Digitalizing Public Services

Opportunities for Latin America and the Caribbean

Coordinated by
Julián Cristia
Razvan Vlaicu

IDB

Latin American and Caribbean Microeconomic Report

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Preface

The COVID-19 pandemic dealt a severe blow to Latin America and the Caribbean in many areas critical for development, including education, health, women's participation in the workforce, and public finances, to name only a few. However, the crisis also notably accelerated the digital transformation, which, among other things, now enables us to imagine a variety of ways to leverage technology for better public service delivery, thereby democratizing and improving the quality of life of millions of people. But how can governments move forward in this direction? To answer this question, this report analyzes how to harness digital technology to increase the State's efficiency by improving public services that enhance public welfare and drive inclusive development.

The challenges facing the region are many and complex. Governments must constantly make decisions on how to address these challenges and respond to them with the most appropriate policies. There are no magic formulas, nor should we assume that digitalization will be a cure-all for every problem affecting the region. But as this report demonstrates, digitalization provides concrete opportunities to deploy public services that are of great value to society, on a large scale and at low cost.

Deploying digitalization can have significant benefits for citizens throughout the region by addressing key issues on the development agenda. This can be illustrated with two examples. In education, digital technologies have been used to raise awareness among secondary school students as to the benefit of completing their studies. These interventions can be very effective, and with a very minimal investment, they can ensure that more students finish secondary school, with better educational results. Why not try this? Something similar can be seen in the health sector. A few simple text messages sent over a period of two years can decrease diabetes emergencies in prediabetic patients between 5% and 30% by encouraging them to eat better and engage in more physical activity. With a small amount of money and using this simple and almost universal technology, thousands of lives can be improved.

The four sectors analyzed in the report (the two mentioned above, as well as fiscal management and transactional services) offer very clear and concrete examples of interventions that are easy to implement and have extremely high social value. And without question, there are many more opportunities in these and other areas. The report's first message, therefore, focuses on the importance of identifying these

opportunities and implementing the changes needed to move toward building more inclusive and better developed societies. The possibilities are clear and limited only by the imagination and the capacity to think up interventions, using evidence to identify them, and administrative capacity to implement them. In this regard, the report seeks to serve as a source of inspiration and a call to action.

The second message focuses on the importance of prioritization. In a context where fiscal resources and implementation capacity are limited, it is impossible to carry out all available projects. How does one decide which projects to prioritize from among the enormous number of options in a multitude of policy areas? This is perhaps the fundamental question of economics: How do we allocate resources in contexts of scarcity? Technology can help us address numerous policy challenges, while economics can help us prioritize from among the different projects available. The importance of properly prioritizing investments is a long-standing recommendation, but it is even more important when technology is involved, as this report documents wide variability in the value-added of the different projects.

The chapters in this volume analyze the available evidence on digital interventions in key development areas. They delve into specific projects from a range of countries, with the aim—where possible, and with the evidence available—of standardizing the outcomes and providing a cost-benefit analysis in order to compare different policy options.

The document also reviews the progress made on digitalization in the region. It calls for taking advantage of the low-hanging fruit and explains the mechanisms that make it possible for digitalization to increase the value of public services, including by reducing costs, enhancing benefits, and expanding access.

But in the quest to digitalize public services, we cannot ignore the potential risks and gaps hindering equitable access for all members of society. Given the challenges that still persist, the key seems to be to implement solutions that work on the most basic cell phones or by text message, with efforts focused on making digital services available to those with the lowest incomes while using the savings resulting from these projects on nondigital services for those who lack access. Additionally, long-term progress must continue to be oriented toward closing the gaps in access to technology that persist in the region.

To be successful, we have to reach scale and take advantage of the opportunities digitalization offers in terms of monitoring and evaluation. We also must focus on end users, ensuring that we understand them well, building equitable solutions, and achieving the ideal combination of technology and the human touch. Above all, however, we must prioritize. Digital public services offer an immense range of possible applications. However, because of the great variability in the value added of different projects, governments must be selective and make decisions based on evidence.

This report extends well beyond evaluating particular projects. It sets out a research agenda to help technology drive development and let economics define how to do so. We hope the lessons learned from these pages can serve as a guide for those who are tasked with shaping public policy in Latin America and the Caribbean. We have at our fingertips a unique opportunity to improve the lives of millions of people in our region. We cannot let it pass us by.

Eric Parrado
Chief Economist

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How Governments Can Reap the Low-Hanging Fruit of Digitalization

Julián Cristia | Razvan Vlaicu

Governments in Latin America and the Caribbean are facing structural challenges in key sectors that, in some cases, have been deepened by the COVID-19 pandemic. For example, in education, students have low levels of learning and many drop out before completing high school. In health, people are suffering an increasing burden from non-communicable diseases such as depression and diabetes. In civil registration, citizens face difficulties making basic transactions with governments such as obtaining an identity card. And in social protection, high levels of tax evasion and imperfect targeting of subsidies diminish the capacity of governments to reduce poverty through effective redistribution of resources. Tackling these challenges can have direct effects on the ability of millions of people in the region to live productive, healthy, and fulfilling lives. Moreover, advances in these areas will have ripple effects in other areas of the economy and society because they can contribute to improving the business climate, enhancing productivity, reducing crime, and fostering less polarized and more democratic and cohesive societies. In short, better public services mean better lives. But how can governments effectively tackle these challenges in an environment of limited fiscal resources and implementation capacity?

This report argues that governments in the region can make progress in these areas quickly and with limited investments by developing and deploying digital public services that generate large value to society. The provision of these services involves using digital technologies such as apps, SMS, and videos to tackle a specific objective such as increasing student learning, reducing the prevalence of depression, or helping more people get valid identity cards. This approach is prompted by two related developments. First, there has been a rapid proliferation of smartphones in Latin America

and the Caribbean. For example, in Peru, the share of the population aged 12 and older with a smartphone increased from 9 percent in 2012 to 71 percent in 2021. More generally, about three-quarters of the population in the region uses the Internet and current trends point to increasing use in the coming years. Second, Latin American digital companies are exploiting this rapid increase in access to smartphones to provide new and innovative digital services in different sectors such as commerce and finance. The growth of such firms has been nothing short of astonishing: the number of digital Latin American companies valued at more than US$1 billion jumped from 9 to 28 between 2017 and 2020, and their collective value skyrocketed from US$23 billion to US$175 billion during those three years.

The widespread adoption of digital devices and applications creates a once-in-a-generation opportunity for governments in the region. Digital infrastructure, including mobile broadband, electronic payments, and online identification, is improving and expanding. Governments need to continue improving broadband connectivity and strengthening the regulatory framework for digital payments and identification. Also, governments need to advance the development of comprehensive software systems such as educational management information systems, which maintain rich data on students, teachers, and schools, and electronic health records, which maintain similar data on patients. At the same time, governments must take advantage of the proliferation of mobile infrastructure, as the private sector does, to deploy more focused digital public services that tackle specific needs of citizens and generate large value for society.

Compared to developed countries, governments in Latin America and the Caribbean are significantly lagging in offering digital applications such as learning platforms, apps to promote healthy behaviors, apps for online business registration, and tax e-filing. In many cases, governments offer some type of digital public service related to an important development challenge, but the specific service provided is not expected to generate large value to society. For example, 92 percent of the Inter-American Development Bank's 26 borrowing countries had an online portal with educational materials in 2021. However, there is little evidence suggesting that this type of digital initiative generates learning gains. In contrast, there is overwhelming evidence that the use of math or reading learning platforms that provide automatic feedback to students generate large learning gains. Unfortunately, only 15 percent of these 26 countries had a math platform and only 8 percent had a reading platform in 2021. Similarly, there is strong evidence showing that the use of an app designed to reduce the prevalence of depression generates large improvements in mental health among patients suffering from depression. But again, though a few countries such as Chile and Mexico provide some material on websites about how to deal with this illness, there is scarce evidence that governments in the region are providing access to these specialized apps that effectively tackle this health problem.

But how can the deployment of low-cost digital public services generate value for society? The broad answer is that such services make the capture, processing, and distribution of information across people more efficient. More specifically, digital public services can complement and increase the effectiveness of service providers such as teachers or nurses by automating repetitive tasks; streamline transactions between government and citizens while reducing errors; increase the transparency of government operations; improve targeting of social benefits; and make services more accessible to previously underserved populations, such as those living in rural or remote areas. Moreover, the provision of many digital services has a low cost per capita as long as the service is provided to many users. This is because deploying them requires a certain fixed cost (e.g., the development of an app) but minimal marginal costs per each additional person who uses the service.

These theoretical considerations suggest that governments can generate large value to society with the provision of digital public services. But is there evidence to back up this claim? Unfortunately, to date there is a lack of thorough studies of how much value to society the provision of digital public services can generate in Latin America and the Caribbean. To fill this gap, this report first reviews the evidence of studies that evaluated the impacts of the provision of digital public services in key sectors. Then, for interventions that showed improvements in targeted outcomes, the report assesses the benefits and costs of specific implementation options in order to estimate how much value these projects generate. A total of 11 policy options are analyzed. To make the results comparable, the assumptions and methodology are standardized as much as possible (e.g., the discount rate is set at 3 percent in all cases). Additionally, the contextual conditions are standardized by presenting the main results for Peru, a country that quite closely resembles average statistics for important indicators for the region. Robustness results are also reported for other countries (Chile, El Salvador, and Jamaica).

The main findings of this analysis are presented and discussed in this report. Additionally, a companion technical note presents the methodology used (Cristia et al. 2022). The examples, assumptions, and procedures presented in the technical note can facilitate the production of new, standardized cost-benefit analyses that can be collectively used to promote evidence-based policy decisions in this area.[1]

The main results from the analysis can be illustrated by the following contrasting examples. An innovative project implemented in El Salvador during the pandemic

1 A leading example of how standardized cost-benefit analysis can help inform better policy decisions is the work performed by the Washington State Public Policy Institute (www.wsipp.wa.gov). This institute has produced comparable, standardized cost-benefit analysis contextualized for the state of Washington in the United States, and it provides invaluable nonpartisan information for the legislature there to support the allocation of limited public funds to competing public policies.

entailed sending SMS to parents to promote the adoption of good parenting practices to improve child development. A rigorous evaluation showed that the intervention did not improve child development and, unfortunately, actually increased stress and anxiety among parents, perhaps by creating expectations for their behavior that were difficult to fulfill in real life. On the other hand, as mentioned, there is strong evidence that interventions that provide students access to a math learning platform and promote its use produce important gains in student learning. The cost-benefit analysis performed as part of this report indicates that this type of program in Peru could generate a total net present value of US$97 million per year with an implementation cost of just US$4 million per year.

These examples underscore the two main findings from the report. First, there are untapped opportunities to deploy digital public services and generate large value for society. In particular, there are possibilities to offer valuable digital public services that require limited resources and can be implemented quickly at large scale. Second, there is wide variation in the value added of potential digital public services. These findings have important policy implications. To start with, while there are many digital public services that governments can potentially provide, governments have limited financial resources and capacity, so they can only implement a small subset of these services in a given period. Consequently, governments must critically assess the benefits and costs of alternative projects to prioritize those that generate more value for society. Additionally, governments should fund smart investments in research and development to support the process of experimentation and evaluation necessary to ensure that digital public service projects generate large value. But how can governments make these smart investments? A guiding principle is to draw from the successful experience of the private sector, which has been able to produce many digital services that are revolutionizing lives and generating, in some cases, large value to society.

Given the relative novelty of these technologies, however, there are also risks to be considered and managed. Technical complexity means that governments must pilot-test digital applications before making them widely available. In addition, to make services accessible to a broad set of citizens who may have different levels of digital sophistication, the user interface must be intuitive and easy to navigate. Furthermore, some services may require optimally complementing digital features with human support, rather than creating a fully digital version of a previously analog service. Finally, since digital information is transmitted on public networks, protocols must be put in place to secure sensitive data and protect government websites from cyberattacks.

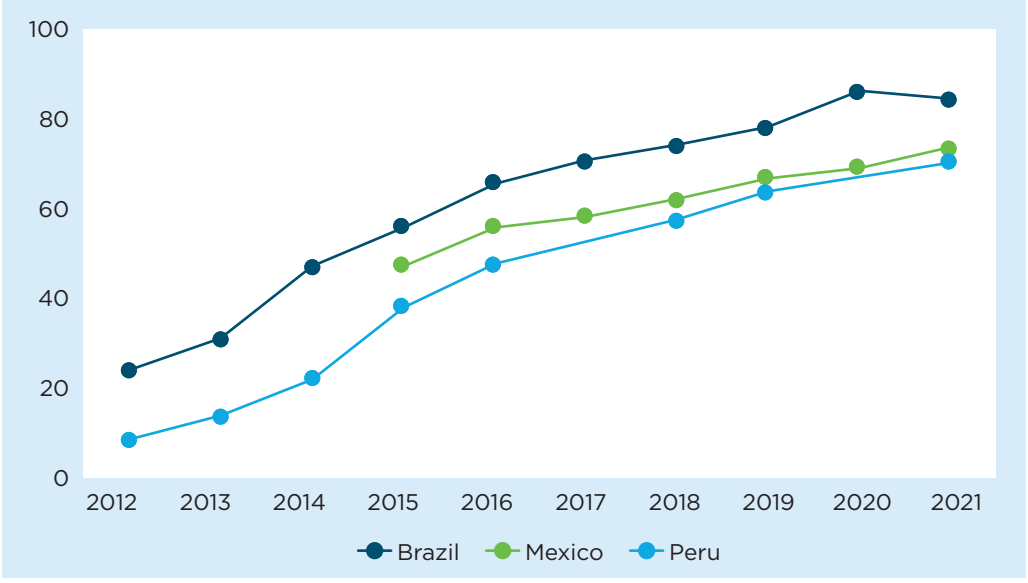
The road ahead will surely be bumpy but the reward of reaching the finish line promises to be substantial. To help countries move forward, this report presents a careful analysis of how digital public services contribute to tackling important challenges in key sectors such as education, health, government administrative services, and fiscal

administration (presented in chapters 2, 3, 4, and 5, respectively). Chapter 6 of the report concludes by presenting six actionable and concrete policy recommendations to help governments adopt smart digital strategies and stay away from misguided ones.

1.1. Digitalization in Latin America and The Caribbean: The Region Goes Mobile

In January 2007, Apple launched the iPhone, the first "smartphone" to appeal to a mass market with its attractive design and easy-to-use digital apps. The commercial success of the smartphone has fueled what some now call the "digital revolution." In the last 15 years, digital devices and applications have proliferated and improved as more and more people around the world have adopted them. As mentioned, the use of smartphones has increased markedly in Latin America and the Caribbean, and Figure 1.1 documents this process for three countries in the region that have consistently measured smartphone use over time. In Peru, the share of the population surveyed that reports using a smartphone increased from 9 percent in 2012 to 71 percent in 2021. Similar increases are shown for Brazil and Mexico. The actual numbers are not directly comparable across

FIGURE 1.1 | Trends in Smartphone Use in Brazil, Mexico, and Peru (Percent)

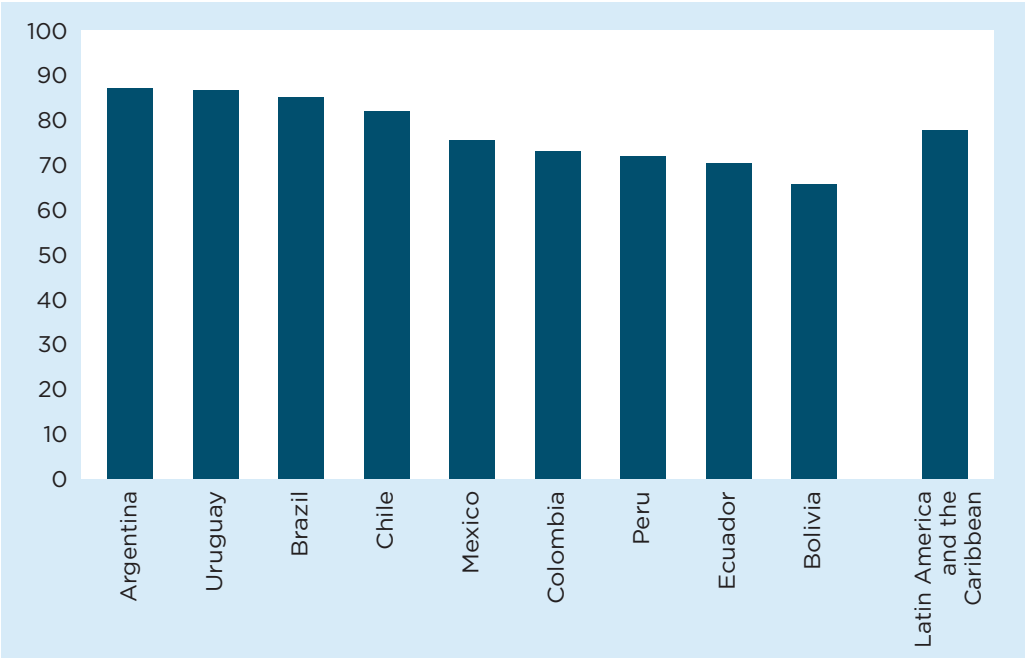


Source: Survey on the Use of Information and Communication Technologies in Brazilian Households (Brazil); Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (Mexico); Encuesta Residencial de Servicios de Telecomunicaciones (Peru).
Note: For Brazil, the figure shows the percentage of people aged 10 and over who used the Internet on their mobile phones in the three months prior to the survey. For Mexico, the figure shows the percentage of people aged 6 and over who used a smartphone in the three months prior to the survey. For Peru, the figure shows the percentage of people aged 12 and over with a mobile phone that can access the Internet.

countries because of slight differences in the age of the population surveyed and the specific question used (see the note of Figure 1.1 for more details). However, the pattern is clear: there has been a dramatic increase in the use of smartphones in the last decade in the countries surveyed.

What share of the population in the region uses the Internet? And how much heterogeneity exists across countries in terms of Internet usage? The latest household surveys show that high levels of Internet use are indeed a regional phenomenon. Figure 1.2 shows the share of the population surveyed that reports using the Internet. Again, country statistics are not directly comparable due to differences in the population surveyed and questions asked. However, results indicate that Internet use is quite high across all nine countries surveyed, and that on average 78 percent of the population surveyed reports using the Internet. However, results also suggest some heterogeneity across countries, with Internet use ranging from 66 percent in Bolivia to 87 percent in Argentina.

FIGURE 1.2 | Population that Uses the Internet in Selected Countries, 2021 (Percent)

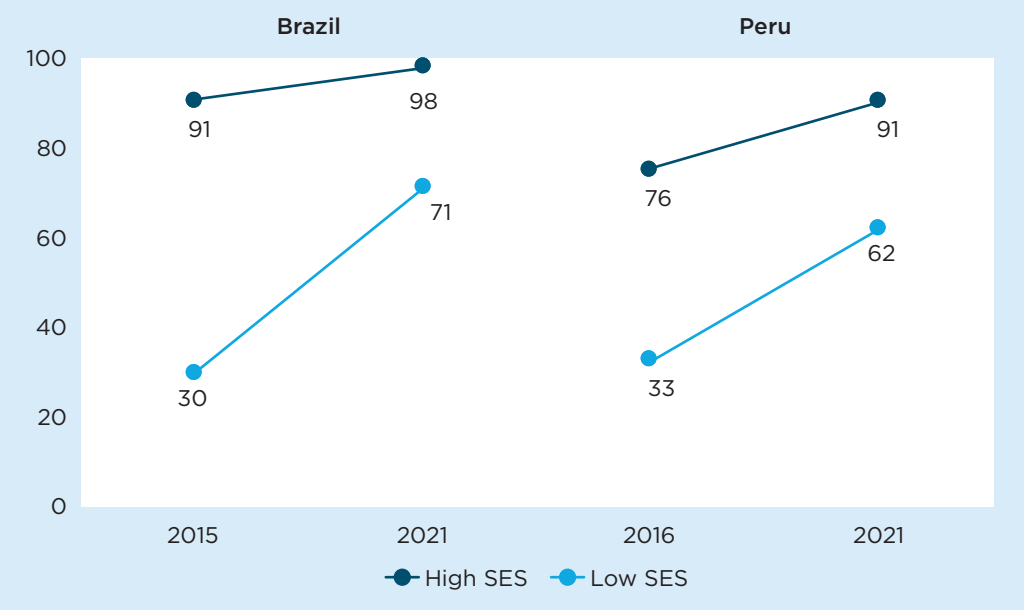


Sources: Encuesta Permanente de Hogares (Argentina); Encuesta de Usos de Tecnologías de la Información y la Comunicación (Uruguay); Survey on the Use of Information and Communication Technologies in Brazilian Households (Brazil); IX Encuesta de Acceso y Usos de Internet (Chile); Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (Mexico); Encuesta de Calidad de Vida (Colombia); Encuesta Residencial de Servicios de Telecomunicaciones (Peru); Encuesta Multipropósito (Ecuador); Encuesta de Hogares (Bolivia).
Note: The figure shows the percentage of people who used the Internet in the three months prior to the survey, except for Ecuador (12 months) and Colombia and Peru (no period of reference). For Chile, Ecuador, and Uruguay, the percentage corresponds to 2017, 2020, and 2019, respectively. The age range for the population included in the computation of this statistic varies across countries, ranging from people aged 4 and older in Argentina to 16 and older in Chile.

