The mechanisms include the emergence of personalized and AI-enhanced products (for example, user-adaptive products, such as learning software), the production of some goods from digital files, and the automation of several tasks. Regarding automation, digitalization and, specifically, AI can shape countries' comparative advantages. Thus, as discussed in Chapter 2,

Figure 14.1. Trade and FDI in Latin America and the Caribbean



Source: IDB staff calculations, based on data from the World Development Indicators, World Bank, 2024, and Dun and Bradstreet database, 2024.
Note: GDP per capita, exports as a percentage of GDP, and the number of multinationals are expressed in natural logarithms and refer to 2024 or the most recent available year. The dashed lines show the linear fit. "Other" includes economies outside Latin America and the Caribbean with available data.

AI can generate adjustments along two margins: a reshoring margin, when firms in advanced economies repatriate offshored tasks; and an import-substitution margin, operating in the other direction as developing countries develop local AI capabilities. Moreover, since information is crucial for AI, countries that have accumulated more data are more likely to develop a comparative advantage in data-intensive sectors (Estevadeordal, Rodríguez Chatruc, and Volpe Martincus 2020; Chen and Volpe Martincus 2022).[2]

More specifically, digital technologies affect *what* is traded, *how* trade is carried out, and *who* trades (Estevadeordal, Rodríguez Chatruc, and Volpe Martincus 2020). Goods that used to be physically traded, for example (such as movies, music, and books), can now be digitally delivered and have mutated into services (video streaming, music downloading, and e-books); goods and services can now also be digitally ordered (Box 14.1); and both new firms and consumers can directly participate in international trade (Volpe Martincus, Sztajerowska, and Santi 2024). These developments have significantly expanded digital trade, particularly trade in digitally delivered services. In Latin America and the Caribbean,

Box 14.1. Digital Trade Definitions

Digitally ordered trade. International transactions for goods and services performed using computer networks in ways that are specifically designed for the purpose of receiving or placing orders. Examples include ordering a T-shirt from abroad on a manufacturer's website or booking a reservation at a foreign restaurant on a digital platform.

Digitally delivered trade. International trade transactions in services that are delivered remotely over computer networks. Examples range from computer services to banking services to remote learning courses.

Digital facilitation of traditional trade in goods. Use of digital technologies to reduce trade costs associated with administrative border processing of physically exchanged goods. This approach does not alter the nature of the good traded.

Digital transformation of trade policy instruments. Redesign of traditional trade and FDI policies addressing market failures, such as those associated with information frictions, through use of digital tools that change the targeting strategy and increase precision. Machine learning, for example, can support proactive trade and investment promotion policies that are evidence based rather than ad hoc and "manual."

[2] As mentioned in Chapter 2, digital technologies can also reshape market structure and the geography of trade through scale, scope, and network effects.

exports of these services have increased fivefold over the last 20 years, while goods exports have increased just twofold (Acosta, Rocha, and Volpe Martincus, forthcoming).

Digital Technologies and Trade Costs

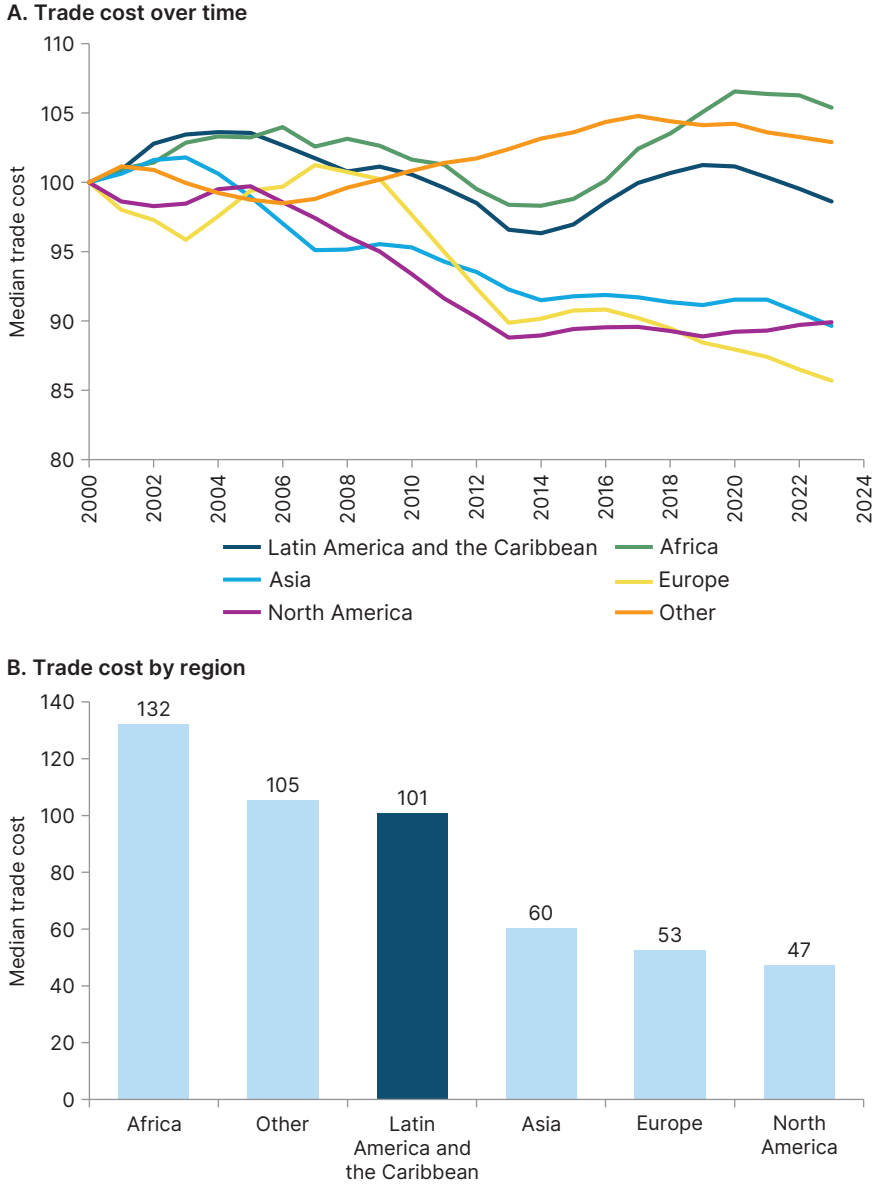
Digital technologies can affect trade and FDI and, thus, productivity in various ways. First, they can help reduce *production costs*. Second, AI (in particular) can facilitate and speed up *innovation* (Cockburn, Henderson, and Stern 2019; Rammer, Fernández, and Czarnitzki 2022; Agrawal, Gans, and Goldfarb 2026), helping to raise productivity and thus boost trade and investment. Third, digital technologies can increase the *efficiency of financial operations*. And, fourth, digital technologies can help lower the *trade costs* that deter Latin American and Caribbean countries and firms from participating in trade and FDI.

Trade costs are an important determinant of both the level and patterns of trade and FDI; see, for example, Anderson and Van Wincoop (2004); Ramondo, Rodríguez-Clare, and Tintelnot (2015); and Mesquita Moreira and Stein (2019). Estimates reveal that, whereas trade costs in Asia, Europe, and North America declined considerably over the last two decades, they did not significantly change in Latin America and the Caribbean, deteriorating the relative conditions under which trade and FDI take place (Figure 14.2, Panel A). Accordingly, trade costs in the region are substantially higher than those in Asia, Europe, and North America, though lower than in other developing regions (Figure 14.2, Panel B).

Trade costs have multiple sources, including tariffs, transportation and logistical costs (including those related to port infrastructure), costs of administrative procedures related to trade and investment, information frictions encountered in identifying business opportunities across borders, and regulatory heterogeneity across countries; see, for example, Mesquita Moreira, Volpe Martincus, and Blyde (2008); Mesquita Moreira et al. (2013); Volpe Martincus (2010, 2016, 2021); and Blyde (2024). In particular, the resources and time required to complete trade and investment procedures to comply with relevant regulations can substantially drive trade costs up. The same applies to the share of shipments subject to delay-creating physical customs inspections and efforts to overcome incomplete information. The opposite holds for institutional arrangements and investments in physical infrastructure that reduce trade costs. This is, for instance, the case with diplomatic missions, whose activities help lower information barriers (Rose 2007; Figure 14.3).

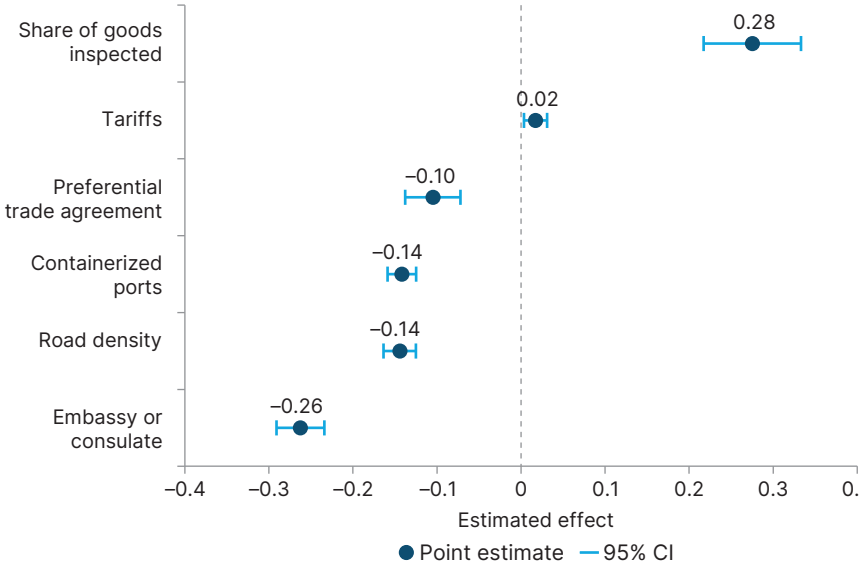
Digital technologies can reduce trade costs across these sources, both independently and when bundled and combined with institutional arrangements.

Figure 14.2. Trade Costs: Latin America and the Caribbean versus Other Regions



Source: IDB staff calculations, based on data from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and World Bank.
Note: Reported values capture the cost of exports to eight of the world's largest economies (Canada, China, France, Germany, Italy, Japan, the United Kingdom, and the United States); see Mesquita Moreira and Stein (2019) for technical details. Estimates for Latin America and the Caribbean are based on 26 countries. Panel A shows the median trade-cost index over time (2000 = 100). Panel B shows median trade-cost levels in 2023.

Figure 14.3. Administrative Procedures and Information Frictions as Sources of Trade Costs



Source: IDB staff calculations, based on data from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP); World Bank; International Finance Corporation (IFC); Moons (2017); Brooks, Gendron-Carrier, and Rua (2021); International Monetary Fund; and Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).
Note: The figure shows the estimated effects of policy variables on bilateral trade costs (as measured in 2023), along with 95 percent confidence intervals (CI). See Mesquita Moreira and Stein (2019) for technical details.

For transportation and logistical costs, autonomous vehicles and AI best-route calculations optimize transportation of goods, and cloud-based internet of things (IoT) optimizes port management of shipments. For costs of regulatory compliance and administrative procedure completion, two types of single windows—broadband internet–supported electronic trade single windows (ETSWs) and electronic investment single windows (EISWs)—help streamline and expedite the administrative processing of cross-border shipments and investments, and AI helps improve border agencies' risk management and reduces unnecessary border delays. For information costs, online platforms lower search and matching costs, and AI can reduce them further. AI can also improve the design, implementation, and evaluation of policies addressing information frictions and associated externalities, namely trade and investment promotion policies (Table 14.1). In so doing, digital technologies can directly and indirectly enhance firms' and countries' trade and investment outcomes.

Table 14.1. Taxonomy of Digital Technologies and Trade Cost Reduction

Type of technology	Transportation and logistical costs	Regulatory compliance and administrative border processing costs	Information frictions
Core digital technologies	Internet of things, smart sensors	Cryptography, blockchain, big data/analytics, AI/ML	Big data/analytics, AI/ML, cloud computing
Bundles of digital technologies	Autonomous vehicles, robots, drones	Digital identity and signatures, digital documents, intelligent document processing	Chatbots, translation, machine virtual/augmented reality
Systems: Digital technologies and institutional arrangements	Port management	Electronic trade/investment single windows	Digital platforms

Source: IDB staff.
Note: The table maps different digital technologies to the sources of trade costs they are likely to reduce the most. The taxonomy in the table is a simplification for expositional purposes.

Digitalization of Administrative Procedures, Trade, and Investment

Digitalization of well-designed administrative procedures reduces costs for firms and can thereby help expand economic activity. This is particularly the case when it is implemented through initiatives that cover the various agencies firms interact with, such as ETSWs and EISWs.

Electronic Trade Single Windows

Firms engaging in international trade have typically confronted cumbersome procedures that remain largely manual and, to a nontrivial extent, still paper based. In several countries, firms have been required to complete as many as 40 documents involving 200 data fields, some 60–70 percent of which had to be keyed in more than once (Sathasivam 2009).

Completing these procedures has, therefore, been time consuming and costly. The costs of the time spent at the border are economically important; each day in transit is equivalent to an ad valorem tariff of 0.6–2.3 percent (Hummels and Schaur 2013). Similarly, a 10 percent increase in shipments' customs processing times has been found to reduce firms' exports by 3.8 percent (Volpe Martincus, Carballo, and Graziano 2015).

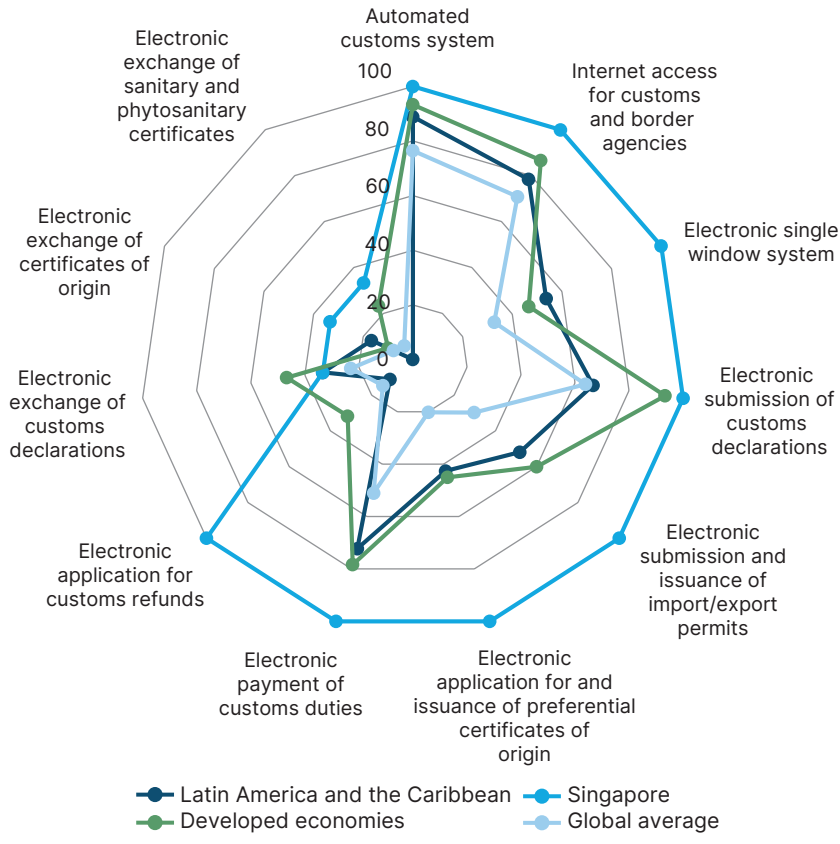
Trade facilitation policies can streamline these border procedures and thus reduce border times and associated costs. Examples include smarter risk

management systems, which help border agencies identify shipments with high noncompliance risks and thus reduce the share of physical inspections, and trade single windows, which allow firms to lodge standardized information with a single entry point to fulfill all import-, export-, and transit-related regulatory requirements; see Volpe Martincus, Carballo, and Graziano (2015); Volpe Martincus (2016); Hillberry, Fernandes, and Mendoza Alcántara (2021); and Carballo, Graziano, et al. (forthcoming).

Importantly, when properly redesigned and optimized, digitalized administrative trade procedures can further lower completion costs, additionally favoring firms' trade and overall performance (Laajaj, Eslava, and Kinda 2023). While Latin American and Caribbean countries have registered progress in recent years, the region still lags developed economies and is clearly behind the leader in this area, Singapore (Figure 14.4), particularly regarding ETSWs.

Figure 14.4. Digitalization to Facilitate Trade: 2015 versus 2025

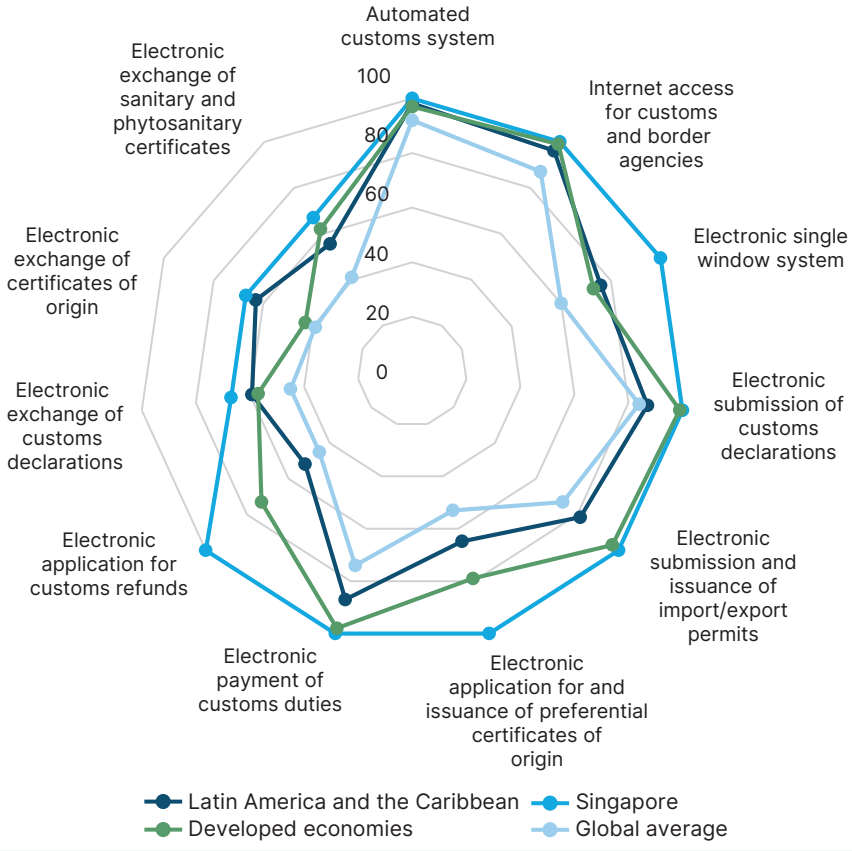
A. 2015



(continued on next page)

Figure 14.4. Digitalization to Facilitate Trade: 2015 versus 2025 *(continued)*

B. 2025



Source: IDB staff calculations, based on data from the UN Global Survey on Digital and Sustainable Trade Facilitation.
Note: The figure shows the degree of implementation of each trade facilitation measure in 2015 and 2025, expressed as a percentage of full implementation. Estimates for Latin America and the Caribbean are based on 18 countries.

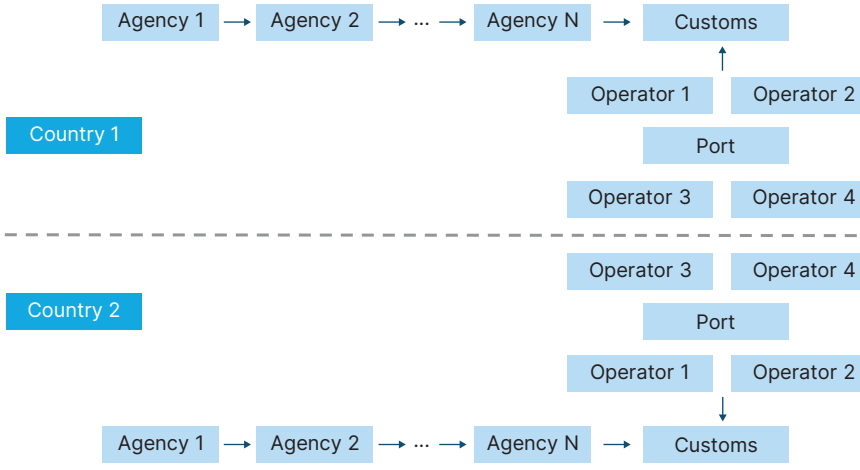
ETSWs are electronic document exchange systems that link several agencies dealing with trade regulations to allow online application for and issuance of trade-related permits and certificates; they also make possible the interagency exchange of these permits and certificates (Figure 14.5, Panels A and B, which show the changes associated with the introduction of an ETSW). Several Latin American and Caribbean countries have digitalized their trade procedures through ETSWs (Figure 14.5, Panel C), but a large share of these systems remain only partially implemented.

Provided that procedures have already been optimized, and relative to standard (manual, paper-based) trade single windows, ETSWs do not change the information regulators demand but, rather, how that information is submitted

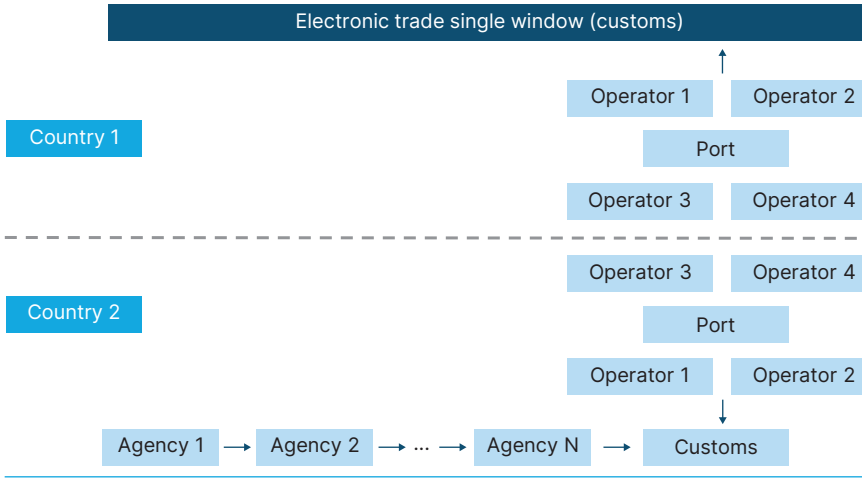
and processed. This change may result in administrative cost savings for three reasons. First, digitalization increases the speed, timeliness, and accuracy of information submission, and it reduces processing and response times. Second, it allows submitted data to be reused multiple times, eliminates rekeying errors, and enhances data consistency. Third, it improves tracking of progress toward completing procedures.

Figure 14.5. Border Processes and the Electronic Trade Single Window

A. Schematic representation of a two-sided border



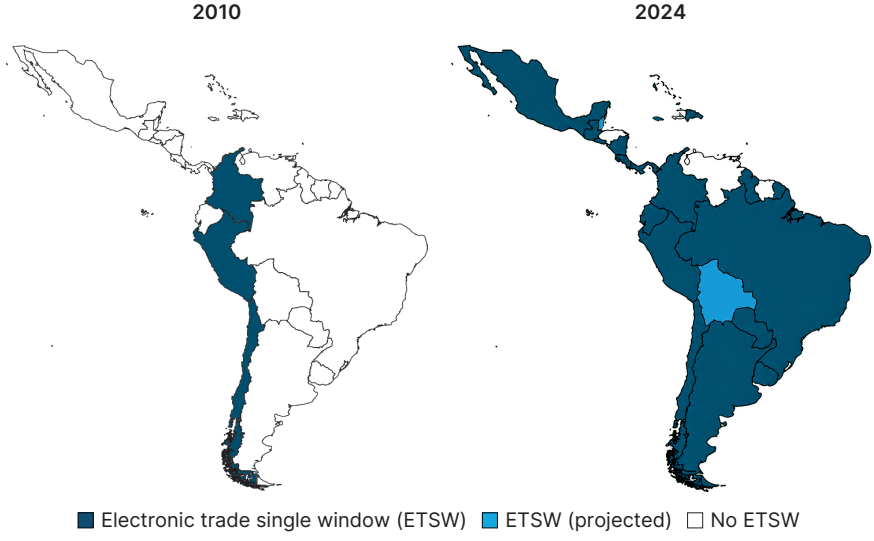
B. Electronic trade single window (ETSW)



(continued on next page)

Figure 14.5. Border Processes and the Electronic Trade Single Window
(continued)

C. ETSW implementation across the region



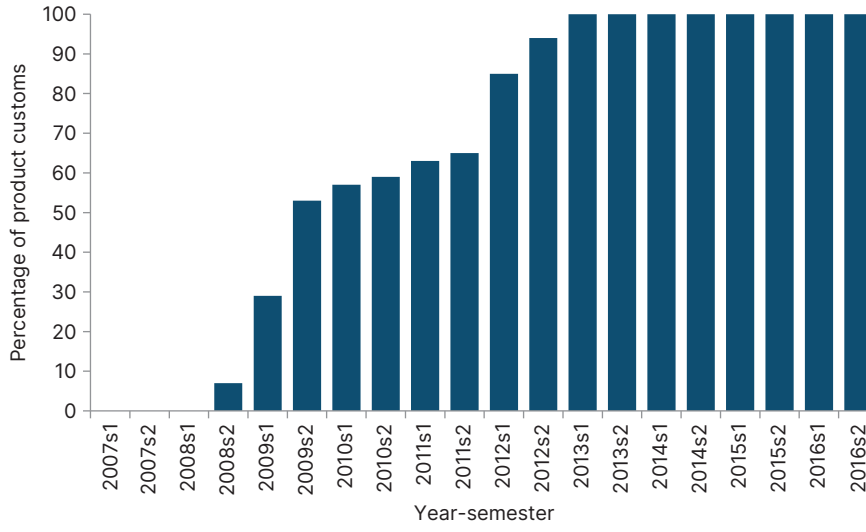
Source: IDB staff elaboration, based on internal data.

Implementing an ETSW is a far-reaching undertaking, one that is technically complex and involves many stakeholders who are usually unconnected and uncoordinated. Thus, implementation is generally gradual, with groups of border agencies and their procedures sequentially incorporated into the arrangement. Costa Rica's introduction of an ETSW provides a clear example of this process (Figure 14.6, Panel A).

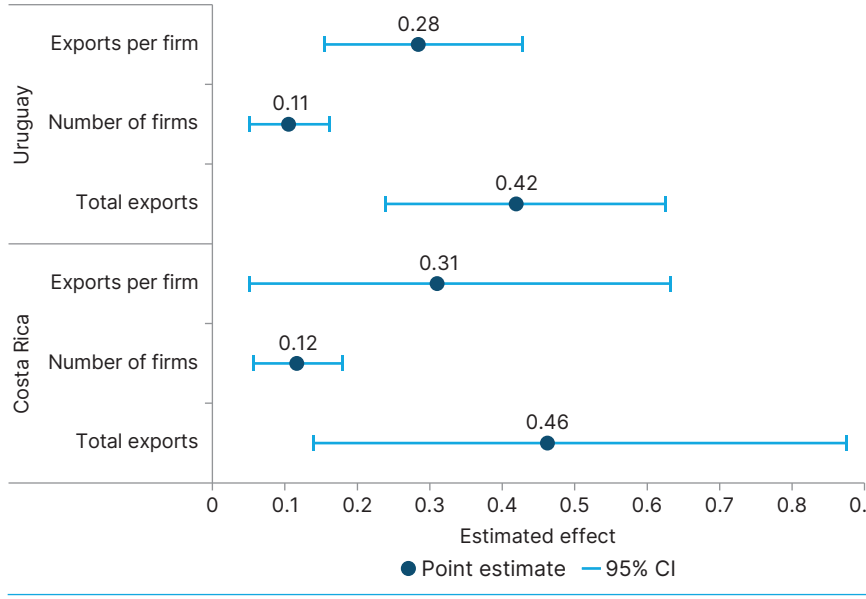
Such sequential introduction allows evaluating the ETSW's impact on exports by using firms' differential exposure to the digital procedures over time and across products and customs offices. Evidence from Costa Rica reveals that the introduction of an ETSW allowing firms to apply for and obtain trade-related permits and certificates for agricultural products has been associated with higher exports overall and along both the extensive and intensive margins. At the policy implementation level, availability of the ETSW increased export values by 46 percent, the number of exporters (extensive margin) by 12 percent, and average export values per firm (intensive margin) by 31 percent (Figure 14.6, Panel B). Estimates further reveal that digitalization of border procedures through an ETSW is equivalent to removing a 7 percent ad valorem tariff at the firm level. Furthermore, these effects have been larger for small firms in noncentral regions—precisely the firms for which the costs of completing in-person, paper-based procedures represent a larger trade barrier; see Carballo, Graziano, et al. (forthcoming).

Figure 14.6. Implementation and Export Effects of ETSWs

A. Costa Rica's ETSW implementation across product customs



B. The impact of ETSW on exports



Source: Carballo, Graziano, et al. (forthcoming) for Costa Rica; Frache, Gómez Decker, and Volpe Martincus (forthcoming) for Uruguay.
Note: The analysis of Costa Rica considered agricultural products; that for Uruguay considered all products. The figure reports the estimated export effects of ETSWs, along with 95 percent confidence intervals (CI).

A more comprehensive evaluation—not limited to trade procedures for agricultural products—was undertaken for Uruguay's ETSW (Frache, Gómez Decker, and Volpe Martincus, forthcoming). It reveals similar effects on export values, number of exporting firms, and average exports per firm (Figure 14.6, Panel B).

The ETSW's positive export effects can be at least partially traced back to increased shipping frequency, exactly what one would expect if the new system reduced per-shipment fixed costs. Firms can thus ship more often, either to meet customers' preferred arrival dates or to supply markets experiencing demand uncertainty.

Importantly, an ETSW implemented by one country alone does not allow countries and their firms to reap all the digitalization benefits. Trade expansion is significantly larger when partner countries also implement ETSWs, as this reduces trade costs on both sides of the border. Estimates suggest that this increase can be twice as large as when only one economy has an operative ETSW (Carballo, Graziano, et al., forthcoming). Such complementarity indicates that both network externalities and potential cross-country coordination problems could lead to suboptimally low adoption, as countries do not typically take partners' trade gains into account when implementing ETSWs.[3]

Further, trade gains can be even larger where integrated digital trade platforms connect all border agencies of countries within and across regions. The Central American Digital Trade Platform (PDCC, for its acronym in Spanish) is an ambitious subregional initiative that seeks such integration of ETSWs with customs, migration, and sanitary and phytosanitary authorities across Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.[4]

Under this system, exporters submit the information required for customs clearance only to the origin country's customs authority. For goods subject to restrictions, ETSWs electronically transmit certificate and permit information through the PDCC, thereby removing the need to resubmit it at the destination country's customs office.

Looking ahead, AI can significantly change the design and operation of these digital public systems. Border agencies have already started to use machine-learning models to increase the effectiveness of their risk management systems. These models can help identify more accurately shipments that are more likely to be noncompliant, thereby helping reduce the share of trade flows that need to be subject to delay-creating border inspections (WCO 2025). Moreover, AI agents could identify required certifications, extract data from commercial invoices to draft declarations, check data consistency, and submit documents with minimal human intervention. In this context, mature ETSWs and digital border systems in general should evolve from submission portals to trusted, AI-enabled orchestration

[3] In practice, ETSW interoperability should be built in from the onset; allowing for it ex post is expensive, particularly with proprietary systems.