The digital revolution in Latin America and the Caribbean generates great promise but also has the potential to increase inequality if disadvantaged groups are not provided the opportunity to take advantage of it. In terms of gender, there are only slight differences in Internet use: the average share of males who were Internet users in 2021 in Argentina, Bolivia, Brazil, Ecuador, and Peru was 77 percent compared to 75 percent for females. However, there are important gaps in Internet use across socioeconomic groups and also across people living in urban and rural areas. These patterns underscore the importance of advancing the policy agenda to reduce these gaps. The good news is that socioeconomic and rural-urban gaps seem to be shrinking, at least in the countries where these trends have been documented. In particular, there were dramatic reductions in smartphone coverage by socioeconomic status in Brazil and Peru between 2015 and 2021 (Figure 1.3).

In Brazil, the share of high-income people with access to smartphones increased by only 7 percentage points compared to an increase of 41 percentage points for low-income

FIGURE 1.3 | Smartphone Use by Socioeconomic Status in Brazil and Peru (Percent)



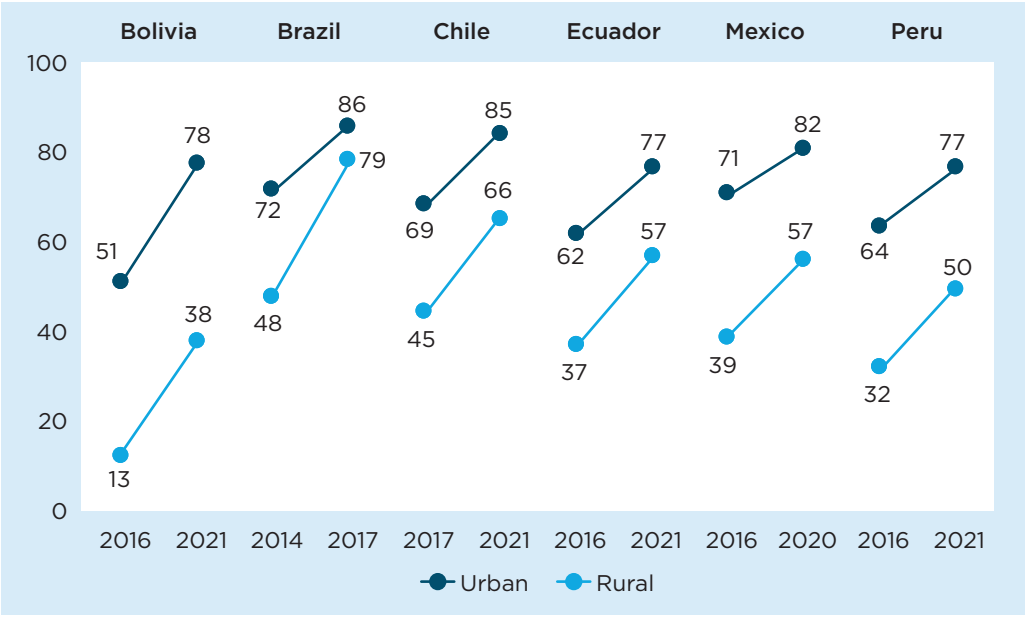
Sources: Survey on the Use of Information and Communication Technologies in Brazilian Households (Brazil); Encuesta Residencial de Servicios de Telecomunicaciones (Peru).
Note: For Brazil, the figure shows the percentage of people aged 10 and older who used the Internet on their mobile phones in the three months prior to the survey. The socioeconomic status (SES) of surveyed individuals was defined by the Brazilian Criteria of Economic Classification, calculated based on information about access to public services, household appliances, and the education of the household head. High SES includes category "A," and low SES includes categories "D" and "E" in the mentioned classification. In Brazil, 3 percent of the population in 2021 was in category "A" and 28 percent of the population was in categories "D" or "E." In Peru, the figure shows the percentage of people aged 12 and older with a mobile phone who can access the Internet. The SES of surveyed individuals was determined by criteria established by the Asociación Peruana de Empresas de Elaboración de Mercados based on information about assets, dwelling, characteristics of household heads, household appliances, and access to public services. High SES includes categories "A" and "B," and low SES includes categories "D" and "E" in the mentioned classification. In Peru, 12 percent of the population in 2018 was in categories "A" or "B" and 60 percent was in categories "D" and "E."

people from 2015 to 2021. In Peru, the patterns are not so stark but still point to much larger increases in access for low-income populations: the share of high-income people with access to smartphones increased by 15 percentage points between 2015 and 2021, while the increase for low-income people was 29 percentage points. Though these trends have to be taken with caution because they correspond to just two countries, they do suggest that socioeconomic gaps in digital access are shrinking in the region.

Figure 1.4 suggests that the rural-urban gaps in Internet use also appear to be shrinking, though more slowly and with more heterogeneity across countries. Again, Brazil has seen the largest reduction in rural-urban gaps in Internet use, with a decline in the gap from 24 to 8 percentage points between 2016 and 2021. On the other hand, in Bolivia the gap increased slightly from 38 to 40 percentage points. Still, the average gap for Bolivia, Brazil, Chile, Ecuador, Mexico, and Peru decreased from 29 to 23 percentage points between 2016 and 2021, suggesting that the region is experiencing improvements in this area.

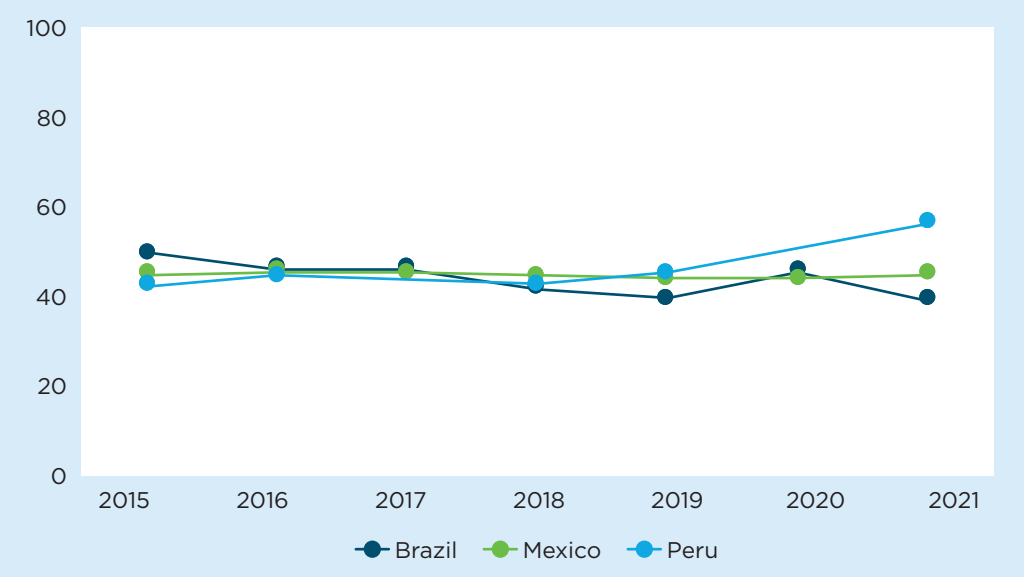
These patterns of expanding smartphone access and shrinking socioeconomic and urban-rural gaps contrast with statistics showing more stagnant trends in access to

FIGURE 1.4 | Internet Use in Urban versus Rural Areas in Selected Countries (Percent)



Sources: Encuesta de Hogares (Bolivia); Survey on the Use of Information and Communication Technologies in Brazilian Households (Brazil); IX Encuesta de Acceso y Usos de Internet (Chile); Encuesta Multipropósito (Ecuador); Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (Mexico); Encuesta Residencial de Servicios de Telecomunicaciones (Peru).
Note: The figure shows the percentage of people who used the Internet in the three months prior to the survey, except for Ecuador (12 months) and Peru (no period of reference). The age range for the population included in the computation of this statistic varies across countries, ranging from ages 5 and older in Bolivia and Ecuador to ages 16 and older in Chile.

FIGURE 1.5 | Trends in Households with Computers or Tablets in Brazil, Mexico, and Peru (Percent)



Sources: Survey on the Use of Information and Communication Technologies in Brazilian Households (Brazil); Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (Mexico); Encuesta Residencial de Servicios de Telecomunicaciones (Peru).
Note: The figure shows the percentage of households that own any of the following devices: desktop computers, laptops, notebooks, and tablets.

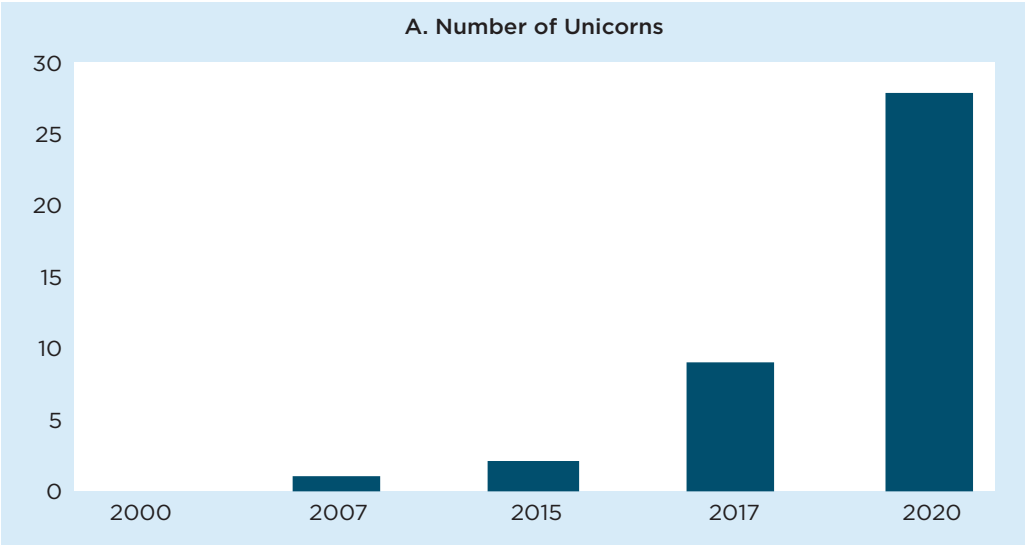
computers or tablets at home. Figure 1.5 shows that most households in Brazil and Mexico do not have access to a desktop, laptop, netbook, or tablet at home. Moreover, the flat trends in access to these devices between 2015 to 2021 suggest stagnant trends going forward. Peru is slightly different, as access to these devices hovered around 45 percent between 2015 and 2020 but then increased to 57 percent in 2021. However, part of this increase may be due to the large national tablet distribution program implemented by the government in response to the COVID-19 pandemic (more than 1 million tablets were distributed among low-income families with students in public schools). More generally, these trends reinforce the results presented earlier that suggest that high levels of Internet use in the region have been fueled by the proliferation of smartphones.

The good news regarding the improvements in Internet access and use and the shrinking gaps should of course be considered in the context of enduring socioeconomic and rural-urban gaps in the region. Moreover, connection speeds as well as the reliability of Internet services can vary significantly both across and within countries. Additionally, the affordability of Internet services continues to be an important challenge driving some of the gaps documented. These challenges point to the important unfinished agenda in terms of continuing to improve the reach, affordability, and reliability of Internet in the region.

Despite these challenges, the private sector has been taking advantage of expanded and improved digital infrastructure and the change in consumer habits. The growth of the technology sector in Latin America and the Caribbean is remarkable. As of 2000, there were no tech companies in the region valued at more than US$1 billion—also known as "unicorns." The first one to grow to that size was Mercado Libre, headquartered in Argentina. During the next two decades of digital growth, the number of unicorns grew to nine in 2017 and then to 28 in 2020 (Figure 1.6, panel a). These companies were growing their customer base even before the COVID-19 pandemic, and after the onset of the pandemic their growth opportunities expanded. Panel b of Figure 1.6 shows the growth in Mercado Libre's annual revenue over the last 12 years. The success of the private sector in exploiting the new digital ecosystem to create commercial value suggests that there are untapped opportunities for the public sector to create social value.

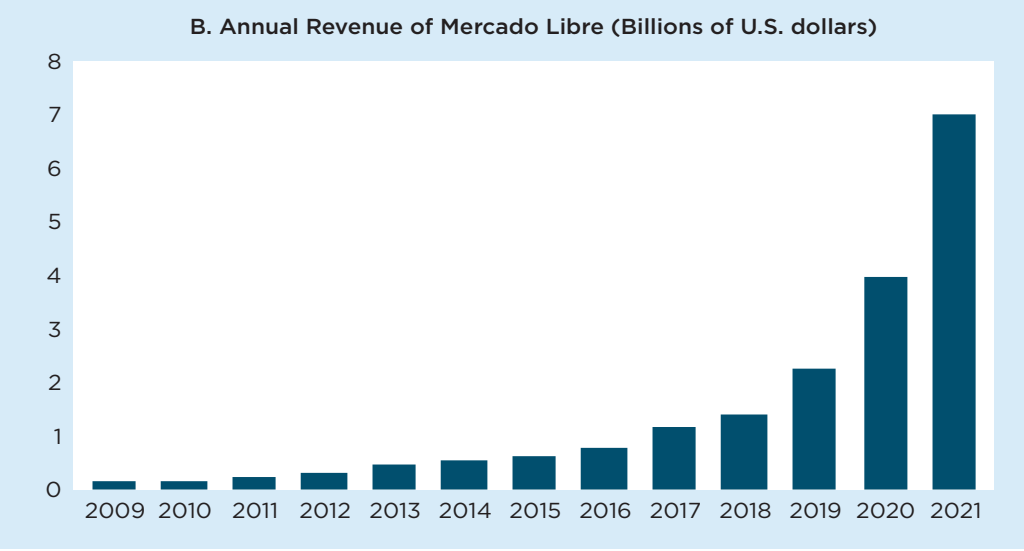
While some Latin American and Caribbean governments have adapted to the growth of digitalization, the region as a whole appears to be lagging behind developed countries. According to 2020 United Nations data, Latin America had an E-government Development Index score of 64, compared to 88 for Organisation for Economic Co-operation and Development (OECD) countries. The average score for Latin America and the Caribbean on the World Bank's 2020 GovTech Maturity Index is 0.53 compared to the OECD average of 0.84. As mentioned in the introduction, a critical explanation for this poor performance is the region's deficit in the digitalization of key public services. Two specific examples are telling. First, according to the 2017 World Bank PFM Global Dataset, 42 percent of Latin American and Caribbean countries had income tax e-filing,

FIGURE 1.6 | The Fast Growth of Digital Firms in Latin America and the Caribbean



(continued on next page)

FIGURE 1.6 | The Fast Growth of Digital Firms in Latin America and the Caribbean *(cont.)*



Sources: Panel A: Latin America Business Stories and Peña (2021); panel B: Macrotrends LLC (www.macrotrends.net/stocks/charts/MELI/mercadolibre/revenue).
Note: Panel A shows the number of tech companies valued at more than US$1 billion (unicorns) in Latin America since 2000. Panel B shows the annual revenue of Mercado Libre.

compared to 94 percent of OECD countries. Second, according to the 2021 World Bank Doing Business survey, 32 percent of Latin American and Caribbean countries had online business registration, compared to 71 percent of OECD countries (Figure 1.7).

FIGURE 1.7 | A Deficit of Digital Public Services in the Region (Percent)

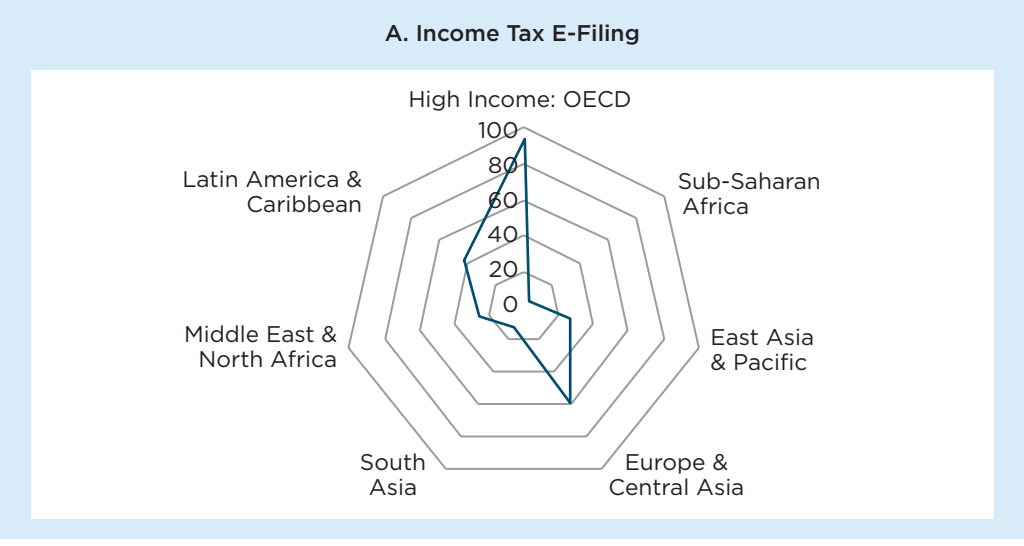


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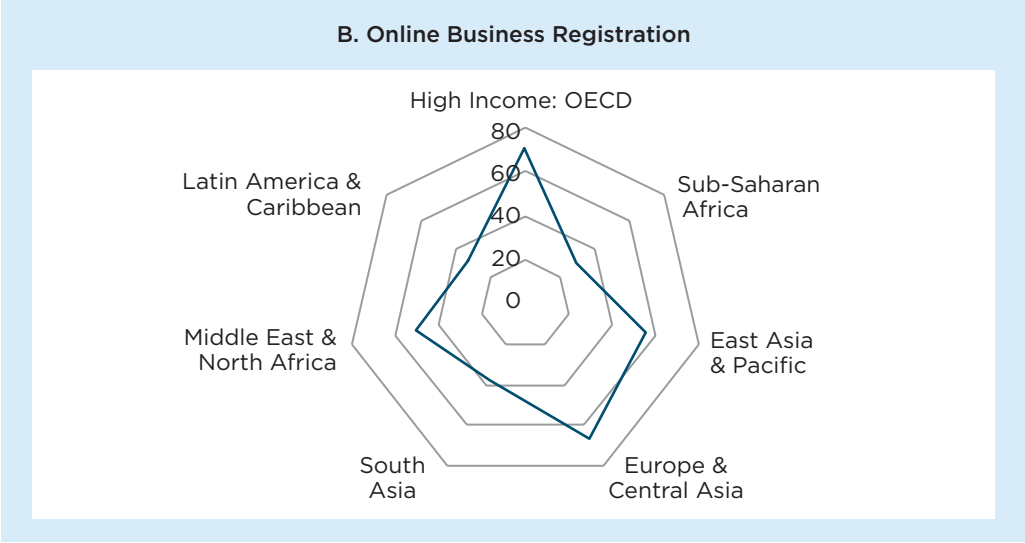
FIGURE 1.7 | A Deficit of Digital Public Services in the Region (Percent) *(continued)*



Sources: Panel A: PFM Systems and eServices Global Dataset 2017; panel B: Doing Business database 2021.
Note: Panel A shows the percentage of economies where electronic filing and payment is available and used by most firms. The sample covers 199 economies. Panel B shows the percentage of economies where there is an electronic system that covers the entire company registration process. The sample covers 191 economies. OECD: Organisation for Economic Co-operation and Development.

1.2. Challenges in Key Public Sectors and Examples of How Technology Is Starting to Help

This report focuses on four key public sectors: public education, public health, government administrative services, and fiscal management. These are sectors with a broad reach in the economy and society and where governments are the central actor. Moreover, reforms in these sectors can have significant positive externalities for the public and private sectors. For instance, developing digital channels to provide medical care in public facilities can stimulate supply and demand of similar services in private clinics. Transitioning to digital transactions for government services can increase the efficiency and accuracy of social assistance programs. Of course, there are many other sectors where digitalizing public services can make an important contribution. The insights, recommendations, and methodology of this report could support a research agenda in this area to foster the development of digital public services in other sectors such as finance, transportation, energy, and labor markets.

Public education in Latin America and the Caribbean faces several longstanding challenges. Chief among them are high dropout rates and inadequate learning outcomes. For instance, secondary school completion rates in the region are 64 percent on average, compared to 79 percent in OECD countries, and the share of 15-year-old

students achieving minimum math proficiency is 35 percent in the region compared to 76 percent in the OECD. In addition, socioeconomic learning gaps persist. Low-income students and those attending rural schools are consistently underperforming compared to high-income students and those attending urban schools. Technology can improve the effectiveness and equity of education by expanding access to quality instruction, increasing student motivation, personalizing learning experiences, and enabling monitoring and experimentation in real time. One example of how technology can help tackle these challenges is the learning platform in Uruguay known as the Plataforma Adaptativa de Matemática, which was first offered to primary and secondary school students in 2013. The platform became particularly useful during the pandemic, when schools had to pivot to remote instruction.

In public health, one of the main challenges in Latin America and the Caribbean is the prevalence of non-communicable diseases, among which cardiovascular disease, diabetes, and depression are responsible for half of deaths and pose a growing economic burden on the region. Key challenges for public health systems are to increase public awareness of preventable diseases, diagnose patients suffering from specific conditions, and provide the needed medical care in a timely manner. Digital tools offer a cost-effective way to provide preventative information and diagnosis, and to expand access to medical care. One example comes from Peru, where in 2017 the Ministry of Health launched a digital information service known as *InfoSalud* on WhatsApp that enabled citizens to obtain information about their health insurance coverage. Later the service was extended to provide free 24/7 counseling on nutrition, medications, mental health, and other health conditions. The app increased accessibility and reduced the cost of obtaining health information, contributing to a reduction in health emergencies.

The simplification and streamlining of government transactions with citizens and firms is at the core of an efficient government. Currently, too many transactions in the region—ranging from applying for a driver's license to registering a new business—are slow and cumbersome. Half of administrative procedures require two or more trips to government offices and long wait times. Before the pandemic, completing an average transaction took 5.5 hours. Digital tools can help reduce transaction costs, particularly for more remote and disadvantaged segments of society that have difficulty accessing services. One example is a tool developed by the Public Prosecutor's Office in Guatemala to expedite crime reporting. This service is provided as an app that can be used to quickly alert the authorities about crimes such as extortion or domestic violence. The main potential benefits of the app are that it allows users to promptly document and locate the crime using audio, video, and geolocation features, improves the response time of the police, and facilitates the filing of and simultaneous access to the reports by Public Prosecutor staff.

The public finances of countries in the region face several challenges. Tax collection is low and ineffective: the cost of tax compliance is higher than the world average, as measured by the number of hours required to fulfill tax obligations. Tax evasion is also high, estimated at 2.3 percent of GDP for the value-added tax and 3.8 percent of GDP for income tax. Public spending is riddled with inefficiencies: leakage in targeted spending amounts to 1.7 percent of GDP. Fiscal transparency is low: by some estimates, corruption in public procurement could account for 20 percent of the transaction value.

The digital modernization of public finances in Latin America and the Caribbean could have a very significant positive impact on countries' fiscal sustainability. Digitalization could streamline revenue collection and generate efficiency savings in public spending. Several national and subnational governments have begun to incorporate digital tools in their fiscal management. Starting in 2010, the state of Rio Grande do Sul in Brazil began implementing a digital procurement system based on data collected through electronic invoicing. Purchasing managers use the new tool to generate more market-based estimates of reference prices of supplies based on a larger number of past market transactions rather than on a limited number of quotes from a few providers. The new digital pricing tool increased savings on procurement of medicines by 10 percent and improved spending efficiency by allowing for the purchase of supplies better matched to the needs of public agencies.

1.3. How Digital Technology Can Improve the Value of Public Services

The economic analysis performed in this report points to several sources of value created by digital technologies that can be grouped into three basic categories: reduction of costs, increase of benefits, and expansion of access. The analysis identifies several types of costs that can be reduced, including those involving replication, data processing, communications, transportation, and verification.

Replication costs can be significantly reduced when a service is digitalized. Information stored in bits can be transmitted to multiple computers or other devices instantaneously and simultaneously. For example, educators can disseminate information to students in multiple schools about the economic returns of completing their degree using digital channels such as informational videos posted on an Internet platform. Similarly, the same online course can be viewed by many students from any computer connected to the Internet, whether at school or at home. Certain medical treatments, such as cognitive behavioral therapy, can be delivered digitally to multiple patients. Data processing costs can be significantly reduced by harnessing the computing power of several computers that communicate with each other. For example, an educational app may create interactive content and deliver personalized student feedback by

processing student responses. In terms of public administrative processes, electronic filing of tax returns can reduce the number of hours government employees need to allocate to process paper forms.

Communication costs can be reduced by replacing traditional methods such as physical letters and telephone calls with SMS texting and email. Digital communication technologies can repeatedly create a personalized message by accessing multiple databases to collect the required information and deliver it quickly and at a low cost. For example, governments can text citizens reminders about the upcoming expiration of vehicle registrations or identification cards, or medical providers can automatically email personalized health information to citizens. Transportation costs can be minimized or even eliminated by delivering services virtually over the Internet. This is the case with telehealth applications that connect the medical professional with the patient through video portals. Another example is government websites where citizens can fill out an electronic form to apply for a document or authorization, or new firms can apply for business registration and existing firms for permits or licenses. Verification costs also have the potential to be reduced, facilitating many transactions whether in-person or online, or whether financial or nonfinancial. For example during the pandemic countries had to move more swiftly toward digital delivery of social transfers, which was made possible through the use of digital identification, which improves the likelihood that transfers go only to those eligible.

Digital applications also create value by increasing the benefits of public services. The analyses in this report identify several types of benefits, including faster information processing, better personalization and targeting, improved task allocation, higher data accuracy, and increased transparency. Digital technologies process data at a higher speed than analog technologies. For example, a math learning app can process the data generated by thousands of students and provide feedback in real time. Tax filing software can perform accounting calculations and produce results almost instantaneously. A related benefit is that online software can access data stored on multiple servers and combine it to deliver more precise and personalized output and an interactive experience. A case in point is health monitoring devices that collect data from the user, combine it with previously stored data, and deliver a customized report based on an analysis of trends in vital indicators. Similar data-based technologies can be used for determining eligibility for social programs and the correct level of benefits.

A key finding of this report is that the benefits of public services can be enhanced by exploiting complementarities between digital technologies and human resources. In other words, tasks can be allocated more efficiently between digital and human providers by harnessing their respective comparative advantages. For instance, repetitive tasks like data collection can be automated and performed by computerized devices, while non-standardized tasks like diagnosing complex medical conditions or providing

empathy and support should be performed by human providers. Data accuracy is another benefit of using digital technology. For instance, electronic voting can reduce the rate of invalidated ballots, and e-filing can reduce mathematical errors in accounting computations. Finally, digital tools enhance the transparency of government operations, which can reduce bribery and corruption. Several countries have implemented public investment portals where citizens can monitor the use of public funds as they are being disbursed.

With increasing connectivity comes the promise of reducing wait times and including more members of disadvantaged groups. Digital technologies make it possible to expand access to public services both in terms of providing services to more people and providing more frequent and better-tailored services to users. The Internet provides the option to access government information and services around the clock and from any location where a connection is available. Thus, existing users can enjoy extended hours and avoid waiting in line at a government office. At the same time new users who previously found it too costly to access a service—such as people in rural or remote areas—may become interested in taking advantage of the service. The small or negligible marginal cost of including an additional user creates economies of scale that make expanded access feasible without the need to build additional offices or hire new public employees.

1.4. Digital Applications for Public Service Delivery

To reap the potential benefits of digitalization, governments can implement both "foundational" and "application" projects. Foundational projects provide the technological, legal, and human infrastructure needed to deploy specific digitalization services. These projects do not aim to tackle a particular development need; rather, their role is to provide the basic building blocks to make the provision of digitalization services possible. Foundational projects include those that create reliable broadband networks, establish standards and regulatory frameworks, and develop digital skills. Some foundational projects seek to establish sectoral infrastructure. For example, education management information systems collect and maintain information on students, teachers, principals, and schools across several dimensions such as demographics, attendance, educational trajectories, assignment to schools, grades and sections, and test scores.

Application projects, on the other hand, exploit the opportunities created by digitalization technologies to tackle particular development challenges. Examples might include a project to develop a health app to improve vaccination rates, or a project that involves sending text messages as part of an informational campaign to promote a desired behavior. Note that application projects do not only involve delivering software (an app), they can also entail providing devices, generating content, or providing

training (or a combination of these inputs). Application projects have specific objectives and typically generate more limited externalities to other projects.

The distinction between foundational and application projects is directly linked to the notion that devices and Internet access are what are called "general purpose technologies." These types of technologies do not produce improvements per se, but rather open up possibilities to provide new services that can generate important improvements (e.g., providing electricity to a home is a general purpose technology because it can be used for many purposes including lighting, heating, and cooking). Hence, though providing Internet access is a necessary step, taking full advantage of this innovation also demands developing and deploying specific digital services. That is, foundational and application projects complement each other. In particular, application projects need some foundational projects that build the underlying infrastructure for digital services. And foundational projects are fruitful only if there are application projects that exploit the opportunities they make possible.

This report is primarily focused on application projects, taking the existing infrastructure and regulatory environment as givens. Strategies to develop infrastructure and create regulations have been addressed elsewhere (Aizenberg 2022; Puíg Gabarró et al. 2021). While continuing to improve the digital infrastructure, which should be a long-term goal, the report argues that it is important to simultaneously develop and deploy applications that provide better services to citizens and firms and support economic activity and social goals. Governments should develop stand-alone digital public services that use existing digital infrastructure, are compatible with citizen devices, and require low connection speeds. These applications require more modest investments but can produce highly scalable and rapidly deployable solutions to specific policy challenges (e.g., more accurate targeting of social transfers).

While countries in Latin America and the Caribbean lag behind developed countries in public service digitalization, and there is significant growth potential in this area, investments in digital applications have to be evaluated on a case-by-case basis because not all of them may generate substantial value. As mentioned earlier, there is little information regarding the actual value that the provision of specific digital services may generate. To start filling that gap, this report assesses the benefits and costs of 11 policy options regarding digital public services.[2] In some cases, these policy options correspond to different ways of implementing the same digital public program. For example, Chapter 2 analyzes four different options to deploy a math platform. The options differed in terms of whether or not new devices were provided to schools, and in how teachers were supported to promote the adoption of this technology. In other cases,

2 The policy options analyzed pertain to education, health, and government administrative services, such as the production of identity cards. Cost-benefit analyses of policy options for fiscal administration were not included as they were still being developed at the time the report was published.

only one policy option is assessed for a digital public program. This was the case of a program that entailed sending SMS to pre-diabetic patients to promote the adoption of healthy behavior to delay the onset of diabetes.

The projects analyzed in this report were selected from among a larger set because (i) rigorous causal evidence was available to quantify their impact, (ii) impact evaluations found positive effects on intended outcomes, and (iii) sufficient data were available to estimate cost parameters. Table 1.1 and the text that follows present four cost-benefit analyses that illustrate how different technologies such as apps, SMS, and videos can be used to tackle key public sector challenges. For each project analyzed, the table presents the net present value per person (how much value the digital service generates per individual targeted) as well as the number of people targeted by the service. The table also presents estimates of two critical parameters for policymaking: the total net present value, that is, how much value on aggregate the project generates (the higher the value the better), and the total implementation costs for the government (the lower the value the better). To ground the analysis and allow for comparisons across projects, all results correspond to the implementation of the projects in Peru for one year using standardized parameters.

The first project involves providing access to a math app to students in grades 3 to 6 in public primary schools and also providing personalized support to teachers to promote the adoption of the app (see column 1 of Table 1.1 and Section 2.4.2 in Chapter 2 for more details). As mentioned earlier, there is strong evidence showing that the intense use of educational platforms generates large learning gains. Hence, this project seeks to promote the use of an educational app to provide students with opportu-

Table 1.1 | Cost-Benefit Analysis of Four Digital Public Services

	(1)	(2)	(3)	(4)
	App to Improve Math Learning	App to Reduce Depression	SMS to Renew Identity Cards	Videos to Reduce Dropout Rates
Net present value per person (U.S. dollars)	99	822	2.6	351
Target population (millions)	1.0	0.05	2.6	1.6
Total net present value (millions of U.S. dollars)	97	39	7	553
Total government implementation costs (millions of U.S. dollars)	3.8	1.6	0.1	1.1

Source: Prepared by the authors.
Note: This table summarizes the results of four cost-benefit analyses produced as part of this report. The results correspond to the implementation of the projects in Peru for one year. Note that results for videos to reduce dropout rates differ from results presented in Chapter 2. The results in this table correspond to a one-year implementation instead of a two-year implementation, as reported in Chapter 2. Note that the net present value per person for the app to reduce depression considers the benefits and costs of those who complete treatment and also of those who drop out. The benefits and costs per person are only reported for those who complete treatment in Chapter 3. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022).

nities to practice math concepts in an engaging way. The benefits of the project arise because the math learning gains that it will produce will increase labor market earnings of student beneficiaries during adulthood. The costs of the project include implementation costs as well as costs that arise because, as students improve their math skills, they are expected to stay in school longer and this will generate additional educational expenses both for the government and families. Overall, it is expected that the implementation of the project in Peru would generate a total net present value of US$97 million. In contrast, the government implementation costs would only be about US$4 million. Hence, a relatively small current investment from the government could generate a large net benefit for society.

The second project also entails an app but, in this case, the objective is to provide services to help people suffering from depression (see column 2 of Table 1.1 and Section 3.4.1 in Chapter 3 for more details). Depression is a common but serious mood disorder that negatively impacts all spheres of daily life, including working, sleeping, and interacting with others. Evidence has been mounting showing that a specific psychotherapy treatment called cognitive behavioral therapy is highly effective in the treatment of depression. This explains why England, among other countries, has implemented a massive public program that employs about 10,000 therapists and provides services to 1.6 million people suffering from depression. The big constraint for countries in Latin America and the Caribbean to implement programs at this scale is the limited availability of medical professionals trained in mental health. One possibility to expand the coverage of cognitive behavioral therapy involves using technology. Different delivery models that use technology have been tested and all share a common structure: patients review modules with information on why and how cognitive behavioral therapy works, followed by practical exercises (tasks) to be completed between modules. One model that has shown great results involves the use of an app together with four sessions with a therapist. Implementing this program employing 2 percent of the existing supply of psychologists in Peru (70 psychologists) could generate a net present value of US$39 million, with modest implementation costs for the government totaling US$1.6 million.

The first two projects discussed require that beneficiaries have access to a device such as a smartphone, computer, or tablet, with at least sporadic access to the Internet. However, although access to smartphones is increasing rapidly, there are still many people in the region who do not have access to these devices. A technology with higher coverage is cell phones. Consequently, governments can take advantage of this extensive available infrastructure to disseminate information through SMS. The third project, which seeks specifically to increase the share of the population that has valid identity cards, is an example of this type of initiative (see column 3 in Table 1.1 and Section 4.2.1 in Chapter 4 for more details). The motivation for this project is that, in most countries in the region, citizens must renew their identity cards at regular intervals

such as every eight years, but many citizens inadvertently let their identity cards expire. An expired identity card precludes people from accessing different services and benefits, including government subsidies and private sector loans. One simple solution to tackle this problem involves sending SMS to citizens to remind them to renew their identity cards. Based on existing evidence, implementation of this project in Peru would generate about US$7 million of net present value, with a small implementation cost for the government of just US$100,000.

The final example also involves the dissemination of information, but with videos, a much richer format compared to SMS. Though the use of videos in public services is not a new idea (Sesame Street has been around for 50 years), digitalization opens up new possibilities in this regard, including using mass media channels such as YouTube to provide 24/7 access; embedding videos in apps or software; automatically personalizing the content of videos to users' profiles; and taking advantage of the rich digital data on who watches the videos and for how long in order to optimize communication campaigns and other efforts. An example of the use of videos involves providing information to students regarding the important economic benefits of schooling, with the final objective to reduce dropout rates. The underlying motivation is that many students drop out, especially students from poor households, because they do not recognize the large economic returns of accumulating more years of schooling. Hence, a potential project entails providing students with information on the economic returns of education through videos (see column 4 in Table 1.1 and Section 2.3.2 in Chapter 2). Based on strong evidence from Peru, the benefits of this project are estimated at US$553 million, and its implementation would require a minimal investment of just US$1.1 million.

It is important to consider that these projects do not represent a random sample of all potential digital projects that governments can implement. In particular, the analysis only looks at digital projects that have shown evidence of improving their intended outcomes. But the evidence that they present, together with the conceptual and empirical analysis presented in this report, do suggest some general findings. To start with, governments in the region have great opportunities to generate value for society by developing and deploying digital public services that can tackle important longstanding challenges. In particular, the cost-benefit analyses indicate that all the projects reviewed generate positive net present value. However, the evidence presented also indicates that there is a large variation in the value added that projects can generate. In particular, the project that involved providing information to students through videos to reduce dropout rates has a net present value almost 80 times larger than the project that involved sending SMS to citizens to remind them to renew their identity cards.

The large variation in value added across projects has profound policy implications. Of course, governments should seek to ensure that they implement projects that "work," in the sense that they produce improvements in the targeted outcomes. But the key

insight is that, though it is obviously good to avoid implementing ineffective projects, the big mistake is to not implement projects with significantly large value added. This insight has already been taken into account by the private sector, as venture capital firms strive to find and invest in companies with the potential to generate large returns. But there has been less recognition of this insight in the public sector in terms of the opportunity lost from not implementing projects that can generate large value added for society.

A question that arises is, why is there so much variation in net present value across projects? Variation in total government implementation costs is not an important factor, considering that these costs are quite low (from US$100,000 to US$3.8 million) and are also small compared to the value added for each project. Still, it is important to recognize that there may also be digital public projects that are quite expensive. The application projects reviewed here have low implementation costs because they take advantage of existing infrastructure (smartphones, cell phones, Internet) and they do not require massive contracting of personnel. The only project that involves hiring personnel for service delivery is the app for depression, which requires hiring psychologists to provide support to patients in tandem with the services provided by the app. Even in that case, however, implementation costs are limited because the actual provision of services requires only two hours of a psychologist's time for each patient treated.

One way to better understand the variation in value added across projects involves recognizing that the total net present value of a project can be computed as the net present value per person times the number of people covered (the first two rows in Table 1.1). This explains why the project with videos generates so much more value than the one employing SMS. For both projects, the targeted population surpasses 1.5 million people. But the big difference is that while the video project has a net present value per person of US$351, the corresponding figure for the SMS project is only US$2.60. That is, the big difference between the two projects is that the video project has a much higher value per person covered, presumably because it affects a major decision in a person's life, such as how many years to stay in school. Similarly, this decomposition can also explain why the video project generates much more value than does the project involving the use of the app to address depression. In this case, the key factor is scale: while the targeted population for the video project is 1.6 million people, the targeted population for the depression app project is about 50,000 people.