[4] The IDB provides technical support and manages the funding for the PDCC.

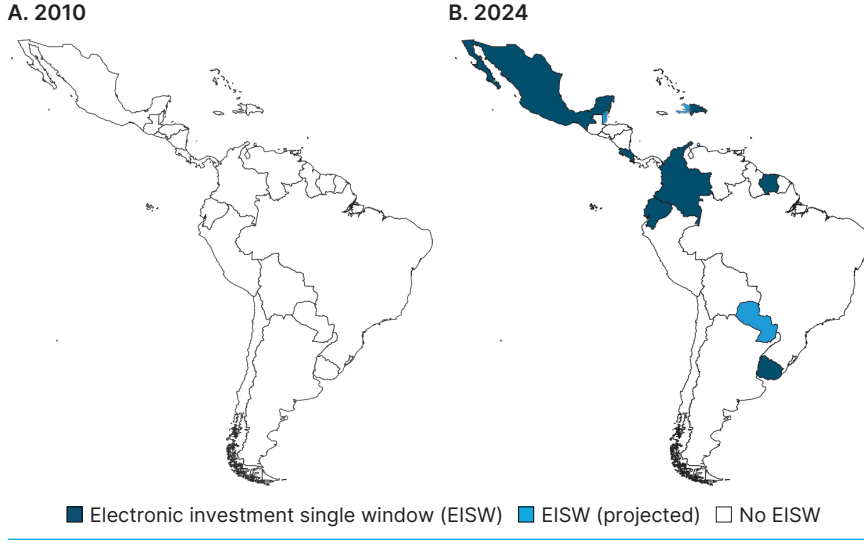
platforms supporting AI agents across public and private ecosystems. For countries whose systems are at earlier stages, it would be crucial to avoid digitalizing procedures through rigid platforms and favor modular interoperable digital trade infrastructure (Duval, Haider, and Pamulapat 2026).

Electronic Investment Single Windows

Investing firms also confront cumbersome, time-consuming procedures to establish themselves and operate in a country. They face various entry and registration hurdles, such as the need to register multiple times, fill out redundant paperwork, and obtain sector-specific licenses, which can take months or years to process without clear timelines. They are also confronted with operational and post-establishment barriers, such as difficulties in obtaining construction permits.

Like their trade counterparts, investment facilitation policies can streamline investment-related procedures to reduce completion times and costs. Digitalizing these procedures can further lower completion costs; it thus favors investment by firms and the expansion of economic activity, particularly when EISWs are instituted. These digital platforms enable government databases to talk to each other and provide investing firms with a single entry point to fulfill local regulatory requirements (registration, licenses, payments) for establishment and reinvestment. They also allow firms to track their applications' status in real time, which increases accountability and thus further expedites completion. The use of EISWs has gained momentum in Latin America and the Caribbean since 2010 (Figure 14.7).

Figure 14.7. Single Windows for Investment: Implementation across the Region

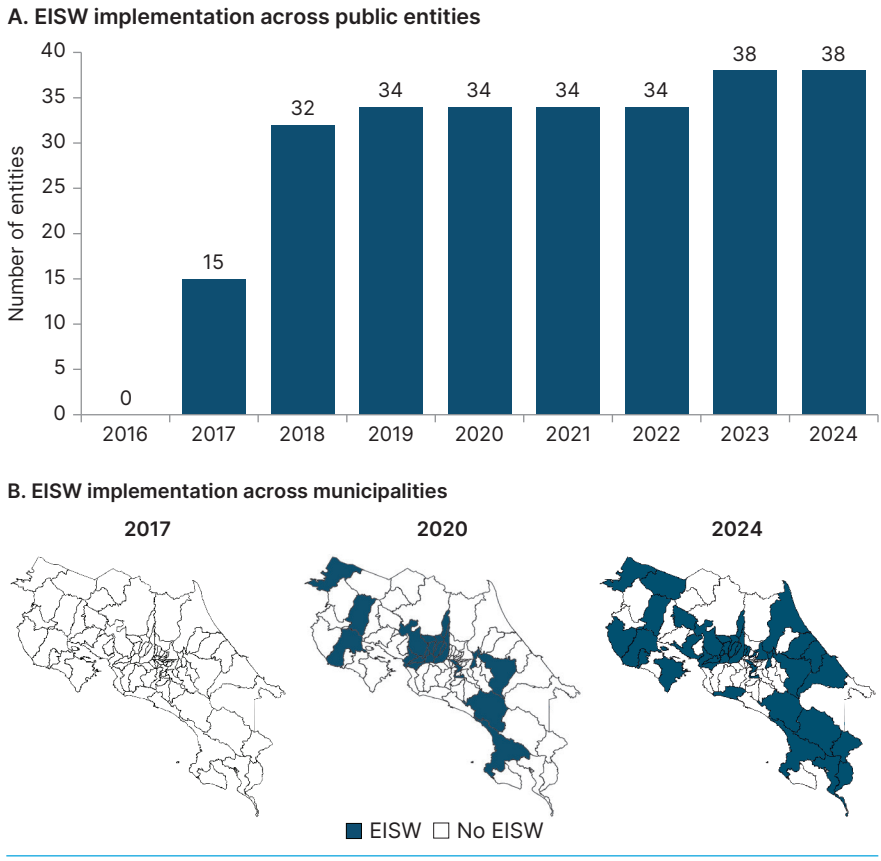


Source: IDB staff elaboration, based on internal data.

The process of designing and introducing EISWs is even more complex than that for ETSWs, as it involves more public entities and jurisdictional layers (national, state/provincial, municipal). Hence, EISWs are implemented stepwise across these entities and levels (Figure 14.8, Panels A and B).

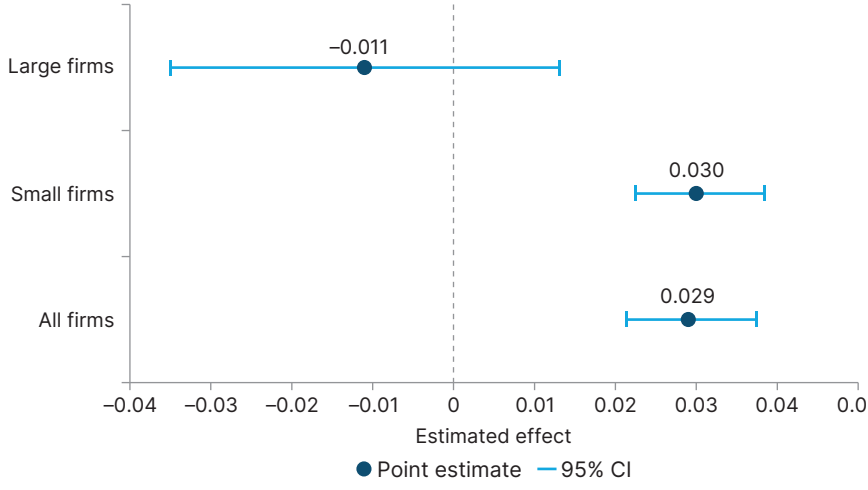
Estimates based on its gradual implementation in Costa Rica reveal that the EISW has been associated with higher economic activity in the municipalities in question, primarily along the firm extensive margin—that is, it has resulted in more firms operating in these municipalities, when cross-municipality differences in activity levels previously did not exist. This effect has been concentrated primarily in relatively small firms, where the EISW-enabled reduction in the burden of investment administrative procedures has made a larger difference (Figure 14.9).

Figure 14.8. Costa Rica's Electronic Investment Single Window



Source: IDB staff calculations, based on data from the Costa Rican Foreign Trade Promoter (PROCOMER).

Figure 14.9. The Impact of Costa Rica's Electronic Investment Single Window



Source: IDB staff calculations, based on Scattolo and Volpe Martincus (forthcoming), who use data from PROCOMER and the Register of Economic Variables (REVEC).
Note: The figure shows the estimated effects of the electronic investment single window on the number of firms operating in a municipality, both overall and by firm size, along with 95 percent confidence intervals (CI).

When Digitalization Works

While the evidence clearly indicates digitalizing relevant procedures effectively facilitates trade and investment, digitalization is not a panacea. Beyond the need for infrastructure and connectivity, several conditions must be met for digitalization to produce the expected results. First, a careful redesign of procedures is essential if adoption of digital technology is to yield trade gains, as the experience of Costa Rica clearly exemplifies (Volpe Martincus 2016). Poorly designed procedures that make compliance with trade regulations cumbersome will not become mechanically efficient once digital technology is introduced.[5] The proper establishment of an electronic single window involves a structured, comprehensive analysis of business processes to map, document, and evaluate all existing procedures and identify redundancies and unnecessary steps and requirements. Based on this analysis, data are harmonized, documents simplified, and processes optimized to eliminate those inefficiencies (UNESCAP 2012).

[5] Even worse, digitalization of redundant procedures can entrench them. Once embedded in software, with agency workflows configured around them and staff trained to operate within them, they become significantly harder to eliminate than in paper form (UNCTAD 2023).

Second, successfully implementing a single window requires an effective institutional incentive mechanism to avoid underinvestment and secure agencies' engagement. This mechanism must help overcome the typical initial fragmentation and even technological incompatibility of agencies' information technology (IT) systems, which impede interoperability and prevent network effects from being captured. The rationale is clear: The social gains from a fully integrated, single-submission system are large but generally distributed across many firms and the economy as a whole, whereas each individual agency bears concentrated private costs. The private costs include those that need to be incurred to integrate the agency's IT system into the ETSW and those associated with the internal adjustments to adopt it effectively.

Third, change management and training are required to ensure the system works as expected. Technology deployment does not equate to actual adoption and use, even if the coordination problem is resolved. Middle managers, for instance, should be involved in process redesign workshops so they can co-own the new procedures. Similarly, it is important to provide the frontline civil servants who face significant change in their work modalities with the new skills they need to operate under the new system.

Finally, cybersecurity must be properly addressed. Commercial data submitted through a single window are sensitive, and a breach of the system compromises several datasets at once.

Digital Technology and Trade: Online Business Platforms

Information is incomplete in international markets. Firms must learn about prevailing conditions in foreign markets and, crucially, find and assess potential business partners (Rangan and Lawrence 1999). Evidence suggests that search costs are large; they amount to more than US$50,000 for nonexporting firms wishing to ensure one potential client per year (Eaton et al. 2025), and they account for more than 90 percent of the empirical gravity relationship between trade flows and shipping distance (Allen 2014).

Digital technology is rapidly transforming how firms interact and trade (Chen and Volpe Martincus 2022). Trade interactions between firms, and between firms and customers, increasingly take place via online platforms (WTO 2018), which can increase firms' visibility to potential buyers, reduce search and matching costs and thus information frictions, and help firms establish reputation and reveal quality (Chen and Wu 2021).

ConnectAmericas, an important online business platform launched by the IDB in 2014, aims to reduce information-related trade barriers in Latin America

and the Caribbean and thus support firms' internationalization.[6] Unlike some similar platforms, ConnectAmericas is purely informational, providing neither payment nor logistical solutions. It offers capacity-building services related to general trade information (for example, webinars and training materials), provides specific commercial information, and allows firms to search for profiles of potential partners and interact with their staff.

Estimates using data on firms' participation and activities in ConnectAmericas and firms' exports from customs agencies reveal that the platform helps reduce search costs by making firms more visible to potential buyers, thus favoring their goods exports along both the intensive and extensive margins. On the former, evidence from Peru reveals that, on average, export values increase 17 percent when a firm joins the platform. This increase in export values is particularly pronounced for products, destinations, and firms subject to more severe information frictions (Carballo et al. 2022).

Moreover, the platform has helped firms increase their goods exports along the destination extensive margin—that is, it has helped them enter new foreign markets (Figure 14.10). ConnectAmericas increased the probability of a firm's selling to a destination by 0.4 percentage points. The positive impact is substantially stronger for those destinations whose firms have visited other firms' ConnectAmericas profiles than for those without such visits—a difference of about 20 percentage points. This indicates that such effects are associated with an increased visibility to potential buyers (Carballo, Chen, et al., forthcoming).

While online platforms reduce them by exposing exporters to potential buyers worldwide, important search and matching frictions remain. Firms and consumers consider a very small subset of all available products. Moreover, a large and rising number of firms can result in market congestion. In online markets, the entry of additional sellers imposes a negative externality on incumbents by intensifying competition for buyers' attention. This can, in turn, lead to potential misallocation, as highly productive firms become less able to effectively signal quality and accordingly capture a suboptimally low market share.[7] This dynamic has important policy implications: In congested online markets, blanket onboarding initiatives mechanically expand supply without internalizing the negative externality imposed on other firms from the same country that are already operating on the platform, thus exacerbating the problem (Bai et al. 2025).[8]

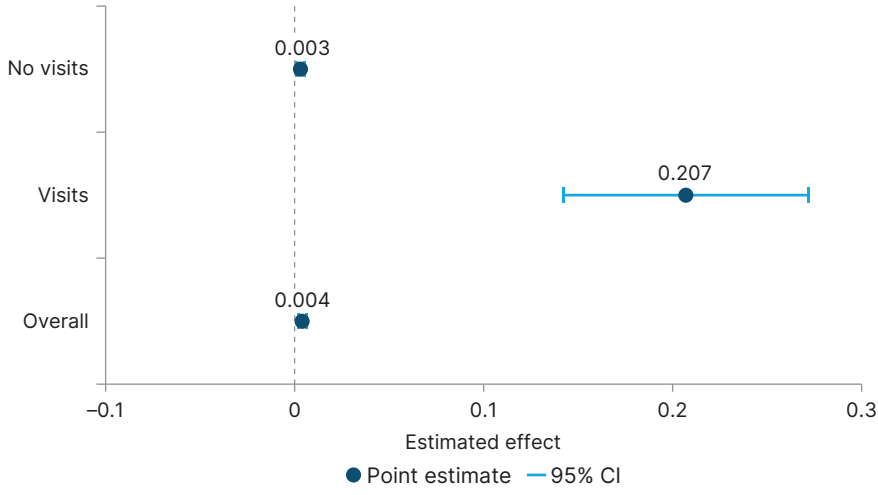
---

[6] Development of ConnectAmericas was supported by Google, DHL, SeaLand, MasterCard, and Facebook.

[7] This result is less likely to be an issue where there are nascent platforms, thin markets, or new product or country niches.

[8] Digital platforms can give rise to additional policy challenges. Network effects, for instance,

Figure 14.10. Impact of Digital Platform on Colombian Firms' Entry into New Foreign Markets



Source: Carballo, Chen, et al. (forthcoming), based on data from ConnectAmericas, DIAN (National Directorate of Taxes and Customs), Confecámaras, PROCOLOMBIA, and Supersociedades.
Note: The figure shows the estimated effects of participation in the ConnectAmericas platform on firms' probability of entering a destination, both overall and depending on whether their profiles were visited by buyers from that destination, along with 95 percent confidence intervals (CI).

Adequate institutional arrangements and fine-tuned policies for the digital environment are called for. These include platform intelligence activities, such as identifying and disseminating viable product–destination combinations within platforms, which can help internalize the information externality associated with the discovery of business opportunities, and targeting capacity-building support to firms selected through proactive screening based on production capacity and product quality, which can generate positive information spillovers in noncongested market niches.

Other appropriate policies might also encompass AI-facilitated firm-to-firm matchmaking services, which would allow covering more potential business partners, considering larger sets of data on them, and using these data more systematically and consistently. Initial evidence suggests that generative AI is effective in reducing information frictions and yields trade gains on top of those associated with platform participation; among firms actually recommended to potential buyers by ConnectAmericas' AI-based matchmaking tool, exports are roughly 45 percent higher than for similar firms that could have been, but were not, recommended (Chen and Volpe Martincus, forthcoming).

can create strong incumbency advantages. It is, hence, crucial to ensure platform markets remain contestable through competition policy and properly calibrated regulation.

How AI Can Make Investment Promotion Policy More Effective

Countries around the world have established investment promotion agencies (IPAs), which provide firms with services that reduce the costs of doing business arising from information frictions. AI can make these services more effective, particularly when complementary conditions, such as leadership and change management, staff training, and high-quality data, are in place.

Information Frictions and Investment Promotion

Firms seeking to invest abroad must solve a multidimensional information problem. They need to know the general and sector-specific regulations to be complied with and the costs and conditions of establishing themselves and operating in the destination country.

Such information can be highly incomplete and very costly to gather. As a result, foreign firms looking for locations may consider a small range of alternatives and disregard several potentially convenient ones; see, for example, Loewendahl (2018). This narrow focus can be particularly detrimental for less popular markets, such as developing economies in Latin America and the Caribbean.

Both within and outside the region, countries have established IPAs to address these information barriers and place their territories on foreign investors' maps (Volpe Martincus and Sztajerowska 2019; Volpe Martincus 2021). The question is which firms IPAs should proactively target and approach, a problem as multidimensional as that faced by firms pursuing investment opportunities overseas. According to standard databases, there are more than 400,000 active multinational firms worldwide—that is, firms with at least one affiliate in a foreign country.

The Standard Approach to Investment Promotion Targeting

IPAs typically follow a couple of steps to reduce the dimensionality of the problem. First, they develop country and sector prioritization strategies, mainly based on inputs from internal experts and consultations with international investors and experts (Volpe Martincus and Sztajerowska 2019). Existing macro evidence indicates that this approach is associated with positive significant effects on FDI inflows; see, for example, Harding and Javorcik (2011). Second, they select specific firms for targeting, relying primarily on the expertise of the officials responsible for the respective sectors or countries and on basic data use.

To assess performance in this dimension, IPAs typically use the assistance–establishment conversion rate—that is, the share of assisted firms that set up an affiliate in the country. In Latin America and the Caribbean, almost 10 percent of IPA-supported multinational firms, on average, establish a first affiliate in a given country.

More formal microeconometric evidence has been produced using firm-level data on investment promotion support and multinational firms' location decisions for 12 Latin American countries (Volpe Martincus 2021); see Carballo et al. (2025). It suggests that the policies described above have been effective in the region: IPA support has been associated with an 8-percentage-point increase in the probability that a multinational will establish its first foreign affiliate there.

The standard investment promotion approach is largely manual, however, and thus has clear shortcomings. Sector prioritization, country prioritization, and the selection of firms for targeting are all limited in scope by scale and complexity and are not evidence based. More specifically, IPAs make suboptimal use of the wealth of microdata on multinational firms available to them; see Volpe Martincus (2021). Specialists can examine very few firms along very few dimensions, and rarely do so consistently with one another or over time. Furthermore, while specialists' expertise is an invaluable asset to IPAs, it is often lost when officials switch positions or leave the organization, thereby eroding institutional memory and learning.

Machine Learning for Investment Promotion Targeting

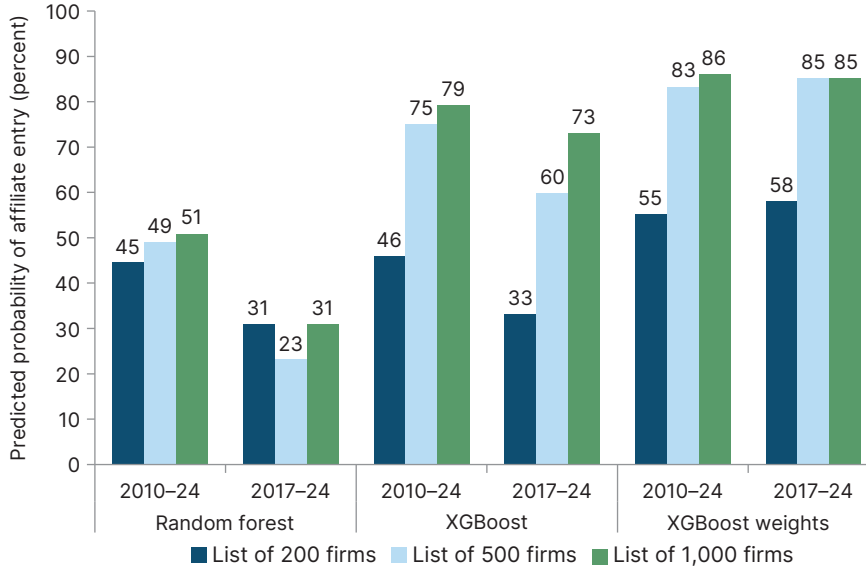
Targeting can be optimized and made more evidence based by exploiting all available data through advanced algorithms. This approach requires framing targeting as a prediction problem, using theory and empirical evidence to single out relevant determinants of firms' location decisions, leveraging comprehensive firm-level databases, and applying machine-learning (ML) models to identify the firms most likely to establish affiliates.

This digital technology–based investment promotion approach has been implemented with different specific methods using Uruguayan data. The results indicate that the approach could significantly increase the effectiveness of these policies. Whereas IPA assistance reaches on average only 10 percent of the multinational firms established in the region, the model's top 200 firms, ranked by their probability of opening an affiliate in Uruguay, include about half of those that did so. When the list is expanded to the top 500–1,000 firms, it includes 75 percent of the multinationals that began operating in the country (Figure 14.11).

Machine-Learning Tools for Better-Informed Policy Decisions

Digital technologies in general and AI in particular are not automatic, standalone solutions to the challenge of designing and implementing effective investment promotion policies. Several complementary factors must be in place for these technologies to work. First, accurate predictions require detailed, high-quality firm-level data as critical algorithm inputs, and potential biases should be assessed and minimized. Training data that reflect historical FDI patterns can

Figure 14.11. Model Performance for Investment Promotion: Capturing Actual Establishments



Source: Carballo and Volpe Martincus (forthcoming).
Note: The figure shows the predicted probability of affiliate entry, in percent, by machine-learning model and estimation period. Within each model-period combination, bars show predictions using firm lists of 200, 500, and 1,000 firms, respectively.

encode biases toward established firms, sectors, and home countries, so that ML reinforces existing investment patterns rather than uncovering new ones. This tendency can be at least partially countered using forward-looking data on FDI signals.

Leadership and change management are also necessary conditions for effective and productive adoption of digital technologies by IPAs. The success of digital initiatives demands support from upper management, active engagement of operational teams, and general openness to using digital technologies. For this openness to materialize, and hence for technology to be effectively adopted and used, IPA officials must be given appropriate incentives and training.[9] The value of this approach is likely highest at the long-to-short-list stage, where ML can help officials efficiently scan large pools of firms and prioritize those meriting human engagement, rather than in fully automating outreach end-to-end.

[9] IPAs lacking the technical capacity to develop, maintain, and critically evaluate these systems can still implement them with technical assistance from international organizations and academia.

Policy Recommendations

The evidence in this chapter indicates that digital technologies in general, and AI in particular, can reduce trade costs across their various sources, thereby expanding trade and FDI and, in turn, fostering productivity and economic growth. Ensuring the gains associated with these channels materialize requires the presence of complementary factors, including enabling conditions (such as regulations and competition policies, to ensure the contestability of online markets), along with the following set of specific, mutually reinforcing policy actions.

Build complete, up-to-date firm registers. Trade and investment agencies should effectively use their respective data to make evidence-based, accurate, unbiased administrative decisions (for example, whether to issue a permit, or whether a shipment should be physically inspected) and predictions (for example, identifying the firms most likely to benefit from, and therefore to be targeted by, trade or investment promotion support). This requires interconnection, or at least interoperability, of the existing administrative databases held by tax authorities, customs and other border agencies, central banks, social security institutions, national statistical offices, and public entities that support firms, as well as access to those databases. It also involves creating new databases to fill important gaps, such as the need for detailed firm-level information on foreign investment and services exports and imports. All of this, in turn, demands appropriate data governance to design and oversee homogenization, quality assurance, and updating mechanisms; to set eligibility criteria and conditions of use; to uphold privacy protection; and to ensure cybersecurity.

Develop comprehensive, AI-ready digital trade and investment systems. Digital systems should be integrated or interoperable within countries and, where feasible, across them, and they should cover the full transaction chain. This way, they can give firms a single point of entry and reduce regulatory compliance and operating costs. This implies extending the scope beyond ETSWs and EISWs, which streamline trade and investment administrative procedures, to systems such as Port Community Systems, which support interactions between trading firms and multiple actors responsible for moving shipments to, within, and across border facilities, such as ports and airports. In addition, the systems should be designed, or upgraded, to accommodate AI, as it can automate both firms' completion of these steps and the decisions made by agencies and providers. Several conditions must be met for these systems to make a difference in practice. Actual adoption and use depend on process reengineering, workable interagency collaboration arrangements, well-conceived change management, effective intra-agency incentive structures, and targeted training.

Use AI to increase the effectiveness of administrative trade and investment decisions and of proactive promotion interventions. Provided the conditions above are met, trade and investment agencies should assess and progressively adopt AI models to make better-informed decisions on permit and certification approvals, which shipments to inspect physically, and which firms to prioritize for trade and investment promotion support. AI-based firm targeting is not limited to traditional offline promotion. It can also be combined with online business platforms, which could be used more intensively and whose reach AI can broaden. It is important to regularly assess the effectiveness of these targeting approaches, and of the specific models on which they rely, so they can be optimized dynamically. Randomized controlled trials are generally well suited to this purpose. AI-driven targeting lends itself naturally to randomization, as capacity constraints imply the shipments that can be inspected and the firms that can be assisted are only a subset of a larger pool sharing the same ex ante probability of, respectively, noncompliance or of benefiting from support.

References

Abernethy, Jacob, Alex Chojnacki, Arya Farahi, Eric Schwartz, and Jared Webb. 2018. "ActiveRemediation: The Search for Lead Pipes in Flint, Michigan." In *KDD '18: Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*, August 19–23, 2018, London, United Kingdom. Association for Computing Machinery, 5–14. https://doi.org/10.1145/3219819.3219896.

Abrahamsson, Sara. 2026. "Smartphone Bans, Student Outcomes and Mental Health." *Journal of Human Resources* 61 (2). https://doi.org/10.3368/jhr.0224-13403R2.

Acemoglu, Daron. 2025. "The Simple Macroeconomics of AI." *Economic Policy* 40 (121): 13–58. https://doi.org/10.1093/epolic/eiae042.

Acemoglu, Daron, Ufuk Akcigit, and Simon Johnson. 2026. "Technology and Economic Development." NBER Working Paper No. 34730. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w34730.

Acemoglu, Daron, and David Autor. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics* 4B, edited by Orley Ashenfelter and David Card. Elsevier.

Acemoglu, Daron, David Autor, Jonathon Hazell, and Pascual Restrepo. 2022. "Artificial Intelligence and Jobs: Evidence from Online Vacancies." *Journal of Labor Economics* 40 (S1): S293–340. https://doi.org/10.1086/718327.

Acemoglu, Daron, David Autor, and Simon Johnson. 2026. "Building Pro-Worker Artificial Intelligence." NBER Working Paper No. 34854. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w34854.

Acemoglu, Daron, Andrea Manera, and Pascual Restrepo. 2020. "Does the US Tax Code Favor Automation?" Brookings Papers on Economic Activity, Spring, 231–300. https://www.brookings.edu/articles/does-the-u-s-tax-code-favor-automation.

Acemoglu, Daron, and Pascual Restrepo. 2018. "The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment." *American Economic Review* 108:1488–1542. https://doi.org/10.1257/aer.20160696.

———. 2019. "Automation and New Tasks: How Technology Displaces and Reinstates Labor." *Journal of Economic Perspectives* 33 (2): 3–30. https://doi.org/10.1257/jep.33.2.3.

———. 2020. "Robots and Jobs: Evidence from US Labor Markets." *Journal of Political Economy* 128 (6): 2188–244. https://doi.org/10.1086/705716.

———. 2022. "Tasks, Automation, and the Rise in US Wage Inequality." *Econometrica* 90 (5): 1973–2016. https://doi.org/10.3982/ECTA19815.

Acosta, Camilo, Nadia Rocha, and Christian Volpe Martincus. Forthcoming. "Determinants of Digitally Delivered Trade: Interactions Between Institutions and Infrastructure." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Acquisti, Alessandro, Curtis Taylor, and Liad Wagman. 2016. "The Economics of Privacy." *Journal of Economic Literature* 54 (2): 442–92. https://doi.org/10.1257/jel.54.2.442.

Aebi, Marcelo F., and Edoardo Cocco. 2024. "SPACE I – 2023 – Council of Europe Annual Penal Statistics: Prison Populations." Council of Europe. https://wp.unil.ch/space/files/2025/04/space_i_2023_report.pdf.

Aghion, Philippe, Antonin Bergeaud, Timo Boppart, Peter J. Klenow, and Huiyu Li. 2023. "A Theory of Falling Growth and Rising Rents." *Review of Economic Studies* 90:2675–702. https://doi.org/10.1093/restud/rdad016.

Aghion, Philippe, and Simon Bunel. 2024. "AI and Growth: Where Do We Stand?" Federal Reserve Bank of San Francisco. Policy note. https://www.frbsf.org/wp-content/uploads/AI-and-Growth-Aghion-Bunel.pdf.

Aghion, Philippe, and Peter Howitt. 1992. "A Model of Growth Through Creative Destruction." *Econometrica* 60 (2): 323. https://doi.org/10.2307/2951599.

Agrawal, Ajay, Joshua Gans, and Avi Goldfarb. 2018. *Prediction Machines: The Simple Economics of Artificial Intelligence*. Boston, MA: Harvard Business Review Press.

———. 2019. "Artificial Intelligence: The Ambiguous Labor Market Impact of Automating Prediction." *Journal of Economic Perspectives* 33 (2): 31–50. https://doi.org/10.1257/jep.33.2.31.

———. 2026. *Power and Prediction: The Disruptive Economics of Artificial Intelligence*. Updated edition. Cambridge, MA: Harvard Business Review Press.

Agrawal, Ajay, John McHale, and Alexander Oettl. 2024. "Artificial Intelligence and Scientific Discovery: A Model of Prioritized Search." *Research Policy* 53 (5). https://doi.org/10.1016/j.respol.2024.104989.

Aguirre De Mora, Florencia, Benjamin Roseth, and Julieth Santamaria. 2024. "Does Reluctance to Share Personal Data Reduce Citizen Demand for Personalized Services? Evidence from a Survey Experiment." IDB Working Paper No. 1540. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/does-reluctance-share-personal-data-reduce-citizen-demand-personalized-services-evidence-survey.

Aitken, Brian, Gordon H. Hanson, and Ann E. Harrison. 1997. "Spillovers, Foreign Investment, and Export Behavior." *Journal of International Economics* 43 (1–2): 103–32. https://doi.org/10.1016/S0022-1996(96)01464-X.

Aitken, Brian J., and Ann E. Harrison. 1999. "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela." *American Economic Review* 89 (3): 605–18. https://doi.org/10.1257/aer.89.3.605.

Aiken, Emily, Tim Ohlenburg, and Joshua Blumenstock. 2023. "Moving Targets: When Does A Poverty Prediction Model Need to Be Updated?" In *Proceedings of the 6th ACM SIGCAS/SIGCHI Conference on Computing and Sustainable Societies*. COMPASS '23, Cape Town, South Africa, August 16–19, 2023. https://dl.acm.org/doi/10.1145/3588001.3609369.

Ajzenman, Nicolás, Ana Teresa del Toro Mijares, Gregory Elacqua, Catalina Hermosilla, and Santiago Veleda. 2026. "Scaling Up Counseling with AI: Evidence from a Nationwide Experiment." IDB Working Paper No. 1887. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0014549.