More generally, to determine which projects might deliver high value added, it is important to consider the three conditions that many venture capital firms look for when deciding to invest in a start-up: (i) a good product that solves some important problem for consumers; (ii) a large potential market that provides the possibility for significant expansion; and (iii) a growth strategy that specifies how the company is going to capture an important share of the potential market. Similarly, for digital public services, a successful project typically involves the provision of a service that is valuable

for citizens, a large target population that suggests that the problem being addressed is important to many citizens, and a strategy that ensures high levels of adoption of the service by the target population.

1.5. Investing in Research and Development to Promote Innovation in Digital Public Services

There is little doubt that the tech sector is revolutionizing our lives. From how we work to how we communicate, shop, play, and even date, technological innovations are affecting important facets of people's lives. But how does the technology sector generate so much innovation? A key factor behind this rapid innovation is the massive investment in research and development by the big tech companies. Amazon invested 11 percent of its revenue in research and development in 2020, while Google and Facebook invested 15 and 21 percent, respectively. Overall, these companies invested US$78 billion in research and development in 2020.

These figures have an obvious implication: if governments want to produce innovation, they need to invest in research and development. And although governments will not be able to invest at the level of the big tech companies, they still need to make whatever investments circumstances allow them to make. The cost-benefit analyses presented in the previous section provide some estimates of the potential value that these projects could generate, but these are just estimates with considerable uncertainty. To reduce this uncertainty, it is necessary to invest in research and development activities to generate knowledge about the effectiveness of specific solutions.

The uncertainty in cost-benefit analyses comes in two forms. First, there is uncertainty regarding the benefits and costs of a specific solution to a problem. For example, there is rigorous evidence from China, England, and India showing that sending SMS to pre-diabetic patients to promote healthy behaviors can reduce the prevalence of diabetes. But what would be the effects of replicating that intervention in Peru? A rigorous experimental evaluation has to be funded to answer this question. Second, there is uncertainty about the benefits and costs of the best solution to a focused problem. Following the example, there are different communications strategies to promote healthy behaviors among pre-diabetic patients in Peru, and there could be variation in their effectiveness. Investing in the development and evaluation of alternative communications strategies could help identify the best solution. In summary, investing in research and development to reduce these two forms of uncertainty can not only generate more precise benefit-cost calculations but also increase the expected net present value of the projects.

Moreover, investing in research and development to maximize the net present value of projects that already seem good can be an excellent investment strategy. For

example, the estimated net present value for the math app project presented earlier was quite high (US$97 million) and it was based on implementing this solution for students in grades 3 to 6 in public primary schools. However, there are strategies to increase the expected net present value of the project that are based on working on the three aforementioned critical factors that underlie effective projects: a good product, a large target population, and a high level of adoption. Regarding the effectiveness of the product, experimental evaluations could be run to find ways to maximize the learning impacts of the app, including varying how much personalization is provided in the content, how feedback is given to students, and how to tailor the software to increase student engagement. In terms of the target population, content could also be designed for all grades in secondary education, which would close to double the target population for this intervention. In addition, since many students in Peru attend low-cost private schools and tend to underperform in math compared to public school students, the project could also target these students. Finally, regarding adoption, there are many alternative strategies using both tech and non-tech approaches to promote take-up among teachers and students. Performing research and development in these three areas could generate large improvements in the value added generated by this digital project.

Importantly, improvements in the three mentioned factors are expected to generate multiplicative effects that could substantially increase the expected value added of the project. For example, if the math app is refined, and the net present value per user is consequently doubled, then the net present value of the project will double. If the target population also simultaneously doubles, then the net present value will be four times larger than the initial amount. Additionally, if the percentage of the target population that uses the app also doubles, then the net present value will be eight times larger than the initial amount. In other words, the effectiveness of the product, the target population, and the adoption rate all enter in multiplicative fashion into the computation of a project's net present value. Consequently, investing in research and development to improve these factors simultaneously generates synergies that lead to large increases in the value added of the project.

This emphasis on research and development may seem to go against the idea that governments can generate large value by providing digital public services quickly and with limited investments. But that is not the case. Governments can advance in the implementation of low-cost, high-value digital projects and simultaneously fund research and development activities to generate knowledge about how to maximize the benefits of these projects. Moreover, as described in Recommendation 6 in Chapter 6, the use of technology dramatically reduces the costs and time necessary to run experiments to measure impacts and optimize solutions. Governments in smaller countries, or those with low capacity, can use the evidence produced in other places and focus

their limited funding and resources on implementing projects with high quality. More generally, when designing their digital strategies, countries (big and small) should avoid "reinventing the wheel" by using evidence and knowledge that is already available about effective solutions.

1.6. The Importance of Prioritizing Investments in Digital Public Services

Section 1.4 presented evidence suggesting that different digital public services can generate value, and that the implementation costs involved in these projects are relatively low. This can create the notion that governments should invest in many projects and that there is not much need to carefully analyze the benefits and costs of alternative projects. The analysis and findings from this report suggest that this is not the case. Rather, several powerful arguments point to the notion that it is critical to carefully prioritize investments in digital public services.

First, many digital public projects do not generate improvements in the targeted outcomes. The cost-benefit analyses performed for this report only focused on those projects that had already shown evidence of generating improvements in targeted outcomes. Hence, a blanket approach to investing in any digital public services is misguided. Second, there is a multitude of potential services and ways to provide these services that governments need to choose from. Though it is difficult to quantify the large set of potential digital projects upon which governments can embark, it is useful to consider, just to have a sense of the potential options, that there are 3.5 million apps available in the Google Play Store. This statistic speaks to the tremendous flexibility of technology to open up a multitude of possibilities. Third, one of the main findings of this report is that there is a large variation in net present value across projects. Consequently, it is critical not to miss the opportunity to implement those projects that generate large returns. Fourth, governments have limited implementation capacity due to constraints related to public sector contracting services and limits on the number of key personnel who can effectively manage complex digital projects. Fifth, deploying new digital public services requires investments in research and development, and available funding for these activities is limited. Sixth, research and development on different factors (product, scale, adoption) acts in a multiplicative way, which provides further incentive to concentrate these investments on a few projects that can generate particularly large value.

Though it is important to recognize all these constraints, and hence the importance of carefully prioritizing investments in the development and deployment of digital public services, it is also relevant to find ways to ameliorate at least some of these constraints. To start with, governments should seek to enlarge the budget allocated to research and development for digital public services. Additionally, other actors could play an

important role in this area. In particular, multilateral development agencies could play a key role, considering that the knowledge produced from research and development is a public good that can be used by all countries in the region (as can software developed as part of these activities). Similarly, academia, foundations, private companies, and civil society can also play a role in providing resources and funding for research and development of solutions that could later be expanded to a national scale by governments. Also, governments should expand their capacity to implement digital products by increasing the pool of talent in the public sector that can manage these projects, adjusting regulations to facilitate project implementation, and establishing alliances with academia, multilateral organizations, foundations, the private sector, and civil society to promote implementation of these projects.

1.7. How Can Governments Promote Inclusion with Digital Public Services?

A common fear about technology is that it can deepen existing inequalities, especially if there are large socioeconomic differences in access to technology. Fortunately, as mentioned earlier, access to smartphones is increasing rapidly and there is evidence to suggest that socioeconomic gaps in access to this technology are shrinking. Against this backdrop, governments should continue investing to further increase the coverage, affordability, and reliability of Internet access. At the same time, governments should make sure that low-income populations benefit from digital public services by adopting a few sensible principles (for a more detailed discussion, see Recommendation 5 in Chapter 6). In particular, governments should (i) develop and deploy solutions that work well with basic smartphones with sporadic Internet access (such as WhatsApp) so that low-income populations with access to these devices can take advantage of the new digital public services offered; (ii) target promotion efforts to spur adoption of digital public services among low-income people to ensure that this population reaps the benefits of the digital public services provided; and (iii) channel savings arising from deploying low-cost digital services to those that have access (e.g., urban populations) in order to provide effective non-digital services to those that currently do not have access (e.g., rural populations).

1.8. A Word of Caution: The Importance of Managing Digital Risks

While digital technologies have the potential to use data, computing power, and connectivity to improve the accessibility and quality of public services, they also create new risks that need to be properly managed. An important risk involves technical complexity. Digital technologies are prone to implementation failures because they

depend on multiple components working together smoothly. Proper technical design of digital applications is key, and project management styles that employ an agile iterative approach generally have a higher success rate. A related risk is poor usability. An application may work well from a technical standpoint but not be user-friendly, thus limiting its effectiveness at the level of the end user. User-centered design of the application interface can be improved by pilot-testing the application with real users during the development process.

Digital applications also raise the risk of data privacy infringement. A strength of digital tools is their ability to collect, store, and process large amounts of data, but regulations need to be put in place to protect the privacy of sensitive personalized data so that the rights and freedoms of citizens are respected by government authorities. Another threat to privacy comes from nongovernmental actors, whether domestic or foreign. As data exchanges through digital applications are accessible on computer networks, they may become vulnerable to hacking and cyberattacks by unauthorized users. Thus, it is important to embed digital applications in a secure Internet infrastructure and develop a regulatory framework for data access. Finally, as more and more applications are being developed in both the public and private sectors, user activity on digital devices may expand to the point where its value is diminished by information overload and limited attention. Countries that were early pioneers in digital services are now developing strategies to integrate and consolidate different digital applications into one-stop solutions that minimize the number of interfaces that users need to know how to navigate.

1.9. Conclusion

Latin America and the Caribbean has been making steady progress in developing its digital infrastructure. The use of smartphones has become commonplace and digital access gaps have been shrinking. The broad adoption of technology in society offers an opportunity for governments in the region to develop digital public services that are relevant to citizens, add economic value, and address longstanding development challenges. This report provides evidence showing that the provision of digital public services can add large value to society. However, the economic value of deploying specific digital public services varies considerably. Thus, there is a need to prioritize projects based on a careful assessment of their benefits and costs. Moreover, governments need to invest in research and development activities to create digital public services that provide effective solutions to important challenges faced by the region. Advancing this agenda for the deployment of high-value-added digital public services is an effective strategy to promote growth, welfare, and equity in Latin America and the Caribbean for years to come.

2

Let's Get Smarter: Using Smart Technological Investments to Improve Learning and High School Completion

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Gabriela Della Nina Gambi | Lisseth Escalante

Learning levels in Latin America and the Caribbean are low and unequal. Students in the region perform worse on international learning assessments than students in developed countries, and there are consistent gaps between poor and wealthier students. In addition, students in the region accumulate fewer years of education, with many dropping out of school before completing their secondary school degree.

To make matters worse, though educational systems in the region were facing a learning crisis long before the COVID-19 pandemic, the crisis has exacerbated these challenges. Latin American and Caribbean students lost more school days during the pandemic than students anywhere else in the world. The likelihood of dropping out has increased, preexisting learning gaps have deepened, and the risk of an unsuccessful transition to the labor market has risen.

Against this backdrop of deepening challenges, an urgent and effective policy response is needed more than ever, and a critical question arises: How can technology help address the region's critical educational issues? The use of technology in education has been increasing in Latin America and the Caribbean and around the world. When schools closed during the COVID-19 pandemic, most teachers and students gained at least some experience with virtual or hybrid learning. While emerging evidence shows that in-person learning is essential to keep students engaged, mentally healthy, and learning (IDB 2022), certain virtual learning experiences seem to have been successful in maintaining the learning process. This offers promise for the role of technology in education and presents an opportunity to explore its potential (and limits) in the field.

Experimental evidence shows that carefully designed and implemented technology in education programs can generate important benefits, especially when teachers and students

are given clear guidance on how to use the technological resources provided (Arias Ortiz and Cristia 2014; Arias Ortiz, Cristia, and Cueto 2020). However, a detailed analysis of the costs and benefits of these policies is needed because countries also face strong fiscal restrictions stemming from the lingering economic effects of the COVID-19 pandemic. Policymakers must carefully assess trade-offs, considering the costs and benefits of potential policy responses so that programs with the highest social returns can be prioritized.

This chapter presents a conceptual framework and reviews evidence on how technology can contribute to reduce dropout rates and improve learning. The framework focuses on teaching and learning interventions, although emerging evidence also suggests technology can be used to support school management, such as by improving teacher assignments to schools (Ajzenman et al. 2021).

To provide a deep analysis of specific uses of technology, the chapter examines the effects, costs, and benefits of two educational interventions: programs that use technology to inform students about the returns to their education, and programs that use digital learning platforms to promote student practice. Both interventions have been implemented in primary and secondary schools to reduce dropout rates and improve learning in math and reading.

Results indicate that both programs are highly effective. First, technology programs that inform students about educational returns reduce dropout rates and improve student learning. Second, although programs to promote student practice using learning platforms are more complex to implement, evidence shows that they can increase student learning. Moreover, results show that both types of programs produce benefits for society that outweigh the costs involved.

However, details matter. For example, in the case of programs that promote student practice, the gains depend heavily on the specific design selected. The programs that seem to deliver the largest gains for society are those that invest in closing digital infrastructure gaps by improving access to shared devices in schools, and those that invest in enhancing digital skills by providing teachers with extra support from coaches.

Though there has been an impressive accumulation of evidence and knowledge about such programs over the last 15 years, there are still lingering questions about their appropriate design that need to be addressed to ensure that technology investments are made wisely. Still, based on the evidence and experiences reviewed, the central message of this chapter is that while technology is not the solution to the region's educational problems, it should be part of the solution.

2.1. Low and Unequal Learning Levels: The Critical Educational Policy Challenges Facing Latin America and the Caribbean

Over the last two decades, Latin America and the Caribbean has made great progress in widening educational access for students, particularly at the primary level. Enrollment

among children 6 to 12 years old reached 95 percent on average in 2018.[1] Secondary school enrollment has been increasing as well, with the share of students enrolled in this level of education increasing on average by 12 percentage points between 2006 and 2018. However, education in the region still faces three critical challenges: (i) a third of students do not graduate from secondary school; (ii) learning levels are low, and skills and competencies are insufficient to ensure a smooth transition to adulthood and the labor market (IDB 2020); and (iii) large education inequities persist between poor and wealthier students both in terms of completion and learning.

While the average rate of secondary school completion in Latin America and the Caribbean is still below the level of Organisation for Economic Co-operation and Development (OECD) countries (79 percent vs. 64 percent), there have been significant improvements over the last few years, as shown in Figure 2.1. Moreover, the regional average hides a huge gap between different socioeconomic backgrounds: only 46 percent of students from the lowest income quintile versus 82 percent of students from the highest income quintile complete secondary school. In Honduras, El Salvador, and Uruguay, the situation is more critical: on average, only 4 of 10 students graduate from secondary school, and from the lowest income quintile less than 20 percent complete this level of education. In addition, students in Latin America and the Caribbean tend to drop out early. The early dropout rate—the proportion of young people ages 18 to 24 years old who completed up to lower secondary school and are not attending any level of education—was 23 percent in 2018.

In contrast to the advances, however uneven, in secondary school graduation, student learning remains low and progress has been limited. The latest regional learning assessment in 2019—the *Evaluación de la Calidad de la Educación en América Latina* (ERCE)—showed that only 52 percent of third graders in the region master basic math concepts and only 57 percent have age-appropriate reading skills, with wide variations across countries.[2] In the Dominican Republic, for example, only 20 percent of third graders achieve basic math proficiency, compared to 71 percent in Peru. Moreover, there are large gaps between students from different socioeconomic levels. Importantly, between the 2013 regional learning assessment (*Tercer Estudio Regional Comparativo y Explicativo* – TERCE) and the 2019 regional learning assessment (2019 ERCE), most participating countries showed either no improvement or a decline in average test scores in third and sixth grades across all areas evaluated (writing, math, reading, and science).

Students who lack these basic academic skills face important challenges going forward to develop new skills, as reflected by learning levels measured for 15-year-old

1 According to the Centro de Información para la Mejora de los Aprendizajes, available at https://cima.iadb.org (accessed June 27, 2022).

2 The ERCE, conducted by UNESCO, covered 19 countries in the region. See https://es.unesco.org/fieldoffice/santiago/llece/ERCE2019 (accessed June 27, 2022).

FIGURE 2.1 | Secondary Schooling Completion Rates by Country

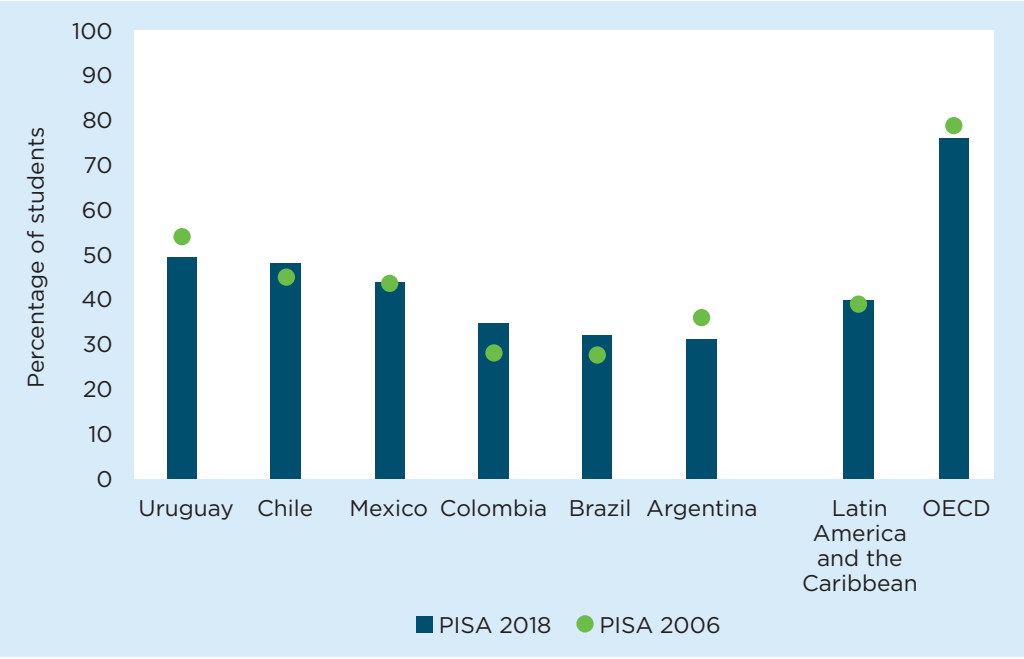
Source: Centro de Información para la Mejora de los Aprendizajes (www.cima.iadb.org).
Note: The figure shows the percentage of people three to five years older than the expected age for the last grade of secondary education who have completed that school level. For example, in the case of Argentina, the figure shows the percentage of people 21 to 23 years old that have completed secondary education. Data years for all countries are approximate based on data availability. OECD: Organisation for Economic Co-operation and Development.

students by the OECD's Programme for International Student Assessment (PISA) in 2018. Only 35 percent of Latin American and Caribbean students attained the minimum proficiency level in math, compared with 76 percent of OECD students (Figure 2.2). Again, socioeconomic disparities are widespread: 60 percent of students from the highest socioeconomic quintile attain this math standard compared to only 17 percent of students from the lowest socioeconomic quintile.[3] Moreover, average learning showed limited improvement in the six Latin American and Caribbean countries that participated in PISA in 2006 and 2018. Of course, it is important to consider that the stagnant learning results in these assessments might be partially due to the fact that coverage grew rapidly during the same period, bringing mostly students from more vulnerable backgrounds into school systems. Still, the region was facing a learning crisis even before the onset of the pandemic.

How did the COVID-19 pandemic affect the challenging educational landscape in Latin America and the Caribbean? As mentioned, the region had the most extended

3 Significant disparities are also observed between students from rural and urban areas and by ethnicity. See Centro de Información para la Mejora de los Aprendizajes (at https://cima.iadb.org, accessed June 27, 2022).

FIGURE 2.2 | Percentage of 15-year Old Students Who Achieve a Minimum Math Proficiency Standard



Source: Centro de Información para la Mejora de los Aprendizajes (www.cima.iadb.org).
Note: The figure shows the percentage of 15 year-old students in the Programme for International Student Assessment (PISA) who are categorized in performance levels 2 to 6 in math (the lowest performance level is 1 and the highest is 6). The Latin American and the Caribbean average includes only countries that participated in the PISA in 2006 and 2018. If all countries that participated in the 2018 PISA were to be considered, the average for Latin America and the Caribbean would be 35 percent. OECD: Organisation for Economic Co-operation and Development.

school closures among all worldwide regions, with an average of 231 days without in-person classes up to October 2021 (IDB 2022) affecting more than 160 million students at all educational levels (ECLAC-UNESCO 2020). Countries tried different strategies to deliver remote educational learning and used multimodal approaches widely. However, these approaches were heavily reliant on the Internet or mobile phone connections (Muñoz-Najar et al. 2021), so the region's significant digital divide left 74 million students (from 3 to 17 years old) unable to access synchronous and interactive pedagogical activities during this period (UNICEF and ITU 2020).

The most recent flagship publication of the Inter-American Development Bank's Education Division analyzes the consequences of this educational disruption (IDB 2022). Early results suggest that the pandemic exacerbated the region's existing structural challenges and that there were considerable learning losses.[4] An assessment conducted

4 Countries have used different strategies for national assessments while taking into account logistical and biosafety protocols that affect the comparability of the results during and after the pandemic (IDB 2022).

in the state of São Paolo, Brazil, found that secondary-level students under remote instruction improved their academic achievement only 27 percent compared to the regular improvements documented during in-person instruction in the previous year (Lichand et al. 2021). In addition, the decrease in social interactions among students and between students and teachers seems to have led to an increase in the risk of dropping out and to the onset of mental health issues (IDB 2022). An assessment by UNICEF (2021) found that half of adolescents ages 10 to 19 in Latin America and the Caribbean had anxiety or depression disorders, which can have devastating effects on life motivation.

Many factors can contribute to the educational challenges discussed above, and they may vary across countries. Among those most cited are that a teaching career is not attractive for the best graduates from secondary school, and that the selectivity and quality of initial academic training of teachers is low (Elacqua et al. 2018). The combination of these two factors results in ineffective and outdated teaching practices throughout the region. A study found that 65 percent or less of classroom time is spent on instruction when it should be around 85 percent, according to international best practices (Bruns and Luque 2015). In addition, while contemporary recommended educational practices have shifted from repetition and memory-based instruction to inquiry-based and experimental learning, pedagogical practices across Latin America and the Caribbean have failed to make this shift (Näslund-Hadley, Loera-Varela, and Hepworth 2014). Students' low level of motivation and engagement is also an explanatory factor, as it is linked with curriculum, instructional time, the learning environment, and teaching practices (OECD 2021).

Regarding socioeconomic gaps in learning, it is important to note that both human and physical inputs are unequally distributed. Teachers are known to be among the most influential inputs for student success, but the assignment of teachers in Latin American and Caribbean countries is still inefficient and ineffective, reproducing socioeconomic inequalities as a result (Bertoni et al. 2018). In addition, access to physical inputs such as connectivity and devices is still scarce and unequal in the region. In 2018, two-thirds of schools reported having insufficient bandwidth to conduct educational activities (Rieble-Aubourg and Viteri 2020). While less than 40 percent of urban children do not have access to the Internet at home, that number jumps to 73 percent among their rural peers (UNICEF and ITU 2020).

Finally, many families in Latin America and the Caribbean do not provide the conditions and support necessary for children to thrive in schools. And this is a challenge, considering that families play a key role in education through various channels such as the home environment and behavior (sociability, quality of interactions, relationship with learning); expectations and disposition regarding education for their children; and parental circumstances (employment and economic resources) (OECD 2013). In fact,

in Latin America and the Caribbean, parent circumstances are strongly related to their students' success (Familiar 2017).

In summary, the COVID-19 pandemic has amplified the main challenges that the region was already facing in terms of completion of secondary school and learning. It is urgent that students develop the skills they need to thrive as individuals and productive members of society. Most students in the region suffered negative consequences from the COVID-19 pandemic to one extent or another, but one-size-fits-all policies to address these consequences might not be appropriate, since students experienced a range of different personal and educational challenges. However they choose to approach it, countries urgently need to mitigate the harmful effects of the pandemic through strong and decisive yet flexible actions that are at the scale that these unprecedented challenges warrant. The question that emerges is how technology can help to tackle these challenges.

2.2. How Can Technology Tackle the Challenges to Education Brought on by the COVID-19 Crisis?

The digital transformation of education has great potential not only to help countries recover from the devastating effects of the COVID-19 pandemic, but also to address the region's structural challenges regarding the quantity and quality of education. Although the use of technology in education is not a goal per se (and should not be), it can be used to tackle different educational challenges on a large scale. Moreover, technology in education opens up clear opportunities for tailored instruction and more efficient school management that, combined with other actions, can help transition educational systems to providing flexible, high-quality, and more inclusive education that promotes 21st-century skills. This is what it is known as "Education 4.0"—education adapted to the needs of what has been called the Fourth Industrial Revolution, strengthening the development of the digital and socio-emotional skills key for jobs of the present and future (Arias Ortiz et al. 2021).

The critical situation of education in Latin America and the Caribbean, exacerbated by the pandemic, is also an opportunity to implement innovative programs and solutions based on evidence that allows countries to leapfrog in the quest to reduce learning gaps. To organize the analysis of how countries can get there, this section presents a conceptual framework that identifies the types of interventions to address these challenges by leveraging the comparative advantages of technology. Table 2.1 displays the conceptual framework of digital interventions in education that primarily aim to improve two outcomes: learning and completion of schooling. Student learning is broader than just math and reading, as other subjects, as well as socioemotional skills, are also important for student success and well-being (Busso et al. 2017). However, they are

beyond the scope of this chapter, which focuses on foundational academic skills where the evidence on the use of technology is more developed. Regarding school completion, the focus is on student enrollment and dropout rates, because these measures have been more extensively monitored and are strongly related to secondary graduation.

In general, digital teaching and learning interventions aim to enhance academic outcomes and use three types of inputs (Arias-Ortiz and Cristia 2014), as shown Table 2.1:[5]

1. Infrastructure: Resources needed for learning technology that perform properly, including the provision of digital devices, access to broadband Internet, labs and creative environments, a structured internal network, and related infrastructure (electricity, physical security, cybersecurity, maintenance, and technical support).
2. Digital content and systems: Software and tools to deliver content (websites, learning platforms, repositories), in many cases with interactive features; learning management systems that deliver content and have additional features such as allowing for building teaching environments, activities, and assessments; and tools to manage classes, grades, users, and reports. These systems and content materials are often associated with delivery methods that provide feedback to different users. For example, some systems allow for informing parents via text messages about their children's performance or attendance.
3. Human resources: Creating incentives (financial and nonfinancial) and fostering an enabling environment for digital transformation in education by mobilizing teachers, principals, parents, and other community members so they can make the best use of technology to support students and enhance learning opportunities. Teachers play a key role in integrating technology into learning. Consequently, enhancing their digital skills by providing training in innovative pedagogical approaches, digital citizenship, and professional development is crucial to take advantage of technology's comparative advantages.

First-generation technology programs focused mostly on the distribution of devices, while considerations of other inputs were marginal (Arias Ortiz and Cristia 2014). However, over the years programs have evolved and each of these inputs has become more complex and tailored to the specific needs of each educational context. Indeed, content and platforms are now often aligned with curriculum, basic teacher training, and online technical support, among other elements. However, important challenges remain in terms of inequality of access to basic digital infrastructure (connectivity and devices).

5 There are also digital interventions in education that focus on improving the efficiency of education spending and equity in the allocation of educational resources (Bertoni et al. 2018; Arias Ortiz et al. 2021). These are called "management interventions" and are centered on helping schools, principals, and administrators improve management processes and systems. However, they are beyond the scope of this chapter.

In Latin America and the Caribbean, less than 30 percent of the most vulnerable households have access to a computer at home to do schoolwork (Rieble-Aubourg and Viteri 2020). However, as documented in Chapter 1, access to smartphones is much higher. Consequently, it is important to avoid interventions that are only beneficial to wealthier students with access to digital resources because they can replicate and even reinforce existing inequality patterns (IDB 2022). As described later in this chapter, programs that use technology for learning should consider measures to expand access to digital infrastructure. In addition, teachers in the region still need strong support to integrate digital tools into teaching practices and develop appropriate digital skills. Fewer than 60 percent of secondary teachers have technical and pedagogical skills to integrate digital components into instruction (Rieble-Aubourg and Viteri 2020). Successful digital interventions must provide training, mentoring and support to teachers.[6]

But when do digital interventions actually generate improvements in educational outcomes? Experience suggests that two necessary conditions need to be met. First, technology should be used in a way that exploits its comparative advantage rather than simply digitally reproduce a current non-digital educational process. For example, technology can increase learning by (i) scaling up high-quality instruction at low cost; (ii) facilitating the delivery of personalized instruction through adaptive learning and tutoring platforms; (iii) enhancing opportunities for students to put

Table 2.1 | Types of Digital Teaching and Learning Interventions

Inputs	Educational processes	Academic outcomes
Infrastructure Devices,* physical environment,** broadband Internet, internal network **Digital content and systems** Educational software, tools, platforms, and portals; websites, digital books, videos, audios, games, and animations; communication applications and learning management systems **Human resources** Teacher training in digital skills and virtual learning communities; leadership and change management training for school principals; communications with and guidelines for families	**Students** Access to content Practice exercises Information on educational returns Feedback Tutoring Instruction at the right level **Teachers** Lesson plans Information on student progress **Parents** Information on education returns Information on behavior and attendance	Learning (math and reading) Completion and dropout rates

Source: Prepared by the authors based on Arias Ortiz and Cristia (2014).
* Devices include any technological device to support learning, such as desktops, laptops, netbooks, tablets, digital whiteboards, cameras, video players, and smartphones.
** Physical environment includes computer labs, mobile laboratories (laptop carts), and maker spaces.

6 One way to address this is to systemically assess the readiness level of schools and teachers for the integration of digital technologies and offer opportunities for their development, Examples of programs that do this are SELFIE (in the European Union) and Guia Edutec (in Brazil).

what they learn into practice through more active, hands-on, and self-paced learning; and (iv) increasing students' motivation and engagement through innovative approaches such as gamification and content creation (Ganimian, Vegas, and Hess 2020). Moreover, technology can produce learning improvements when it is seen as an enabler for enhancing educational opportunities and experiences for students, teachers, schools, and parents (Mateo-Berganza et al. 2020). The second condition for digital interventions is that they must focus on a specific problem or issue in the education system and guide the use of digital resources to tackle the problem identified. This is in line with the findings from a literature review about effective technology interventions on learning that shows that effective programs typically involve clear guidance regarding how technology is used. In contrast, programs that mainly provide infrastructure, content or teacher training, but without clear guidance on how the resources are used, do not generate significant effects on academic achievement (Arias Ortiz and Cristia 2014).

More specifically, it is important to pinpoint which educational process a technology intervention is seeking to strengthen to generate improvements in outcomes. This is why the conceptual framework in Table 2.1 presents potential educational processes to focus on, arranged by each relevant actor.

- **Helping Students**

To start with, interventions can help students by providing them access to materials and platforms that allow them to practice and review content at their own pace and in different spaces (physical and virtual). These platforms and materials can easily integrate features that increase students' motivation, such as interactive and collaboration tools, gamification, and information on future returns. Technology can also support students by facilitating the personalization of the learning process, including by providing tools that assess students' challenges in specific areas and increase opportunities for feedback or tutoring, or by implementing innovative teaching practices that benefit students.

- **Helping Teachers**

The use of technology in the classroom can help teachers by providing them with tools that facilitate the development of lesson plans, curriculum-based learning experiences, and relevant and age-appropriate content, or by building communities of practice and exchange between peers. The platforms described above can also support teachers by delivering individualized information about student progress and shortcomings in specific areas. Existing studies in the region have identified limited

teaching materials, little support for students outside the classroom, and insufficient knowledge among teachers of the factors associated with low math achievement (Arias Ortiz et al. 2021).

- **Helping Parents**

For parents, technology can be a useful tool to support family engagement by facilitating the collection and delivery of information about student attendance, learning progress, and educational returns. Providing parents with information on students' behavior and academic achievements is an opportunity to facilitate following up with their school routine and to intervene early, thus avoiding disengagement (Busso et al. 2017).

2.3. Reducing Dropout Rates: Using Technology to Inform Students about Educational Returns

Though there have been significant improvements in recent years, secondary completion rates in Latin America and the Caribbean are far from universal. These low completion rates are mainly driven by high dropout rates during secondary education. This is unfortunate because accumulating more years of education has large effects on adult earnings. In fact, one additional year of education generates an average increase of 10 percent in wages for workers in Latin America and the Caribbean (Busso et al. 2017).

This section examines whether technology can reduce dropout rates. More specifically, it focuses on programs that seek to reduce misperceptions about the economic returns of education. These programs are motivated by the notion that many parents and students, especially those from low socioeconomic backgrounds, do not have accurate information about the returns to education and, consequently, they may underinvest in skill development. Jensen (2010) first documented that eighth grade students in the Dominican Republic greatly underestimated the returns to education. Additionally, 1,100 students were provided with information about the actual returns to education during one-to-one interviews with enumerators. Strikingly, four years later, these students had accumulated a fifth of a year more of additional education compared to students who did not receive this information. Hence, the study concluded that correcting misperceptions among secondary students in the Dominican Republic about the returns to education through in-person interviews could lead to increases in educational attainment.

2.3.1. Evidence on Program Effectiveness

The seminal study by Jensen (2010) demonstrated that providing information on educational returns to students can reduce dropout rates. But is it possible to provide

this information on a massive scale at low cost? To answer this question, a group of researchers collaborated with the government of the Dominican Republic to design and evaluate an intervention that can be scaled up at a lower cost than the original intervention described in Jensen (2010). In particular, the team identified that technology could help reduce costs and facilitate implementation at a large scale. Specifically, four 15-minute videos were produced that presented the stories of eighth graders who were considering their educational decisions and conveyed the message that accumulating more years of education paid off. The intervention was implemented in 400 schools in 2015 and then the sample was expanded to about 1,600 schools in 2016. Implementation in schools was assigned to school psychologists who were trained by program coordinators. The process faced logistical challenges related to the fact that about only 40 percent of schools had adequate equipment to show the videos. In the other cases, the school psychologists in charge of implementing the program tried creative solutions such as showing the videos in local churches or other nearby venues.

Despite these logistical challenges, an experimental evaluation showed that the intervention produced important improvements in educational outcomes. Students in schools that received the videos in 2015 and 2016 experienced a decrease in the dropout rate of 2.7 percentage points 15 months after the start of the intervention (Abdul Latif Jameel Poverty Action Lab 2018). Moreover, students also improved their performance on a national standardized examination by 10 learning points.[7] Importantly, the marginal cost per student of implementing this intervention was about half a dollar.

At the same time the initiative in the Dominican Republic was being implemented, a team of researchers collaborated with the MineduLAB innovation unit at the Ministry of Education of Peru to explore whether informing students about educational returns could reduce dropout rates. The intervention, called "Decidiendo para un Futuro Mejor" ("Deciding for a Better Future") was quite similar to the one implemented in the Dominican Republic, but the associated cost was even lower. Instead of providing training to school psychologists to implement the intervention, DVDs containing videos were dispatched to schools together with written instructions for teachers regarding how to use them. The intervention entailed showing students four videos in a format similar to a soap opera. Shown during school hours, the videos provided information about the economic and social returns of education as well as possibilities for scholarships and the differential expected payoffs to different areas of specialization in college. The intervention was implemented at a large scale: the target population included 346,000 students in 1,400 schools in urban areas. This massive scale brought some logistical

7 As a point of reference, an average fourth grader in the United States improves math performance by 56 learning points in a year (Hill et al. 2008). Technically, 100 learning points is equivalent to one standard deviation in the distribution of student performance.

complications. When the intervention was first implemented in 2015, only one-third of the targeted schools received the videos. In 2016, the team made some adjustments in the implementation strategy and the percentage of targeted schools that received the videos climbed to two-thirds.

Despite these implementation issues, an experimental evaluation demonstrated that the intervention in Peru produced a large reduction in dropout rates. The dropout rate decreased by 1.8 percentage points in targeted urban schools two years after the start of the intervention (Gallego, Neilson, and Molina 2018). This is a large effect considering that control students, who did not receive the intervention, experienced a dropout rate of 9.6 percent. Additionally, students in targeted schools also improved their learning outcomes in math and language (by 3 and 4 learning points, respectively), as measured by Peru's standardized national examination. All of these educational gains were achieved with a small investment: the marginal cost per additional student was only US$0.05. As in the case of the Dominican Republic, the intervention took advantage of a simple technology (DVDs with videos), but managed to reduce costs even more by replacing in-person training with detailed written instructions for teachers.

Can such interventions also produce positive results in rural contexts? To tackle this question, the implementation team in Peru adapted the intervention to a single 30-minute video that was shown during school hours by field workers using portable projectors. The intervention targeted 125 schools and 2,500 primary students. In this intervention almost all schools received the videos, and the results of the experimental evaluation were even more impressive: the dropout rate decreased by 7.2 percentage points after two years (Gallego, Neilson, and Molina 2018). That is, the intervention reduced the dropout rate by 50 percent, as control students experienced a dropout rate of 14.3 percent.

A third experimental study, in Mexico in 2009, also evaluated an intervention that presented information about educational returns to students, but in a more interactive way. The intervention, called "Percepciones," provided 10th grade students with information on average earnings by education level, scholarship opportunities, and life expectancy. The rationale for providing this information was to emphasize that investing in education was a smart decision. Participating students used computer software in schools that presented the information interactively. The intervention was brief: students interacted with the software just once and used the computers for 12 minutes on average. In spite of the low intensity of the intervention, three years later students who participated in the program experienced average math and language test scores 22 learning points higher than those who did not participate in the program, though no effects were found for on-time graduation (Avitabile and de Hoyos 2018). The authors also documented large positive effects on self-reported student effort, suggesting that this was the channel through which the gains in learning were produced.

In sum, there is conclusive evidence that providing information on educational returns to secondary students can reduce dropout rates and improve student learning, and that technology can be used to deliver this information at low cost and high scale. Moreover, this analysis leads to a more general conclusion: technology is a powerful tool to provide information and improve behavior at scale. An array of technological tools can be used and combined toward this end, including text messages, platform-based messages such as WhatsApp, emails, app notifications, podcasts, and websites. These tools can be employed to inform not only students, but also parents, teachers, and principals. In fact, these information channels, combined with principles from behavioral economics and the availability of near-real-time data to monitor and experiment with alternative approaches, open up important opportunities to improve outcomes at scale. Still, substantial research and development is needed to identify which interventions can combine these elements and generate sizable effects.

2.3.2. Evidence on Potential Social Returns

Technology programs that inform students about the economic returns of acquiring more years of education produce significant educational improvements at low cost. But how much value can these programs provide to society? To answer this question, this section estimates the costs and benefits of implementing this type of program at the national level in Peru, using as a basis for the estimates results from the evaluation of Decidiendo por un Futuro Mejor.[8]

The analysis is centered on estimating the "net present value" for this project. This is a standard metric used in project evaluation that basically represents the total benefits minus the total costs, in both cases discounted to the present. Essentially, the net present value assesses how much value the project is going to generate in terms of current dollars. Additionally, cost-benefit ratios are presented that inform how many dollars of benefits the program generates for each dollar invested. The analysis takes the perspective of society and includes all costs and benefits for society irrespective of whether it is the government or families that are going to experience them.

To simplify the presentation, the average benefit per person minus the average cost per person is estimated to determine the average net present value per person. This figure is later multiplied by the number of beneficiaries in order to arrive at the total net present value of the project.

8 The baseline benefits and costs are estimated for the program in Peru because Decidiendo por un Futuro Mejor was implemented and evaluated there and because rich data are available that can be used to assess the benefits and costs of this program for that country. For that reason, the program in Peru was analyzed in this section instead of the programs that have been evaluated in the Dominican Republic and Mexico.

Based on the estimates, each student in a school targeted by the program will experience an increase in total adult earnings of US$982.[9] Implementation costs are estimated at US$1.4 per student. Because the program will induce students to continue their studies, there are costs associated with this additional schooling that will be covered by the government (US$98) and families (US$161). Note that the costs covered by families include tuition and also the opportunity costs arising because beneficiary students will spend more time in school. Hence, the total cost per beneficiary stands at US$280, including the deadweight loss (US$20). This implies that the estimated total gain per beneficiary is US$702 (US$982 minus US$280). Because 1.6 million students would benefit from this intervention, the net value for this project is US$1.1 billion and the total implementation costs stand at US$2.2 million. Note that this figure corresponds to the implementation of the program for two years.