Ajzenman, Nicolás, Gregory Elacqua, Analía Jaimovich, and Graciela Pérez-Núñez. 2026. "Humans Versus Chatbots: Scaling-Up Behavioral Interventions to Reduce Teacher Shortages." *Journal of Political Economy: Microeconomics* 4 (2). https://doi.org/10.1086/735788.

Akcigit, Ufuk, and Sina T. Ates. 2023. "What Happened to US Business Dynamism?" *Journal of Political Economy* 131 (8): 2059–124. https://doi.org/10.1086/724289.

Aker, Jenny C. 2010. "Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger." *American Economic Journal: Applied Economics* 2 (3): 46–59. https://doi.org/10.1257/app.2.3.46.

Akerman, Anders, Ingvil Gaarder, and Magne Mogstad. 2015. "The Skill Complementarity of Broadband Internet." *Quarterly Journal of Economics* 130 (4): 1781–824. https://doi.org/10.1093/qje/qjv028.

Alarcón, Arturo, and Jairo Quiros-Tortos. 2025. "Unlocking the Grid: How to Ensure Reliable and Sustainable Energy in Latin America and the Caribbean." IDB Technical Note No. 3224. Inter-American Development Bank, Washington, DC. https://dx.doi.org/10.18235/0013798.

Alfaro, Laura. 2017. "Gains from Foreign Direct Investment: Macro and Micro Approaches." *World Bank Economic Review* 30 (supp. 1): S2–15. https://doi.org/10.1093/wber/lhw007.

Alfaro, Laura, and Andrés Rodríguez-Clare. 2004. "Multinationals and Linkages: An Empirical Investigation." *Economía* 4 (2): 113–69. https://doi.org/10.1353/eco.2004.0012.

Alfaro-Ureña, Alonso, Isabela Manelici, and Jose P. Vasquez. 2022. "The Effects of Joining Multinational Supply Chains: New Evidence from Firm-to-Firm Linkages." *Quarterly Journal of Economics* 137 (3): 1495–552. https://doi.org/10.1093/qje/qjac006.

Alfarwan, Nawwarah, Alexander Hodkinson, Maria Panagioti, Lamiece Hassan, and Evangelos Kontopantelis. 2024. "Clinical and Cost-Effectiveness of Telemedicine among Patients with Type 2 Diabetes in Primary Care: A Systematic Review and Meta-Analysis." *Diabetic Medicine: A Journal of the British Diabetic Association* 41 (8): e15345. https://doi.org/10.1111/DME.15343.

Allcott, Hunt, E. Jason Baron, Thomas Dee, Angela L. Duckworth, Matthew Gentzkow, and Brian Jacob. 2026. "The Effects of School Phone Bans: National Evidence from Lockable Pouches." NBER Working Paper No. 35132. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w35132.

Allcott, Hunt, Matthew Gentzkow, Benjamin Wittenbrink, Juan Carlos Cisneros, Adriana Crespo-Tenorio, Drew Dimmery, Deen Freelon, et al. 2025. "The Effect of Deactivating Facebook and Instagram on Users' Emotional State." NBER Working Paper No. 33697. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w33697.

Allen, Treb. 2014. "Information Frictions in Trade." *Econometrica* 82 (6): 2041–83. https://doi.org/10.3982/ECTA10984.

Alm, James, Jay A. Soled, and Kathleen DeLaney Thomas. 2023. "Multibillion-Dollar Tax Questions." Tulane Economics Working Paper No. 2302. Tulane University, Department of Economics. https://repec.tulane.edu/RePEc/pdf/tul2302.pdf.

Allouard, Hugo, Grazia Cecere, Jose De Sousa, Olivier Marie, and Ines Picard. 2024. "Deliver Us from Crime? Online Platforms, Gig Jobs, and Offending." CEPR Discussion Paper No. 21089. Centre for Economic Policy Research, Paris and London. https://cepr.org/publications/dp21089.

Alomar, Dalia, Maryam Almashmoum, Iliada Eleftheriou, Pauline Whelan, and John Ainsworth. 2024. "The Impact of Patient Access to Electronic Health Records on Health Care Engagement: Systematic Review." *Journal of Medical Internet Research* 26:E56473. https://doi.org/10.2196/56473.

Alstadsæter, Annette, Niels Johannesen, and Gabriel Zucman. 2019. "Tax Evasion and Inequality." *American Economic Review* 109 (6): 2073–103. https://doi.org/10.1257/aer.20172043.

Al-Ubaydli, Omar, John A. List, Danielle LoRe, and Dana Suskind. 2017. "Scaling for Economists: Lessons from the Non-Adherence Problem in the Medical Literature." *Journal of Economic Perspectives* 31 (4): 125–44. https://doi.org/10.1257/jep.31.4.125.

Álvarez Alonso, Oliverio, Noé Augusto Afonso Pérez, Alberto González-Salas Mosquera, and Estefanía Hernández Raya. 2023. "Smart Metering in Latin America and the Caribbean: Regulatory Recommendations to Encourage the Deployment of Smart Metering Appropriate to the Needs of Individual Countries." Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/Smart-metering-in-Latin-America-and-the-Caribbean-Regulatory-recommendations-to-encourage-the-deployment-of-smart-metering-appropriate-to-the-needs-of-individual-countries.pdf.

Álvarez Alonso, Oliverio, Alberto Díaz Echeverría, Noé Afonso, Alfonso Sánchez Campos, and Cecilia Bordiu Garcia-Ovies. 2023. *Roadmap for the Digital Transformation of the Energy Sector in Latin America and the Caribbean*, edited by J. Irigoyen, A. Riobó, E. F. Boeck Daza, and M. Pfeifer. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0005215.

Alviarez, Vanessa, Matías Busso, Philip Keefer, Cezar Santos, and Rodolfo Stucchi, eds. 2025. *Markets for Development: Improving Lives through Competition*. Development in the Americas Series. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013850.

Aminuddin, Haziqah Binte, Nana Jiao, Ying Jiang, Jingfang Hong, and Wenru Wang. 2021. "Effectiveness of Smartphone-Based Self-Management Interventions on Self-Efficacy, Self-Care Activities, Health-Related Quality of Life and Clinical Outcomes in Patients with Type 2 Diabetes: A Systematic Review and Meta-Analysis." *International Journal of Nursing Studies* 116:103286. https://doi.org/10.1016/J.IJNURSTU.2019.02.003.

Amir, Eli, Shai Levi, and Tsafrir Livne. 2018. "Do Firms Underreport Information on Cyber-Attacks? Evidence from Capital Markets." *Review of Accounting Studies* 23 (3): 1177–206. https://doi.org/10.1007/s11142-018-9452-4.

Ancker, Jessica S., Alison Edwards, Sarah Nosal, Diane Hauser, Elizabeth Mauer, and Rainu Kaushal. 2017. "Effects of Workload, Work Complexity, and Repeated Alerts on Alert Fatigue in a Clinical Decision Support System." *BMC Medical Informatics and Decision Making* 17 (1): article no. 36. https://doi.org/10.1186/S12911-017-0430-8.

Anderson, James E., and Eric van Wincoop. 2004. "Trade Costs." *Journal of Economic Literature* 42 (3): 691–751. https://doi.org/10.1257/0022051042177649.

Andrews, Dan, Chiara Criscuolo, and Peter N. Gal. 2016. "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy." OECD Productivity Working Papers, No. 5. Organisation for Economic Co-operation and Development. https://www.oecd.org/en/publications/the-best-versus-the-rest_63629cc9-en.html.

Andrews, Matt, Lant Pritchett, and Michael Woolcock. 2017. *Building State Capability: Evidence, Analysis, Action*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198747482.001.0001.

Ang, Amanda, Peter Christensen, and Renato Vieira. 2020. "Should Congested Cities Reduce Their Speed Limits? Evidence from São Paulo, Brazil." *Journal of Public Economics* 184:104155. https://doi.org/10.1016/j.jpubeco.2020.104155.

Angelucci, Manuela, Raissa Fábregas, and Antonia Vazquez. 2026. "The Well-Being Effects of Digital Mental Health Care." IZA Discussion Paper No. 18538. Institute of Labor Economics, Bonn, Germany. https://docs.iza.org/dp18538.pdf.

Anker, Anne Sofie Tegner, Jennifer L. Doleac, and Rasmus Landersø. 2021. "The Effects of DNA Databases on the Deterrence and Detection of Offenders." *American Economic Journal: Applied Economics* 13 (4): 194–225. https://doi.org/10.1257/app.20190207.

Antinyan, Armenak, and Zareh Asatryan. 2025. "Nudging for Tax Compliance: A Meta-Analysis." *Economic Journal* 135 (668): 1033–68. https://doi.org/10.1093/ej/ueae088.

Araujo, María Caridad, Pedro Carneiro, Yyannu Cruz-Aguayo, and Norbert Schady. 2016. "Teacher Quality and Learning Outcomes in Kindergarten." *Quarterly Journal of Economics* 131 (3): 1415–53. https://doi.org/10.1093/qje/qjw016.

Araya, Roberto, Elena Arias Ortiz, Nicolas L. Bottan, and Julian P. Cristia. 2019. "Does Gamification in Education Work? Experimental Evidence from Chile." IDB Working Paper No. 982. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0001777.

———. 2025. "Integrating Learning Platforms within Regular School Time: Experimental Evidence from Chilean Primary Schools." *Economics of Education Review* 106 (June): 102647. https://doi.org/10.1016/j.econedurev.2025.102647.

Arenas-Arroyo, Esther, Daniel Fernandez-Kranz, and Natalia Nollenberger. 2025. "High Speed Internet and the Widening Gender Gap in Adolescent Mental Health: Evidence from Spanish Hospital Records." *Journal of Health Economics* 102: 103014. https://doi.org/10.1016/j.jhealeco.2025.103014.

Arias Ortiz, Elena, Nicolás Castro Vergara, Tatiana Forero Pabón, Gabriela Della Nina Gambi, Cecilia Giambruno, Marcelo Pérez-Alfaro, and Daniel Rodríguez Segura. 2025. "AI and Education: Building the Future through Digital Transformation." IDB Technical Note No. 3122. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013500.

Arias Ortiz, Elena, and Cecilia Giambruno. 2025. "Nota CIMA 37: Inteligencia artificial en las escuelas: Evidencia desde TALIS 2024" [CIMA note 37: Artificial intelligence in schools: Evidence from TALIS 2024]. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/es/publications/spanish/viewer/Nota-CIMA-37-Inteligencia-artificial-en-las-escuelas-evidencia-desde-TALIS-2024.pdf.

Arias Ortiz, Elena, Cecilia Giambruno, and Sofia Karsaclian. 2026. "The State of Education in Latin America and the Caribbean 2026: A Geospatial Perspective." IDB Technical Note No. 03287. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/state-education-latin-america-and-caribbean-2026-geospatial-perspective.

Aridor, Guy, Yeon-Koo Che, and Tobias Salz. 2023. "The Effect of Privacy Regulation on the Data Industry: Empirical Evidence from GDPR." *RAND Journal of Economics* 54 (4): 695–730. https://doi.org/10.1111/1756-2171.12455.

Arietti, Rachael. 2024. "Do Real-Time Crime Centers Improve Case Clearance? An Examination of Chicago's Strategic Decision Support Centers." *Journal of Criminal Justice* 90:102145. https://doi.org/10.1016/j.jcrimjus.2023.102145.

Arredondo, Armandi. 2014. "Type 2 Diabetes and Health Care Costs in Latin America: Exploring the Need for Greater Preventive Medicine." *BMC Medicine* 12 (1): article no. 136. https://doi.org/10.1186/S12916-014-0136-Z.

Arzola, María Paz. 2011. "Impacto de la jornada escolar completa en la evolución del SIMCE" [Impact of the full school day on the evolution of SIMCE]. Social Report Series No. 132. Libertad y Desarrollo. https://lyd.org/storage/other/files_mf/siso132impactodelajornadaescolarcompletaenlaevoluciondelsimcemparzolaabril2011.pdf.

Athey, Susan, Christian Catalini, and Catherine Tucker. 2017. "The Digital Privacy Paradox: Small Money, Small Costs, Small Talk." NBER Working Paper No. 23488. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w23488.

Atkin, David, Amit K. Khandelwal, and Adam Osman. 2017. "Exporting and Firm Performance: Evidence from a Randomized Experiment." *Quarterly Journal of Economics* 132 (2): 551–615. https://doi.org/10.1093/qje/qjx002.

Atsebi, Jean-Marc B., Nikolay Gueorguiev, and Manabu Nose. 2025. "Enhancing Tax Capacity: Revenue Gains from Strengthening Tax Administration." IMF Working Paper No. 25/219. International Monetary Fund, Washington, DC. https://doi.org/10.5089/9798229029827.001.

Audretsch, David B., Erik E. Lehmann, and Susanne Warning. 2005. "University Spillovers and New Firm Location." *Research Policy* 34 (7): 1113–22. https://doi.org/10.1016/j.respol.2005.05.009.

Autor, David. 2024. "Applying AI to Rebuild Middle Class Jobs." NBER Working Paper 32140. National Bureau of Economic Research, Cambridge, MA. http://www.nber.org/papers/w32140.

Autor, David H., and David Dorn. 2013. "The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market." *American Economic Review* 103 (5): 1553–97. https://doi.org/10.1257/aer.103.5.1553.

Autor, David H., David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. 2020. "The Fall of the Labor Share and the Rise of Superstar Firms." *Quarterly Journal of Economics* 135 (2): 645–709. https://doi.org/10.1093/qje/qjaa004.

Autor, David H., Lawrence F. Katz, and Alan B. Krueger. 1998. "Computing Inequality: Have Computers Changed the Labor Market?" *Quarterly Journal of Economics* 113 (4): 1169–213. https://doi.org/10.1162/003355398555874.

Autor, David H., Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics* 118 (4): 1279–333. https://doi.org/10.1162/003355303322552801.

Avellán, Leopoldo, and Steve Brito. 2023. "Crossroads in a Fog: Navigating Latin America's Development Challenges with Text Analytics." Technical note. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/crossroads-fog-navigating-latin-americas-development-challenges-text-analytics.

Ayers, John W., Adam Poliak, Mark Dredze, Eric C. Leas, Zechariah Zhu, Jessica B. Kelley, Dennis J. Faix, et al. 2023. "Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum." *JAMA Internal Medicine* 183 (6). https://doi.org/10.1001/jamainternmed.2023.1838.

Azmi, Anna, Noor Sharoja Sapiei, Mohd Zulkhairi Mustapha, and Mazni Abdullah. 2016. "SMEs' Tax Compliance Costs and IT Adoption: The Case of a Value-Added Tax." *International Journal of Accounting Information Systems* 23 (December): 1–13. https://doi.org/10.1016/j.accinf.2016.06.001.

Babina, Tania, Anastassia Fedyk, Alex He, and James Hodson. 2024. "Artificial Intelligence, Firm Growth, and Product Innovation." *Journal of Financial Economics* 151 (C): 103745. https://doi.org/10.1016/j.jfineco.2023.103745.

Babina, Tania, Alex Xi He, and Renhao Jiang. 2026. "Canaries in the Gold Mine: Early Productivity Gains from Artificial Intelligence Creating Organization Capital." NBER Working Paper No. 35684. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w35684.

Baer, Katherine, Matthieu Bellon, Matt Davies, Ruud de Mooij, Vitor Gaspar, Andrea Lemgruber, Mario Mansour, et al. 2025. "Building Tax Capacity for Growth and Development: Evidence-Based Analysis for Mobilizing Domestic Revenue." Departmental Papers Series 2025 (007): 1. https://doi.org/10.5089/9798229027298.087.

Baez, Javier, Varun Kshirsagar, and Emmanuel Skoufias. 2019. "Adaptive Safety Nets for Rural Africa: Drought-Sensitive Targeting with Sparse Data." Policy Research Working Paper No. 9071. World Bank, Washington, DC. https://documents1.worldbank.org/curated/en/104851575303189267/pdf/Adaptive-Safety-Nets-for-Rural-Africa-Drought-Sensitive-Targeting-with-Sparse-Data.pdf.

Bagabaldo, Alben Rome, Qianxin Gan, Alexandre M. Bayen, and Marta C. González. 2024. "Impact of Navigation Apps on Congestion and Spread Dynamics on a Transportation Network." *Data Science for Transportation* 6 (2): 12. https://doi.org/10.1007/s42421-024-00099-w.

Bagnoli, Lisa, and Eduardo Cavallo, eds. 2025. *From Risk to Reliability: Resilient Infrastructure Services to Face Nature's Challenges*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0013769.

Bagnoli, Lisa, and Priscila Stisman. 2026. "Beyond Coverage: A Multidimensional Diagnostic of Infrastructure Access in Latin America and the Caribbean." Inter-American Development Bank, Washington, DC.

Bai, Jie, Maggie X. Chen, Jin Liu, Xiaosheng Mu, and Daniel Yi Xu. 2025. "Stand Out from the Millions: Market Congestion and Information Friction on Global E-Commerce Platforms." Working paper. Duke University. https://www.wto.org/english/res_e/reser_e/gtdw_e/wkshop22_e/prof_jie_bai_paper.pdf (accessed July 2026).

Bakker, Bas B., Sophia Chen, Dmitry Vasilyev, Olga Bespalova, Moya Chin, Daria Kolpakova, Archit Singhal, and Yuanchen Yang. 2024. "What Can Artificial Intelligence Do for Stagnant Productivity in Latin America and the Caribbean?" IMF Working Paper No. 219. International Monetary Fund. https://www.imf.org/en/publications/wp/issues/2024/10/11/what-can-artificial-intelligence-do-for-stagnant-productivity-in-latin-america-and-the-556243.

Balsvik, Ragnhild. 2011. "Is Labor Mobility a Channel for Spillovers from Multinationals? Evidence from Norwegian Manufacturing." *Review of Economics and Statistics* 93 (1): 285–97. https://doi.org/10.1162/REST_a_00061.

Bando, Rosangela, Emma Näslund-Hadley, and Paul Gertler. 2018. "Inquiry and Problem-Based Pedagogy: Evidence from 10 Field Experiments." IDB Working Paper No. 958. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0001491.

Banerjee, Abhijit, Tahir Andrabi, Rukmini Banerji, Susan Dynarski, Rachel Glennerster, Sally Grantham-McGregor, Karthik Muralidharan, et al. 2023. "Cost-Effective Approaches to Improve Global Learning: What Does Recent Evidence Tell Us Are Smart Buys for Improving Learning in Low- and Middle-Income Countries?" World Bank Group, Washington, DC. https://documents1.worldbank.org/curated/en/719211603835247448/pdf/Cost-Effective-Approaches-to-Improve-Global-Learning-What-Does-Recent-Evidence-Tell-Us-Are-Smart-Buys-for-Improving-Learning-in-Low-and-Middle-Income-Countries.pdf.

Banerjee, Abhijit, Rukmini Banerji, James Berry, Esther Duflo, Harini Kannan, Shobhini Mukherji, Marc Shotland, and Michael Walton. 2017. "From Proof of Concept to Scalable Policies: Lessons from Teaching at the Right Level." *Journal of Economic Perspectives* 31 (4): 73–102. https://doi.org/10.1257/jep.31.4.73.

Banerjee, Abhijit, Esther Duflo, Clément Imbert, Santhosh Mathew, and Rohini Pande. 2020. "E-Governance, Accountability, and Leakage in Public Programs: Experimental Evidence from a Financial Management Reform in India." *American Economic Journal: Applied Economics* 12 (4): 39–72. https://doi.org/10.1257/app.20180302.

Baptista, Belén, Alessandra Gonzáles, and Elisa Hernández. Forthcoming. "Resultados de corto plazo de las políticas de fomento a la digitalización en Uruguay: Evaluación de impactos del Instrumento Vouchers de Transformación Digital" [Short-term results of digitalization promotion policies in Uruguay: Impact evaluation of the Digital Transformation Vouchers instrument]. Working paper. Inter-American Development Bank, Washington, DC.

Baqaee, David Rezza, and Emmanuel Farhi. 2019. "The Macroeconomic Impact of Microeconomic Shocks: Beyond Hulten's Theorem." *Econometrica* 87 (4): 1155–203. https://doi.org/10.3982/ECTA15202.

Bellon, Matthieu, Jillie Chang, Era Dabla-Norris, Salma Khalid, Juan Carlos Paliza, and Pilar Villena. 2022. "Digitalization and Tax Compliance Spillovers: Evidence from a VAT e-Invoicing Reform in Peru." IMF Working Paper No. 2022/057. International Monetary Fund, Washington, DC. https://doi.org/10.5089/9798400204876.001.

Bellon, Matthieu, Era Dabla-Norris, Salma Khalid, and Frederico Lima. 2022. "Digitalization to Improve Tax Compliance: Evidence from VAT e-Invoicing in Peru." *Journal of Public Economics* 210:104661. https://doi.org/10.1016/j.jpubeco.2022.104661.

Barreix, Alberto Daniel, Martín Bès, Oscar Fonseca, María Belén Fonteñez, Dalmiro Morán, Emilio Pineda, and Jerónimo Roca. 2022. "Revisiting Personalized VAT: A Tool for Fiscal Consolidation with Equity." IDB Discussion Paper No. 939. Inter-American Development Bank. https://doi.org/10.18235/0004147.

Barreix, Alberto, Melina Rocha, and José Tostes. 2025. "The Three Innovative Features of VAT in Brazil's Indirect Tax Reform." Inter-American Development Bank, Washington, DC. http://dx.doi.org/10.18235/0013787.

Barreix, Alberto Daniel, and Raul Zambrano, eds. 2018. *Electronic Invoicing in Latin America*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0001038.

Barro, Robert J., and Jong-Wha Lee. 2013. "A New Data Set of Educational Attainment in the World, 1950–2010." *Journal of Development Economics* 104:184–98. Data set updated September 2021, https://barrolee.github.io/BarroLeeDataSet/.

Bartel, Ann, Casey Ichniowski, and Kathryn Shaw. 2007. "How Does Information Technology Affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement, and Worker Skills." *Quarterly Journal of Economics* 122 (4): 1721–58. https://doi.org/10.1162/qjec.2007.122.4.1721.

Bashir, Noman, Priya Donti, James Cuff, Sydney Sroka, Marija Ilic, Vivienne Sze, Christina Delimitrou, and Elsa Olivetti. 2024. "The Climate and Sustainability Implications of Generative AI." An MIT Exploration of Generative AI, March 2024. https://doi.org/10.21428/e4baedd9.9070dfe7.

Battaglini, Marco, Luigi Guiso, Chiara Lacava, Douglas L. Miller, and Eleonora Patacchini. 2025. "Refining Public Policies with Machine Learning: The Case of Tax Auditing." *Journal of Econometrics* 249 (May): 105847. https://doi.org/10.1016/j.jeconom.2024.105847.

Baumann, Ursel, Zoë B. Cullen, Ester Faia, Annalisa Ferrando, Ricardo Perez-Truglia, and Judit Rariga. 2026. "Innovation without Borders? The Geography of Technological Diffusion." NBER Working Paper No. 35314. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w35314.

Bedoya-Maya, Felipe, Lynn Scholl, Orlando Sabogal-Cardona, and Daniel Oviedo. 2022. "Interactions of Transport Network Companies (TNCS) and Public Transit in Medellín." *Case Studies on Transport Policy* 10 (4): 1965–79. https://doi.org/10.1016/j.cstp.2022.08.011.

Behaghel, Luc, Bruno Crépon, and Thomas Le Barbanchon. 2015. "Unintended Effects of Anonymous Résumés." *American Economic Journal: Applied Economics* 7 (3): 1–27. https://doi.org/10.1257/app.20140185.

Beland, Louis-Philippe, and Richard Murphy. 2016. "Ill Communication: Technology, Distraction & Student Performance." *Labour Economics* 41 (August): 61–76. https://doi.org/10.1016/j.labeco.2016.04.004.

Bellon, Matthieu, Era Dabla-Norris, and Salma Khalid. 2023. "Technology and Tax Compliance Spillovers: Evidence from a VAT E-Invoicing Reform in Peru." *Journal of Economic Behavior & Organization* 212: 756–77. https://doi.org/10.1016/j.jebo.2023.06.004.

Belur, Jyoti, Amy Thornton, Lisa Tompson, Matthew Manning, Aiden Sidebottom, and Kate Bowers. 2020. "A Systematic Review of the Effectiveness of the Electronic Monitoring of Offenders." *Journal of Criminal Justice* 68: 101686. https://doi.org/10.1016/j.jcrimjus.2020.101686.

Bergolo, Marcelo, Juliana Londoño-Vélez, and Darío Tortarolo. 2023. "Tax Progressivity and Taxing the Rich in Developing Countries: Lessons from Latin America." *Oxford Review of Economic Policy* 39 (3): 530–49. https://doi.org/10.1093/oxrep/grad029.

Bernal, Pedro, María Fernanda García, Sofía Castro Vargas, Ricardo Pérez Cuevas, and Sebastian Bauhoff. 2025. "Preventable Hospitalizations Due to Ambulatory Care Sensitive Conditions in Latin America (2015–2019): A Multi-Country Descriptive Analysis." *Lancet Regional Health—Americas* 50:101238. https://doi.org/10.1016/j.lana.2025.101238.

Bernal, Pedro, María Fernanda García, Vilma Irazola, and Paul Rodríguez-Lesmes. 2026. "Hypertension Care Cascade in Latin America: Detection Gaps, Inequities, and the Paradox of Healthy Behaviors." Available at SSRN. https://dx.doi.org/10.2139/ssrn.7386798.

Bernal, Pedro, Jennifer Nelson, Nicolas Irazoque, Carolina Bernal, and Donghyun Kang. 2022. "Time for an Upgrade: Using Digital Interventions to Tackle Non-Communicable Diseases." In *Digitalizing Public Services: Opportunities for Latin America and the Caribbean*, coordinated by Julián Cristia and Razvan Vlaicu. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0004543.

Bertot, John C., Paul T. Jaeger, and Justin M. Grimes. 2010. "Using ICTs to Create a Culture of Transparency: E-Government and Social Media as Openness and Anti-Corruption Tools for Societies." *Government Information Quarterly* 27 (3): 264–71. https://doi.org/10.1016/j.giq.2010.03.001.

Besley, Timothy, and Hannes Mueller. 2018. "Predation, Protection, and Productivity: A Firm-Level Perspective." *American Economic Journal: Macroeconomics* 10 (2): 184–221. https://pubs.aeaweb.org/doi/pdfplus/10.1257/mac.20160120.

Bessen, James. 2015a. *Learning by Doing: The Real Connection between Innovation, Wages, and Wealth*. New Haven, CT: Yale University Press.

———. 2015b. "Toil and Technology: Innovative Technology Is Displacing Workers to New Jobs Rather than Replacing Them Entirely." *Finance & Development* 52 (001): 16. https://doi.org/10.5089/9781498351942.022.A007.

Bettinger, Eric, Robert Fairlie, Anastasia Kapuza, Elena Kardanova, Prashant Loyalka, and Andrey Zakharov. 2022. "Diminishing Marginal Returns to Computer-Assisted Learning." *Journal of Policy Analysis and Management* 42 (2): 552–70. https://doi.org/10.1002/pam.22442.

Beuermann, Diether W., Bridget Hoffmann, Marco Stampini, David L. Vargas, and Diego Vera-Cossio. 2025. "Shooting a Moving Target: Evaluating Targeting Tools for Social Programs when Income Fluctuates." *Journal of Development Economics* 172:103395. https://doi.org/10.1016/j.jdeveco.2024.103395.

Beuermann, Diether, Moises Schwartz, Gerardo Reyes-Tagle, Carlos Silvani, Laura Ospina, Jose Fajgenbaum, Claudio Loser, et al. 2021. *Economic Institutions for a Resilient Caribbean*, edited by Moises Schwartz and Diether Beuermann. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0003053.

Bhargava, Saurabh, and Dayanand Manoli. 2015. "Psychological Frictions and the Incomplete Take-Up of Social Benefits: Evidence from an IRS Field Experiment." *American Economic Review* 105 (11): 3489–529. https://doi.org/10.1257/aer.20121493.

Bhuyan, Soumitra, Vidyoth Sateesh, Naya Mukul, Alay Galvankar, Asos Mahmood, Muhammad Nauman, Akash Rai, Kahuwa Bordoloi, Urmi Basu, and Jim Samuel. 2025. "Generative Artificial Intelligence Use in Healthcare: Opportunities for Clinical Excellence and Administrative Efficiency." *Journal of Medical Systems* 49 (1): article no. 10. https://doi.org/10.1007/s10916-024-02136-1.

Bick, Alexander, Adam Blandin, and David J. Deming. 2026. "The Rapid Adoption of Generative AI." *Management Science*, January 20, 2026. https://doi.org/10.1287/mnsc.2025.02523.

Blackman, Allen, Eduardo A. Cavallo, Bridget Hoffmann, and Adrien Vogt-Schilb, eds. 2025. *Peril and Promise: Tackling Climate Change in Latin America and the*

Caribbean. Development in the Americas Series. Washington, DC: Inter-American Development Bank. http://dx.doi.org/10.18235/0013427.

Blair-Stanek, Andrew, Nils Holzenberger, and Benjamin Van Durme. 2026. "Can LLMs Identify Tax Abuse?" *Proceedings of the AAAI Conference on Artificial Intelligence* 40 (45): 38261–69. https://doi.org/10.1609/aaai.v40i45.41165.

Blattman, Christopher, Donald P. Green, Daniel Ortega, and Santiago Tobón. 2021. "Place-Based Interventions at Scale: The Direct and Spillover Effects of Policing and City Services on Crime." *Journal of the European Economic Association* 19 (4): 2022–51. https://doi.org/10.1093/jeea/jvab002.

Blomström, Magnus, and Ari Kokko. 1998. "Multinational Corporations and Spillovers." *Journal of Economic Surveys* 12 (3): 247–77. https://doi.org/10.1111/1467-6419.00056.

Bloom, Nicholas, Luis Garicano, Raffaella Sadun, and John Van Reenen. 2014. "The Distinct Effects of Information Technology and Communication Technology on Firm Organization." *Management Science* 60 (12): 2859–85. https://doi.org/10.1287/mnsc.2014.2013.

Bloom, Nicholas, Renata Lemos, Raffaella Sadun, Daniela Scur, and John Van Reenen. 2014. "The New Empirical Economics of Management." *Journal of the European Economic Association* 12 (4): 835–76. https://doi.org/10.1111/jeea.12094.

Bloom, Nicholas, Raffaella Sadun, and John Van Reenen. 2012. "Americans Do IT Better: US Multinationals and the Productivity Miracle." *American Economic Review* 102 (1): 167–201. https://doi.org/10.1257/aer.102.1.167.

Bloom, Nicholas, Raffaella Sadun, and John Van Reenen. 2016. "Management as a Technology?" NBER Working Paper No. 22327. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w22327.

Bloom, Nicholas, Mark Schankerman, and John Van Reenen. 2013. "Identifying Technology Spillovers and Product Market Rivalry." *Econometrica* 81 (4): 1347–93. https://doi.org/10.3982/ECTA9466.

Bloom, Nicholas, and John Van Reenen. 2010. "Why Do Management Practices Differ across Firms and Countries?" *Journal of Economic Perspectives* 24 (1): 203–24. https://doi.org/10.1257/jep.24.1.203.