The analysis also examined the robustness of the same cost-benefit analysis as for Peru, conducted in the cases of Chile, El Salvador, and Jamaica (Table 2.2). In all cases, the benefits of the program were found to exceed its costs. In fact, the cost-benefit ratios range from 1.85 for Jamaica to 4.16 for Chile. And the total net present value of the

TABLE 2.2 | Cost-Benefit Analysis of a Digital Intervention to Reduce Dropout Rates in Selected Countries

	Peru	Chile	El Salvador	Jamaica
Students covered (millions)	1.6	1.0	0.2	0.2
Benefit per student (U.S. dollars)	982	2,800	806	457
Cost per student (U.S. dollars)	280	672	244	247
Net present value per student (U.S. dollars)	702	2,128	563	210
Benefit-cost ratio	**3.5**	**4.2**	**3.3**	**1.9**
Net present value (millions of U.S. dollars)	**1,106**	**2,200**	**97**	**33**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of a program providing information about educational returns through videos. The target population includes students in grades 5 to 9 in urban public schools that have adequate infrastructure to show the videos (at least 10 computers). Results correspond to a two-year implementation. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Section 2.3.2 presents the main assumptions included in the analysis. Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022).

9 The methodology used to produce this cost-benefit analysis is presented in Cristia et al. (2022). However, the main assumptions are summarized here. To estimate lifetime earnings, it is assumed that the average student enters the labor market at age 18 and exit at age 65. The discount rate is 3 percent. The effect of increasing test scores by 1 standard deviation on earnings is 10.6 percent. The effect of the intervention on years of education is 0.09 years. The effect of a year of education on earnings is 8.1 percent. We account for an opportunity cost of studying valued for six hours a day and 193.5 days a year at the average wage for full-time workers of the same age of the student who is studying. A 20 percent additional cost is included for all governmental expenses to incorporate the deadweight loss of tax-related distortions.

program ranges from US$33 million for Jamaica to US$2,200 million for Chile. The variation in the cost-benefit ratios and the total net present value across countries is mainly due to differences in wage levels and the total target population that can be covered by the program in each country. In spite of these differences, the main qualitative findings hold: the program analyzed is a worthwhile investment from a societal perspective.

The main results presented in this section suggest two key policy implications. First, governments in the region have at their disposal a strategy to reduce dropout rates using technology that has been proven at scale in the Dominican Republic and Peru and that can generate large gains for society (in the case of Peru, on the order of US$1.1 billion for a two-year implementation). Second, these remarkable social gains can be triggered by a small initial investment of US$2.2 million to fund implementation of the program for 1.6 million students. As described above, this initial investment is expected to catalyze massive changes in educational choices, which in turn could generate substantial additional investments by governments and families. Because of the large returns that these educational investments will produce, each dollar initially invested in implementing the program is expected to generate a large benefit for society. This result is extremely important for different actors such as multilateral organizations, foundations, and government agencies that can collaborate in ensuring that the initial funding to implement the program is secured. Moreover, considering the high dropout rates in the region and the potential negative consequences of the COVID-19 pandemic on school enrollment, programs that can help to tackle this challenge at a low cost are critical to improving educational outcomes in the region.

2.4 Using Technology to Promote Student Practice and Improve Learning Outcomes

As documented earlier in this chapter, a central challenge faced by educational systems in Latin America and the Caribbean is how to improve learning outcomes. Though there are different ways to improve the learning process through technology, this section will focus on programs to promote student practice using learning platforms because there is a clear rationale regarding how these programs can improve learning and they have been extensively evaluated. As before, evidence on program effectiveness is presented first, followed by a discussion of the potential social returns of different policy options.

2.4.1. Evidence on Program Effectiveness

An example of a program focused on student practice was the one evaluated by Mo et al. (2014). The program was implemented in 36 primary schools in China and aimed to increase math learning for third and fifth graders. Beneficiary students attended

a computer lab twice a week for 40 minutes, during which they mainly played math games designed as practice for the material covered during regular instruction. Short videos that reinforced the main concepts were shown at the beginning of the learning session and students also received feedback about their responses. The learning sessions took place during time that previously had been allocated to learn Microsoft Office and other digital tools. The intervention lasted one year and generated large improvements in math learning of about 16 learning points.

Such programs in Latin America and the Caribbean have also been evaluated. In particular, an experimental evaluation in Chile analyzed the learning effects of a program called "Conecta Ideas." In this program, fourth graders in disadvantaged schools in Santiago attended two weekly 90-minute math sessions in computer labs, where they used an online math platform with exercises aligned with the national curriculum. One of the weekly sessions replaced traditional math classroom instruction, while the other involved additional instructional time in math. The intervention used "gamification," that is, it incorporated game elements into instruction to motivate students to solve the exercises. For example, students were awarded "flags" when they correctly solved exercises, and they could see how many flags they had accumulated and compare their performance with their classmates.

The effects of the program on math learning were impressive. After seven months of program participation, beneficiary students outperformed those who continued with standard instruction by 27 learning points (Araya et al. 2019). Importantly, these effects were measured using the broad and highly reliable national standardized exam administered annually by the Ministry of Education to all fourth graders in Chile. Moreover, these effects are substantially larger than those produced by other more traditional interventions such as extending the school day from four to seven hours or providing training to teachers, which have increased learning on average by only 6 and 9 learning points, respectively (Busso et al. 2017).

The results documented in Chile and China suggest that technology programs focused on student practice generate large effects on learning. However, there is an important caveat to consider when evaluating taking these programs to scale. The two programs analyzed required that the time allocated by teachers to the targeted subject be increased—by 80 minutes in the case of China and 90 minutes in the case of Chile. Increasing the time allocated to teaching a subject is complicated because it requires reducing the time spent on other subjects, or entails hiring new teachers to conduct these sessions in schools. Hence, an important question is whether technology programs focused on student practice can generate learning gains if the time allocated to the targeted subject is kept constant.

An experimental evaluation in El Salvador tackled this question. Students in 29 schools were assigned to three different groups. Students in the first group used the

Khan Academy platform in a computer lab during two weekly extra 90-minute sessions. Students in the second group also attended these extra sessions for the same amount of time but practiced math concepts using standard instructional methods. In turn, students in the third group did not receive any additional instruction. By comparing learning across students in these three groups, the authors could measure the effects of using a math learning platform when increasing the time allocated to math and also when keeping the time allocated to math constant.

In line with the results found in Chile and China, using the math platform during additional instructional time generated a large increase in student learning of 24 learning points (Büchel et al. 2020). Importantly, using the math platform but keeping the total time allocated to math constant also improved math learning, though the effect was smaller at 8 learning points. Hence, this study suggests that the use of technology platforms can increase student learning even when the instructional time allocated by teachers to the subject is constant, though the effects are larger if the technology sessions involve additional instructional time.

But do these results replicate in different contexts? That is, do technology programs focused on student practice increase learning even when instructional time remains constant? To answer this question, a review was conducted of evaluations published over the past 10 years of technology programs that focused on student practice for math or language in primary and secondary schools. Table 2.3 summarizes the studies reviewed. The top panel presents evaluations of programs where the time allocated to instruction of the targeted subject increased for beneficiary students. The bottom panel presents evaluations of programs where the instructional time was kept constant. Results indicate that the average effect for technology programs that promote student practice with additional instructional time was 18 learning points for math and 14 learning points for language. Importantly, the average effect for technology programs that promote student practice but keep the time allocated to instruction constant was 11 learning points for both math and language. In summary, there is strong evidence suggesting that technology programs that promote student practice increase learning even in cases when the time allocated to instruction to the target subject is kept constant.

2.4.2. Evidence on Potential Social Returns

Implementing technology programs focused on student practice can improve student learning, but how much value can they generate for society? And more specifically, how much value can they generate when they tackle, in different ways, the digital infrastructure gap in schools and the problem of low digital skills among teachers? To answer these questions, this section looks at the costs and benefits of different policy options related to these critical barriers to effective implementation of technology in

Table 2.3 | Evidence on Technology Programs Focused on Student Practice

1. Programs that Increased Instructional Time				
		Effects on		
Study	Country	Math	Language	Target Subject
Araya et al. (2019)	Chile	27	–1	Math
Bai et al. (2016)	China	—	6	Language
Bai et al. (2018)	China	—	56	Language
Büchel et al. (2020)	El Salvador	23	—	Math
Fafchamps and Mo (2018)	China	17	—	Math
Lai et al. (2012)	China	22	19	Language
Lai et al. (2013)	China	19	—	Math
Lai et al. (2015)	China	21	11	Math
Ma et al. (2020)	China	3	—	Math
Mo et al. (2014)	China	16	5	Math
Mo et al. (2020)	China	5	—	Language
Muralidharan, Singh, and Ganimian (2019)	India	37	23	Both
Rutherford et al. (2014)	United States	11	–5	Math
2. Programs that Kept Instructional Time Constant				
		Effects on		
Study	Country	Math	Language	Target Subject
Beal et al. (2013)	United States	23	—	Math
Bettinger et al. (2020)	Russia	11	3	Both
Büchel et al. (2020)	El Salvador	8	—	Math
Ferman, Finamor, and Lima (2019)	Brazil	–2	—	Math
Pane et al. (2014)	United States	8	—	Math
Roschelle et al. (2016)	United States	18	—	Math
Spichtig et al. (2019)	United States	—	11	Language
Wijekumar, Meyer, and Lei (2012)	United States	—	10	Language
Wijekumar et al. (2014)	United States	—	20	Language

Source: Prepared by the authors.
Note: This table shows a summary of reviewed technology programs focused on student practice. The identification of these studies was conducted for the production of this report and included programs that fulfilled these conditions: (i) implemented in primary or secondary school; (ii) aimed to improve learning in math or language; (iii) results are reported in papers or other sources published after 2011; (iv) compared the treatment group to the status quo; (v) effects measured at least 12 weeks after the start of the program; (vi) effects estimated using experimental evaluations; and (vii) samples included at least 200 students. Effects are expressed as learning points. 100 learning points are equivalent to one standard deviation.

education programs. To ground the analysis, a hypothetical case is presented of a program focused on student practice to increase math learning among students in grades 3 to 6 in primary schools in Peru. The analysis uses the Conecta Ideas program in Chile discussed above, but with certain adaptations for the Peruvian context. In contrast to the analysis of Decidiendo por un Futuro Mejor in Section 2.4.2, which was derived

from a nationwide experimental evaluation, in this case there is limited information to estimate important parameters in the cost-benefit calculation. Hence, this analysis should be considered as exploratory rather than conclusive.

Specifically, the analysis looks at four different policy options that differ in whether new infrastructure is purchased and whether teachers are supported through workshops or coaches to help them adopt and use the math learning platform. Option 1 involves implementing the program just using the infrastructure already available in schools and promoting the use of the platform through three workshops with teachers. Results for this option are presented in Column 1 of Table 2.4. About 1 million students in schools with the necessary infrastructure are expected to be covered by this program. Based on data from the implementation of Conecta Ideas in Peru in 2021 and other assumptions, it is expected that the program will induce an increase in math learning of almost 1 learning point.[10] This effect is small compared to other educational interventions due mainly to the limited adoption expected when teachers attend workshops but receive

Table 2.4 | Cost-Benefit Analysis of Different Policy Options to Promote Student Practice Using Technology in Peru

	(1)	(2)	(3)	(4)
	No New Infrastructure		New Infrastructure	
	Workshops	Coaches	Workshops	Coaches
Students covered (millions)	1.0	1.0	1.8	1.8
Learning points per student	0.9	2.8	0.9	2.8
Cost per student (U.S. dollars)	1.2	3.9	8.4	11.0
Cost per learning point (U.S. dollars)	1.4	1.4	9.1	4.0
Total benefits (millions of U.S. dollars)	48	143	89	268
Costs in extra schooling and deadweight loss (millions of U.S. dollars)	14	43	29	83
Implementation costs (millions of U.S. dollars)	1	4	15	20
Net present value (millions of U.S. dollars)	**32**	**97**	**45**	**165**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of four policy options for a program seeking to improve math academic achievement by promoting student practice. The target population includes students in grades 3 to 6 in public primary schools in Peru. Each column presents results for a different policy option: Column (1): no new infrastructure and teachers supported with workshops; Column (2): similar to Column (1) but teachers are supported with coaches; Column (3): new infrastructure is purchased so all students in the schools and grades mentioned can participate in the program and teachers are supported with workshops; and Column (4): similar to Column (3) but teachers are supported with coaches. Results correspond to a one-year implementation. Common assumptions with the analysis summarized in Table 2.2 use the same values. For example, the discount rate is 3 percent. Additional main assumptions include (i) an effect on math test score of 2.8 learning points when teachers are supported by coaches (25 percent of the average effect estimated for technology programs focused on practice that kept instructional time constant presented in Table 2.3); (ii) an effect on math test scores of 0.9 learning points when teachers are supported with workshops (one-third of the effect when teachers are supported with coaches); and (iii) an effect of increasing test scores by 1 standard deviation on total years of education of 0.89. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022).

10 The methodology and assumptions underlying this analysis are presented in Cristia et al. (2022).

no personalized support. On the positive side, this program is remarkably inexpensive, costing just US$1.2 per student. In turn, the cost per learning point, that is, how much should be spent to increase achievement by one learning point, is close to US$1.5. Consequently, this program is highly cost-effective in comparison with many other educational interventions (Busso et al. 2017).[11]

Column 1 in Table 2.4 also shows that the discounted benefits for this program amount to US$48 million due to the increase in adult earnings induced by the improvement in math achievement as well as expected increases in labor taxes collected by the government. Since students will have better math skills, they will accumulate more years of education, which increases costs for both families and the government by a total of US$14 million, including deadweight loss. In turn, implementation costs stand at about US$1 million. Hence, the net present value for this program per year is estimated at US$32 million.

Option 2, presented in Column 2 of Table 2.4, also involves using existing infrastructure but now teachers received personalized support from coaches. In this case, effects on math achievement amount to about 3 learning points and costs stand at almost US$4 per student. Hence, this option increases a learning point at a cost of about US$1.5 (US$4 divided by 3 learning points). Because of the larger learning effects, costs and benefits associated with extra schooling increase substantially, and due to the costs of providing coaching, implementation costs increase proportionally more. However, the absolute increase in benefits is much higher than the increase in costs, and hence, the net present value increases to US$97 million. That is, this second option is as cost-effective as the previous option, but it delivers much more value to society.

Option 3 is similar to Option 1 in that teachers attend workshops, but now schools that do not have infrastructure are provided with tablets and other equipment so that all students in grades 3 to 6 can have one 90-minute weekly session of Conecta Ideas.[12] In this case, the effects on learning are the same as in Option 1, but costs increase to almost US$8.5 per student because of the new infrastructure provided. In comparison to Option 1, this program is less cost-effective, as it costs about US$9 to increase 1 learning point (compared to US$1.5 for Option 1). Costs and benefits due to increased years of education increase because now 1.8 million students are covered compared to the 1 million covered in Option 1. In turn, implementation costs increase to US$15 million, mainly due to the infrastructure costs, but also because the workshops have

11 Busso et al. (2017) analyze the cost-effectiveness of different educational interventions and estimate that the cost per learning point of reducing the class size from 25 to 20 students is US$47 and that only a few selected interventions have a cost per learning point below US$5.

12 In places where there is Internet access, schools also receive this service, and in other cases the software is run offline. Even when the Internet is used, the necessary bandwidth is low because tablets only need to connect weekly to download new exercises and upload students' responses.

to be provided to more teachers. Hence, the net present value stands at US$45 million, which is larger than for Option 1 (US$32 million) but substantially smaller than for Option 2 (US$97 million).

Option 4 is the most intensive, as teachers are supported by coaches and new infrastructure is provided so that all students in grades 3 to 6 can participate in the program. The effect on learning is 3 points as in Option 2 but, because of the increased infrastructure costs, the cost per student increases to US$11 and the cost per learning point climbs to US$4. In addition, the costs associated with additional schooling and implementation are the highest among all options. However, these additional investments generate the largest net present value among all options at US$165 million. These substantial gains are generated through two complementary interventions: providing infrastructure to expand the number of potential beneficiaries, and providing coaching to ensure high levels of adoption among teachers.[13]

The robustness of the results already presented for Peru were also examined for the context of Chile, El Salvador, and Jamaica (Table 2.5). In general, the main results

Table 2.5 | Cost-Benefit Analysis of Different Policy Options to Promote Student Practice Using Technology in Selected Countries

	(1)	(2)	(3)	(4)
	No New Infrastructure		New Infrastructure	
	Workshops	Coaches	Workshops	Coaches
Benefit-cost ratio				
Peru	3.1	3.1	2.0	2.6
Chile	3.2	3.2	2.9	3.1
El Salvador	1.1	1.9	1.1	1.9
Jamaica	0.7	1.1	0.6	1.0
Net present value (millions of U.S. dollars)				
Peru	32	97	45	165
Chile	45	137	53	167
El Salvador	0.1	2.2	0.3	7.5
Jamaica	–0.5	0.2	–1.8	0.1

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of four policy options for a program seeking to improve math academic achievement by promoting student practice. The target population includes students in grades 3 to 6 in public primary schools. Results correspond to a one-year implementation. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Each policy option is presented in a column in the same order as in Table 2.4 (see the notes of that table for more information about the policy option presented in each column). Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022).

13 Option 4 generates a much larger net present value than Option 3 because the absolute increase in benefits, which is induced by a sizable increase in expected learning, is much larger than the increase in costs.

hold. That is, the different options present benefits that exceed costs in almost all cases.[14] And the net present value is maximized for the policy option that involves providing new infrastructure and supporting teachers with coaches.

These results suggest several general, though tentative, policy implications. To start with, technology in education programs focused on practice can generate large gains for society. However, the potential gains for society depend heavily on the specific design selected. In particular, programs that prioritize infrastructure provision at the expense of supporting teachers are not expected to be as cost-effective as other policy options. In fact, programs that prioritize supporting teachers with workshops or coaches and use existing infrastructure seem to be highly cost-effective. Also, programs that combine infrastructure provision with strong support to teachers through coaches seem to be cost-effective.

But which of these options should governments implement? In a sense, this decision boils down to the budget that the government (or other funders) has available, and the cost-benefit ratios of alternative programs. If limited funds are available, and just focusing on the four policy options analyzed here, the most cost-effective option (with workshops and no new infrastructure) should be prioritized. In the hypothetical program analyzed for Peru it can be seen that this option can generate 1 additional learning point at a cost of about US$1.5. Moreover, this option generates US$32 million of added value for society. However, if governments have a larger budget to invest, then the gains for society can be much larger. In particular, if governments can fund coaches for teachers, the value added to society can grow substantially. Finally, if governments can fund coaches and can also provide new infrastructure to schools that do not have technological resources, then there could be even larger gains for society. For the hypothetical case program analyzed here, it is estimated that this option can generate US$165 million of additional value for society.

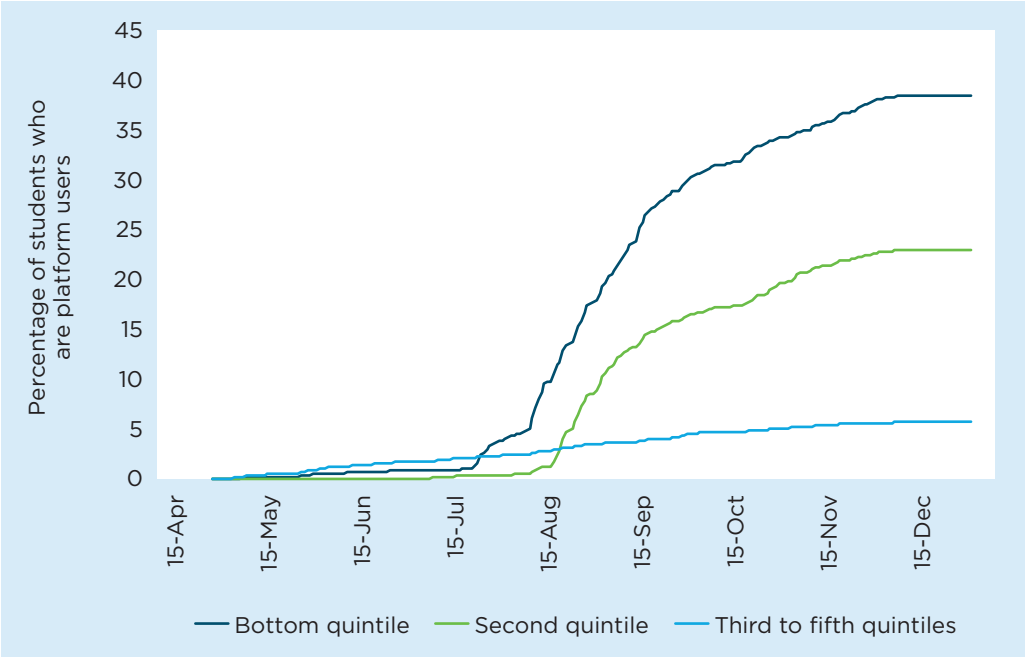
The analysis presented here suggests how governments can make efficient use of scarce resources. But, how can governments ensure that these investments primarily benefit disadvantaged populations? The central strategy to achieve this objective involves targeting the most effective interventions to the least advantaged populations. For example, governments could fund workshops for all teachers in schools that already have infrastructure, but fund coaches for teachers in the schools that have infrastructure but are attended by low-income populations. Or governments could provide new infrastructure as well as coaches to schools in low-income areas. Moreover, even if the

14 The exceptions to this general pattern are the two policy options in which teachers are supported with workshops in Jamaica. In these cases, the benefits are lower than the costs because the fixed costs entailed in implementing the program are too large compared to the total benefits, which are limited due to the smaller target population. However, if we assume that some of the fixed costs (e.g., for content development) are shared among other Caribbean countries where the program can be implemented, then the benefits also exceed the costs for Jamaica.

government chooses to invest in new infrastructure so all public schools have the necessary equipment and also provides coaching, it can provide extra support to teachers in disadvantaged schools. When designing this strategy, private schools should also be considered, as disadvantaged students may be attending low-cost private schools. Hence, the government could also allocate resources (e.g., for providing workshops or teacher coaches) to private schools attended by low-income students.

A good example of this strategy is the implementation of Conecta Ideas in Lima in 2021. This program entailed providing access to the Conecta Ideas learning platform for all students in grades 4 to 6 in public schools in Lima. However, schools that performed in the bottom quintile during the 2016 and 2018 national standardized exams held the workshops described above and received some additional support. Schools in the second quintile participated in an experimental evaluation to assess the effectiveness of different strategies to support teachers. Hence, some, though not all, teachers in these schools attended workshops and received additional support. Figure 2.3 shows how these targeted promotion activities, which started in July 2021 for schools in the

FIGURE 2.3 | Percentage of Students Who Used the Conecta Ideas Platform at Least Once, by School Pre-pandemic Academic Achievement



Source: Prepared by the authors.
Note: This figure shows the percentage of students who used Conecta Ideas at least once in 2021, separately by schools in different quintiles of performance on pre-pandemic national standardized tests. In July 2021, teachers in schools from the bottom quintile started participating in activities to promote use. In August 2021, some of the teachers in schools from the second quintile started participating in the promotional activities.

bottom quintile and in August for schools in the second quintile, affected the fraction of students who used the platform at least once. The figure shows that in June, before the start of the promotion activities, the use of the platform was higher in schools in the third to fifth quintiles. However, as the workshops started taking place, use increased markedly in targeted schools and an impressive negative gradient between pre-pandemic academic achievement and platform use arose. In fact, by the end of 2021, 39 percent of students in public schools in the bottom quintile of pre-pandemic academic achievement had used Conecta Ideas, compared to 23 percent of students in the second quintile, and 6 percent of students in schools in the top three quintiles. These results highlight how equity considerations in technology programs can be incorporated by directing investments towards effective strategies for disadvantaged populations.

2.5. Conclusions: Using Low-cost Technology for a Better Educated Region

Though educational systems in Latin America and the Caribbean were facing a learning crisis long before COVID-19, the pandemic has exacerbated these educational issues (IDB 2022). Governments must prepare a sound policy response not only to recover from the devastating effects of prolonged pandemic-related school closures, but also to build high-quality, inclusive educational systems that can tackle longstanding inequalities. To add to this complex scenario, interventions need to be implemented at an unprecedented scale in the face of significant fiscal constraints. While there is no silver bullet to solve these challenges, reviewing the evidence and assessing the costs and benefits of digital interventions in education can offer insights about smart programs to recover and transform learning in the region.

This chapter has identified two important examples of digital interventions to improve learning and reduce dropout rates. First, technology programs that inform students about the returns to their education reduce dropout rates while improving student learning, and they can generate large gains for society as well. In addition, to reap these benefits governments need only a relatively small initial investment. Second, while programs to promote student practice using learning platforms are more complex to implement, evidence indicates that they can increase student learning. When computing how much value they can generate for society, the results show that programs that promote student practice can generate large gains, but these depend heavily on the specific design selected. Programs that invest in closing digital infrastructure gaps by improving access to shared devices in schools, and in enhancing digital skills by providing teachers with extra support from coaches, seem to deliver the largest gains for society.

Beyond these important examples, this chapter has also examined some common challenges faced by technology in education programs and how to address them. In

terms of access to infrastructure, the distribution of low-cost devices to schools to be shared among students (computer or mobile labs) can keep infrastructure costs low. Distribution of such devices can also greatly increase the benefits of technology in education programs by reaching children who would not otherwise have access to technology. Regarding teachers, pedagogical practices and time of instruction remain critical inputs, though even when these are kept constant, evidence shows that the use of technology can generate learning gains. Finally, digital interventions pose the risk of increasing learning gaps, given that students from poorer families face more challenges to use technology at home, an issue that became more salient during the COVID-19 pandemic. Targeting the most effective interventions to the poorest populations can be an effective strategy to ensure equal adoption and use of the learning tools deployed. Common strategies include providing extra support for teachers in low-performing schools and promoting activities that target students at the lower end of the income distribution.

By seizing on the investments made during the COVID-19 pandemic to digitalize infrastructure, content, and teaching, policymakers have a unique opportunity to draw on the evidence from these interventions to implement programs that effectively use technology to close learning gaps and reinvent learning. While learning levels in Latin America and the Caribbean historically have been low and unequal, this chapter has shown that digital interventions can play a significant role in reversing that trend and changing the trajectory of learning in the region going forward.

3

Time for an Upgrade: Using Digital Interventions to Tackle Non-communicable Diseases

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Healthcare in Latin America and the Caribbean is overdue for an upgrade, and it is clear that technology is opening up excellent opportunities to tackle critical health challenges in a cost-effective and scalable way. Pushed forward by the challenges of addressing the COVID-19 pandemic, many countries in the region are now looking to digitally transform healthcare to improve quality, efficiency, and equity. However, successful digital transformation of the health sector will require deliberate investment in digital foundations, well-thought-out digital strategies, and the patience to deliver results over the long term. Meanwhile, the pressure is on: health systems and citizens face a growing burden of non-communicable diseases (NCDs) such as diabetes, cardiovascular diseases, and mental health disorders. Are there digital health investments that governments can make today to both curb this growing burden and start countries on the path of sustainable digital transformation?

This chapter focuses on vertical or stand-alone digital health applications that have demonstrated effectiveness to reduce this burden on both the people who suffer from these diseases and the health systems that treat them. The chapter first documents the epidemiologic and economic burdens of NCDs in Latin America and the Caribbean. It then describes conceptually how digital interventions can improve health outcomes through prevention, screening, and management of these conditions and reviews relevant empirical evidence. Two examples are presented of effective digital applications to manage depression and prevent diabetes, and their potential or ex ante costs and benefits are calculated based on available evidence. The chapter concludes

by providing recommendations to bring evidence-based digital applications to scale in Latin America and the Caribbean in an equitable manner.

3.1. The Burden of Non-communicable Diseases in Latin America and the Caribbean

In 2019, NCDs accounted for 77 percent of deaths in Latin America and the Caribbean (Global Burden of Disease Collaborative Network 2020). The leading risk factors for mortality and morbidity in the region are all associated with NCDs, including high body mass index, high glucose levels, high blood pressure, smoking, and an unhealthy diet (IDB 2021). Worse yet, estimates indicate that NCDs will become increasingly widespread in the years ahead due to a greater prevalence of risk factors and population aging. In response to these challenges, United Nations Sustainable Development Goal 3.4 urges countries to reduce by one-third premature mortality from NCDs through prevention and treatment and the promotion of mental health and well-being by 2030 (United Nations 2015).

Cardiovascular diseases, diabetes, and mental health disorders combined—a subset of NCDs—are responsible for half of the deaths and 39 percent of disability adjusted life years (DALYS) in Latin America and the Caribbean, placing a growing epidemiologic and economic burden on the region (Global Burden of Disease Collaborative Network 2020).[1] Cardiovascular diseases include those affecting the heart or blood vessels, or conditions due to poor blood supply (WHO 2021c). Hypertension, or high blood pressure, is a serious medical condition and one of the most important risk factors for cardiovascular diseases. Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (blood sugar) and can cause damage to the heart, blood vessels, eyes, kidneys, and nerves (WHO 2020b). The Pan American Health Organization (PAHO) estimates that 30–40 percent of cases of diabetes in the Americas are undiagnosed, and that 50–75 percent of cases of diabetes are uncontrolled (PAHO 2022).[2] Depression is a common but serious mental health disorder that interferes with virtually all aspects of daily life, including working, sleeping, and interacting with others (PAHO 2022).

Studies consistently show that those suffering from one of the three above-mentioned conditions have a higher propensity of also experiencing the other conditions (Carnethon et al. 2007; Davydow et al. 2011; Gan et al. 2014). Also, the burden of these diseases varies widely between countries both in terms of their prevalence and a health system's ability to timely detect and effectively treat them. Moreover, important socioeconomic inequalities have been documented for these conditions and the poorest tend

1 See Cristia et al. (2022) for detailed information regarding the regional and country-level burden.

2 The Americas refers to all countries in Central, North, and South America.

to be affected disproportionately (Bassanesi, Azambuja, and Achutti 2008; Rosengren et al. 2009; Fleischer et al. 2008).

Addressing the risk factors that cause NCDs would have the largest impact on improving health and reducing health system demands, but those risk factors are often particularly difficult to address (IDB 2021). The World Health Organization (WHO) states that an integrated chronic care model is key to prevention, detection, and treatment of NCDs, and that it needs to include such components as patient self-management support, delivery system design, decision support, clinical information systems, community resources, and multisector collaboration (WHO 2013).

Regarding mental health and depression, WHO has created a menu of cost-effective population and individual interventions (WHO 2021a). However, the resources allocated by Latin American and Caribbean countries to tackle mental health are insufficient, inefficiently used, and inequitably distributed. In fact, prior to the pandemic 73 percent of adults with depression in the region did not receive treatment (PAHO 2014). Moreover, there are substantial inequities in the geographical distribution of providers. For example, most human resources for mental health are concentrated in large urban areas and in psychiatric hospitals (PAHO 2013b). The stigma, social exclusion, and discrimination related to mental disorders also make seeking care a complex process (PAHO 2014). Timely detection and treatment are a challenge, and median public spending on mental health across the region is a mere 2 percent of the health budget, with most (60 percent) of this amount allocated to psychiatric hospitals (PAHO 2014).

Along with the prevalence of NCDs, their economic burden is expected to rise substantially in the coming years both in terms of direct healthcare costs and indirect costs measured in terms of foregone earnings due to years of productive life lost because of premature mortality and disability. In fact, it is estimated that NCDs will cost the world economy US$30 trillion between 2011 and 2031 and that mental health conditions will account for an additional US$16.1 trillion over this time frame (Bloom et al. 2011).

It is also expected that chronic diseases will cost countries more in the future. While as a group they are devastating, individual diseases can play a major role in driving up expenditures. For example, people with diabetes are estimated to consume two to three times the healthcare resources of persons without diabetes, and diabetes consumes up to 15 percent of national healthcare budgets (Zhang et al. 2010). One study that projected healthcare spending in Latin America and the Caribbean through 2050 estimated declining expenditures for infectious diseases, but rising expenditures for circulatory diseases and cancer (Rao et al. 2022). Looking ahead, the challenge to health systems will be to limit expenditures without reducing coverage and quality and increasing equity. Key strategies involve strengthening primary care, improving the integration of services, providing cost-effective preventive and public health services, and improving interoperable and integrated information systems that

enhance coverage, while also reducing transaction costs, inefficiency, and redundancies (Rao et al. 2022).

3.2 Can Digital Interventions Reduce the Burden of Non-communicable Diseases in Latin America and the Caribbean?

Pushed forward by the challenges of addressing the COVID-19 pandemic, many countries in the region are now looking to digitally transform healthcare to improve quality, efficiency, and equity. Successful digital transformation of the health sector will require deliberate investment, well-thought-out digital strategies, and time to achieve results. All of this will need to occur while health systems and citizens face a growing burden of NCDs. This section looks at digital health interventions that governments can deploy today to both address this health problem and at the same time start on the right path of sustainable digital transformation.

3.2.1. How to Accelerate the Adoption of Digital Health

There is a consensus that, if implemented well, digital transformation of the health sector has the potential to improve the quality, efficiency, and equity of healthcare (Bagolle et al. 2022). The global strategy on digital health released by WHO (2021d, 10) highlights the need for "appropriate, accessible, affordable, scalable and sustainable person-centric digital health solutions to prevent, detect and respond to epidemics and pandemics, developing infrastructure and applications that enable countries to use health data to promote health and well-being." Latin American and Caribbean countries have prioritized digital health on the regional agenda, and all PAHO member countries have approved two regional policies promoting digital health (PAHO 2019, 2021a).

One important aspect of digital health transformation is the deployment of evidence-based digital health applications and services, in this chapter referred to as digital health applications. Often, an application or service will have many functionalities, depending on its intended use. Based on WHO guidelines, three dimensions of digital applications are analyzed: (1) the health condition tackled (e.g., diabetes, mental health); (2) the functionality performed (e.g., patient communication, ordering a prescription); and (3) the channel used (e.g., SMS, mobile application, web applications) (WHO 2019). They are categorized using the WHO Classification of Digital Health Interventions. Although these dimensions should be thought of in the broader context of the digital ecosystem and the health system, this chapter focuses on the specific value of digital health applications for NCDs, as opposed to foundational aspects required for their deployment at scale, which are explored elsewhere (Bagolle et al. 2022; WHO 2019, 2021a).

3.2.2. How Digital Applications Help Create Value to Tackle Non-communicable Diseases

Reducing the burden of NCDs requires population health initiatives, multisectoral action, and improvements in healthcare service quality (Savedoff et al. 2021). Actions are required by health systems to detect, prevent, and manage NCDs in a timely manner, while individuals play a key role in adopting healthy behaviors that can reduce risk factors to prevent new diseases and manage existing ones. Can digital applications influence individual behavior, increase access to specialized care, and improve screening or patient safety? Table 3.1 describes system challenges and illustrates ways that digital health can help to tackle NCDs.

Just as approaches to healthcare have often been separated into vertical approaches targeting specific diseases (such as tuberculosis), and horizontal approaches that are intended to strengthen health systems broadly (such as a primary healthcare platform), the digital health applications described in Table 3.1 can also be grouped into the same categories depending on their scope and approach. To scale, both approaches require investments in digital foundations. Table 3.2 provides definitions used in this chapter and examples. It should be noted that vertical applications can also connect to horizontal platforms, resulting in integrated approaches to digital health.

Table 3.1 | How Digital Health Can Create Value to Tackle Non-communicable Diseases

Health System Challenges to Address Non-communicable Diseases	How Digital Health Can Help
Trained human resource shortages	• Use of digital decision support systems to help shift tasks in order to increase access to screening and education while increasing productivity. • Use of self-guided digital applications for education, support, and disease management and treatment.
Equitable access to specialized and patient-centered care	• Use of telehealth to increase equitable access to specialized care, reducing geographic barriers and supporting patients with mobility or stigma issues.
Care coordination between providers	• Use of personal health records, electronic health records, and health information exchange to promote care coordination by sharing patient health data among multiple care providers safely and securely.
Patient safety and quality	• Use of digital decision support and knowledge management systems for providers to increase quality and safety.
Early detection of risk/disease	• Use of digital triage and screening tools at community or primary care levels and/or through self-assessment to detect early risk or signs of disease. • Digital reminders for patients for timely screening based on age, gender, or other risk factors. • Use of digital tools to replace traditional laboratory screening or increase throughput of diagnostics.
Behavior change and risk factor reduction outside of healthcare settings	• Empower patients through access to educational platforms, reminders, digital coaching, or peer-to-peer platforms to improve healthy behaviors and reduce risk factors.

Source: Prepared by the authors.

Table 3.2 | Digital Health Definitions

Term	Definition	Examples
Vertical digital applications	Digital health applications that can "stand on their own" and require little integration with other digital applications for successful deployment.	Text messages to remind patients to take their medication; video conferencing to monitor adherence to tuberculosis treatment; apps to improve mental health and well-being through guided meditation; wearable device that monitors physical activity.
Horizontal digital applications	Digital health applications that are heavily coupled with other digital applications or components in digital foundations for successful deployment.	Electronic health record system; health information exchange; electronic prescription; radiology information system.
Digital foundations	Enablers for digital health that are required to create an environment to scale digital health interventions.	Policies for cybersecurity and health data exchange; change management strategy; broadband access; end-user devices; unique patient identifier; catalogs and terminologies for interoperability.

Source: Prepared by the authors.

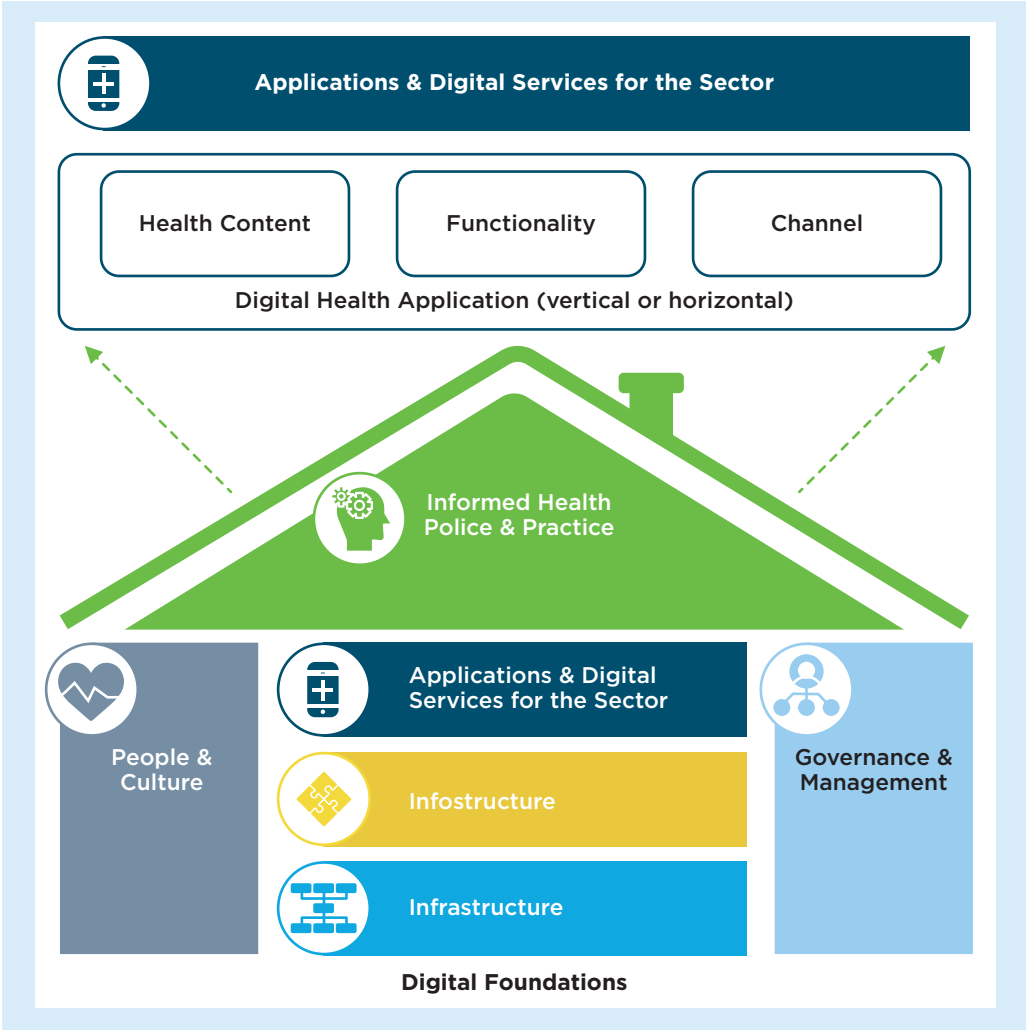
This chapter focuses in particular on vertical digital applications, that is, digital health applications that can "stand on their own" and require little integration with other digital applications for successful deployment. These include the use of digital applications to (i) support shifting simple tasks to less skilled workers or to patients (task-shifting); (ii) increase access to base interventions like screening and triage; and (iii) improve patient awareness and behavior change. Task-shifting also increases the productivity of specialized workers, reserving their time for specialized tasks or complicated patients. Task-shifting directly to patients can also empower them to manage their health outside of the health center by improving awareness and education, and by reminding them of the need to adopt and maintain healthy habits. Providing patients with access to care directly from their homes can also improve equity (particularly for those living in remote areas or with mobility issues) and reduce stigma by increasing patient privacy and comfort.