Blumenstock, Joshua E. 2018. "Estimating Economic Characteristics with Phone Data." *AEA Papers and Proceedings* 108: 72–76. https://doi.org/10.1257/pandp.20181033.

Blumenstock, Joshua, Gabriel Cadamuro, and Robert On. 2015. "Predicting Poverty and Wealth from Mobile Phone Metadata. *Science* 350 (6264): 1073–76. https://doi.org/10.1126/science.aac4420.

Blyde, Juan S., ed. 2013. *Synchronized Factories: Latin America and the Caribbean in the Era of Global Value Chains*. Washington, DC: Inter-American Development Bank.

Blyde, Juan S. 2024. *Barriers or Enablers? Towards Trade-Compatible Technical Measures in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0013014.

Bogmans, Christian, Ganchimeg Ganpurev, Patricia Gomez-Gonzalez, Giovanni Melina, Andrea Pescatori, and Sneha Thube. 2026. "Power Hungry: How AI Will Drive Energy Demand." *Energy Economics* 158:109278. https://doi.org/10.1016/j.eneco.2026.109278.

Boone, Claire, Pablo Celhay, Paul Gertler, Tadeja Gracner, and Josefina Rodriguez. 2022. "How Scheduling Systems with Automated Appointment Reminders Improve Health Clinic Efficiency." *Journal of Health Economics* 82:102598. https://doi.org/10.1016/J.JHEALECO.2022.102598.

Borges Almeida Da Fonseca, Cíntia. 2024. "Avança Saúde SP Digital Transformation of Health in the City of São Paulo." Digital Health Case Studies, Edition 12. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/Avanca-Saude-SP-Digital-Transformation-of-Health-in-the-City-of-S%C3%A3o-Paulo.pdf.

Bosch, Mariano, Ángel Melguizo, and Carmen Pagés. 2013. *Better Pensions, Better Jobs: Towards Universal Coverage in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0012584.

Bosch, Mariano, and Norbert Schady. 2019. "The Effect of Welfare Payments on Work: Regression Discontinuity Evidence from Ecuador." *Journal of Development Economics* 139 (June): 17–27. https://doi.org/10.1016/j.jdeveco.2019.01.008.

Braga, Anthony A., Brandon Turchan, Andrew V. Papachristos, and David M. Hureau. 2019. "Hot Spots Policing of Small Geographic Areas Effects On Crime." *Campbell Systematic Reviews* 15 (3): e1046. https://doi.org/10.1002/cl2.1046.

Braga, Anthony A., and David L. Weisburd. 2022. "Does Hot Spots Policing Have Meaningful Impacts on Crime? Findings from an Alternative Approach to Estimating Effect Sizes from Place-Based Program Evaluations." *Journal of Quantitative Criminology* 38 (1): 1–22. https://doi.org/10.1007/s10940-020-09481-7.

Braghieri, Luca, Ro'ee Levy, and Alexey Makarin. 2022. "Social Media and Mental Health." *American Economic Review* 112 (11): 3660–93. https://doi.org/10.1257/aer.20211218.

Brambilla, Irene, Andrés César, Guillermo Falcone, and Leonardo Gasparini. 2023. "The Impact of Robots in Latin America: Evidence from Local Labor Markets." *World Development* 170:106271. https://doi.org/10.1016/j.worlddev.2023.106271.

Brandon, Alec, Christopher M. Clapp, John A. List, Robert D. Metcalfe, and Michael Price. 2022. "The Human Perils of Scaling Smart Technologies: Evidence from Field Experiments." NBER Working Paper No. 30482. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w30482.

Brands, Martijn R., Samantha C. Gouw, Molly Beestrum, Robert M. Cronin, Karin Fijnvandraat, and Sherif Badawy. 2022. "Patient-Centered Digital Health Records and Their Effects on Health Outcomes: Systematic Review." *Journal of Medical Internet Research* 24 (12). https://doi.org/10.2196/43086.

Bresnahan, Timothy F., Erik Brynjolfsson, and Lorin M. Hitt. 2002. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence." *Quarterly Journal of Economics* 117 (1): 339–76. https://doi.org/10.1162/003355302753399526.

Bresnahan, Timothy, and Manuel Trajtenberg. 1995. "General Purpose Technologies 'Engines of Growth'?" *Journal of Econometrics* 65 (1): 83–108. https://doi.org/10.1016/0304-4076(94)01598-T.

Brichetti, Juan Pablo, Eduardo Cavallo, Diego Pitetti, Carlos León-Gómez. 2026. *Eppur si muove: La Evolución de las brechas de infraestructura de ALC 2021–2026* [And yet it moves: The evolution of infrastructure gaps in LAC 2021–2026]. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0014449.

Brichetti, Juan Pablo, Leonardo Mastronardi, María Eugenia Rivas, Tomás Serebrisky, and Ben Solís. 2021. *The Infrastructure Gap in Latin America and the Caribbean: Investment Needed through 2030 to Meet the Sustainable Development Goals*. IDB Monograph No. 962. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0003759.

Britto, Diogo G. C., Paolo Pinotti, and Breno Sampaio. 2022. "The Effect of Job Loss and Unemployment Insurance on Crime in Brazil." *Econometrica* 90 (4): 1393–1423. https://doi.org/10.3982/ECTA18984.

Brockmeyer, Anne, Spencer Smith, Marco Hernandez, and Stewart Kettle. 2019. "Casting a Wider Tax Net: Experimental Evidence from Costa Rica." *American Economic Journal: Economic Policy* 11 (3): 55–87. https://doi.org/10.1257/pol.20160589.

Brooks, Leah, Nicolas Gendron-Carrier, and Gisela Rua. 2021. "The Local Impact of Containerization." *Journal of Urban Economics* 126: 103388. https://dx.doi.org/10.1016/j.jue.2021.103388.

Brown, Ryan, Veronica Montalva, Duncan Thomas, and Andrea Velasquez. 2019. "Impact of Violent Crime on Risk Aversion: Evidence from the Mexican Drug War." *Review of Economics and Statistics* 101 (5): 892–904. https://doi.org/10.1162/rest_a_00788.

Bruhn, Miriam, Dean Karlan, and Antoinette Schoar. 2018. "The Impact of Consulting Services on Small and Medium Enterprises: Evidence from a Randomized Trial in Mexico." *Journal of Political Economy* 126 (2). https://doi.org/10.1086/696154.

Bruns, Barbara, and Javier Luque. 2014. *Great Teachers: How to Raise Student Learning in Latin America and the Caribbean*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/833781468238477204.

Brynjolfsson, Erik. 2022. "The Turing Trap: The Promise & Peril of Human-Like Artificial Intelligence." *Dædalus* 151 (2): 272–87. https://doi.org/10.1162/daed_a_01915.

Brynjolfsson, Erik, Bharat Chandar, and Ruyu Chen. 2026. "Canaries in the Coal Mine? Six Facts about the Recent Employment Effects of Artificial Intelligence." Stanford Digital Economy Lab Working Paper. https://digitaleconomy.stanford.edu/app/uploads/2026/08/Canaries_August2026.pdf.

Brynjolfsson, Erik, and Lorin M. Hitt. 2000. "Beyond Computation: Information Technology, Organizational Transformation and Business Performance." *Journal of Economic Perspectives* 14 (4): 23–48. https://doi.org/10.1257/jep.14.4.23.

———. 2003. "Computing Productivity: Firm-Level Evidence." *Review of Economics and Statistics* 85 (4): 793–808. https://doi.org/10.1162/003465303772815736.

Brynjolfsson, Erik, Xiang Hui, and Meng Liu. 2019. "Does Machine Translation Affect International Trade? Evidence from a Large Digital Platform." *Management Science* 65 (12): 5449–60. https://doi.org/10.1287/mnsc.2019.3388.

Brynjolfsson, Erik, Danielle Li, and Lindsey Raymond. 2025. "Generative AI at Work." *Quarterly Journal of Economics* 140 (2): 889–942. https://doi.org/10.1093/qje/qjae044.

Brynjolfsson, Erik, and Kristina McElheran. 2016. "The Rapid Adoption of Data-Driven Decision-Making." *American Economic Review* 106 (5): 133–39. https://doi.org/10.1257/aer.p20161016.

Brynjolfsson, Erik, Daniel Rock, and Chad Syverson. 2021. "The Productivity J-Curve: How Intangibles Complement General Purpose Technologies." *American Economic Journal: Macroeconomics* 13 (1): 333–72. https://doi.org/10.1257/mac.20180386.

Büchel, Konstantin, Martina Jakob, Christoph Kühnhanss, Daniel Steffen, and Aymo Brunetti. 2022. "The Relative Effectiveness of Teachers and Learning Software: Evidence from a Field Experiment in El Salvador." *Journal of Labor Economics* 40 (3): 737–77. https://doi.org/10.1086/717727.

Bursztyn, Leonardo, Jan Fasnacht, Benjamin R. Handel, Rafael Jimenez-Duran, Aaron Leonard, Filip Milojevic, Christopher Roth, and Cass R. Sunstein. 2026. "Non-User Externalities." NBER Working Paper No. 35279. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w35279.

Busso, Matías, Lucía Madrigal, and Carmen Pagés. 2013. "Productivity and Resource Misallocation in Latin America." *B.E. Journal of Macroeconomics* 13 (1): 903–32. https://doi.org/10.1515/bejm-2012-0087.

Bustos, Paula. 2011. "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms." *American Economic Review* 101 (1): 304–40. https://doi.org/10.1257/aer.101.1.304.

Bustos, Sebastián, Dina Pomeranz, Juan Carlos Suárez Serrato, José Vila-Belda, and Gabriel Zucman. 2026. "The Race Between Tax Enforcement and Tax Planning: Evidence from a Natural Experiment in Chile." CEPR Discussion Paper 21105. CEPR Press. https://cepr.org/publications/dp21105.

Butler, Jenna, Sonia Jaffe, Rebecca Janssen, Nancy Baym, Jake Hofman, Brent Hecht, Sean Rintel, et al., eds. 2025. "Microsoft New Future of Work Report 2025." Microsoft Research Technical Report No. MSR-TR-2025-58. Microsoft. https://aka.ms/nfw2025.

Caldés, Natàlia, and John A. Maluccio. 2005. "The Cost of Conditional Cash Transfers." *Journal of International Development* 17 (2): 151–68. https://doi.org/10.1002/jid.1142.

Callaway, Brantly, and Pedro H. C. Sant'Anna. 2021. "Difference-in-Differences with Multiple Time Periods." *Journal of Econometrics* 225:200–230. https://doi.org/10.1016/j.jeconom.2020.12.001.

Calvino, Flavio, and Luca Fontanelli. 2023. "A Portrait of AI Adopters across Countries: Firm Characteristics, Assets' Complementarities and Productivity." OECD Science, Technology and Industry Working Paper No. 2023/02. OECD Publishing, Paris.

Camacho, Adriana, and Emily Conover. 2011. "Manipulation of Social Program Eligibility." *American Economic Journal: Economic Policy* 3 (2): 41–65. https://doi.org/10.1257/pol.3.2.41.

Camacho-Leon, Genesis, Marco Faytong-Haro, Keila Carrera, Marlyn Molero, Franhe Melean, Yuliana Reyes, Hans Mautong, et al. 2022. "A Narrative Review of Telemedicine in Latin America during the COVID-19 Pandemic." *Healthcare* 10 (8): 1361. https://doi.org/10.3390/healthcare10081361.

Campos Rivera, Paola Abril, Berenice Alfaro Ponce, Michelle Ramírez, Daniel Choperena Aguilar, Pablo Villalobos Dintrans, and Miguel Ángel Torres Cruzaley. 2025. "Reimaginar los sistemas de salud latinoamericanos en la era digital" [Reimagining Latin American health systems in the digital age]. Elcano Policy Paper. October 2025. https://media.realinstitutoelcano.org/wp-content/uploads/2025/11/2025-policy-paper-reimaginar-sistemas-de-salud-latinoamericanos-en-era-digital.pdf.

Capasso, Ariadna, Mercedes Colomar, Dora Ramírez, Suzanne Serruya, and Bremen de Mucio. 2024. "Digital Health and the Promise of Equity in Maternity Care: A Mixed Methods Multi-Country Assessment on the Use of Information and Communication Technologies in Healthcare Facilities in Latin America and the Caribbean."

Research paper. *PLOS One*, February 27, 2024. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0298902.

Carballo, Jerónimo, Maggie X. Chen, Jennifer P. Poole, and Christian Volpe Martincus. Forthcoming. "Trade and Gender: Evidence from an Online Business Platform." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Carballo, Jerónimo, Alejandro Graziano, Georg Schaur, and Christian Volpe Martincus. 2025. "Import Processing and Trade Costs." *Journal of International Economics* 154:104060. https://doi.org/10.1016/j.jinteco.2025.104060.

———. Forthcoming. "Trade Policy Meets Digital Technologies." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Carballo, Jerónimo, Marisol Rodríguez Chatruc, Catalina Salas Santa, and Christian Volpe Martincus. 2022. "Online Business Platforms and International Trade." *Journal of International Economics* 137: 103599. https://doi.org/10.1016/j.jinteco.2022.103599.

Carballo, Jerónimo, and Christian Volpe Martincus. Forthcoming. "Machine Learning for Investment Promotion Targeting." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Carpentier, Elodie, Diego D'Adda, Daniel Nepelski, and Johan Stake. 2025. "European Digital Innovation Hubs Network's Activities and Customers: State of Play Report 2024." Luxembourg: Publications Office of the European Union, for the European Commission, Joint Research Centre. https://publications.jrc.ec.europa.eu/repository/handle/JRC140547.

Carrillo, Paul E., Ivette Contreras, and Carlos Scartascini. 2024. "Turn Off the Faucet: Can Individual Meters Reduce Water Consumption?" *Journal of Environmental Economics and Management* 128:103065. https://doi.org/10.1016/j.jeem.2024.103065.

Carrillo, Paul, Dina Pomeranz, and Monica Singhal. 2017. "Dodging the Taxman: Firm Misreporting and Limits to Tax Enforcement." *American Economic Journal: Applied Economics* 9 (2): 144–64. https://doi.org/10.1257/app.20140495.

Carroll, James, Sean Lyons, and Eleanor Denny. 2014. "Reducing Household Electricity Demand through Smart Metering: The Role of Improved Information about Energy Saving." *Energy Economics* 45:234–434. https://doi.org/10.1016/j.eneco.2014.07.007.

Cavallo, Alberto, Eduardo Cavallo, and Roberto Rigobon. 2014. "Prices and Supply Disruptions during Natural Disasters." *Review of Income and Wealth* 60: S449–71. https://doi.org/10.1111/roiw.12141.

Cavallo, Eduardo A., Arturo Galindo, Victoria Nuguer, and Andrew Powell. 2022. *From Recovery to Renaissance: Turning Crisis into Opportunity*. Latin American and Caribbean Macroeconomic Report. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0004180.

Cavallo, Eduardo A., Andrew Powell, and Tomás Serebrisky, eds. 2020. *From Structures to Services: The Path to Better Infrastructure in Latin America and the Caribbean*. Development in the Americas Series. Washington, DC: Inter-American Development Bank. https://flagships.iadb.org/en/DIA2020/from-structures-to-services.

CBRE. 2025. *Global Data Center Trends 2025*. https://www.cbre.be/insights/reports/global-data-center-trends-2025.

———. 2026. *Global Data Center Trends 2026*. https://www.cbre.be/insights/reports/global-data-center-trends-2026.

CEJA (Centro de Estudios de Justicia de las Americas). 2025. *I Índice de Congestión Judicial en las Américas: Estudio comparado de poderes judiciales*. Santiago, Chile: CEJA. https://biblioteca.cejamericas.org/handle/2015/5753.

Cerdan-Infantes, Pedro, and M. J. Vermeersch. 2007. "More Time Is Better: An Evaluation of the Full Time School Program in Uruguay." Policy Research Working Paper No. WPS 4167. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/814001468124480715.

Chainey, Spencer, Nathalie Alvarado, and Rodrigo Serrano-Berthet. 2024. *Hot Spots Policing: An Evidence-Based Practice Guide for Police in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0013062.

Chainey, Spencer P., Rodrigo Serrano-Berthet, and Federico Veneri. 2021. "The Impact of a Hot Spot Policing Program in Montevideo, Uruguay." *Police Practice and Research* 22 (5): 1541–56. https://doi.org/10.1080/15614263.2020.1749619.

Chalfin, Aaron, and Justin McCrary. 2017. "Criminal Deterrence: A Review of the Literature." *Journal of Economic Literature* 55 (1): 5–48. https://doi.org/10.1257/jel.20141147.

Chatterji, Aaron, Thomas Cunningham, David J. Deming, Zoe Hitzig, Christopher Ong, Carl Yan Shan, and Kevin Wadman. 2025. "How People Use ChatGPT." NBER Working Paper No. 34255. National Bureau for Economic Research, Cambridge, MA. https://dx.doi.org/10.3386/w34255.

Check Point Research. 2026. *Cyber Security Report 2026*. No. 14. Check Point. https://www.checkpoint.com/security-report/?flz-category=items&flz-item=report-cyber-security-report-2026.

Chen, Maggie X., and Christian Volpe Martincus. 2022. "Digital Technologies and Globalization: A Survey of Research and Policy Applications." IDB Discussion Paper No. 933. Inter-American Development Bank, Washington, DC. https://dx.doi.org/10.18235/0004117.

———. 2026. "Searching for Trade: Evidence from AI-Firm Interactions." Inter-American Development Bank, Washington, DC. Presented at the CESifo Area Conference on Global Economy, Munich, May 2026.

———. Forthcoming. "Searching for Trade: Evidence from AI-Firms Interactions." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Chen, Maggie X., and Min Wu. 2021. "The Value of Reputation in Trade: Evidence from Alibaba." *Review of Economics and Statistics* 103 (5): 857–73. https://doi.org/10.1162/rest_a_00932.

Chen, Tao, and Chen Lin. 2017. "Does Information Asymmetry Affect Corporate Tax Aggressiveness?" *Journal of Financial and Quantitative Analysis* 52 (5): 2053–81. https://doi.org/10.1017/S0022109017000576.

Chen, Yuanyuan, and Zhipeng Chen. 2024. "Can E-Government Online Services Offer Enhanced Governance Support? A National-Level Analysis Based on fsQCA and NCA." *Journal of Innovation & Knowledge* 9 (3): 100526. https://doi.org/10.1016/j.jik.2024.100526.

Cho, Kit W., and Vahe Permzadian. 2024. "The Impact of Open Educational Resources on Student Achievement: A Meta-Analysis." *International Journal of Educational Research* 126:102365. https://doi.org/10.1016/j.ijer.2024.102365.

Choi, Taelim, and Jeong-Il Park. 2025. "The Role of Agglomeration in Digitalization and Productivity: An Empirical Examination of Manufacturing SMEs in South Korea." *Asian Journal of Technology Innovation* 33 (1): 227–43. https://doi.org/10.1080/19761597.2024.2355223.

Chong, Alberto, Daniel Velásquez, and Mónica Yáñez-Pagans. 2022. "Computers and Discretion: Evidence from Two Randomized Natural Experiments." *Economic Development and Cultural Change* 71 (1): 63–109. https://doi.org/10.1086/714066.

Christian, Paul J., Felipe A. Dunsch, Jonas Heirman, Erin M. Kelley, Florence Kondylis, Gregory Lane, Jennifer Waidler, et al. 2025. "Fast Action for Floods: RCT Evidence on Forecast-based Cash Transfers from Bangladesh and Nepal." NBER Working Paper No. 34414. National Bureau of Economic Research, Cambridge, MA.

Ciarli, Tommaso, Martin Kenney, Silvia Massini, and Lucia Piscitello. 2021. "Digital Technologies, Innovation, and Skills: Emerging Trajectories and Challenges." *Research Policy* 50 (7): 104289. https://doi.org/10.1016/j.respol.2021.104289.

Cirera, Xavier, Diego Comin, and Marcio Cruz. 2022. "Bridging the Technological Divide: Technology Adoption by Firms in Developing Countries." World Bank, Washington, DC. https://doi.org/10.1596/978-1-4648-1826-4.

Cirera, Xavier, and William F. Maloney. 2017. *The Innovation Paradox: Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1160-9.

City, Elizabeth A., Richard Elmore, Sarah E. Fiarman, and Lee Teitel. 2009. *Instructional Rounds in Education*. Cambridge: Harvard Education Press.

CNJ (Conselho Nacional de Justiça). 2025. *Relatório justiça em números 2025 (ano-base 2024)* [Justice report in numbers 2025 (base year 2024)]. Brasília: CNJ.

Coady, David, César Martinelli, and Susan W. Parker. 2013. "Information and Participation in Social Programs." *World Bank Economic Review* 27 (1): 149–70. https://doi.org/10.1093/wber/lhs021.

Coady, David P., and Susan W. Parker. 2009. "Targeting Performance under Self-Selection and Administrative Targeting Methods." *Economic Development and Cultural Change* 57 (3): 559–87. https://doi.org/10.1086/596615.

Cockburn, Iain M., Rebecca Henderson, and Scott Stern. 2019. "The Impact of Artificial Intelligence on Innovation." In *The Economics of Artificial Intelligence*, edited by Ajay K. Agrawal, Joshua Gans, and Avi Goldfarb, 115–46. Chicago: University of Chicago Press.

Comin, Diego, and Martí Mestieri. 2018. "If Technology Has Arrived Everywhere, Why Has Income Diverged?" *American Economic Journal: Macroeconomics* 10 (3): 137–78. https://doi.org/10.1257/mac.20150175.

Cook, Philip J., Songman Kang, Anthony A. Braga, Jens Ludwig, and Mallory E. O'Brien. 2015. "An Experimental Evaluation of a Comprehensive Employment-Oriented Prisoner Re-Entry Program." *Journal of Quantitative Criminology* 31 (3): 355–82. https://doi.org/10.1007/s10940-014-9242-5.

Cooper, Russell, and Andrew John. 1988. "Coordinating Coordination Failures in Keynesian Models." *Quarterly Journal of Economics* 103 (3): 441–63. https://doi.org/10.2307/1885539.

Cornelli, Giulio, Sebastian Doerr, Leonardo Gambacorta, and Ouarda Merrouche. 2024. "Regulatory Sandboxes and Fintech Funding: Evidence from the UK." *Review of Finance* 28 (1): 203–33. https://doi.org/10.1093/rof/rfad017.

Crandall, William Joseph, Elizabeth Gavin, Zhaoqing Liu, Andrew R. Masters, and Poorva Navalgundkar. 2026. "ISORA 2023: Tax Administration: Performance and Practices." Departmental Paper 2026/008. International Monetary Fund, Washington, DC. https://doi.org/10.5089/9798229044790.087.

Crespi, Gustavo, Eduardo Fernández-Arias, and Ernesto Stein, eds. 2014. *Rethinking Productive Development: Sound Policies and Institutions for Economic Transformation*. Development in the Americas Series. Washington, DC: Inter-American Development Bank. Synopsis: https://publications.iadb.org/en/rethinking-productive-development-sound-policies-and-institutions-economic-transformation-synopsis. Full report in Spanish: https://publications.iadb.org/es/como-repensar-el-desarrollo-productivo-politicas-e-instituciones-solidas-para-la-transformacion.

Crespi, Gustavo, María Paula Gerardino, Edwin A. Goñi Pacchioni, Oscar A. Mitnik, Rodolfo Stucchi, and Christian Volpe Martincus. 2024. *What Works to Improve Lives? What Works to Foster Productive Sector Development*. Monograph No. IDB-MG-1072. Washington, DC: Inter-American Development Bank. http://dx.doi.org/10.18235/0012887.

Crespi, Gustavo A., Charlotte Guillard, Mónica Salazar, and Fernando Vargas. 2022. "Harmonized Latin American Innovation Surveys Database (LAIS): Firm-Level Microdata for the Study of Innovation." Technical Note No. IDB-DT-2418. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/publications/english/document/Harmonized-Latin-American-Innovation-Surveys-Database-LAIS-Firm-Level-Microdata-for-the-Study-of-Innovation.pdf.

Crespi, Gustavo, Ezequiel Tacsir, and Fernando Vargas. 2016. "Innovation Dynamics and Productivity: Evidence for Latin America." In *Firm Innovation and Productivity in Latin America and the Caribbean: The Engine of Economic Development*, edited by Matteo Grazzi and Carlo Pietrobelli. Palgrave Macmillan. https://link.springer.com/chapter/10.1057/978-1-349-58151-1_2.

Cristia, Julián, Pedro Bernal, Julieth Santamaria, Paula Algarra, Carolina Bernal, Lisseth Escalante, Andrés Gallegos, et al. 2022. "A Cost-Benefit Analysis of Selected Digital Projects in Latin America and the Caribbean." IDB Technical Note No. 2585. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/A-Cost-Benefit-Analysis-of-Selected-Digital-Projects-in-Latin-America-and-the-Caribbean.pdf.

Cristia, Julián, Pablo Ibarrarán, Santiago Cueto, Ana Santiago, and Eugenio Severín. 2017. "Technology and Child Development: Evidence from the One Laptop per Child Program." *American Economic Journal: Applied Economics* 9 (3): 295–320. https://doi.org/10.1257/app.20150385.

Cristia, Julián, and Razvan Vlaicu. 2022. "Digitalizing Public Services: Opportunities for Latin America and the Caribbean." Latin American and Caribbean Microeconomic Report. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/digitalizing-public-services-opportunities-latin-america-and-caribbean.

Crosignani, Matteo, Marco Macchiavelli, and André F. Silva. 2023. "Pirates without Borders: The Propagation of Cyberattacks through Firms' Supply Chains." *Journal of Financial Economics* 147 (2): 432–48. https://doi.org/10.1016/j.jfineco.2022.12.002.

Cueto, Santiago, Diether W. Beuermann, Julián Cristia, Ofer Malamud, and Francisco Pardo. 2025. "Laptops in the Long Run: Evidence from the One Laptop per Child

Program in Rural Peru." *Journal of Public Economics* 252: 105538. https://doi.org/10.1016/j.jpubeco.2025.105538.

Cui, Kevin, Mert Demirer, Sonia Jaffe, Leon Musolff, Sida Peng, and Tobias Salz. 2026. "The Effects of Generative AI on High-Skilled Work: Evidence from Three Field Experiments with Software Developers." *Management Science*, published online ahead of print. https://doi.org/10.1287/mnsc.2025.00535.

Curioso, Walter H. 2019. "Building Capacity and Training for Digital Health: Challenges and Opportunities in Latin America." *Journal of Medical Internet Research* 21 (12): e16513. https://doi.org/10.2196/16513.

Currie, Janet, and Reed Walker. 2011. "Traffic Congestion and Infant Health: Evidence from E-ZPass." *American Economic Journal: Applied Economics* 3 (1): 65–90. https://doi.org/10.1257/app.3.1.65.

Cusolito, Ana Paula, and William F. Maloney. 2018. *Productivity Revisited: Shifting Paradigms in Analysis and Policy*. Washington, DC: World Bank. http://hdl.handle.net/10986/30588.

Czajka, Léo, Awa Diouf, and Fabrizio Santoro. 2026. "Do Electronic Filing and Payment Increase Tax Compliance? Evidence from Large Taxpayers in Senegal." ICTD Working Paper 238. Institute of Development Studies, University of Sussex, Brighton, UK. https://doi.org/10.19088/ICTD.2026.010.

Dahlke, Johannes, Mathias Beck, Jan Kinne, David Lenz, Robert Dehghan, Martin Wörter, and Bernd Ebersberger. 2024. "Epidemic Effects in the Diffusion of Emerging Digital Technologies: Evidence from Artificial Intelligence Adoption." *Research Policy* 53 (2): 104917. https://doi.org/10.1016/j.respol.2023.104917.

Daminato, Claudio, Eugenio Diaz-Fariña, Massimo Filippini, and Noemi Padrón-Fumero. 2021. "The Impact of Smart Meters on Residential Water Consumption: Evidence from a Natural Experiment in the Canary Islands." *Resource and Energy Economics* 64:101221. https://doi.org/10.1016/j.reseneeco.2021.101221.

Da Silva, Jarbas Barboza, Marcos Espinal, Sebastian Garcia-Saiso, James Fitzgerald, Myrna Marti, Ernesto Bascolo, Ana E. Haddad, and Marcelo D'Agostino. 2024. "A Digital Transformation for Primary Health Care." *Bulletin of the World Health Organization* 102 (1): 2. https://doi.org/10.2471/BLT.23.290726.

Da Silva, Ronaldo Carneiro, Leandro Nicolás Wirz, Estuardo Solares Reyes, and Miguel Angel Del Moral Stevenel. 2020. "Development of DNA Databases in Latin America." *Forensic Science International* 316:110540. https://doi.org/10.1016/j.forsciint.2020.110540.

Daude, Christian, and Eduardo Fernández-Arias. 2010. "On the Role of Productivity and Factor Accumulation in Economic Development in Latin America and the Caribbean." OECD Development Centre Working Paper No. 290. https://doi.org/10.1787/5kmh5gpqtdjc-en.

David, Joel M., Hugo A. Hopenhayn, and Venky Venkateswaran. 2016. "Information, Misallocation, and Aggregate Productivity." *Quarterly Journal of Economics* 131 (2): 943–1005. https://doi.org/10.1093/qje/qjw006.

David, Paul A. 1990. "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox." *American Economic Review* 80 (2): 355–61. https://www.jstor.org/stable/2006600.

Dean, Andrés, Sebastian Fleitas, and Mariana Zerpa. 2024. "Dynamic Incentives in Retirement Earnings-Replacement Benefits." *Review of Economics and Statistics* 106 (3): 762–77. https://doi.org/10.1162/rest_a_01193.

De Barros, Andreas, and Alejandro J. Ganimian. 2024. "Which Students Benefit from Computer-Based Individualized Instruction? Experimental Evidence from Public Schools in India." *Journal of Research on Educational Effectiveness* 17 (2): 318–43. https://doi.org/10.1080/19345747.2023.2191604.

De La Torre, Alejandro, Peter Diaz, and Rafael Perdomo. 2024. "Analysis of the Virtual Healthcare Model in Latin America: A Systematic Review of Current Challenges and Barriers." *mHealth* 10 (April 30, 2024). https://mhealth.amegroups.org/article/view/122932/html.

Delera, Michele, Carlo Pietrobelli, Elisa Calza, and Alejandro Lavopa. 2022. "Does Value Chain Participation Facilitate the Adoption of Industry 4.0 Technologies in Developing Countries?" *World Development* 152:105788. https://doi.org/10.1016/j.worlddev.2021.105788.

De Lima Friche, Amélia Augusta, Uriel Moreira Silva, Usama Bilal, Olga L. Sarmiento, Maria Angélica de Salles Dias, Francisco Javier Prado-Galbarro, Roberto Briceño-León, et al. 2023. "Variation in Youth and Young Adult Homicide Rates and Their Association with City Characteristics in Latin America: The SALURBAL Study." *Lancet Regional Health—Americas* 20:100476. https://doi.org/10.1016/j.lana.2023.100476.

Dell'Acqua, Fabrizio, Edward McFowland III, Ethan Mollick, Hila Lifshitz-Assaf, Katherine C. Kellogg, Saran Rajendran, Lisa Krayer, François Candelon, and Karim R. Lakhani. 2023. "Navigating the Jagged Technological Frontier: Field Experimental Evidence of the Effects of AI on Knowledge Worker Productivity and Quality." Harvard Business School Working Paper No. 24-013. Harvard Business School, Boston. https://ssrn.com/abstract=4573321.

De Loecker, Jan, Jan Eeckhout, and Gabriel Unger. 2020. "The Rise of Market Power and the Macroeconomic Implications." *Quarterly Journal of Economics* 135 (2): 561–644. https://doi.org/10.1093/qje/qjz041.

Del Toro Mijares, Ana Teresa, Jorge Duarte, Gregory Elacqua, Catalina Hermosilla, and Sonia Suárez. Forthcoming. "Can AI Scale Teacher Support? Evidence from an RCT with Novice Teachers in Peru." Working paper. Inter-American Development Bank, Washington, DC.

Deming, David J. 2011. "Better Schools, Less Crime?" *Quarterly Journal of Economics* 126 (4): 2063–115. https://doi.org/10.1093/qje/qjr036.

Demirer, Mert, Diego Jiménez-Hernández, Dean Li, and Sida Peng. 2026. "Data, Privacy Laws and Firm Production: Evidence from the GDPR." NBER Working Paper No. 32146. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w32146.

Demirer, Mert, Leon Musolff, and Liyuan Yang. 2026. "Writing Code vs. Shipping Code: Productivity Effects across Generations of AI Coding Tools." NBER Working Paper No. 35275. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w35275.

Demmou, Lilas, and Guido Franco. 2021. "Mind the Financing Gap: Enhancing the Contribution of Intangible Assets to Productivity." OECD Economics Department Working Papers No. 1681. OECD Publishing, Paris. https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/09/mind-the-financing-gap-enhancing-the-contribution-of-intangible-assets-to-productivity_d2e72eb1/7aefd0d9-en.pdf.

De Ridder, Maarten. 2024. "Market Power and Innovation in the Intangible Economy." *American Economic Review* 114 (1): 199–251. https://doi.org/10.1257/aer.20201079.

De Souza Ferreira, Emily, Fernanda de Aguiar Franco, Marina Marilac dos Santos Lara, André Amaral Levcovitz, Mateus Araújo Dias, Tiago Ricardo Moreira, Ary Henrique Morais de Oliveira, and Rosângela Minardi Mitre Cotta. 2023. "The Effectiveness of Mobile Application for Monitoring Diabetes Mellitus and Hypertension in the Adult and Elderly Population: Systematic Review and Meta-Analysis." *BMC Health Services Research* 23 (1): 855. https://doi.org/10.1186/s12913-023-09879-6.

DeStefano, Timothy, Richard Kneller, and Jonathan Timmis. 2025. "Cloud Computing and Firm Growth." *Review of Economics and Statistics* 107 (6): 1638–51. https://doi.org/10.1162/rest_a_01393.

Dinarte, Lelys, James Gresham, Renata Lemos, and Rony Rodriguez-Ramirez. 2025. "Investing in Human Capital during Wartime: Experimental Evidence from Ukraine." Policy Research Working Paper No. 11196. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/099918209022550719.

Dinlersoz, Emin, Can Dogan, and Nikolas Zolas. 2024. "Starting Up AI." Center for Economic Studies Working Paper No. CES-WP-24-09R, Center for Economic Studies, U.S. Census Bureau, Washington, DC.

Di Tella, Rafael, and Ernesto Schargrodsky. 2013. "Criminal Recidivism after Prison and Electronic Monitoring." *Journal of Political Economy* 121 (1): 28–73. https://doi.org/10.1086/669786.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty*. Princeton, NJ: Princeton University Press.

Dobbie, Will, Jacob Goldin, and Crystal Yang. 2018. "The Effects of Pretrial Detention on Conviction, Future Crime, and Employment: Evidence from Randomly Assigned Judges." *American Economic Review* 108 (2): 201–40. https://doi.org/10.1257/aer.20161503.

Doleac, Jennifer L. 2017. "The Effects of DNA Databases on Crime." *American Economic Journal: Applied Economics* 9 (1): 165–201. https://doi.org/10.1257/app.20150043.

Domínguez, Patricio, and Leopoldo Lazcano. 2025. "The Effects of Pretrial Detention on Sentencing Outcomes." SOFI Working Papers in Labour Economics, August 2025. Stockholm University, Swedish Institute for Social Research. https://ideas.repec.org/p/hhs/sofile/2025_008.html.

Donati, Dante, Ruben Durante, Francesco Sobbrio, and Dijana Zejcirovic. 2025. "Lost in the Net? Broadband Internet and Youth Mental Health." *Journal of Health Economics* 103:103017. https://doi.org/10.1016/j.jhealeco.2025.103017.

Douenne, Thomas, Marcelo Pedroni, and María Schweitzer. Forthcoming. "The Productivity and Labor Market Effects of Generative AI in Latin America and the Caribbean." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Duncan, Greg J., and Richard J. Murnane. 2014. *Restoring Opportunity: The Crisis of Inequality and the Challenge for American Education*. Harvard Education Press.

Duval, Yann, Syed Haider, and Neelima Pamulapat. 2026. "Will AI Kill the Single Window?" United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Blog, Bangkok, Thailand. https://www.unescap.org/blog/will-ai-kill-single-window.

Eames, Taryn, Emma Brunskill, Bogdan Yamkovenko, Kodi Weatherholtz, and Philip Oreopoulos. 2026. "Computer-Assisted Learning in the Real World: How Khan Academy Influences Student Math Learning." *Proceedings of the National Academy of Sciences* 123 (1): e2507708123. https://www.pnas.org/doi/10.1073/pnas.2507708123.

Eaton, Jonathan, Marcela Eslava, David Jinkins, C. J. Krizan, and James Tybout. 2025. "A Search and Learning Model of Export Dynamics." *Journal of International Economics* 157(C):104155. https://doi.org/10.1016/j.jinteco.2025.104155.

Eberle, Claudia, and Stefanie Stichling. 2021. "Clinical Improvements by Telemedicine Interventions Managing Type 1 and Type 2 Diabetes: Systematic Meta-Review." *Journal of Medical Internet Research* 23 (2): e23244. https://doi.org/10.2196/23244.

Eckel, Carsten, and J. Peter Neary. 2010. "Multi-Product Firms and Flexible Manufacturing in the Global Economy." *Review of Economic Studies* 77 (1): 188–217. https://doi.org/10.1111/j.1467-937X.2009.00573.x.

ECLAC (Economic Commission for Latin America and the Caribbean). 2018. "Regional Digital Market: Strategic Aspects." Production Productivity and Management Division, Economic Commission for Latin America and the Caribbean. https://www.cepal.org/en/publications/43633-regional-digital-market-strategic-aspects.

ECLAC (Economic Commission for Latin America and the Caribbean) and CENIA (Centro Nacional de Inteligencia Artificial). 2025. *Índice Latinoamericano de Inteligencia Artificial (ILIA) 2025* [Latin American artificial intelligence index [ILIA] 2025]. Documentos de Proyectos LC/TS.2025/68/Rev.1. Santiago: ECLAC. https://www.cepal.org/es/publicaciones/82514-indice-latinoamericano-inteligencia-artificial-ilia-2025.

Elacqua, Gregory, Catalina Hermosilla, Macaréna Kutscher, and Ana Teresa Del Toro Mijares. 2025. "Scaling Teacher Support: Piloting 'Profe Gabi,' an AI-Powered Mentoring Chatbot for Novice Teachers in Chile." IDB Working Paper No. 01728. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013856.

Elacqua, Gregory, Diana Hincapié, Emiliana Vegas, and Mariana Alfonso. 2018. *Profesión: profesor en América Latina: ¿Por qué se perdió el prestigio docente y cómo recuperarlo?* [The teaching profession in Latin America: Why has teacher prestige been lost, and how can it be restored?]. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0001172.

Elacqua, Gregory, Luana Marotta, Matías Martínez, Carolina Méndez, and Danielle Nascimento. 2025. *Smart Spending in Education in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013632.

Eloundou, Tyna, Sam Manning, Pamela Mishkin, and Daniel Rock. 2024. "GPTs Are GPTs: Labor Market Impact Potential of LLMs." *Science* 384 (6702): 1306–8. https://doi.org/10.1126/science.adj0998.

Ensign, Danielle, Sorelle A. Friedler, Scott Neville, Carlos Scheidegger, and Suresh Venkatasubramanian. 2018. "Runaway Feedback Loops in Predictive Policing." *Proceedings of the 1st Conference on Fairness, Accountability and Transparency* (FAT*) 81:160–71.

Eoyang, Mieke, Allison Peters, Ishan Mehta, and Brandon Gaskew. 2018. *To Catch a Hacker: Toward a Comprehensive Strategy to Identify, Pursue, and Punish Malicious Cyber Actors*. Third Way. https://www.thirdway.org/report/to-catch-a-hacker-toward-a-comprehensive-strategy-to-identify-pursue-and-punish-malicious-cyber-actors.

EPE (Empresa de Pesquisa Energética). 2024. *Plano Decenal de Expansão de Energia 2034*. Rio de Janeiro: EPE. https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/plano-decenal-de-expansao-de-energia-2034.

———. 2025. *Plano Decenal de Expansão de Energia 2035*. Rio de Janeiro: EPE. https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/plano-decenal-de-expansao-de-energia-2035.

eSafety Commissioner. 2026. "Talking to Machines: Children's Experiences with AI Assistants and Companions." Australian Government. https://www.esafety.gov.au/research/talking-to-machines-childrens-experiences-with-ai-assistants-and-companions.

Escueta, Maya, Andre J. Nickow, Philip Oreopoulos, and Vincent Quan. 2020. "Upgrading Education with Technology: Insights from Experimental Research." *Journal of Economic Literature* 58 (4): 897–996. https://doi.org/10.1257/jel.20191507.

Esteban, Santiago, Gastón Quintana, Mario Sanchez, Adolfo Rubinstein, and Alejandro Szmulewicz. 2026. "Comparative Effectiveness of Single vs. Dual WhatsApp Reminders on No-Shows: A Target Trial Emulation within the Public Health System of Buenos Aires, Argentina." MedRxiv, 2026.08.17.26360609. https://doi.org/10.64898/2026.08.17.26360609.

Estevadeordal, Antoni, Marisol Rodríguez Chatruc, and Christian Volpe Martincus. 2020. "New Technologies and Trade: New Determinants, Modalities, and Varieties." IDB Discussion Paper No. 746. Inter-American Development Bank, Washington, DC. https://dx.doi.org/10.18235/0002173.

Estrada, Ricardo, and María Lombardi. 2023. "Skills and Selection into Teaching: Evidence from Latin America." *Economía LACEA Journal* 22 (1): 218–39. https://doi.org/10.31389/eco.412.

Ethier, Wilfred J. 1982. "National and International Returns to Scale in the Modern Theory of International Trade." *American Economic Review* 72 (3): 389–405. https://www.jstor.org/stable/1831539.

Eurostat. 2026. "Digital Economy and Society Statistics–Enterprises." https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Digital_economy_and_society_statistics_-_enterprises#E-business_integration.

Evans, David K., and Fei Yuan. 2022. "How Big Are Effect Sizes in International Education Studies?" *Educational Evaluation and Policy Analysis* 44 (3): 532–40. https://doi.org/10.3102/01623737221079646.

Fafchamps, Marcel, and Di Mo. 2018. "Peer Effects in Computer Assisted Learning: Evidence from a Randomized Experiment." *Experimental Economics* 21 (2): 355–82. https://doi.org/10.1007/s10683-017-9538-z.

Faúndez-Ugalde, Antonio, Rafael Mellado-Silva, and Eduardo Aldunate-Lizana. 2020. "Use of Artificial Intelligence by Tax Administrations: An Analysis Regarding Taxpayers' Rights in Latin American Countries." *Computer Law & Security Review* 38 (September): 105441. https://doi.org/10.1016/j.clsr.2020.105441.

Fay, Marianne, Luis Alberto Andrés, Charles Fox, Ulf Narloch, Stéphane Straub, and M. A. Slawson. 2017. *Rethinking Infrastructure in Latin America and the Caribbean: Spending Better to Achieve More*. Washington, DC: World Bank Group. https://documents1.worldbank.org/curated/en/691941502376110277/pdf/9781464811012.pdf.

Feldman, Maryann P., and Dieter F. Kogler. 2010. "Stylized Facts in the Geography of Innovation." In *Handbook of the Economics of Innovation* 1, edited by Bronwyn H.

Hall and Nathan Rosenberg, 381–410. Amsterdam: Elsevier. https://doi.org/10.1016/S0169-7218(10)01008-7.

Felten, Edward, Manav Raj, and Robert Seamans. 2023. "How Will Language Modelers like ChatGPT Affect Occupations and Industries?" Working paper. March 18, 2023. http://dx.doi.org/10.2139/ssrn.4375268.

Ferman, Bruno, Lucas Finamor, and Lycia Lima. 2019. "Are Public Schools in Developing Countries Ready to Integrate EdTech into Regular Instruction?" Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/109063/1/MPRA_paper_109063.pdf.

Fernandes, Ana M., Aaditya Mattoo, Huy Nguyen, and Marc Schiffbauer. 2019. "The Internet and Chinese Exports in the Pre-Alibaba Era." *Journal of Development Economics* 138: 57–76. https://doi.org/10.1016/j.jdeveco.2018.11.003.

Ferreyra, Maria Marta, Ciro Avitabile, Javier Botero Álvarez, Francisco Haimovich Paz, and Sergio Urzúa. 2017. "At a Crossroads: Higher Education in Latin America and the Caribbean." World Bank, Washington, DC. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/271781495774058113.

Figlio, David N., and Umut Özek. 2025. "The Impact of Cellphone Bans in Schools on Student Outcomes: Evidence from Florida." NBER Working Paper No. 34388. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w34388.

Finkelstein, Amy, and Matthew J. Notowidigdo. 2019. "Take-Up and Targeting: Experimental Evidence from SNAP." *Quarterly Journal of Economics* 134 (3): 1505–56. https://doi.org/10.1093/qje/qjz013.

Fiscalía Nacional de Chile. 2024. *Reporte anual 2023: Homicidios en Chile* [Annual report 2023: Homicides in Chile]. https://www.fiscaliadechile.cl/sites/default/files/documentos/Homicidios_2023_v2.pdf.

Flanagan, Kieron, Elvira Uyarra, and Manuel Laranja. 2011. "Reconceptualising the 'Policy Mix' for Innovation." *Research Policy* 40 (5): 702–13. https://doi.org/10.1016/j.respol.2011.02.005.

Flom, Hernán. 2018. "The Political Economy of Citizen Security: A Conceptual Framework." IDB Technical Note No. 1382. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/The-Political-Economy-of-Citizen-Security-A-Conceptual-Framework.pdf.

Florackis, Chris, Christodoulos Louca, Roni Michaely, and Michael Weber. 2023. "Cybersecurity Risk." *Review of Financial Studies* 36 (1): 351–407. https://doi.org/10.1093/rfs/hhac024.

Fonseca, Miguel A., and Shaun B. Grimshaw. 2017. "Do Behavioral Nudges in Prepopulated Tax Forms Affect Compliance? Experimental Evidence with Real Taxpayers." *Journal of Public Policy & Marketing* 36 (2): 213–26. https://doi.org/10.1509/jppm.15.128.

Forman, Chris, and Kristina McElheran. 2024. "Production Chain Organization in the Digital Age: Information Technology Use and Vertical Integration in U.S. Manufacturing." *Management Science* 71 (2): 1027–49. https://doi.org/10.1287/mnsc.2019.01586.

Foster, Andrew D., and Mark R. Rosenzweig. 1995. "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture." *Journal of Political Economy* 103 (6): 1176–209. https://doi.org/10.1086/601447.

Frache, Serafin, Federica Gómez Decker, and Christian Volpe Martincus. Forthcoming. "Electronic Trade Single Windows and Exports: Evidence from Uruguay." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Francis, David C., Nona Karalashvili, Hibret Belete Maemir, and Jorge Luis Rodriguez Meza. 2020. "Measuring Total Factor Productivity using the Enterprise Surveys: A Methodological Note." Policy Research Working Paper No. 9491. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-9491.

Frankenthal, Isadora A. 2025. "The Gig Economy and Crime." Working paper. Massachusetts Institute of Technology, August 2025. https://economics.mit.edu/sites/default/files/inline-files/Gig_Economy_and_Crime_Oct25.pdf.

Fratrič, Peter, Nils Holzenberger, and David Restrepo Amariles. 2025. "Can AI Expose Tax Loopholes? Towards a New Generation of Legal Policy Assistants." Version 1. Preprint, arXiv. https://doi.org/10.48550/ARXIV.2503.17339.

Freund, Caroline L., and Diana Weinhold. 2002. "The Internet and International Trade in Services." *American Economic Review* 92 (2): 236–40. https://doi.org/10.1257/000282802320189320.

———. 2004. "The Effect of the Internet on International Trade." *Journal of International Economics* 62 (1): 171–89. https://doi.org/10.1016/S0022-1996(03)00059-X.

Gagete-Miranda, Jessica, Daniel Grimaldi, Lucas A. Mariani, José Renato Ornelas, and Diego A. Vera-Cossio. Forthcoming. "Who Is Left Behind? Digital Divide and Take-Up of Digital Programs: Evidence from Brazil." Inter-American Development Bank, Washington, DC.

Gal, Peter, Giuseppe Nicoletti, Théodore Renault, Stéphane Sorbe, and Christina Timiliotis. 2019. "Digitalisation and Productivity: In Search of The Holy Grail—Firm-Level Empirical Evidence from EU Countries." OECD Economics Department Working Paper No. 1533. OECD Publishing, Paris.

Galbiati, Roberto, Aurélie Ouss, and Arnaud Philippe. 2021. "Jobs, News and Reoffending after Incarceration." *Economic Journal* 131 (633): 247–70. https://doi.org/10.1093/ej/ueaa057.

Gallagher, Justin, and Paul J. Fisher. 2020. "Criminal Deterrence When There Are Offsetting Risks: Traffic Cameras, Vehicular Accidents, and Public Safety." *American Economic Journal: Economic Policy* 12 (3): 202–37. https://www.aeaweb.org/articles?id=10.1257/pol.20170674.

Gallegos, Sebastian, Benjamin Roseth, Ana Cuesta, and Mario Sánchez. 2023. "Increasing the Take-Up of Public Health Services: An At-Scale Experiment on Digital Government." *Journal of Public Economics* 227:104975. https://doi.org/10.1016/J.JPUBECO.2023.104975.

Galo, José Luís, Enrico Di Martino, Jesús María Velásquez Bermúdez, and Alberto Delgadillo Gomez. 2023. *Tecnologías de Inteligencia Artificial (AI) en el mantenimiento de activos del sector eléctrico*. Edited by J. Irigoyen, A. Alarcón, and E. F. Boeck Daza. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0004901.

Gandelman, Néstor, and Alejandro Rasteletti. 2017. "Credit Constraints, Sector Informality and Firm Investments: Evidence from a Panel of Uruguayan Firms." *Journal of Applied Economics* 20 (2): 351–72. https://doi.org/10.1016/S1514-0326(17)30016-8.

Garcia, Patricia, Stephen P. Ma, Shreya Shah, Margaret Smith, Yejin Jeong, Anna Devon-Sand, Ming Tai-Seale, et al. 2024. "Artificial Intelligence–Generated Draft Replies to Patient Inbox Messages." *JAMA Network Open* 7 (3): e243201. https://pubmed.ncbi.nlm.nih.gov/38506805.

Garcia Saiso, Sebastian, Myrna C. Marti, Victoria Malek Pascha, Adrian Pacheco, Daniel Luna, Fernando Plazzotta, Jennifer Nelson, et al. 2021. "Barreras y facilitadores a la implementación de la telemedicina en las Américas" [Barriers to and facilitators of the implementation of telemedicine in the Americas]. *Pan American Journal of Public Health*. 45: e131. https://doi.org/10.26633/RPSP.2021.131.

García Zaballos, Antonio, Sebastián M. Cabello, Pau Puig, Enrique Iglesias, and Maribel Dalio. 2023. *Challenges in the Growth of Fiber in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://publications.iadb.org/en/challenges-growth-fiber-latin-america-and-caribbean.

García Zaballos, Antonio, Pau Puig Gabarró, Enrique Iglesias Rodriguez, and Rafael Pérez Colón. 2025. *Capturing the Data Center Opportunity in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013774.

García Zaballos, Antonio, Enrique Iglesias Rodriguez, and Pau Puig Gabarró. 2023. *Informe anual del Índice de Desarrollo de la Banda Ancha: Brecha digital en América Latina y el Caribe: IDBA 2023* [Broadband Development Index annual report: The digital divide in Latin America and the Caribbean: IDBA 2023]. Washington, DC: Inter-American Development Bank.

Garganta, Santiago, María Florencia Pinto, and Joaquín Zentner. 2024. "Do Longer School Days Improve Learning? The Case of the Dominican Republic." IDB Technical Note No. 3060. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/Do-Longer-School-Days-Improve-Learning-The-Case-of-the-Dominican-Republic.pdf.

Garganta, Santiago, and Leonardo Gasparini. 2015. "The Impact of a Social Program on Labor Informality: The Case of AUH in Argentina." *Journal of Development Economics* 115 (July): 99–110. https://doi.org/10.1016/j.jdeveco.2015.02.004.

Garicano, Luis. 2000. "Hierarchies and the Organization of Knowledge in Production." *Journal of Political Economy* 108 (5): 874–904. https://doi.org/10.1086/317671.

Gasparetto, Alessandro, and Lorenzo Scalera. 2019. "From the Unimate to the Delta Robot: The Early Decades of Industrial Robotics." In *Explorations in the History and Heritage of Machines and Mechanisms*, edited by B. Zhang and M. Ceccarelli. HMMS 37. Cham: Springer. https://doi.org/10.1007/978-3-030-03538-9_23.

Gerard, François, and Gustavo Gonzaga. 2021. "Informal Labor and the Efficiency Cost of Social Programs: Evidence from Unemployment Insurance in Brazil." *American Economic Journal: Economic Policy* 13 (3): 167–206. https://doi.org/10.1257/pol.20180072.

Gethin, Amory. 2025. "Distributional Growth Accounting: Education and the Reduction of Global Poverty, 1980–2019." *Quarterly Journal of Economics* 140 (4): 2571–2618. https://doi.org/10.1093/qje/qjaf033.

Gobierno de Chile. 2020. "Los Chilenos realizan el 85% de sus trámites con el Estado por Internet" [Chileans carry out 85 percent of their procedures with the state on the internet]. Government of Chile, November 20, 2020. https://www.gob.cl/noticias/los-chilenos-realizan-el-85-de-sus-tramites-con-el-estado-por-internet/.

Goldberg, Pinelopi Koujianou, Amit Kumar Khandelwal, Nina Pavcnik, and Petia Topalova. 2010. "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India." *Quarterly Journal of Economics* 125 (4): 1727–67. https://doi.org/10.1162/qjec.2010.125.4.1727.

Goldberg, Samuel G., Garrett A. Johnson, and Scott K. Shriver. 2024. "Regulating Privacy Online: An Economic Evaluation of the GDPR." *American Economic Journal: Economic Policy* 16 (1): 325–58. https://doi.org/10.1257/pol.20210309.

Goldfarb, Avi, and Verina F. Que. 2023. "The Economics of Digital Privacy." *Annual Review of Economics* 15 (March): 267–86. https://doi.org/10.1146/annurev-economics-082322-014346.

Goldfarb, Avi, and Catherine Tucker. 2019. "Digital Economics." *Journal of Economic Literature* 57 (1): 3–43. https://doi.org/10.1257/jel.20171452.

Goldin, Claudia, and Lawrence F. Katz. 2008. *The Race between Education and Technology*. Belknap Press.

Gómez, Santiago, Daniel Mejía, and Santiago Tobón. 2021. "The Deterrent Effect of Surveillance Cameras on Crime." *Journal of Policy Analysis and Management* 40 (2): 553–71. https://doi.org/10.1002/pam.22280.

González Ramírez, Felipe, and Hugo E. Silva. 2025. "JUE Insight: Efficiency of Bus Priority Infrastructure." *Journal of Urban Economics* 146 (March): 103751. https://doi.org/10.1016/j.jue.2025.103751

Gonzalez-Uribe, Juanita, and Michael Leatherbee. 2018. "The Effects of Business Accelerators on Venture Performance: Evidence from Start-Up Chile." *Review of Financial Studies* 31 (4): 1566–1603. https://doi.org/10.1093/rfs/hhx103.

González-Velosa, Carolina, David S. Kaplan, Auri Melissa Minaya, and María Teresa Silva Porto. 2026. *Making Labor Markets Work: Improving Productivity and Worker Welfare in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0014415.

Goos, Maarten, Alan Manning, and Anna Salomons. 2014. "Explaining Job Polarization: Routine-Biased Technological Change and Offshoring." *American Economic Review* 104 (8): 2509–26. https://doi.org/10.1257/aer.104.8.2509.

Gordon, Lawrence A., Martin P. Loeb, William Lucyshyn, and Lei Zhou. 2015. "Increasing Cybersecurity Investments in Private Sector Firms." *Journal of Cybersecurity*, November 26, tyv011. https://doi.org/10.1093/cybsec/tyv011.

Gorodnichenko, Yuriy, and Monika Schnitzer. 2013. "Financial Constraints and Innovation: Why Poor Countries Don't Catch Up." *Journal of the European Economic Association* 11 (5): 1115–52. https://doi.org/10.1111/jeea.12033.

Górski, Łukasz, Błażej Kuźniacki, Marco Almada, Kamil Tyliński, Madalena Calvo, Pablo Matias Asnaghi, Luciano Almada, et al. 2025. "Exploring Explainable AI in the Tax Domain." *Artificial Intelligence and Law* 33 (3): 551–79. https://doi.org/10.1007/s10506-024-09395-w.

Graetz, Georg, and Guy Michaels. 2018. "Robots at Work." *Review of Economics and Statistics* 100 (5): 753–68. https://doi.org/10.1162/rest_a_00754.

Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell. 1997. "Long-Run Implications of Investment-Specific Technological Change." *American Economic Review* 87 (3): 342–62. https://www.jstor.org/stable/2951349.

Grenet, Julien, Hans Grönqvist, and Susan Niknami. 2024. "The Effects of Electronic Monitoring on Offenders and Their Families." *Journal of Public Economics* 230:105051. https://doi.org/10.1016/j.jpubeco.2023.105051.

Griffith, Rachel, Stephen Redding, and John Van Reenen. 2004. "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries." *Review of Economics and Statistics* 86 (4): 883–95. https://doi.org/10.1162/0034653043125194.

Griliches, Zvi. 1992. "The Search for R&D Spillovers." *Scandinavian Journal of Economics* 94 (supplement): S29–47. https://doi.org/10.3386/w3768.

Grossman, Gene M., and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.

Grossman, Gene M., and Ezra Oberfield. 2022. "The Elusive Explanation for the Declining Labor Share." *Annual Review of Economics* 14:93–124. https://doi.org/10.1146/annurev-economics-080921-103046.

Gu, Haishuo, Yaqi Guo, Huigen Yang, Peng Chen, Minggang Yao, and Jiaqi Hou. 2019. "Detecting Pickpocketing Offenders by Analyzing Beijing Metro Subway Data." *2019 IEEE 4th International Conference on Big Data Analytics (ICBDA)*, Suzhou, China, March 15–18, 2019, 62–66. https://doi.org/10.1109/ICBDA.2019.8712833.

Guerzoni, Marco, and Emilio Raiteri. 2015. "Demand-Side vs. Supply-Side Technology Policies: Hidden Treatment and New Empirical Evidence on the Policy Mix." *Research Policy* 44 (3): 726–47. https://doi.org/10.1016/j.respol.2014.10.009.

Gutiérrez, Luis H., Juan Miguel Gallego, and Magaly Faride Herrera Giraldo. 2025. "Exploring the Drivers and Performance Impacts of Advanced Digital Technologies in Latin American Economies." IDB Technical Note No. 3197. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013728.

Guven, Melis, Agastya Yeachuri, and Mohamed Almenfi. 2025. "Global Insights on Social Registries: Coverage and Beyond." World Bank, Washington, DC. http://hdl.handle.net/10986/43585.

Guyton, John, Patrick Langetieg, Daniel Reck, Max Risch, and Gabriel Zucman. 2023. "Tax Evasion at the Top of the Income Distribution: Theory and Evidence." NBER Working Paper 28542, revised December 2023. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w28542.

Guzman, Luis A., Carlos Beltran, Jorge A. Bonilla, and Santiago Gómez Cardona. 2021. "BRT Fare Elasticities from Smartcard Data: Spatial and Time-of-the-Day Differences." *Transportation Research Part A: Policy and Practice* 150 (August): 335–48. https://doi.org/10.1016/j.tra.2021.06.018.

Guzman, Luis A., and Philippe Hessel. 2022. "The Effects of Public Transport Subsidies for Lower-Income Users on Public Transport Use: A Quasi-Experimental Study." *Transport Policy* 126 (September): 215–24. https://doi.org/10.1016/j.tranpol.2022.07.016.

Guzman, Luis A., Jorge L. Ochoa, Santiago Gómez Cardona, and Ignacio Sarmiento-Barbieri. 2025. "Pro-Poor Transport Subsidies: More User Welfare and Faster Travel." *Transportation Research Part A: Policy and Practice* 195 (May): 104454. https://doi.org/10.1016/j.tra.2025.104454.

Hajizada, Abulfaz, Dana Etgar Itzhaki, Noa Barnir, Tyler Moore, and Neil Gandal. 2026. "The Impact of Cyber Attacks on Security Portfolios: Firm-Level Panel Data." Preprint, SSRN. https://doi.org/10.2139/ssrn.6303062.

Halpern, László, Miklós Koren, and Adam Szeidl. 2015. "Imported Inputs and Productivity." *American Economic Review* 105 (12): 3660–3703. https://doi.org/10.1257/aer.20150443.

Hampole, Menaka, Dimitris Papanikolaou, Lawrence D. W. Schmidt, and Bryan Seegmiller. 2025. "Artificial Intelligence and the Labor Market." NBER Working Paper No. 33509. National Bureau of Economic Research, Cambridge, MA. https://doi. org/10.3386/w33509.

Hanushek, Eric A., Guido Schwerdt, Ludger Woessmann, and Lei Zhang. 2017. "General Education, Vocational Education, and Labor-Market Outcomes over the Lifecycle." *Journal of Human Resources* 52 (1): 48–87. https://doi.org/10.3368/jhr.52.1.0415-7074R.

Hanushek, Eric A., and Ludger Woessmann. 2008. "The Role of Cognitive Skills in Economic Development." *Journal of Economic Literature* 46 (3): 607–68. https://doi.org/10.1257/jel.46.3.607.

Harding, Torfinn, and Beata S. Javorcik. 2011. "Roll Out the Red Carpet and They Will Come: Investment Promotion and FDI Inflows." *Economic Journal* 121 (557): 1445–76. https://doi.org/10.1111/j.1468-0297.2011.02454.x.

Hardy, Morgan, and Jamie McCasland. 2021. "It Takes Two: Experimental Evidence on the Determinants of Technology Diffusion." *Journal of Development Economics* 149 (March): 102600. https://doi.org/10.1016/j.jdeveco.2020.102600.

Hechenleitner-Carvallo, Marcela, Jacqueline Ibarra-Peso, Rayen Zapata-Toloza, and Camila Barra-Andalaft. 2025. "Telehealth and Telemedicine in Latin America: A Scoping Review." *Salud, Ciencia y Tecnología* 5:1185. https://sct.ageditor.ar/index.php/sct/article/view/1185.

Heckman, James J., and Carmen Pagés, eds. 2004. *Law and Employment: Lessons from Latin America and the Caribbean*. National Bureau of Economic Research Conference Report. Chicago: University of Chicago Press.

Heinz, Michael, Daniel Mackin, Brianna Trudeau, Sukanya Bhattacharya, Yinzhou Wang, Haley Banta, and Abi Jewett. 2025. "Randomized Trial of a Generative AI Chatbot for Mental Health Treatment." *New England Journal of Medicine* 2 (4). https://doi.org/10.1056/AIoa2400802.

Heller, Sara B., Benjamin Jakubowski, Zubin Jelveh, and Max Kapustin. 2026. "Machine Learning Can Predict Shooting Victimization Well Enough to Help Prevent It." *Review of Economics and Statistics*, 1–16. https://doi.org/10.1162/rest_a_01519.

Helpman, Elhanan, ed. 1998. *General Purpose Technologies and Economic Growth*. MIT Press.

Hernández, Karla, Diego A. Vera-Cossio, Bridget Hoffmann, and Camilo Pecha. 2024. "The Promises of Digital Bank Accounts for Low-Income Individuals." IDB Working Paper No. 1568. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005521.

Higgins, Sean. 2024. "Financial Technology Adoption: Network Externalities of Cashless Payments in Mexico." *American Economic Review* 114 (11): 3469–512. https://doi.org/10.1257/aer.20201952.

Hill, Carolyn J., Howard S. Bloom, Alison Rebeck Black, and Mark W. Lipsey. 2008. "Empirical Benchmarks for Interpreting Effect Sizes in Research." *Child Development Perspectives* 2 (3): 172–77. https://doi.org/10.1111/j.1750-8606.2008.00061.x.

Hillberry, Russell, Ana Margarida Fernandes, and Alejandra Mendoza Alcántara. 2021. "Trade Effects of Customs Reform: Evidence from Albania." *World Bank Economic Review* 35 (1): 34–57. https://doi.org/10.1596/40279.

Hincapie, Diana. 2016. "Do Longer School Days Improve Student Achievement? Evidence from Colombia." IDB Working Paper No. 679. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0000268.

Hjort, Jonas, and Jonas Poulsen. 2019. "The Arrival of Fast Internet and Employment in Africa." *American Economic Review* 109 (6): 2582–612. https://doi.org/10.1257/aer.20161385.

Hoffer-Hawlik, Michael, Andrew Moran, Lillian Zerihun, John Usseglio, Jennifer Cohn, and Reena Gupta. 2021. "Telemedicine Interventions for Hypertension Management in Low- and Middle-Income Countries: A Scoping Review." *PLOS One* 16 (7): e0254222. https://doi.org/10.1371/JOURNAL.PONE.0254222.

Hood, Rosie, Akash Kaura, and Mar Carpanelli. 2025. "AI Data Partnerships—LinkedIn Methodology." Working Paper EG WP No. 6. LinkedIn Economic Graph Research & Insights, March 2025.

HRW (Human Rights Watch). 2025. "Double Injustice: How Mexico's Criminal Justice System Fails Victims and the Accused in Homicide Investigations." Human Rights Watch, February 19, 2025. https://www.hrw.org/report/2025/02/19/double-injustice/how-mexicos-criminal-justice-system-fails-victims-and-the.

Hsieh, Chang-Tai, and Peter J. Klenow. 2009. "Misallocation and Manufacturing TFP in China and India." *Quarterly Journal of Economics* 124 (4): 1403–48. https://doi.org/10.1162/qjec.2009.124.4.1403.

Hulten, Charles R. 1978. "Growth Accounting with Intermediate Inputs." *Review of Economic Studies* 45 (3): 511–18. https://doi.org/10.2307/2297252.

Hummels, David L., and Georg Schaur. 2013. "Time as a Trade Barrier." *American Economic Review* 103 (7): 2935–59. https://doi.org/10.1257/aer.103.7.2935.

Hutton, Eric. 2010. "A Basic Framework for Evaluating Value Added Tax Expenditures." IDB Discussion Paper No. 138. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0006539.

Iacovone, Leonardo, William F. Maloney, and David McKenzie. 2022. "Improving Management with Individual and Group-Based Consulting: Results from a Randomized Experiment in Colombia." *Review of Economic Studies* 89 (1): 346–71. https://doi.org/10.1093/restud/rdab005.

IBM. 2025. *Cost of a Data Breach Report 2025: The AI Oversight Gap*. IBM. https://www.ibm.com/reports/data-breach.

Ibrahim, Abdul Halil Hi., Idris Sudin, Hardi Kemhay, M. Rusdy Namsa, and Lesdia Pora. 2025. "Digital Transformation in Public Services: Political Challenges and Global Implications." *International Journal of Social Sciences* 8 (3): 72–78. https://doi.org/10.21744/ijss.v8n3.2409.

IDB (Inter-American Development Bank). 2024. "Bucking the Trend: The Potential of Knowledge-Based Services." 2024 Trade and Integration Monitor. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/Trade-and-Integration-Monitor-2024-Bucking-the-Trend-The-Potential-of-Knowledge-Based-Services.pdf.

IDB (Inter-American Development Bank) and World Bank. 2024. "Learning Can't Wait: Lessons for Latin America and the Caribbean from PISA 2022." Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005671.

IDB (Inter-American Development Bank). Forthcoming. "Digital Transformation and AI Thematic Framework Document." Inter-American Development Bank, Washington, DC.

IDBG (Inter-American Development Bank Group). 2025. *IDB Strategy+ Approach to Bolstering Sustainable Regional Growth* (GN-3241-5). Washington, DC: Inter-American Development Bank Group. https://www.iadb.org/en/who-we-are/institutional-strategy.

IICA (Instituto Interamericano de Cooperación para la Agricultura). 2022. "Conectividad rural en América Latina y el Caribe: Estado de situación, retos y acciones para la digitalización y el desarrollo sostenible" [Rural connectivity in Latin America and the Caribbean: Current status, challenges, and actions for digitalization and sustainable development]. IICA.

ILO (International Labour Office). 2012. *Structure, Group Definitions and Correspondence Tables*. Vol. 1 of *International Standard Classification of Occupations: ISCO-08*. Geneva: ILO.

IMF (International Monetary Fund). 2018. "Measuring the Digital Economy." IMF Staff Report. February. https://www.imf.org/en/publications/policy-papers/issues/2018/04/03/022818-measuring-the-digital-economy.

IMF (International Monetary Fund). 2025a. "Dominican Republic: Technical Assistance Report—Revenue Administration Gap Analysis Program (RA-GAP)—Gap in the Tax on Transfers of Industrialized Commodities and Services (ITBIS)." *Technical Assistance Reports No.* 2025, 095 (2025). https://www.imf.org/en/publications/technical-assistance-reports/issues/2025/11/19/dominican-republic-technical-assistance-report-revenue-administration-gap-analysis-program-571901.

———. 2025b. *Fiscal Monitor: Spending Smarter: How Efficient and Well-Allocated Public Spending Can Boost Economic Growth*. Washington, DC: IMF, October. https://www.imf.org/en/publications/fm/issues/2025/10/07/fiscal-monitor-october-2025.

INEGI (Instituto Nacional de Estadística y Geografía). 2024. "Censo Nacional de Sistema Penitenciario Federal y Estatales. Presentación de resultados generales" [National Census of Federal and State Penitentiary Systems: Presentation of general results]. https://www.inegi.org.mx/contenidos/programas/cnsipee/2024/doc/cnsipee_2024_resultados.pdf.

———. 2026. "Módulo sobre ciberacoso. MOCIBA 2025" [Module on cyberbullying. MOCIBA 2025]. July 2026. https://www.inegi.org.mx/contenidos/programas/mociba/2025/doc/mociba2025_resultados.pdf.

Institute for Health Metrics and Evaluation. 2025. "Global Burden of Disease (GBD)." Global Burden of Disease Collaborative Network. https://www.healthdata.org/research-analysis/about-gbd.

Instituto Sou da Paz. 2025. "Onde mora a impunidade? Por que o Brasil precisa de um indicador de esclarecimento de homicídios?" [Where does he die with impunity? Why does Brazil need a homicide clarification indicator?]. https://soudapaz.org/documentos/onde-mora-a-impunidade-porque-o-brasil-precisa-de-um-indicador-nacional-de-esclarecimento-de-homicidios/.

IOM (Institute of Medicine). 2003. "Key Capabilities of an Electronic Health Record System: Letter Report." National Academies Press. https://doi.org/10.17226/10781.

ISO. 2005. "Electronic Health Record: Definition, Scope and Context." Technical Report 20514. https://www.researchgate.net/publication/237035371_Technical_Report_20514_Electronic_health_record_Definition_scope_and_context.

Iyer, Subramanian R., Betty J. Simkins, and Heng Wang. 2020. "Cyberattacks and Impact on Bond Valuation." *Finance Research Letters* 33 (March): 101215. https://doi.org/10.1016/j.frl.2019.06.013.

Izquierdo, Alejandro, Carola Pessino, and Guillermo Vuletin, eds. 2018. *Better Spending for Better Lives: How Latin America and the Caribbean Can Do More with Less*. Development in the Americas Series. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0001217-es.

Jaccoud, Florencia. 2025. "Digital Adoption in Micro and Small Firms in Uruguay." Technical Note No. 03100. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/digital-adoption-micro-and-small-firms-uruguay.

Jaffe, Marc, Grace Lee, Joseph Young, Stephen Sidney, and Alan Go. 2013. "Improved Blood Pressure Control Associated with a Large-Scale Hypertension Program." *JAMA* 310 (7): 699–705. https://doi.org/10.1001/JAMA.2013.108769.

Jaffe, Marc, and Joseph Young. 2016. "The Kaiser Permanente Northern California Story: Improving Hypertension Control from 44% to 90% in 13 Years (2000 to 2013)." *Journal of Clinical Hypertension* 18 (4): 260–61. https://doi.org/10.1111/jch.12803.

Jaramillo, Daniel. 2026. "The Spillover Effects of Prisoner Releases: Evidence from an Ecuadoran Mass Pardon." https://djaramilloc.github.io/assets/pdf/Daniel_Jaramillo_JMP.pdf?raw=True.

Javorcik, Beata Smarzynska. 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review* 94 (3): 605–27. https://doi.org/10.1257/0002828041464605.

Jean, Neal, Marshall Burke, Michael Xie, W. Matthew Alampay Davis, David B. Lobell, and Stefano Ermon. 2016. "Combining Satellite Imagery and Machine Learning to Predict Poverty." *Science* 353 (6301): 790–94. https://doi.org/10.1126/science.aaf7894.

Jenkins, Glenn P., Siamand Hesami, Osaid Alshamleh, Anastasiya Yarygina, and Carola Pessino. 2023. "Cost-Benefit Analysis Methodology for Administrative Prefilling of Value-Added Tax Returns: An Application for Chile." IDB Technical Note No. 2765. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005068.

Jensen, Anders D., and Jonathan L. Weigel. 2026. "No Taxation without Administration: Bringing the State Back into the Public Finance of Developing Countries." *Journal of Economic Literature* 64 (1): 246–80. https://doi.org/10.1257/jel.20251760.

Jensen, Robert. 2007. "The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector." *Quarterly Journal of Economics* 122 (3): 879–924. https://doi.org/10.1162/qjec.122.3.879.

Jessoe, Katrina, and David Rapson. 2014. "Knowledge Is (Less) Power: Experimental Evidence from Residential Energy Use." *American Economic Review* 104 (4): 1417–38. https://doi.org/10.1257/aer.104.4.1417.

Johnson, Thaddeus L., Natasha Johnson, Volkan Topalli, Denise McCurdy, and Aislinn Wallace. 2024. "Police Facial Recognition Applications and Violent Crime Control in U.S. Cities." *Cities* 155:105472. https://doi.org/10.1016/j.cities.2024.105472.

Jones, Charles I. 2019. "Paul Romer: Ideas, Nonrivalry, and Endogenous Growth." *Scandinavian Journal of Economics* 121 (3): 859–83. https://doi.org/10.1111/sjoe.12370.

———. 2026. "AI and Our Economic Future." *Journal of Economic Perspectives* 40 (3): 3–22. http://doi.org/10.1257/jep.20261505.

Jones, Charles I., and Christopher Tonetti. 2020. "Nonrivalry and the Economics of Data." *American Economic Review* 110 (9): 2819–58. https://doi.org/10.1257/aer.20191330.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. 2008. "A Retrospective Look at the U.S. Productivity Growth Resurgence." *Journal of Economic Perspectives* 22 (1): 3–24. https://doi.org/10.1257/jep.22.1.3.

J-PAL (Abdul Latif Jameel Poverty Action Lab). 2022. *Sectoral Employment Programs as a Path to Quality Jobs: Lessons from Randomized Evaluations*. Cambridge, MA: J-PAL. https://www.povertyactionlab.org/publication/sectoral-employment-programs-path-quality-jobs-lessons-randomized-evaluations.

———. 2023. "Vocational and Skills Training Programs to Improve Labor Market Outcomes." Policy Insight, March. J-PAL, Cambridge, MA. https://www.povertyactionlab.org/policy-insight/vocational-and-skills-training-programs-improve-labor-market-outcomes.

Jubayer, Shamim, Jubaida Akhtar, Ahmad Khairul Abrar, Md. Noor Nabi Sayem, Shahinul Islam, Khondoker Ehsanul Amin, Muhtamim Fuwad Nahid, et al. 2024. "Text Messaging to Improve Retention in Hypertension Care in Bangladesh." *Journal of Human Hypertension* 38 (11): 765–71. https://doi.org/10.1038/s41371-024-00942-1.

Jung, Juan, and Raúl L. Katz. 2026. "Impacto económico de la inteligencia artificial en América Latina: Transformación tecnológica y rezago en materia de inversión y capacidades laborales" [Economic impact of artificial intelligence in Latin America: Technological transformation and lag in investment and workforce capabilities]. CEPAL Project Documents Series. Economic Commission for Latin America and the Caribbean, January 7, 2026.

Kamiya, Shinichi, Jun-Koo Kang, Jungmin Kim, Andreas Milidonis, and René M. Stulz. 2021. "Risk Management, Firm Reputation, and the Impact of Successful Cyberattacks on Target Firms." *Journal of Financial Economics* 139 (3): 719–49. https://doi.org/10.1016/j.jfineco.2019.05.019.

Kappes, Maria, Pilar Espinoza, Vanessa Jara, and Amanda Hall. 2023. "Nurse-Led Telehealth Intervention Effectiveness on Reducing Hypertension: A Systematic Review." *BMC Nursing* 22 (1): article no. 19. https://link.springer.com/article/10.1186/s12912-022-01170-z.

Katz, Michael L., and Carl Shapiro. 1985. "Network Externalities, Competition, and Compatibility." *American Economic Review* 75 (3): 424–40. https://www.jstor.org/stable/1814809.

Katz, Raúl, Juan Jung, Ramiro Valencia, and Fernando Callorda. 2025. "Impacto económico de las tecnologías digitales y la inteligencia artificial en América Latina" [Economic impact of digital technologies and artificial intelligence in Latin America]. Unpublished report, Telecom Advisory Services LLC, prepared for the Inter-American Development Bank, December 2025.

Kay, Owen, Robert Reaser, and Reid Taylor. 2026. "Processing Power: The Effect of Data Centers on Wholesale Electricity Markets." Working paper. Federal Reserve Bank of Dallas, Research Department. https://ideas.repec.org/p/fip/feddwp/102959.html.

Keefer, Philip, and Carlos Scartascini. 2022. "Trust: The Key to Social Cohesion and Growth in Latin America and the Caribbean." Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/trust-key-social-cohesion-and-growth-latin-america-and-caribbean.

Keefer, Philip, and Razvan Vlaicu. 2024. "Employee Trust and Performance Constraints in Public Sector Organizations." *European Journal of Political Economy* 81 (January): 102503.

Keese, Jeffrey, Christopher Thompson, Hersh Waxman, Karen McIntosh, and Megan Svajda-Hardy. 2023. "A Worthwhile Endeavor? A Meta-Analysis of Research on Formalized Novice Teacher Induction Programs." *Educational Research Review* 38:100505. https://doi.org/10.1016/j.edurev.2022.100505.

Kelly, Bryan, Dimitris Papanikolaou, Amit Seru, and Matt Taddy. 2021. "Measuring Technological Innovation over the Long Run." *American Economic Review: Insights* 3 (3): 303–20. https://doi.org/10.1257/aeri.20190499.

Kerr, David, David Ahn, Kayo Waki, Jing Wang, Boris Breznen, and David C. Klonoff. 2024. "Digital Interventions for Self-Management of Type 2 Diabetes Mellitus: Systematic Literature Review and Meta-Analysis." *Journal of Medical Internet Research* 26:E55757. https://doi.org/10.2196/55757.

Kessel, Dany, Hulda Lif Hardardottir, and Björn Tyrefors. 2020. "The Impact of Banning Mobile Phones in Swedish Secondary Schools." *Economics of Education Review* 77:102009. https://doi.org/10.1016/j.econedurev.2020.102009.

Kholodov, Yaroslav, Erik Jenelius, Oded Cats, Niels van Oort, Niek Mouter, Matej Cebecauer, and Alex Vermeulen. 2021. "Public Transport Fare Elasticities from Smartcard Data: Evidence from a Natural Experiment." *Transport Policy* 105:35–43. https://doi.org/10.1016/j.tranpol.2021.03.001.

Kitsios, Emmanouil, João Tovar Jalles, and Genevieve Verdier. 2020. "Tax Evasion from Cross-Border Fraud: Does Digitalization Make a Difference?" IMF Working Paper No. 20 (245). International Monetary Fund. https://doi.org/10.5089/9781513561189.001.

Klein Teeselink, Bouke. 2025. "Generative AI and Labor Market Outcomes: Evidence from the United Kingdom." SSRN Working Paper. https://www.researchgate.net/publication/396264130_Generative_AI_and_Labor_Market_Outcomes_Evidence_from_the_United_Kingdom.

Kleinberg, Jon, Himabindu Lakkaraju, Jure Leskovec, Jens Ludwig, and Sendhil Mullainathan. 2018. "Human Decisions and Machine Predictions." *Quarterly Journal of Economics* 133 (1): 237–93. https://doi.org/10.1093/qje/qjx032.

Kochanova, Anna, Zahid Hasnain, and Bradley Larson. 2020. "Does E-Government Improve Government Capacity? Evidence from Tax Compliance Costs, Tax Revenue, and Public Procurement Competitiveness." *World Bank Economic Review* 34 (1): 101–20. https://doi.org/10.1093/wber/lhx024.

Koh, Dongya, Raül Santaeulàlia-Llopis, and Yu Zheng. 2020. "Labor Share Decline and Intellectual Property Products Capital." *Econometrica* 88 (6): 2609–28. https://doi.org/10.3982/ECTA17477.

Kopittke, Alberto L. W., and Marília Patta Ramos. 2021. "O que funciona e o que não funciona para reduzir homicídios no Brasil: Uma revisão sistemática" [What works and what does not work to reduce homicides in Brazil: A systematic review]. *Revista de Administração Pública* 55 (2): 414–37. https://doi.org/10.1590/0034-761220190168.

Korinek, Anton, and Donghyun Suh. 2024. "Scenarios for the Transition to AGI." NBER Working Paper No. 32255. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w32255.

Kotidis, Antonis, and Stacey L. Schreft. 2025. "The Propagation of Cyberattacks through the Financial System: Evidence from an Actual Event." *Journal of Finance* 80 (6): 3313–58. https://doi.org/10.1111/jofi.13475.

Kotlikoff, Laurence J., Guillermo Lagarda, and Gabriel Marin. 2023. "A Personalized VAT with Capital Transfers: A Reform to Protect Low-Income Households in Mexico." IDB Working Paper No. 1475. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005028.

Kotsogiannis, Christos, Luca Salvadori, John Karangwa, and Innocente Murasi. 2025. "E-Invoicing, Tax Audits and VAT Compliance." *Journal of Development Economics* 172 (January): 103403. https://doi.org/10.1016/j.jdeveco.2024.103403.

Kraft, Matthew A., David Blazar, and Dylan Hogan. 2018. "The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence." *Review of Educational Research* 88 (4): 547–88. https://doi.org/10.3102/0034654318759268.

Krusell, Per, Lee E. Ohanian, José-Victor Ríos-Rull, and Giovanni L. Violante. 2000. "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis." *Econometrica* 68 (5): 1029–53. https://doi.org/10.1111/1468-0262.00150.

Kuan, Pei Xuan, Weng Ken Chan, Denisa Khoo Fern Ying, Mohd Aizzudin Addul Rahman, Kalaiarasu M. Peariasamy, Nai Ming Lai, Nicholas L. Mills, and Atul Anand. 2022. "Efficacy of Telemedicine for the Management of Cardiovascular Disease: A Systematic Review and Meta-Analysis." *Lancet Digital Health* 4 (9): e676–91. https://www.thelancet.com/journals/landig/article/PIIS2589-7500(22)00124-8/fulltext.

Künnapas, Kaido, Palina Maslionkina, Risto Hinno, and Raivis Liberts. 2025. "Current AI Applications by Estonian Tax Authorities and Use Case Scenarios." *TalTech Journal of European Studies* 15 (1): 179–208. https://doi.org/10.2478/bjes-2025-0010.

Kwan, Janice L., Lisha Lo, Jacob Ferguson, Hanna Goldberg, Juan Pablo Diaz-Martinez, George Tomlinson, Jeremy M. Grimshaw, and Kaveh G. Shojania. 2020. "Computerised Clinical Decision Support Systems and Absolute Improvements in Care: Meta-Analysis of Controlled Clinical Trials." *BMJ* 370:3216. https://doi.org/10.1136/bmj.m3216.

Kyle, Michael Anne, and Austin B. Frakt. 2021. "Patient Administrative Burden in the US Health Care System." *Health Services Research* 56 (5): 755–65. https://doi.org/10.1111/1475-6773.13861.

Laajaj, Rachid, Marcela Eslava, and Tidiane Kinda. 2023. " The Costs of Bureaucracy and Corruption at Customs: Evidence from the Computerization of Imports in Colombia." *Journal of Public Economics* 225: 104969. https://doi.org/10.1016/j.jpubeco.2023.104969.

Labadze, Lasha, Maya Grigolia, and Lela Machaidze. 2023. "Role of AI Chatbots in Education: Systematic Literature Review." *International Journal of Educational Technology in Higher Education* 20 (1): 56. https://doi.org/10.1186/s41239-023-00426-1.

Lai, Fang, Renfu Luo, Linxiu Zhang, Xinzhe Huang, and Scott Rozelle. 2015. "Does Computer-Assisted Learning Improve Learning Outcomes? Evidence from a Randomized Experiment in Migrant Schools in Beijing." *Economics of Education Review* 47 (October): 34–48. https://doi.org/10.1016/j.econedurev.2015.03.005.

Lai, Fang, Linxiu Zhang, Yu Bai, Chengfang Liu, Yaojiang Shi, Fang Chang, and Scott Rozelle. 2016. "More Is Not Always Better: Evidence from a Randomised Experiment of Computer-Assisted Learning in Rural Minority Schools in Qinghai." *Journal of Development Effectiveness* 8 (4): 449–72. https://doi.org/10.1080/19439342.2016.1220412.

Lai, Fang, Linxiu Zhang, Xiao Hu, Qinghe Qu, Yaojiang Shi, Yajie Qiao, Matthew Boswell, and Scott Rozelle. 2013. "Computer Assisted Learning as Extracurricular Tutor? Evidence from a Randomised Experiment in Rural Boarding Schools in Shaanxi." *Journal of Development Effectiveness* 5 (2): 208–31. https://doi.org/10.1080/19439342.2013.780089.

Lai, Fang, Linxiu Zhang, Qinghe Qu, Xiao Hu, Yaojiang Shi, Matthew Boswell, and Scott Rozelle. 2012. "Does Computer-Assisted Learning Improve Learning Outcomes? Evidence from a Randomized Experiment in Public Schools in Rural Minority Areas in Qinghai, China." Rural Education Action Project Working Paper No. 237. https://www.researchgate.net/publication/266457438_Does_Computer-Assisted_Learning_Improve_Learning_Outcomes_Evidence_from_a_Randomized_Experiment_in_Public_Schools_in_Rural_Minority_Areas_in_Qinghai_China.

La Porta, Rafael, and Andrei Shleifer. 2014. "Informality and Development." *Journal of Economic Perspectives* 28 (3): 109–26. https://doi.org/10.1257/jep.28.3.109.

Lee, Suan, and Byeonghak Kim. 2023. "Machine Learning Model for Leak Detection Using Water Pipeline Vibration Sensor." Sensors 23 (21): 8935. https://doi.org/10.3390/s23218935.

Levesque, Karen, Sarah Bardack, and Antonie Chigeda. 2020. "Tablet-Based Learning for Foundational Literacy and Math: An 8-Month RCT in Malawi." Imagine Worldwide. https://www.imagineworldwide.org/wp-content/uploads/An-8-month-RTC-in-Malawi_Final-Report_Jan-2020.pdf.

Levy, Dan, and Angela Pérez Albertos. 2024. *Teaching Effectively with ChatGPT: A Practical Guide to Creating Better Learning Experiences for Your Students in Less Time*. Amazon.

Levy, Santiago. 2018. *Under-Rewarded Efforts: The Elusive Quest for Prosperity in Mexico*. Washington, DC: Inter-American Development Bank. https://publications.iadb.org/en/publications/english/viewer/Under-Rewarded_Efforts_The_Elusive_Quest_for_Prosperity_in_Mexico.pdf.

Lichand, Guilherme, Luca Moreno-Louzada, Thiago da Costa, and Matthew Gentzkow. 2026. "The Educational Impacts of School Phone Bans: Evidence from Brazil." NBER Working Paper No. 35233. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w35233.

Lileeva, Alla, and Daniel Trefler. 2010. "Improved Access to Foreign Markets Raises Plant-Level Productivity . . . for Some Plants." *Quarterly Journal of Economics* 125 (3): 1051–99. https://doi.org/10.1162/qjec.2010.125.3.1051.

Lim, Sungjin, and Junhyoung Oh. 2025. "Navigating Privacy: A Global Comparative Analysis of Data Protection Laws." *IET Information Security* 2025 (1): 5536763. https://doi.org/10.1049/ise2/5536763.

Linden, Leigh L. 2008. "Complement or Substitute? The Effect of Technology on Student Achievement in India." InfoDev Working Paper No. 17. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/804371468034237060.

List, John A. 2022. *The Voltage Effect: How to Make Good Ideas Great and Great Ideas Scale*. New York: Currency.

Liu, Fang, Ting Song, Ping Yu, Ning Deng, Yingping Guan, Yang Yang, and Yuanji Ma. 2023. "Efficacy of an mHealth App to Support Patients' Self-Management of Hypertension: Randomized Controlled Trial." *Journal of Medical Internet Research* 25: e43809. https://doi.org/10.2196/43809.

Loewendahl, Henry. 2018. "Innovations in Foreign Direct Investment Attraction." IDB Discussion Paper No. 572. Inter-American Development Bank, Washington, DC. https://dx.doi.org/10.18235/0001442.

Lopez, Priscilla M., Anna Divney, Keith Goldfeld, Jennifer Zanowiak, Radhika Gore, Rashi Kumar, Phoebe Laughlin, et al. 2019. "Feasibility and Outcomes of an Electronic Health Record Intervention to Improve Hypertension Management in Immigrant-Serving Primary Care Practices." *Medical Care* 57:s164–71. https://doi.org/10.1097/MLR.0000000000000994.

Ludwig, Jens, and Sendhil Mullainathan. 2024. "Machine Learning as a Tool for Hypothesis Generation." *Quarterly Journal of Economics* 139 (2): 751–827. https://doi.org/10.1093/qje/qjad055.

Lukošiūtė, Kamilė, John Halstead, and Luca Righetti. 2026. "Global Cybercrime Damages: A Baseline for Frontier AI Risk Assessment." GovAI Technical Report. https://arxiv.org/abs/2603.20570.

Lum, Cynthia, Christopher S. Koper, and James Willis. 2017. "Understanding the Limits of Technology's Impact on Police Effectiveness." *Police Quarterly* 20 (2): 135–63. https://doi.org/10.1177/1098611116667279.

Lum, Cynthia, Megan Stoltz, Christopher S. Koper, and J. Amber Scherer. 2019. "Research on Body-Worn Cameras." *Criminology & Public Policy* 18 (1): 93–118. https://doi.org/10.1111/1745-9133.12412.

Lum, Kristian, and William Isaac. 2016. "To Predict and Serve?" *Significance* 13 (5): 14–19. https://doi.org/10.1111/j.1740-9713.2016.00960.x.

Lupu, Noam, Mariana Rodríguez, Carole J. Wilson, and Elizabeth J. Zechmeister, eds. 2023. "The Pulse of Democracy in the Americas: Results of the 2023 AmericasBarometer." LAPOP. https://www.vanderbilt.edu/lapop/ab2023/AB2023-Pulse-of-Democracy-final-20231127.pdf

Lynham, John, Kohei Nitta, Tatsuyoshi Saijo, and Nori Tarui. 2016. "Why Does Real-Time Information Reduce Energy Consumption?" *Energy Economics* 54:173–81. https://doi.org/10.1016/j.eneco.2015.11.007.

Ma, Yue, Cody Abbey, Derek Hu, Oliver Lee, Weiting Hung, Xinwu Zhang, Chiayuan Chang, et al. 2020. "The Impact of Computer Assisted Learning on Rural Taiwanese Children: Evidence from a Randomized Experiment." Working paper. Stanford University, August 2020. https://www.academia.edu/68090018/The_Impact_of_Computer_Assisted_Learning_on_Rural_Taiwanese_Children_Evidence_from_a_Randomized_Experiment.

Ma, Yue, Chongbo Zhao, Yan Zhao, Jiahong Lu, Hong Jiang, Yanpei Cao, and Yafang Xu. 2022. "Telemedicine Application in Patients with Chronic Disease: A Systematic Review and Meta-Analysis." *BMC Medical Informatics and Decision Making* 22:105. https://pmc.ncbi.nlm.nih.gov/articles/PMC9017076/.

Mabeza, Russyan Mark S., Kahtrel Maynard, and Derjung M. Tarn. 2022. "Influence of Synchronous Primary Care Telemedicine versus In-Person Visits on Diabetes, Hypertension, and Hyperlipidemia Outcomes: A Systematic Review." *BMC Primary Care* 23: article no. 52. https://doi.org/10.1186/s12875-022-01662-6.

Maloney, William F., and Carlos Molina. 2016. "Are Automation and Trade Polarizing Developing Country Labor Markets, Too?" World Bank Policy Research Working Paper No. 7922. World Bank, Washington, DC. https://documents1.worldbank.org/curated/en/869281482170996446/pdf/WPS7922.pdf.

Mandal, Soumik, Batia M. Wiesenfeld, Adam C. Szerencsy, William R. Small, Vincent Major, Safiya Richardson, Antoinette Schoenthaler, et al. 2025. "Utilization of Generative AI-Drafted Responses for Managing Patient–Provider Communication." *NPJ Digital Medicine* 8:591. https://doi.org/10.1038/s41746-025-01972-w.

Manning, Peter K. 2008. *The Technology of Policing: Crime Mapping, Information Technology, and the Rationality of Crime Control*. NYU Press.

Marcus, Maja E., Anna Reuter, Lisa Rogge, and Sebastian Vollmer. 2024. "The Effect of SMS Reminders on Health Screening Uptake: A Randomized Experiment in Indonesia." *Journal of Economic Behavior & Organization* 227:106715. https://doi.org/10.1016/J.JEBO.2024.106715.

Markusen, James R., and Anthony J. Venables. 1999. "Foreign Direct Investment as a Catalyst for Industrial Development." *European Economic Review* 43 (2): 335–56. https://doi.org/10.1016/S0014-2921(98)00048-8.

Maroz, Raman, Oleksandra Popova, and Santiago Satizabál Acosta. 2023. "Digitizing Court Systems: Benefits and Limitations." Global Indicators Brief No. 25. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/099825001082425972.

Martinez Palomares, Jorge G. 2019. "Did Mexico's National Crime Prevention Program Reduce Crime? An Evaluation of PRONAPRED." Master's thesis, Texas A&M University.

Martins-Neto, Antonio, Yan Liu, Saloni Khurana, and Juan Manuel Porras Lopez. 2025. "Click, Code, Earn: The Returns to Digital Skills." SSRN Scholarly Paper No. 5529280. Social Science Research Network. https://doi.org/10.2139/ssrn.5529280.

Marzi, Giacomo, Anna Marrucci, Donato Vianelli, and Cristiano Ciappei. 2023. "B2B Digital Platform Adoption by SMEs and Large Firms: Pathways and Pitfalls." *Industrial Marketing Management* 114:80–93. https://doi.org/10.1016/j.indmarman.2023.08.002.

Masood, Ayesha, and Muhammed Azfar Nisar. 2021. "Administrative Capital and Citizens' Responses to Administrative Burden." *Journal of Public Administration Research and Theory* 31 (1): 56–72. https://doi.org/10.1093/jopart/muaa031.

Matsukawa, Isamu. 2018. "Information Acquisition and Residential Electricity Consumption: Evidence from a Field Experiment." *Resource and Energy Economics* 53:1–19. https://doi.org/10.1016/j.reseneeco.2018.02.001.

Mauer, Nicole, Pascal Geldsetzer, Jennifer Manne-Goehler, Justine Davies, Andrew Stokes, Margaret McConnell, Mohammed K. Ali, Volker Winkler, and Nikkil Sudharsanan. 2022. "Longitudinal Evidence on Treatment Discontinuation, Adherence, and Loss of Hypertension Control in Four Middle-Income Countries." *Science Translational Medicine* 14 (652). https://doi.org/10.1126/scitranslmed.abi9522.

McElheran, Kristina, J. Frank Li, Erik Brynjolfsson, Zachary Kroff, Emin Dinlersoz, Lucia Foster, and Nikolas Zolas. 2024. "AI Adoption in America: Who, What, and Where." *Journal of Economics & Management Strategy* 33 (2): 375–415. https://doi.org/10.1111/jems.12576.

McEwan, Patrick J. 2015. "Improving Learning in Primary Schools of Developing Countries: A Meta-Analysis of Randomized Experiments." *Review of Educational Research* 85 (3): 353–94. https://doi.org/10.3102/0034654314553127.

McRae, Shaun D. 2024. "Efficiency and Equity Effects of Electricity Metering: Evidence from Colombia." Working paper. Centro de Investigación Económica and Department of Economics, ITAM. https://www.sdmcrae.com/files/electricity-metering.pdf.

Meeks, Robyn, Jacquelyn Pless, and Zhenxuan Wang. 2025. "Can Digitalization Improve Public Services? Evidence from Innovation in Energy Management." Working Paper. https://dx.doi.org/10.2139/ssrn.4709524.

Meghir, Costas, Renata Narita, and Jean-Marc Robin. 2015. "Wages and Informality in Developing Countries." *American Economic Review* 105 (4): 1509–46. https://doi.org/10.1257/aer.20121110.

Mejía, Daniel. 2025a. "Perfil de riesgo de reincidencia para solicitudes de medida de aseguramiento" [Recidivism risk profile for pretrial detention requests]. Fiscalía General de la Nación. Bogotá, DC.

———. 2025b. "PRiSMA Recidivism Risk Tool in Colombia." Inter-American Development Bank, Washington, DC.

Melitz, Marc J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71 (6): 1695–1725. https://doi.org/10.1111/1468-0262.00467.

Méndez Reátegui, Ruben, Gabriel Suárez Jácome, Monica Safar Díaz, and César Ribeiro Donayre. 2023. "Thoughts on Bureaucratic Barriers: A Brief from Chile, Colombia, Ecuador, and Peru." *Revista Digital de Derecho Administrativo* 31:305–26. https://doi.org/10.18601/21452946.n31.12.

Mesquita Moreira, Mauricio, Juan S. Blyde, Christian Volpe Martincus, and Danielken Molina. 2013. *Too Far to Export: Domestic Transport Costs and Regional Export Disparities in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0012838.

Mesquita Moreira, Mauricio, and Ernesto Stein, eds. 2019. *Trading Promises for Results: What Global Integration Can Do for Latin America and the Caribbean*. Development in the Americas Series. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0001886.

Mesquita Moreira, Mauricio, Christian Volpe Martincus, and Juan S. Blyde. 2008. *Unclogging the Arteries: The Impact of Transport Costs on Latin American and Caribbean Trade*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0012316.

Microsoft. 2025. *Microsoft Digital Defense Report 2025: Lighting the Path to a Secure Future*. Microsoft. https://cdn-dynmedia-1.microsoft.com/is/content/microsoftcorp/microsoft/msc/documents/presentations/CSR/Microsoft-Digital-Defense-Report-2025.pdf#page=1.

Microsoft AI Economy Institute. 2026. "Global AI Diffusion: Q1 2026 Trends and Insights." https://www.microsoft.com/en-us/corporate-responsibility/topics/ai-economy-institute/reports/global-ai-adoption-2026-q1/.

Mikulski, Bruna Spiller, Ericles Andre Bellei, Daiana Biduski, and Ana Carolina Bertoletti De Marchi. 2022. "Mobile Health Applications and Medication Adherence of Patients with Hypertension: A Systematic Review and Meta-Analysis." *American Journal of Preventive Medicine* 62 (4): 626–34. https://doi.org/10.1016/j.amepre.2021.11.003.

Miller, Klaus M., Karlo Lukic, and Bernd Skiera. 2025. "The Impact of the General Data Protection Regulation (GDPR) on Online Tracking." *International Journal of Research in Marketing*, March, S0167811625000229. https://doi.org/10.1016/j.ijresmar.2025.03.002.

MinTIC (Colombia Ministry of Information and Communications Technologies). 2014. "Informe de resultados medición de variables de impacto de la estrategia de gobierno en línea—ciudadanos, empresas y entidades" [Results report: Measurement of impact variables for the e-government strategy—citizens, businesses, and entities]. MinTIC.

Mo, Di, Linxiu Zhang, Renfu Luo, Qinghe Qu, Weiming Huang, Jiafu Wang, Yajie Qiao, et al. 2014. "Integrating Computer-Assisted Learning into a Regular Curriculum: Evidence from a Randomised Experiment in Rural Schools in Shaanxi." *Journal of Development Effectiveness* 6 (3): 300–323. https://doi.org/10.1080/19439342.2014.911770.

Mohler, George O., M. B. Short, Sean Malinowski, Mark Johnson, George E. Tita, Andrea L. Bertozzi, and P. Jeffrey Brantingham. 2015. "Randomized Controlled Field Trials of Predictive Policing." *Journal of the American Statistical Association* 110 (512): 1399–1411. https://doi.org/10.1080/01621459.2015.1077710.

Mohsin Ali, Sameen A., and Samia W. Altaf. 2021. "Citizen Trust, Administrative Capacity and Administrative Burden in Pakistan's Immunization Program." *Journal of Behavioral Public Administration* 4 (1). https://doi.org/10.30636/jbpa.41.184.

Monge, Karol Acón, and Cecilia Chávez. 2025. "SIUBEN's Role in Public Policy in the Dominican Republic." Case Studies in Digital Social Protection, Edition No. 04. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013639.

Moons, Selwyn. 2017. "Heterogeneous Effects of Economic Diplomacy: Instruments, Determinants and Developments." Ph.D. thesis, Erasmus University, Rotterdam, Netherlands. https://repub.eur.nl/pub/100817.

Motta Café, Renata, Anastasiya Yarygina, and Lisseth Escalante. 2024. "Leveraging Data to Improve Tax Compliance for Micro and Small Firms: Evidence from Brazil." IDB Working Paper No. 1590. Inter-American Development Bank. Washington, DC. https://doi.org/10.18235/0013027.

Moynihan, Donald, Pamela Herd, and Hope Harvey. 2015. "Administrative Burden: Learning, Psychological, and Compliance Costs in Citizen-State Interactions." *Journal of Public Administration Research and Theory* 25 (1): 43–69. https://doi.org/10.1093/jopart/muu009.

Moynihan, Donald P., Pamela Herd, and Elizabeth Ribgy. 2016. "Policymaking by Other Means: Do States Use Administrative Barriers to Limit Access to Medicaid?" *Administration & Society* 48 (4): 497–524. https://doi.org/10.1177/0095399713503540.

Muendler, Marc-Andreas, James Rauch, and Oana Tocoian. 2012. "Employee Spinoffs and Other Entrants: Stylized Facts from Brazil." *International Journal of Industrial Organization* 30 (5): 447–58. https://doi.org/10.1016/j.ijindorg.2012.02.001.

Muggah, Robert, and Ilona Szabó de Carvalho. 2018. "Violent Crime in São Paulo Has Dropped Dramatically. Is This Why?" World Economic Forum on Latin America, March 7, 2018. https://www.weforum.org/stories/2018/03/violent-crime-in-sao-paulo-has-dropped-dramatically-this-may-be-why/.

Munizaga, Marcela A., Antonio Gschwender, and Nestor Gallegos. 2020. "Fare Evasion Correction for Smartcard-Based Origin-Destination Matrices." *Transportation Research Part A: Policy and Practice* 141:307–22. https://doi.org/10.1016/j.tra.2020.09.008.

Muralidharan, Karthik, Paul Niehaus, and Sandip Sukhtankar. 2016. "Building State Capacity: Evidence from Biometric Smartcards in India." *American Economic Review* 106 (10): 2895–929. https://doi.org/10.1257/aer.20141346.

———. 2025. "Identity Verification Standards in Welfare Programs: Experimental Evidence from India." *Review of Economics and Statistics* 107 (2): 372–92. https://doi.org/10.1162/rest_a_01296.

Muralidharan, Karthik, and Abhijeet Singh. 2025. "Adapting for Scale: Experimental Evidence on Technology-Aided Instruction in India." NBER Working Paper No. 34205. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w34205.

Muralidharan, Karthik, Abhijeet Singh, and Alejandro J. Ganimian. 2019. "Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India." *American Economic Review* 109 (4): 1426–60. https://doi.org/10.1257/aer.20171112.

Musgrave, Richard A. 1959. *The Theory of Public Finance: A Study in Public Economy*. New York: McGraw-Hill.

Nakayama, Luis Filipe, William Warr Binotti, Naira Link Woite, Chrystinne Oliveira Fernandes, Pia Gabrielle Alfonso, Leo Anthony Celi, and Caio Vinicius Regatieri. 2023. "The Digital Divide in Brazil and Barriers to Telehealth and Equal Digital Health Care: Analysis of Internet Access using Publicly Available Data." *Journal of Medical Internet Research* 25:e42483. https://www.jmir.org/2023/1/e42483.

Näslund-Hadley, Emma, and Ximena Dueñas Herrera, eds. 2026. *Built to Last: Advancing Education, Equity and Economic Development through Literacy and Numeracy*. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0014497.

National Police of Colombia. 2019. "El sistema de denuncia virtual 'ADenunciar' crece" [The "ADenunciar" online reporting system is growing]. Policía Nacional de Colombia. May 4, 2019. https://www.policia.gov.co/noticia/sistema-denuncia-virtual-adenunciar-crece.

National Research Council. 2000. *How People Learn: Brain, Mind, Experience, and School*, expanded ed. National Academy Press.

Nemati, Mehdi, Steven Buck, and Hilary Soldati. 2025. "High-Frequency Analytics and Residential Water Consumption: Estimating Heterogeneous Effects." *Resource and Energy Economics* 83 (August): 101500. https://doi.org/10.1016/j.reseneeco.2025.101500.

Nieto-Morales, Fernando, Rik Peeters, and Gabriela Lotta. 2024. "Burdens, Bribes, and Bureaucrats: The Political Economy of Petty Corruption and Administrative Burdens." *Journal of Public Administration Research and Theory* 34 (4): 481–97. https://doi.org/10.1093/jopart/muae010.

Norberg, Patricia A., Daniel R. Horne, and David A. Horne. 2007. "The Privacy Paradox: Personal Information Disclosure Intentions versus Behaviors." *Journal of Consumer Affairs* 41 (1): 100–126. https://doi.org/10.1111/j.1745-6606.2006.00070.x.

Noriega-Campero, Alejandro, Bernardo Garcia-Bulle, Luis F. Cantu, Michiel A. Bakker, Luis Tejerina, and Alex Pentland. 2020. "Algorithmic Targeting of Social Policies: Fairness, Accuracy, and Distributed Governance." *FAT* '20: Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency*, 241–51. https://dl.acm.org/doi/10.1145/3351095.3375784.

North, Douglass C. 1984. "Transaction Costs, Institutions, and Economic History." *Zeitschrift für die gesamte staatswissenschaft / Journal of Institutional and Theoretical Economics* 140 (1): 7–17. https://www.jstor.org/stable/40750667.

Nose, Manabu. 2023. "Exploring the Adoption of Selected Digital Technologies in Tax Administration." *IMF Notes* 2023 (008): 1. https://doi.org/10.5089/9798400258183.068.

Noy, Shakked, and Whitney Zhang. 2023. "Experimental Evidence on the Productivity Effects of Generative Artificial Intelligence." *Science* 381 (6654): 187–92. https://doi.org/10.1126/science.adh2586.

Nuckols, Teryl, Crystal Smith-Spangler, Sally Morton, Steven Asch, Vaspaan Patel, Laura Anderson, Emily Deichsel, and Paul Shekelle. 2014. "The Effectiveness of Computerized Order Entry at Reducing Preventable Adverse Drug Events and Medication Errors in Hospital Settings: A Systematic Review and Meta-Analysis." *Systematic Reviews* 3: article no. 56. https://doi.org/10.1186/2046-4053-3-56.

Ochoa Chaves, Luisa, Oscar Mario Jiménez Alvarado, and Fernando Martínez de Lemos. 2023. "Costa Rica's Unified Digital Health Record (EDUS): Best Practices, History, and Implementation." Digital Health Case Study No. 6. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005019.

OECD (Organisation for Economic Co-operation and Development). 2004. *Compliance Risk Management: Use of Random Audit Programmes*. OECD Publishing. https://doi.org/10.1787/4efbff23-en.

———. 2014. *Tax Compliance by Design: Achieving Improved SME Tax Compliance by Adopting a System Perspective*. OECD. https://doi.org/10.1787/9789264223219-en.

———. 2019. "The Digital Innovation Policy Landscape in 2019." OECD Science, Technology and Innovation Policy Paper No. 71. https://www.oecd.org/en/publications/the-digital-innovation-policy-landscape-in-2019_6171f649-en.html.

———. 2020. "OECD Digital Economy Outlook 2020." OECD Publishing, Paris. https://www.oecd.org/en/publications/oecd-digital-economy-outlook-2020_bb167041-en.html.

———. 2022a. "Building Trust to Reinforce Democracy: Main Findings from the 2021 OECD Survey on Drivers of Trust in Public Institutions, Building Trust in Public Institutions." OECD Publishing, Paris. https://doi.org/10.1787/b407f99c-en.

———. 2022b. *Tax Administration 2022: Comparative Information on OECD and Other Advanced and Emerging Economies*. Paris: OECD Publishing. https://doi.org/10.1787/1e797131-en.

———. 2024. *Consumption Tax Trends 2024: VAT/GST and Excise, Core Design Features and Trends*. Paris: OECD Publishing. https://doi.org/10.1787/dcd4dd36-en.

———. 2025a. *Governing with Artificial Intelligence: The State of Play and Way Forward in Core Government Functions*. OECD Publishing. https://doi.org/10.1787/795de142-en.

———. 2025b. "Health at a Glance 2025: OECD Indicators." OECD Publishing, Paris, https://doi.org/10.1787/8f9e3f98-en.

———. 2025c. Tax Administration Digitalisation and Digital Transformation Initiatives. OECD Publishing. https://doi.org/10.1787/c076d776-en.

———. 2026a. *Digital Continuous Transactional Reporting for Value Added Tax: Policy and Design Considerations for Introduction and Operation*. Paris: OECD Publishing. https://doi.org/10.1787/34c88c39-en.

———. 2026b. *PISA 2025 Results (Volume I): Future-Ready Students*. Paris: OECD Publishing. https://doi.org/10.1787/73451bc5-en.

OECD (Organisation for Economic Co-operation and Development), Economic Commission for Latin America and the Caribbean, CAF Development Bank of Latin America, and European Commission. 2024. *Latin American Economic Outlook 2024: Financing Sustainable Development*. Paris: OECD. https://doi.org/10.1787/c437947f-en.

OECD (Organisation for Economic Co-operation and Development), Economic Commission for Latin America and the Caribbean, Inter-American Center of Tax Administrations, and Inter-American Development Bank. 2025. *Revenue Statistics in Latin America and the Caribbean 2026*. Paris: OECD Publishing. https://doi.org/10.1787/2f21f131-en.

OECD (Organisation for Economic Co-operation and Development) and World Bank. 2023. "Health at a Glance: Latin America and the Caribbean 2023." OECD Publishing, Paris, https://doi.org/10.1787/532b0e2d-en.

Okunogbe, Oyebola, and Victor Pouliquen. 2022. "Technology, Taxation, and Corruption: Evidence from the Introduction of Electronic Tax Filing." *American Economic Journal: Economic Policy* 14 (1): 341–72. https://doi.org/10.1257/pol.20200123.

Okunogbe, Oyebola, and Fabrizio Santoro. 2023. "The Promise and Limitations of Information Technology for Tax Mobilization." *World Bank Research Observer* 38 (2): 295–324. https://doi.org/10.1093/wbro/lkac008.

Okunogbe, Oyebola, and Gabriel Tourek. 2024. "How Can Lower-Income Countries Collect More Taxes? The Role of Technology, Tax Agents, and Politics." *Journal of Economic Perspectives* 38 (1): 81–106. https://doi.org/10.1257/jep.38.1.81.

Orbeta, Aniceto C., Jr., Vicente B. Paqueo, and Bilal Siddiqi. 2021. "Impacts of Electronic Case Management Systems on Court Congestion in the Philippines." 3ie Impact Evaluation Report No. 133. International Initiative for Impact Evaluation. https://www.3ieimpact.org/evidence-hub/publications/impact-evaluations/impacts-electronic-case-management-systems-court.

Ordunez, Pedro, Norm R. C. Campbell, Donald J. DiPette, Marc G. Jaffe, Andrés Rosende, Ramón Martínez, Angelo Gamarra, et al. 2024. "HEARTS en las Américas: Impulsar el cambio en el sistema de salud para mejorar el control de la hipertensión en la población" [HEARTS in the Americas: Targeting health system change to improve population hypertension control]. *Revista Panamericana de Salud Pública* 48:e17. https://doi.org/10.26633/RPSP.2024.17.

Ortega, Daniel, and Carlos Scartascini. 2015. "Don't Blame the Messenger: A Field Experiment on Delivery Methods for Increasing Tax Compliance." IDB Working

Paper No. 627. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0000204.

Oviedo, Daniel, Orlando Sabogal-Cardona, and Lynn Scholl. 2025. "Ready to Ride: Security and Transit-Related Determinants of Ride-Hailing Adoption in Latin America." *Case Studies on Transport Policy* 22:101608. https://doi.org/10.1016/j.cstp.2025.101608.

Pagés, Carmen, ed. 2010. *The Age of Productivity: Transforming Economies from the Bottom Up*. New York: Palgrave Macmillan.

PAHO. (Pan American Health Organization). 2025. "Major Storm on the Horizon: Health and Macroeconomic Burdens of Noncommunicable Diseases and Mental Health Conditions in South America." PAHO, July 15, 2025. https://www.paho.org/en/news/15-7-2025-major-storm-horizon-ncds-and-mental-health-conditions-cost-south-america-trillions.

———. 2026. "Informe regional sobre la situación de los sistemas de información para la salud en las Américas: Acelerando la transformación digital del sector salud en las Américas." [Regional report on the status of health information systems in the Americas: Accelerating the digital transformation of the health sector in the Americas]. PAHO. https://iris.paho.org/handle/10665.2/70909.

Pallero, Susana, and Silvia Marquez. 2023. "Reporte de accesibilidad digital en sitios web gubernamentales de países de América Latina y el Caribe" [Digital accessibility report on government websites]. Consulting report for the Inter-American Development Bank, Washington, DC.

Panzar, John C., and Robert D. Willig. 1981. "Economies of Scope." *American Economic Review* 71 (2): 268–72. https://www.jstor.org/stable/1815729.

Parfitt, Rafael, Bruno Pantaleão, and Alberto Kopittke. 2026. "Police Autonomy, Data-Driven Strategies, and Violence: Evidence from Brazil's Policing Reform." *Journal of Development Economics* 178 (January): 103603. https://doi.org/10.1016/j.jdeveco.2025.103603.

Peláez Longinotti, Fernando. 2026. "Efficiency and Tax Gap in Latin American and Caribbean Countries: Value Added Tax and Corporate Income Tax." CIAT Working Paper No. 2. Inter-American Center of Tax Administrations. https://www.ciat.org/wp-02-2026-efficiency-and-tax-gap-in-latin-american-and-caribbean-countries-value-added-tax-and-corporate-income-tax-coming-soon/?lang=en.

Peng, Sida, Eirini Kalliamvakou, Peter Cihon, and Mert Demirer. 2023. "The Impact of AI on Developer Productivity: Evidence from GitHub Copilot." arXiv:2302.06590. https://arxiv.org/pdf/2302.06590.

Pereira, Mariano, María Florencia Barletta, and Gabriel Yoguel. 2016. "The Performance of the Computer Software and Services Sector in Argentina: Microeconometric Evidence on Public-Sector Support Programmes." *Revista CEPAL* 2016 (120): 171–88. Naciones Unidas Comisión Económica para América Latina y el Caribe (CEPAL). https://doi.org/10.18356/03fdcb50-en.

Pérez Serna, Débora Margarita. 2023. "Implementation Process for the Unified Electronic Medical Record (UEMR) in Bogotá." Digital Health Case Studies, Edition 07. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005108.

Pérez-Urdiales, María, and Carolina Tojal Ramos Dos Santos. 2024. "Water Expenditure, Service Quality and Inequality in Latin America and the Caribbean." IDB Working

Paper No. 01657. Inter-American Development Bank, Washington, DC. http://dx.doi.org/10.18235/0013248.

Perez Villasenor, Alejandro, Cansu Alakuş, Lynn Scholl, and Luis Miranda-Moreno. Forthcoming. "Application of a Machine Learning Approach for Pedestrian Surrogate Safety Analysis: A Case Study in Intersections with BRT Stations and Bus Stops in Mexico City." *IDB Working Paper*. Inter-American Development Bank, Washington, DC.

Perez-Vincent, Santiago M., Verónica Abril, Cynthia Chen, Teniola Tayo, and Andres Urrego-Jimenez. 2024. Crime Underreporting in Latin America and the Caribbean. Washington, DC: Inter-American Development Bank. https://publications.iadb.org/en/crime-underreporting-latin-america-and-caribbean.

Pessino, Carola, Alejandro Rasteletti, Daniel Artana, and Nora Lustig. 2023. "Distributional Effects of Taxation in Latin America." Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005230.

Phadke, Anuradha, Yingjie Weng, Cati Brown Johnson, Marcy Winget, Megan Mahoney, Christopher Sharp, Amelia Sattler, et al. 2025. "Integrating a High Blood Pressure Advisory across a Primary Care Network." *JAMA Network Open* 8 (4): e257313. https://pmc.ncbi.nlm.nih.gov/articles/PMC12032570.

Pierce, William, Dirk Schroeder, and Robb Suchecki. 2021. "Telehealth in Latin America: Progress, Challenges, and Opportunities in the Face of COVID-19." *Telehealth and Medicine Today* 6 (1). https://doi.org/10.30953/tmt.v6.238.

Pinotti, Paolo. 2015. "The Economic Costs of Organised Crime: Evidence from Southern Italy." *Economic Journal* 125 (586): F203–32. https://doi.org/10.1111/ecoj.12235.

Pires, Cleyton Andre. 2024. "Supervised Machine Learning for Tax Evasion Detection: A Case Study with the Brazilian Tax Administration." *Companion Proceedings of the Brazilian Symposium on Databases (SBBD)*. October, 288–94. https://doi.org/10.5753/sbbd_estendido.2024.244262.

Piza, Eric, Brandon Welsh, David Farrington, and Amanda Thomas. 2019. "CCTV Surveillance for Crime Prevention." *Criminology & Public Policy* 18 (1): 135–59. https://doi.org/10.1111/1745-9133.12419.

Pizzolato Gonçalves, Bruna, and Rafael Venijio Maggion. 2022. "Economic Benefits of Public Service Digital Transformation: The Case of the City of São Paulo." Technical Note No. IDB-TN-2500. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/economic-benefits-public-service-digital-transformation-case-city-sao-paulo.

Podgornik, Ales, Boris Sucic, and Bostjan Blazic. 2016. "Effects of Customized Consumption Feedback on Energy Efficient Behaviour in Low-Income Households." Journal of Cleaner Production 130 (September): 25–34. https://doi.org/10.1016/j.jclepro.2016.02.009.

Pombo, Cristina, Benjamin Roseth, Julieth Santamaria, Carolina Rivas, and Mateo Vásquez. 2025. ¿(Des)conectados? Servicios públicos digitales y el reto de la equidad [(Dis)connected? Digital public services and the challenge of equity]. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013765.

Poole, Jennifer P. 2013. "Knowledge Transfers from Multinational to Domestic Firms: Evidence from Worker Mobility." *Review of Economics and Statistics* 95 (2): 393–406. https://doi.org/10.1162/REST_a_00258.

Prince, Jeffrey, and Scott Wallsten. 2020. "How Much Is Privacy Worth around the World and across Platforms?" Paper presented at TPRC48: The 48th Research Conference on Communication, Information and Internet Policy. January 30. http://dx.doi.org/10.2139/ssrn.3528386.

Puig Gabarró, Pau, Antonio García-Zaballos, Enrique Iglesias, Ana Sepúlveda, Alex Wong, and Cristopher Yoo. 2021. *Strategies and Business Models for Improving Broadband Connectivity in Latin America and the Caribbean: Guidelines for the Planning, Investment, and Rollout of Broadband Networks*. Washington, DC: Inter-American Development Bank.

Qudus, Lawal. 2025. "Cybersecurity Governance: Strengthening Policy Frameworks to Address Global Cybercrime and Data Privacy Challenges." *International Journal of Science and Research Archive* 14 (1): 1146–63. https://doi.org/10.30574/ijsra.2025.14.1.0225.

Ramírez-Álvarez, José, Nicolás Oliva, and Mauro Andino. 2022. "Cumplimiento tributario y facturación electrónica en Ecuador: evaluación de impacto" [Tax compliance and electronic invoicing in Ecuador: Impact assessment]. *Problemas del Desarrollo* 53 (208): 97–123. https://doi.org/10.22201/iiec.20078951e.2022.208.69712.

Rammer, Christian, Gastón P. Fernández, and Dirk Czarnitzki. 2022. "Artificial Intelligence and Industrial Innovation: Evidence from German Firm-Level Data." *Research Policy* 51 (7): 104555. https://doi.org/10.1016/j.respol.2022.104555.

Ramondo, Natalia, Andrés Rodríguez-Clare, and Felix Tintelnot. 2015. "Multinational Production: Data and Stylized Facts." *American Economic Review* 105 (5): 530–36. https://doi.org/10.1257/aer.p20151046.

Rangan, Subramanian, and Robert Z. Lawrence. 1999. "Search and Deliberation in International Exchange: Learning from Multinational Trade about Lags, Distance Effects, and Home Bias." NBER Working Paper No. 7012. National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w7012.

Rao, Neel. 2015. "General Training in Labor Markets: Common Value Auctions with Unobservable Investment." *Journal of Economic Behavior & Organization* 120 (December): 19–45. https://doi.org/10.1016/j.jebo.2015.07.013.

Rasteletti, Alejandro. 2021. "IVA personalizado: Experiencia de 5 países y su importancia estratégica para la política y la administración tributaria" [Personalized VAT: Experience from five countries and its strategic importance for tax policy and administration]. Inter-American Development Bank, Washington, DC. https://www.iadb.org/es/blog/modernizacion-del-estado/gestion-fiscal/iva-personalizado-experiencia-de-5-paises-y-su-importancia-estrategica-para-la-politica-y-la.

Reimers, Fernando M., and Connie K. Chung. 2016. *Teaching and Learning for the Twenty-First Century: Educational Goals, Policies, and Curricula from Six Nations*. Harvard Education Press.

Resende, Davi, Gabriel Richter, Marcelo Castello Branco Sant'Anna, and André Trindade. 2025. "Pricing and Informality: Evidence from Energy Theft in Brazil." Center for Open Science, preprint. https://osf.io/preprints/socarxiv/m4ev5_v1.

Restuccia, Diego. 2013. "The Latin American Development Problem: An Interpretation." *Economía* 13 (2): 69–100. https://www.jstor.org/stable/23608145.

Restuccia, Diego, and Richard Rogerson. 2017. "The Causes and Costs of Misallocation." *Journal of Economic Perspectives* 31 (3): 151–74. https://doi.org/10.1257/jep.31.3.151.

Reyes, Ángela María, Benjamin Roseth, and Diego Vera-Cossio. 2025. "Expanding Access to Identification Cards and Social Programs: Experimental Evidence from Panamá." *Journal of Policy Analysis and Management* 44 (3): 893–916. https://doi.org/10.1002/pam.22596.

Reyes-Tagle, Gerardo, Mónica Calijuri, Osvaldo Santín, Carolina Roca, Luis Fernando Cadena, Fernando Barraza Luengo, and Erick Marinkovic Febré. 2021. "The Digital Transformation of Latin American Tax Administrations: The Case of Chile." IDB Discussion Paper No. 885. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0003871.

Reyes-Tagle, Gerardo, Christina Dimitropoulou, and Cristian Camilo Rodríguez Peña. 2023. *Digitalization of Tax Administration in Latin America and the Caribbean: Best-Practice Framework for Improving E-Services to Taxpayers*. IDB Monograph No. 1153. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0005260.

Reyes-Tagle, Gerardo, Inder J. Ruprah, and Jorge F. Baca Campodónico. 2024. *Not Just Taxes: Revenue, Economic Growth and Inequality in the Caribbean*, edited by Gerardo Reyes-Tagle. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013350.

Ribeiro, Rafael Dias, Valter Gomes, and Daniela Gomes. 2024. "Saúde digital e políticas públicas: Evolução e desafios para o Brasil" [Digital health and public policies: Evolution and challenges for Brazil]. *Revista Aracê* 6 (3). https://periodicos.newsciencepubl.com/arace/article/view/1394.

Riley, Emma, and Abu S. Shonchoy. 2025. "Encouraging Digital Financial Technology Adoption during a Crisis: Experimental Evidence from Ghana." *Economic Development and Cultural Change* 73 (4): 1659–84. https://doi.org/10.1086/732597.

Rodriguez-Segura, Daniel. 2022. "EdTech in Developing Countries: A Review of the Evidence." *World Bank Research Observer* 37 (2): 171–203. https://doi.org/10.1093/wbro/lkab011.

Rogers, Everett M. 1983. *Diffusion of Innovations*, 3rd ed. New York: Free Press.

Romanosky, Sasha. 2016. "Examining the Costs and Causes of Cyber Incidents." *Journal of Cybersecurity*, August 25, tyw001. https://doi.org/10.1093/cybsec/tyw001.

Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98 (5, part 2): S71–102. https://doi.org/10.1086/261725.

Romero, Mauricio, and Abhijeet Singh. 2022. "The Incidence of Affirmative Action: Evidence from Quotas in Private Schools in India." RISE Working Paper No. 22/088. https://riseprogramme.org/sites/default/files/2022-02/Incidence_Affirmative_Action_Evidence_Quotas_Private_Schools_India.pdf.

Romero-Ben, Luis, Débora Alves, Joaquim Blesa, Gabriela Cembrano, Vincenç Puig, and Eric Duviella. 2023. "Leak Detection and Localization in Water Distribution Networks: Review and Perspective." *Annual Reviews in Control* 55:392–419. https://doi.org/10.1016/j.arcontrol.2023.03.012.

Rose, Andrew K. 2007. "The Foreign Service and Foreign Trade: Embassies as Export Promotion." *World Economy* 30 (1): 22–38. https://doi.org/10.1111/j.1467-9701.2007.00870.x.

Rosenshine, Barak. 2012. "Principles of Instruction: Research-Based Strategies that Every Teacher Should Know." *American Educator* 36 (1): 12–19. https://www.aft.org/sites/default/files/Rosenshine.pdf.

Roseth, Benjamin, Angela María Reyes, and Karla Yee Amézaga. 2021. "Public Services and Digital Government during the Pandemic: Perspectives of Citizens, Civil Servants, and Government Institutions." Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/publications/english/viewer/Public-Services-and-Digital-Government-during-the-Pandemic-Perspectives-of-Citizens-Civil-Servants-and-Government-Institutions.pdf.

Roseth, Benjamin, Angela Reyes, and Carlos Santiso, eds. 2018. *Wait No More: Citizens, Red Tape, and Digital Government*. Washington, DC: Inter-American Development Bank. https://publications.iadb.org/es/publications/english/viewer/Wait-No-More-Citizens-Red-Tape-and-Digital-Government.pdf.

Ruamviboonsuk, Paisan, Richa Tiwari, Rory Sayres, Variya Nganthavee, Kornwipa Hemarat, Apinpat Kongprayoon, and Rajiv Raman, et al. 2022. "Real-Time Diabetic Retinopathy Screening by Deep Learning in a Multisite National Screening Programme: A Prospective Interventional Cohort Study." *Lancet Digital Health* 4 (4): e235–44. https://doi.org/10.1016/S2589-7500(22)00017-6.

Sabogal-Cardona, Orlando, Daniel Oviedo, Lynn Scholl, Amado Crotte, and Felipe Bedoya-Maya. 2021. "Not My Usual Trip: Ride-Hailing Characterization in Mexico City." Travel *Behaviour and Society* 25 (October): 233–45. https://doi.org/10.1016/j.tbs.2021.07.010.

Sanchez, Zila M., Juliana Y. Valente, Patricia P. Galvão, Fabiane A. Gubert, Márcia H. S. Melo, Sheila C. Caetano, Jair J. Mari, and Hugo Cogo-Moreira. 2021. "A Cluster Randomized Controlled Trial Evaluating the Effectiveness of the School-Based Drug Prevention Program #Tamojunto2.0." *Addiction*. 116:1580–92. https://doi.org/10.1111/add.15358.

Santoro, Fabrizio, Razan Amine, and Tanele Magongo. 2022. "Mandating Digital Tax Tools as a Response to Covid: Evidence from Eswatini." ICTD Working Paper No. 140. Institute of Development Studies, University of Sussex, Brighton, UK. https://doi.org/10.19088/ICTD.2022.006.

Santoro, Fabrizio, Adrienne Lees, Marco Carreras, Theonille Mukamana, Naphtal Hakizimana, and Yves Nsengiyumva. 2023. "Technology and Tax: Adoption and Impacts of E-Services in Rwanda." ICTD Working Paper No. 153. Institute of Development Studies, University of Sussex, Brighton, UK. https://doi.org/10.19088/ICTD.2023.001.

Santoro, Fabrizio, Phindile T. Masuku, and Tanele Magongo. 2026. "Cashless Tax Systems: Voluntary vs. Mandated Digital Payments in Eswatini." *International Tax and Public Finance*. https://doi.org/10.1007/s10797-026-09982-4.

Sathasivam, Kumaahran. 2009. "Single Window Implementation: Trade Facilitation through Integration of Information." Paper presented at the Twelfth Anniversary of the Asia-Pacific Paperless Trading Group, Taipei.

Scattolo, Gabriel, and Christian Volpe Martincus. Forthcoming. "Electronic Investment Single Windows and Firm Establishment: Evidence from Costa Rica." IDB Working Paper. Inter-American Development Bank, Washington, DC.

Schivardi, Fabiano, and Tom Schmitz. 2020. "The IT Revolution and Southern Europe's Two Lost Decades." *Journal of the European Economic Association* 18 (5): 2441–86. https://doi.org/10.1093/jeea/jvz048.

Schumpeter, Joseph A. 1942. *Capitalism, Socialism and Democracy*. Harper & Brothers.

Schwalm, J. D., Philip Joseph, Darryl Leong, Jose Patricio Lopez-Lopez, Oyere Onuma, Palki Bhatt, and Alvaro Avezum, et al. 2025. "Cardiovascular Disease in the Americas: Optimizing Primary and Secondary Prevention of Cardiovascular Disease." *Lancet Regional Health—Americas* 42:100964. https://doi.org/10.1016/j.lana.2024.100964.

Schwarz, Natalie V., and Marco Stampini. 2025. "Landscape of Non-Contributory Cash Transfers in Latin America and the Caribbean, before and after the Covid-19 Pandemic." IDB Policy Brief No. 0420. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013579.

Schwarzbauer, Karla, Pedro Bernal, Emmanuelle Sánchez-Monin, Ana Aguilar, Sebastian Bauhoff, and Emma Iriarte. 2026. "Towards High-Performing Health Systems." Regional Policy Dialogue 2025, September 10–12 Medellín, Colombia. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0014070.

Scur, Daniela, Raffaella Sadun, John Van Reenen, Renata Lemos, and Nicholas Bloom. 2021. "The World Management Survey at 18: Lessons and the Way Forward." *Oxford Review of Economic Policy* 37 (2): 231–58. https://doi.org/10.1093/oxrep/grab009.

Secretaría de Economía. 2009. "Evaluación de impacto del Programa para el Desarrollo de la Industria del Software (evaluación integral 2008–2009 del PROSOFT)" [Impact assessment of the Program for the Development of the Software Industry (comprehensive assessment 2008–2009 of PROSOFT)]. ITAM, Secretaría de Economía, México, Centro de Estudios de Competitividad. https://www.economia.gob.mx/files/transparencia/prosoft_eval_2008_integral.pdf.

Selod, Harris, and Souleymane Soumahoro. 2020. "Big Data in Transportation: An Economics Perspective." Policy Research Working Paper No. 9308. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-9308.

SENAPPEN (Secretaria Nacional de Políticas Penais). 2025. "Relatório de Informações Penitenciárias" [Penitentiary information report]. Ministério da Justiça e Segurança Pública. https://www.gov.br/senappen/pt-br/servicos/sisdepen/relatorios/relatorios-de-informacoes-penitenciarias/relatorio-do-2o-semestre-de-2024.pdf.

Serrano-Berthet, Rodrigo. 2018. "Smart Spending on Citizen Security: Beyond Crime and Punishment." In *Better Spending for Better Lives: How Latin America and the Caribbean Can Do More with Less*, edited by Alejandro Izquierdo, Carola Pessino, and Guillermo Vuletin. Development in the Americas Series. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0001217-es.

Setzler, Bradley, and Felix Tintelnot. 2021. "The Effects of Foreign Multinationals on Workers and Firms in the United States." *Quarterly Journal of Economics* 136 (3): 1943–91. https://doi.org/10.1093/qje/qjab015.

Singh, Abhijeet, Laia Navarro-Sola, and Philip Oreopoulos, eds. 2025. "Education Technology." *VoxDevLit* 20 (1). https://www.voxdev.org/sites/default/files/2025-12/EdTech_Issue_1.pdf,

Slemrod, Joel. 2019. "Tax Compliance and Enforcement." *Journal of Economic Literature* 57 (4): 904–54. https://doi.org/10.1257/jel.20181437.

Soares, Fábio, Rafael Perez Ribas, and Rafael Guerriero Osório. 2007. "Evaluating the Impact of Brazil's Bolsa Família: Cash Transfer Programmes in Comparative Perspective." *Latin American Research Review* 45 (2): 173–90. https://www.jstor.org/stable/27919200.

SPH-Digital. 2022. "Telemedicine: Comparison between Countries in the Región Latinoamérica y el Caribe (LAC)." Inter-American Development Bank, Washington, DC. https://socialdigital.iadb.org/en/sph/dashboard/telemedicine.

Spindler, Wesley, Laura Fisher, and Luna Atamian Hahn-Petersen. 2025. "Data Centres Use Vast Amounts of Water—Here's How We Advance Water Circularity." World Economic Forum, November 18, 2025. https://www.weforum.org/stories/2025/11/data-centres-and-water-circularity/.

Stampini, Marco, Nadin Medellín, and Pablo Ibarrarán. 2023. "Cash Transfers, Poverty, and Inequality in Latin America and the Caribbean." IDB Working Paper No. 01531. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0005235.

Stanford Center for Digital Health. 2024. "Generative AI for Health in Low & Middle Income Countries." White paper. https://cdh.stanford.edu/research-portfolio/generative-ai-health-low-middle-income-countries.

Stevenson, Megan T. 2018. "Assessing Risk Assessment in Action." *Minnesota Law Review* 103: 303–84.

Stiglitz, Joseph E. 1989. "Markets, Market Failures, and Development." *American Economic Review* 79 (2): 197–203. https://www.jstor.org/stable/1827756.

Stiroh, Kevin J. 2002. "Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?" *American Economic Review* 92 (5): 1559–76. https://doi.org/10.1257/000282802762024638.

Strömberg, David, Victor Lei, and Yanhui Wu. 2026. "The Generative AI Learning Penalty: Evidence from Chinese Secondary Education." CEPR Discussion Paper No. 21577. CEPR Press, Paris and London.

Stubrin, Lilia, Julián Asisten, Carlos Zornada, and Ana Castillo Leska. 2026. "De la promesa a la acción: Un panorama de la adopción de la inteligencia artificial en startups en América Latina y el Caribe" [From promise to action: An overview of artificial intelligence adoption in startups in Latin America and the Caribbean]. Unpublished manuscript. Inter-American Development Bank, Washington, DC.

SUMMA and J-PAL (Abdul Latif Jameel Poverty Action Lab). 2023. "Conecta Ideas—Evaluación de Impacto. Proyecto del Fondo de Impacto 'Construcción de un ecosistema global de evidencia para mejorar la enseñanza'" [Conecta Ideas—Impact evaluation. Impact fund project: 'Building a global evidence ecosystem to improve teaching']. https://summaedu.org/wp-content/uploads/2025/03/01.-Informe-Conecta-Ideas.pdf.

Sun, Ruiqi, and Daniel Trefler. 2026. "The Impact of AI and Cross-Border Data Regulation on International Trade in Digital Services." *Journal of International Economics* 164:104328.

Sun, Xiaoran, Yunqi Wang, and Brandon T. McDaniel. 2026. "AI Companions and Adolescent Social Relationships: Benefits, Risks, and Bidirectional Influences." *Child Development Perspectives* 20 (2): 91–98. https://doi.org/10.1093/cdpers/aadaf009.

Svanberg, Maja, Wensu Li, Martin Fleming, Brian C. Goehring, and Neil C. Thompson. 2024. "Beyond AI Exposure: Which Tasks Are Cost-Effective to Automate with Computer Vision?" Working paper. https://ide.mit.edu/wp-content/uploads/2024/01/Beyond-AI-Exposure-Which-Tasks-are-Cost-Effective-to-Automate-with-Computer-Vision.pdf.

Szedmák, Borbála, László Varga, and Roland Z. Szabó. 2025. "Digital Transformation of Public Services: The Case of the Document Management Application." *International Journal of Public Administration*, 1–18. https://doi.org/10.1080/01900692.2025.2520522.

Tapia, Waldo, Ekaterina Cuéllar, Daniel Gamboa, and Manuel García-Huitrón. 2023. "The Future of Work in Latin America and the Caribbean: How to Move Towards Sustainable Pension Systems for Longer-Lived Societies?" Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0004953.

Tarduno, Matthew. 2021. "The Congestion Costs of Uber and Lyft." *Journal of Urban Economics* 122 (March): 103318. https://doi.org/10.1016/j.jue.2020.103318.

Tejerina, Luis, and Luis Hernán Vargas. 2025. "The Social Registry of Households: Innovation in Beneficiary Identification in Chile: Case Study of the Social Policy Beneficiary Identification System." Case Studies in Digital Social Protection, Edition No. 02. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013625.

Tejerina, Luis, Ricardo Pérez Cuevas, and Jorge Francisco García Castro. 2023. "Implementación de inteligencia artificial para mejorar la atención de la retinopatía diabética en el Estado de Jalisco, México" [Implementation of artificial intelligence to improve diabetic retinopathy care in the State of Jalisco, Mexico]. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/publications/spanish/viewer/Implementacion-de-inteligencia-artificial-para-mejorar-la-atencion-de-la-retinopatia-diabetica-en-el-Estado-de-Jalisco-Mexico.pdf.

Tesliuc, Emil Daniel, and Maria Belen Fonteñez. 2025. "Adaptive Social Protection Agenda Lessons from Responses to COVID-19 Shock." Discussion Paper No. 2509. World Bank, Washington, DC. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099907504032517291.

Tierney, Aaron A., Gregg Gayre, Brian Hoberman, Britt Mattern, Manuel Ballesca, Sarah B. Wilson Hannay, Kate Castilla et al. 2025. "Ambient Artificial Intelligence Scribes: Learnings after 1 Year and over 2.5 Million Uses." *NEJM Catalyst Innovations in Care Delivery* 6 (5). https://catalyst.nejm.org/doi/full/10.1056/CAT.25.0040.

Tironi, Martin, and Camila Albornoz. 2025. "Divergent Futures in a Damaged Territory: The Rise of Data Centers and Water Conflicts in Santiago de Chile." *Journal of Urban Technology* 32 (4): 51–68. https://doi.org/10.1080/10630732.2025.2546784.

Tobón, Santiago. 2022. "Do Better Prisons Reduce Recidivism? Evidence from a Prison Construction Program." *Review of Economics and Statistics* 104 (6): 1256–72. https://doi.org/10.1162/rest_a_01007.

Transparency International. 2003. "Global Corruption Report 2003: Access to Information." January 23, 2003. https://www.transparency.org/en/publications/global-corruption-report-2003-access-to-information.

———. 2019. "Global Corruption Barometer – Latin America & the Caribbean 2019: Citizens' Views and Experiences of Corruption." https://issuu.com/transparencyinternational/docs/2019_gcb_latinamerica_caribbean_full_report.

Ulyssea, Gabriel. 2018. "Firms, Informality, and Development: Theory and Evidence from Brazil." *American Economic Review* 108 (8): 2015–47. https://doi.org/10.1257/aer.20141745.

Ulyssea, Gabriel. 2020. "Informality: Causes and Consequences for Development." *Annual Review of Economics* 12:525–46. https://doi.org/10.1146/annurev-economics-082119-121914.

UNCTAD (United Nations Conference on Trade and Development). 2023. *Digital and Sustainable Trade Facilitation: Global Report 2023*. Geneva: United Nations Conference on Trade and Development.

UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific). 2012. *Business Process Analysis Guide to Simplify Trade Procedures*. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2021. *UNESCO Science Report: The Race Against Time for Smarter Development*, edited by Susan Schneegans, Tiffany Straza, and Jake Lewis. Paris: UNESCO.

———. 2026. "Phone Bans in Schools Are Spreading Worldwide as the Policy Debate Rages On." Global Education Monitoring Report, March 17, 2026. https://www.unesco.org/gem-report/en/articles/phone-bans-schools-are-spreading-worldwide-policy-debate-rages.

United Nations. 2020. *Fiscal Panorama of Latin America and the Caribbean 2020: Fiscal Policy amid the Crisis Arising from the Coronavirus Disease (COVID-19) Pandemic*. Santiago: United Nations. https://doi.org/10.18356/51406625-en.

UNODC (United Nations Office on Drugs and Crime). 2023. "Global Study on Homicide 2023." United Nations Office on Drugs and Crime, Vienna. https://www.unodc.org/documents/data-and-analysis/gsh/2023/Global_study_on_homicide_2023_web.pdf.

———. 2025. "Global Prison Population and Trends: A Focus on Rehabilitative Environments." United Nations Office on Drugs and Crime, Vienna.

Urban, Tobias, Dennis Tatang, Martin Degeling, Thorsten Holz, and Norbert Pohlmann. 2020. "Measuring the Impact of the GDPR on Data Sharing in Ad Networks." In *Proceedings of the 15th ACM Asia Conference on Computer and Communications Security*, 222–35. New York: Association for Computing Machinery. https://doi.org/10.1145/3320269.3372194.

Urquidi, Manuel, Ruben González, and Gloria Ortega. 2023. "Paperless Labor: A Story of Digital Transformation at Paraguay's Ministry of Labor, Employment and Social Security." IDB Technical Note No. 2569. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/paperless-labor-story-digital-transformation-paraguays-ministry-labor-employment-and-social.

U.S. Department of Energy. 2024. "Potential Benefits and Risks of Artificial Intelligence for Critical Energy Infrastructure." Office of Cybersecurity, Energy Security, and Emergency Response (CESER), April 26, 2024. https://www.energy.gov/sites/default/files/2024-04/DOE%20CESER_EO14110-AI%20Report%20Summary_4-26-24.pdf.

Valcarcel Pineda, Paolo E. 2023. "Impacto de los Centros de Innovación Productiva y Transferencia Tecnológica (CITE) en la adopción de comercio electrónico" [Impact of the Productive Innovation and Technology Transfer Centers (CITE) on e-commerce adoption]. Undergraduate thesis, Universidad de los Andes. https://hdl.handle.net/1992/73227.

Van Dijk, Wilco W., Sjoerd Goslinga, Bart W. Terwel, and Eric Van Dijk. 2020. "How Choice Architecture Can Promote and Undermine Tax Compliance: Testing the Effects of Prepopulated Tax Returns and Accuracy Confirmation." *Journal of Behavioral and Experimental Economics* 87 (August): 101574. https://doi.org/10.1016/j.socec.2020.101574.

Vargas, Fernando, and Arturo Muente. 2025. "Artificial Intelligence Framework for the Inter-American Development Bank." Inter-American Development Bank, Washington, DC. http://dx.doi.org/10.18235/0013377.

Varian, Hal. 2019. "Artificial Intelligence, Economics, and Industrial Organization." In *The Economics of Artificial Intelligence: An Agenda*, edited by Ajay Agrawal, Joshua Gans, and Avi Goldfarb. University of Chicago Press.

Velasco, Andrea, Adriana Arce, Hugo Salgado, Rossy Talancha, and Diether W. Beuermann. 2026. *Digital Technologies for Development: A Global Database of Impact Evaluations*. Mimeograph. Inter-American Development Bank, Washington, DC.

Vera-Cossio, Diego A., ed. 2025. *Beyond Cash: The Digital Payments Revolution in Latin America and the Caribbean*. Latin American and Caribbean Microeconomic Report. Washington, DC: Inter-American Development Bank. https://doi.org/10.18235/0013688.

Vera-Cossio, Diego A., Mariano Bosch, Jonathan M. Leganza, Tatiana Mojica Uruena, and María Laura Oliveri. 2025. *Public Pensions and the Strategic Timing of Formal Employment*. IDB Working Paper No. 1700. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013583.

Vera-Cossio, Diego A., Bridget Hoffmann, Camilo Pecha, Jorge Gallego, Marco Stampini, David Vargas, María Paula Medina, and Esteban Álvarez. 2023. "Re-Thinking Social Protection: From Poverty Alleviation to Building Resilience in Middle-Income Households." IDB Working Paper No. 1412. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0004969.

Vergara Cobos, Estefania. 2024. *Cybersecurity Economics for Emerging Markets*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-2120-2.

Vilalta, Carlos, Pablo Lopez-Ramirez, and Gustavo Fondevila. 2023. "Testing the Local and Spatial Spillover Effects of Police Monitored CCTV Systems on Crime." *Applied Geography* 151:102873. https://doi.org/10.1016/j.apgeog.2023.102873.

Vilgis, Veronika, Valeria Jordán, and Alejandro Patiño. 2024. "Measuring the Internet Economy in Latin America: The Cases of Brazil, Chile, Colombia and Mexico." Economic Commission for Latin America and the Caribbean. https://www.cepal.org/en/publications/80415-measuring-internet-economy-latin-america-cases-brazil-chile-colombia-and-mexico.

Vlaicu, Razvan. 2025. "Digital Payments Adoption by Consumers and Firms: Implications for Financial Inclusion." IDB Working Paper No. 1705. Inter-American Development Bank, Washington, DC. https://publications.iadb.org/en/digital-payments-adoption-consumers-and-firms-implications-financial-inclusion.

Volpe Martincus, Christian. 2010. *Odyssey in International Markets: An Assessment of the Effectiveness of Export Promotion in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0012312.

———. 2016. *Out of the Border Labyrinth: An Assessment of Trade Facilitation Initiatives in Latin America and the Caribbean*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0000548.

———. 2021. *Making the Invisible Visible: Investment Promotion and Multinational Production*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0003807.

Volpe Martincus, Christian, Jerónimo Carballo, and Alejandro Graziano. 2015. "Customs." *Journal of International Economics* 96 (1): 119–37. https://doi.org/10.1016/j.jinteco.2015.01.011.

Volpe Martincus, Christian, and Monika Sztajerowska. 2019. *How to Solve the Investment Promotion Puzzle: A Mapping of Investment Promotion Agencies in Latin America and the Caribbean and OECD Countries*. Washington, DC: Inter-American Development Bank. https://dx.doi.org/10.18235/0001767.

Volpe Martincus, Christian, Monika Sztajerowska, and Mariana Santi. 2024. "Consumers and Firms in International Trade." IDB Working Paper No. 1607. Inter-American Development Bank, Washington, DC. https://dx.doi.org/10.18235/0012977.

WCO (World Customs Organization). 2025. *Detailed Report on the Adoption of Artificial Intelligence and Machine Learning in Customs*. Brussels: World Customs Organization. Smart Customs Project.

Westphal, Larry E. 1990. "Industrial Policy in an Export-Propelled Economy: Lessons from South Korea's Experience." *Journal of Economic Perspectives* 4 (3): 41–59. https://doi.org/10.1257/jep.4.3.41.

Wheeler, Andrew P., and Scott W. Phillips. 2018. "A Quasi-Experimental Evaluation using Roadblocks and Automatic License Plate Readers to Reduce Crime in Buffalo, NY." *Security Journal* 31 (1): 190–207. https://doi.org/10.1057/s41284-017-0094-1.

WHO (World Health Organization). 2023. "Population Health Management in Primary Health Care: A Proactive Approach to Improve Health and Well-Being." WHO Regional Office for Europe, June 7, 2023. http://apps.who.int/

———. 2024. "Going Digital for Noncommunicable Diseases: The Case for Action." World Health Organization, Geneva. https://iris.who.int/server/api/core/bitstreams/c37cd1ca-f02d-4d75-a940-8474ac57735d/content.

Williams, Jenny, and Don Weatherburn. 2022. "Can Electronic Monitoring Reduce Reoffending?" *Review of Economics and Statistics* 104 (2): 232–45. https://doi.org/10.1162/rest_a_00954.

Wintjes, René, and Fernando Vargas. 2023. "Digital Innovation Hubs: Insights from European Experience in Supporting Business Digitalization." Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0004995.

WIPO (World Intellectual Property Organization). 2024. *Global Innovation Index 2025: Innovation at a Crossroads*. Geneva: WIPO.

Wood, Peter. 2024. "The Reality of Latin American Connectivity." *TeleGeography*, April 3, 2024. https://blog.telegeography.com/the-reality-of-latin-american-connectivity.

World Bank. 2018. *World Development Report 2018: Learning to Realize Education's Promise*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1096-1.

———. 2021. "World Development Report 2021: Data for Better Lives." World Bank, Washington, DC.

———. 2025a. *Business Ready 2025*. Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/099122925140531373/pdf/P178471-62c5108c-22a1-4d37-8fc0-2ee5ec06ab9f.pdf.

———. 2025b. "TaxTech : Leveraging Digitalization to Improve Tax Compliance and Revenue Mobilization." World Bank, Washington, DC. https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/099061225023042590.

World Economic Forum. 2025. "Artificial Intelligence's Energy Paradox: Balancing Challenges and Opportunities." World Economic Forum white paper, January 2025. https://reports.weforum.org/docs/WEF_Artificial_Intelligences_Energy_Paradox_2025.pdf.

Wright, Richard, Erdal Tekin, Volkan Topalli, Chandler McClellan, Timothy Dickinson, and Richard Rosenfeld. 2017. "Less Cash, Less Crime: Evidence from the Electronic Benefit Transfer Program." *Journal of Law and Economics* 60 (2): 361–83. https://doi.org/10.1086/693745.

WTO (World Trade Organization). 2018. *World Trade Report 2018: The Future of World Trade—How Digital Technologies Are Transforming Global Commerce*. Geneva: World Trade Organization.

Wu, Jianxian. 2026. "Does Open Government Data Alleviate the Burden on Government Employees? Evidence From a Quasi-Experiment in China." *Review of Policy Research* 43 (3): e70068. https://doi.org/10.1111/ropr.70068.

Wu, Lynn, Lorin Hitt, and Bowen Lou. 2020. "Data Analytics, Innovation, and Firm Productivity." *Management Science* 66 (5): 2017–39. https://doi.org/10.1287/mnsc.2018.3281.

Xiao, Tianqi, Francesco Fuso Nerini, H. Damon Matthews, Massimo Tavoni, and Fengqi You. 2025. "Environmental Impact and Net-Zero Pathways for Sustainable Artificial Intelligence Servers in the USA." *Nature Sustainability* 8 (November): 1541–53. https://www.nature.com/articles/s41893-025-01681-y.

Yadamsuren, Borchuluun, Steven Keith Platt, and Miguel Diaz. 2026. "LLM-Assisted Formalization for Deterministic Detection of Statutory Inconsistency in Tax Law." *Artificial Intelligence and Law*. https://doi.org/10.1007/s10506-026-09525-6.

Yotzov, Ivan, José María Barrero, Nicholas Bloom, Philip Bunn, Chanya Chawla, Steven J. Davis, Kevin M. Foster, et al. 2026. "Firm Data on AI." NBER Working Paper No. 34836. National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w34836.

Young, Alwyn. 1991. "Learning by Doing and the Dynamic Effects of International Trade." *Quarterly Journal of Economics* 106 (2): 369–405. https://doi.org/10.2307/2937942.

Zeira, Joseph. 1998. "Workers, Machines, and Economic Growth." *Quarterly Journal of Economics* 113 (4): 1091–117. https://doi.org/10.1162/003355398555847.

Zolas, Nikolas, Zachary Kroff, Erik Brynjolfsson, Kristina McElheran, David N. Beede, Cathy Buffington, Nathan Goldschlag, Lucia Foster, and Emin Dinlersoz. 2020. "Advanced Technologies Adoption and Use by U.S. Firms: Evidence from the Annual Business Survey." NBER Working Paper No. 28290. National Bureau of Economic Research, Cambridge, MA.

Zuluaga, Daniela, and Luis Tejerina. 2025. "30 Years of Social Targeting in Colombia: From Sisbén to the Social Registry of Households." Case Studies in Digital Social Protection, Edition No. 03. Inter-American Development Bank, Washington, DC. https://doi.org/10.18235/0013640.

Zumaya, Martin, Rita Guerrero, Eduardo Islas, Omar Pineda, Carlos Gerhenson, Gerardo Iñiguez, and Carlos Pineda. 2021. "Identifying Tax Evasion in Mexico with Tools from Network Science and Machine Learning." In *Corruption Networks*, edited by Oscar M. Granados and José R. Nicolás-Carlock. Understanding Complex Systems. Springer International Publishing. https://doi.org/10.1007/978-3-030-81484-7_6.

Low productivity growth and inefficient public service delivery have plagued Latin America and the Caribbean for decades. Can digitalization and artificial intelligence reverse these trends? This book presents new evidence that digital technologies, and AI in particular, can improve both outcomes. However, adoption in the region remains shallow, limiting actual gains. Realizing their potential requires stronger institutions, upgraded skills, digital data, adequate infrastructure, and addressing relevant market and coordination failures. This volume sets out a policy agenda to strengthen these enabling conditions and spread effective use across the public and private sectors, while managing potential disruptions.

"This exciting book presents well-executed original research on how digital technologies, including AI, can generate inclusive growth in Latin America and the Caribbean. Drawing on examples and data from across the region, it explores how technology can improve healthcare, education, tax administration, safety, and a wide variety of government services. The book delivers on its subtitle, showing how technological promises can translate into tangible improvements in people's lives."

Avi Goldfarb – Professor, Marketing, Rotman Chair in A.I. & Healthcare, University of Toronto

"Advances in AI are making quality-adjusted prediction cheaper. Turning that capability into productivity requires complementary investments and a willingness to redesign how organizations work. This landmark IDB report brings that economic logic to life for Latin America and the Caribbean, combining rigorous evidence with practical guidance for transforming firms and public services. Its great contribution is showing why access to technology is only the beginning and what leaders can do to unlock its value."

Ajay Agrawal – Professor, University of Toronto, and Founder of Intrepid Growth Partners

"How can digitalization and artificial intelligence contribute to higher productivity and better public services in Latin America and the Caribbean? What are the barriers that prevent these technological advances from delivering economic and social gains? Combining original research with rigorous evidence, this IDB flagship report identifies the changes needed to realize these gains. Its emphasis on complementary skills, supportive institutions, and organizational change gives policymakers a concrete agenda for action."

Hernan Galperin – Professor, University of Southern California

"This flagship report is the most comprehensive review to date of how digital technologies and AI can shape productivity in a developing region. Its breadth is remarkable, spanning education, health, infrastructure, taxation, firms, and trade. Its depth is equally outstanding. Drawing on fresh evidence, the report shows that AI amplifies what digitalization has built, and the region's gains will depend on how deeply firms and governments integrate these technologies and on the data, skills, and institutions that make such integration possible. It's a must-read for economists and policymakers."

Maggie Chen – Professor of Economics, George Washington University

ISBN 978-1-59782-618-1
90000>
9 781597 826181

IDB