However, horizontal digital health applications—such as electronic health record systems, electronic prescriptions, and health information exchange (i.e., the capability to electronically share clinical information among disparate healthcare information systems)—are generally required for self-management, care coordination, patient safety, and the use of evidence-based protocols (Bagolle et al. 2022; Nelson, Cafagna, and Tejerina 2020). Studies have shown that horizontal digital interventions such as electronic health record systems can produce significant health improvements, including fewer medical errors, shorter documentation times, and fewer drug reactions, and can play a key role in national digital health transformations (Campanella et al. 2016; Bagolle et al. 2022).

Nevertheless, for digital applications to create value in these areas, digital foundations such as cybersecurity protocols and interoperability standards are

required to allow for data sharing among providers, and electronic health records that support patient communication and application of evidence-based protocols must be in place. Best practices and recommendations for digital foundations include investments and interventions in six dimensions (Figure 3.1): (i) governance and management; (ii) infrastructure; (iii) infostructure, which refers to the technical components needed to enable interoperability; (iv) digital services and applications for the sector; (v) people and culture; and (vi) informed policy and practice (Savedoff et al. 2021; Bagolle et al. 2022). A national approach that encompasses

FIGURE 3.1 | Foundational Elements for Digital Health Transformation and Their Relationship to Digital Health Interventions



Source: Prepared by the authors based on Bagolle et al. (2022) and WHO (2019).

these six dimensions takes time and investment. Countries in the region that have undertaken such interventions, such as Uruguay, needed more than a decade to implement them on a national scale (Bagolle et al. 2022; Friedmann 2022). It is not suggested here that vertical applications replace the need for horizontal, or foundational investments in digital health, but rather that they be explored as a first step towards system transformation.

3.3. Vertical Digital Interventions to Address Depression, Diabetes, and Cardiovascular Diseases

This section summarizes the rapidly expanding and already vast literature on vertical digital applications that can help to address depression, diabetes, and cardiovascular diseases. Specifically, it reviews the effectiveness of digital applications that provide the following functionalities: (i) targeted client communication; (ii) on-demand information; (iii) personal health tracking tools; (iv) provider-patient telemedicine tools; and (v) health worker support systems. Table 3.3 shows how these functionalities, in line with the WHO taxonomy, can tackle health challenges and provides specific examples for each category. This section starts by analyzing the effectiveness of digital applications for depression and then presents those for diabetes and cardiovascular diseases.

Table 3.3 | Features of Digital Applications Analyzed

Non-communicable Disease Challenges	Functionality/Feature of Digital Health Application	Examples from the Literature
Self-care and self-management	Targeted client communication	Text messages and apps that provide reminders for appointments and medications; targeted behavior-change messages; educational tools to help patients better understand the importance of treatment plans and medication.
	On-demand information services to clients	Websites, apps, and chatbots providing education and tools for the prevention, treatment, and management of a condition.
	Personal health tracking	Websites or apps that provide tools for self-screening and monitoring (blood pressure, blood glucose, weight, diet, exercise); wearables and connected devices.
Lack of trained human resources in geographic area and equitable access to treatment	Client-to-provider telemedicine	Telehealth for patient check-ups, treatment, and follow-up.
	Health worker decision support	Screening tools for community health workers and primary healthcare providers.

Source: Prepared by the authors.

3.3.1. Depression

In most cases, depression can be effectively treated with psychotherapy and/or medication. Unfortunately, many cases go untreated, partially due to human and financial resource shortages and the stigma associated with seeking treatment. Digital applications can address these challenges by boosting access to psychotherapy through several delivery modes, increasing the productivity of psychologists, and reducing barriers such as distance and stigma for seeking care.

In the last few years, cognitive behavioral therapy (CBT) has been recognized as an effective method to treat a range of mental health conditions, including depression (Butler et al. 2006; Shafran et al. 2009; NICE 2009). CBT is a structured psychological therapy that aims to provide skills to alter unproductive thoughts and modify behavior. In contrast to other types of psychological therapy, CBT focuses on present-day difficulties and develops skills to overcome them through practice. Effects can be seen by taking weekly sessions for as few as 10 weeks (Andersson, Carlbring, and Lindefors 2016). CBT is commonly recommended as a first line of treatment for persons experiencing depression and can be effective without medication in some patients (WHO 2015; Herrman et al. 2022).

CBT has been adapted to multiple delivery modes, including books, websites, apps, and, more recently, chatbots. All of these delivery modes share a similar structure: modules with information on psycho-education and coping strategies, followed by practical exercises to be completed between modules. The most modern versions involve an extensive use of multimedia, are interactive, and allow for tailoring to the specific needs of patients. These digital versions are commonly known as Internet-based cognitive behavioral therapy (iCBT), and multiple alternatives have been developed and tested (Andersson, Wagner, and Cuijpers 2016).[3] iCBT can be self-guided—that is, completed by patients without contact with a psychologist—or guided, where patients have some contact with a psychologist or trained worker who provides encouragement and feedback. Guided iCBT can be completed with less time demands on health workers compared to traditional face-to-face CBT. For example, for a complete guided iCBT treatment over two to three months, a psychologist will need to spend on average between 1.5 and 2 hours (Josephine et al. 2017; Etzelmueller et al. 2020). In contrast, a psychologist should devote at least 6 hours per patient to complete 12 in-person or phone CBT sessions (Castro et al. 2020; Orsolini et al. 2021). Moreover, evidence suggests that for guided iCBT, a trained non-psychologist such as a nurse or social worker can be as effective as a psychologist (Titov et al. 2010). This finding is in line with evidence from the region (Araya et al. 2003) and globally (WHO 2015) showing that even

3 Some examples of iCBT that have been widely tested are Beating the Blues (www.beatingtheblues.co.uk) in the United Kingdom and MoodGym (www.moodgym.com.au) in Australia.

for in-person care, non-psychologist health workers can provide brief psychological treatments for depression.[4]

Evidence is mounting showing that iCBT is effective in both preventing and managing depression (Rauschenberg et al. 2021; Karyotaki et al. 2021). Moreover, in-person, telephone, and guided iCBT have shown similar effectiveness, while unguided iCBT tends to have smaller, though positive effects (Cuijpers 2019). However, self-guided iCBT can be more effective for mild cases, whereas guided iCBT can be more effective in moderate to severe cases of depression (Karyotaki et al. 2021).

Importantly, there are differences in adherence between delivery modes. Van Ballegooijen et al. (2014) report that 26 percent of patients using unguided iCBT complete the treatment compared to 65 percent of patients receiving guided iCBT. In contrast, 85 percent of patients complete telephone CBT, which is comparable to rates for in-person CBT (Richards and Richardson 2012; van Ballegooijen et al. 2014). There is limited evidence on the long-term effects of iCBT, but available evidence shows that effects for guided iCBT appear to last for six months (Bennet et al. 2020; Nair et al. 2018) and for unguided iCBT they can last from three to six months (Bennet et al. 2020; Schouten et al. 2022).

Moreover, evidence shows that psychological sessions (using CBT or other techniques) conducted over the telephone or via teleconference can be as effective as in-person care (Barnett et al. 2021; Orsolini et al. 2021), but at lower cost due to time and transportation savings (Näslund et al. 2020; Guaiana et al. 2021). These results suggest that teletherapy can be used to improve access to populations with limited mobility or in geographical areas with human resource shortages.

Prevention and early detection of depression are crucial to address the burden of this disease. For instance, early detection and treatment of depression might reduce the incidence of future episodes, and treating mild depression might prevent it from progressing into major depression (Herrman et al. 2022). Digital interventions can help not only in the management of depression, but also in its prevention and early detection. For example, webpages can provide access to self-administered assessments to determine risk of depression and referral to different resources such as self-help online tools, education, or professional help, depending on the risk level.[5] Many countries have experience with this approach, especially during the COVID-19 pandemic.[6] The limited

4 Another example, which is currently being rolled out and tested in Pakistan, is the mHealth Alliance Community Health Worker Application (https://rb.gy/ndvrnl), which allows community health workers to screen for depression and anxiety and refer patients to services provided by trained community mental health workers.

5 An interesting example of automated resources for self-care is PAHO's Pahola (www.paho.org/en/alcohol/pahola), a chatbot for alcohol use that can answer questions and provide advice interactively.

6 Some examples from high-income countries include GoodThinking (www.good-thinking.uk) from the United Kingdom and BeyondBlue (www.beyondblue.org.au) in Australia. In the region, there are also some examples such as Saludable Mente (www.gob.cl/saludablemente) in Chile and Salud Mental (www.coronavirus.gob.mx/salud-mental) in Mexico, although these programs have fewer online resources available.

available evidence suggests that these approaches could improve well-being and reduce symptoms of mental illness, at least in the short run (Sin et al. 2020). Finally, there is evidence that several Internet-based and mobile-app-based interventions for the prevention of depression can have small effects on reducing symptoms (Deady et al. 2017; Rauschenberg et al. 2021) and that unguided iCBT can be effective in reducing symptoms of mild depression (Karyotaki et al. 2021).

3.3.2. Diabetes and Cardiovascular Diseases

Addressing the risk factors that cause NCDs could have the largest impact on improving health and reducing health system demands (Savedoff et al. 2021). In fact, 80 percent of cases of diabetes and heart disease could be prevented by lifestyle changes such as increasing physical activity, adopting a healthy diet, and avoiding tobacco (WHO 2005). However, achieving these lifestyle changes is complex and involves interventions at the individual level to promote healthy behaviors complemented with other actions at the societal level, including information campaigns, food labeling, and providing access to spaces for physical activity. Unfortunately, health systems are often ill-equipped to help patients achieve lifestyle changes. In most cases, health workers recommend lifestyle changes and provide educational materials, but patients are expected to achieve them through self-care. Evidence shows that structured lifestyle interventions that support high-risk patients in reducing risk factors can be effective in reducing weight, increasing physical activity, and delaying the onset of conditions such as diabetes (Ali et al. 2017). However, these interventions tend to be costly and hard to scale, as they are intensive in human resources.

An example of a structured and validated lifestyle intervention was the Diabetes Prevention Program in the United States. It targeted populations at risk of developing diabetes and aimed to reduce weight and increase physical activity by providing education, coaching, and support. Enrolled patients received a 16-lesson curriculum covering diet, exercise, and behavior modification tools over six months in individual sessions followed by bi-monthly individual sessions and quarterly group sessions for follow-up and support for about three years. The curriculum and sessions were delivered by a case manager who specialized in nutrition, exercise, and behavior modification. The program was highly successful, as it achieved a reduction in the onset of diabetes of 58 percent and its effects persisted over 10 years (Diabetes Prevention Program Research Group 2002, 2009). Following this seminal work, substantial research has been done to develop adaptations to the program so that it can be less intensive in human resources, less costly, more scalable, and hence more feasible in the context of lower- and middle-income countries.

In recent years, a common approach to adapting structured lifestyle interventions is to shift tasks usually performed by healthcare workers to digital applications. This approach can include providing (i) education via websites, apps, or SMS; (ii) reminders

and motivational messages via SMS or app notifications; (iii) tracking tools for patients to set goals and monitor their progress using websites, apps, wearables, and/or Internet-connected devices such as scales; and (iv) peer-support via websites with forums or apps to connect with other users. These adaptations can save time for health workers and allow them to focus on enrolling, motivating, problem-solving, and/or providing feedback to patients through digital communication channels such as SMS, emails, phone calls, or teleconferencing. This in turn enables the health workers to serve more patients. Note that the digital lifestyle interventions described can be readily applied to reduce risk factors not only for diabetes but also for other NCDs.

Multiple systematic reviews have analyzed the effects of digitally enhanced lifestyle interventions for patients at risk of diabetes and cardiovascular diseases. The evidence shows that they can be effective in reducing weight and glucose levels, as well as in improving diet and physical activity (Barengo et al. 2022; Bian et al. 2017; Duan et al. 2021). In the case of diabetes prevention, digital interventions have smaller though meaningful effects on weight reduction compared to traditional face-to-face interventions (Sun et al. 2017; Bian et al. 2017). Digital interventions for cardiovascular disease prevention can also be effective in reducing weight and addressing other disease risks (Widmer et al. 2015). However, while systematic reviews provide evidence on the effectiveness of digital interventions in preventing diabetes and cardiovascular diseases, there is substantial heterogeneity in the effects of specific digital interventions. Hence, at present there is uncertainty about which digital interventions are more effective. Still, because of the great potential of these interventions, two examples are presented here that illustrate how they can be implemented in low- and middle-income countries.

The first intervention promotes healthy eating and physical activity among pre-diabetic patients by sending SMS for about two years. This intervention has been experimentally evaluated in China, India, and the United Kingdom, with effects ranging from a 5 to 30 percent reduction in the onset of diabetes after two years (Ramachandran et al. 2013; Wong et al. 2013; Nanditha et al. 2020). Due to its low cost and scalability, this intervention has received substantial attention and WHO has included it in a set of recommended mobile-based interventions to tackle diabetes (WHO 2016).

The second intervention also promotes healthy eating and physical activity, but among patients with pre-hypertension by providing monthly motivational calls and weekly personalized text messages for about 12 months. This intervention was experimentally evaluated in Argentina, Guatemala, and Peru and resulted in small reductions in body weight and improvements in diet, but no changes in blood pressure (Rubinstein et al. 2016).

Though there is limited evidence on digital tools for screening of diabetes and cardiovascular diseases, there are some promising interventions. In many health systems, screening capacity is limited by the availability of physicians and nurses. However, this capacity can be increased by shifting this responsibility to community health workers.

In fact, the use of prediction tools, with or without laboratory testing, is a cost-effective strategy for screening high-risk patients for cardiovascular diseases (Gaziano et al. 2017). Guatemalan and Mexican community health workers armed with mobile phone tools have shown prediction accuracy similar to that of physicians or nurses (Gaziano et al. 2015). Moreover, PAHO has recently published a cardiovascular risk calculator app to assess risk and discuss potential actions that patients can take.[7] Additionally, personalized SMS messages have been shown to be effective in increasing screening for diabetes and hypertension among those at risk in Indonesia (Marcus et al. 2021). Text messages have also been successfully used to increase the take-up of other health services such as cervical cancer screening in Uruguay (Cuesta et al. 2021) and vaccinations (Milkman et al. 2022).

For patients who have been diagnosed with diabetes or cardiovascular diseases, the course of action is similar to prevention, as lifestyle changes are recommended to reduce risk factors, disease progression, and risk of complications. In addition, depending on the disease stage, patients will likely need to start medications and regular monitoring to screen and prevent complications. At this stage, patients will require frequent contact with healthcare providers, and ideally they will play an active role in self-management of their condition, which includes maintaining a healthy lifestyle, taking their medication, and monitoring for complications.

Digital interventions that support patient self-management have shown effectiveness in reducing blood glucose levels among diabetic patients and in lowering high blood pressure among patients with hypertension (Liang et al. 2011; McLean et al. 2016). As in the case of prevention, there is wide variability in what these interventions entail, but most try to help patients adhere to their treatment plan by providing digital reminders, education, motivation, or easier self-monitoring. A simple example is providing reminders to take medications through SMS or mobile applications. In fact, reminders have been shown to be effective in increasing adherence to treatment for patients with chronic conditions (Gandhi et al. 2017; Thakkar et al. 2016; Chioma and Musco 2021). This is relevant, as it is estimated that adherence to treatment for chronic conditions is only 50 percent in developing countries, and non-adherence is associated with increased risks of morbidity, mortality, and higher healthcare costs (WHO 2003).

Finally, remote interactions with health personnel through telemedicine are an effective way to manage patients with diabetes and cardiovascular diseases. Evidence shows that telemedicine can be used for regular checkups to reduce the occurrence of complications, reduce blood glucose, and improve treatment outcomes among patients with diabetes, and to communicate, counsel, and conduct remote monitoring for patients with chronic conditions (Battineni et al. 2021; Groot et al. 2021; Totten et al. 2016; Zhu, Gu, and Xu 2020).

7 PAHO's cardiovascular risk calculator app is available at https://www.paho.org/en/hearts-americas/cardiovascular-risk-calculator-app.

3.4. Do the Benefits of Digital Interventions Outweigh the Costs?

The previous section demonstrated that digital interventions can improve the prevention and treatment of depression, diabetes, and cardiovascular diseases. But do the benefits of these interventions outweigh their costs? And how much value can they add to society? To tackle these key questions, this section analyzes the ex ante costs and benefits from society's perspective of two promising interventions: CBT for depression and a digital lifestyle intervention to prevent the onset of diabetes. For each of these cases, the section presents details of a cost-benefit analysis in Peru and explores the robustness of the results by showing summary results for three additional countries: Chile, El Salvador, and Jamaica.

3.4.1. Tackling Depression: The Social Returns of Different Types of Cognitive Behavioral Therapy

One of the main challenges to expanding access to psychotherapy in the region is the limited availability of human resources for mental health. Since this is a key constraint, this section analyzes the costs and benefits of assigning a small number of psychologists to provide three types of CBT: face-to-face, telephone-based, and guided iCBT. Because this exercise maintains a fixed number of psychologists, the time requirements to fully treat a patient in each modality will determine the number of patients who could be treated. In the exercise, it is considered that an equivalent to 2 percent of the available supply of psychologists is devoted to this hypothetical program. In the case of Peru, this is equivalent to 70 psychologists. Notice that using a different number of psychologists in the analysis will not affect the relative comparisons across the three modalities studied, since the main costs are variable. The costs and benefits for each type of CBT are considered relative to a scenario of no treatment, given that most depression cases in the region go untreated.

Table 3.4 summarizes the main results of the cost-benefit analysis. The key parameters and assumptions can be found in Cristia et al. (2022). As mentioned, the analysis estimates the total number of patients treated over one year under the different types of CBT considering the time required by a psychologist to complete a course of treatment and adherence to treatment. Based on the literature, a full treatment of CBT will require at a minimum six psychologist-hours if provided face-to-face or via telephone and two hours if provided through guided iCBT. Regarding attrition, estimates from the literature suggest that 85 percent of patients complete treatment in the case of face-to-face and telephone modality and 65 percent in guided iCBT. Considering this, 70 psychologists will be able to provide a complete treatment to 13,300 patients face-to-face or by telephone and 30,600 patients under the guided iCBT modality in one year.

Why is the number of patients who complete treatment much higher for guided iCBT? This result is due to two opposing effects. First, guided iCBT requires only a third

of a psychologist's time compared to the other two options, and hence it is possible to treat three times more patients under this modality. Second, the share of patients who complete treatment among those who started is 65 percent for guided iCBT compared to 85 percent for the other two options. Because the first effect is much larger, it dominates the second effect and, overall, the number of patients who complete treatment is about 130 percent higher for guided iCBT compared to the other two modalities.

The main costs included in the analysis are implementation and patient costs. Implementation costs include operating costs and therapist time, training, phone calls, licensing for iCBT, and administrative costs. The analysis uses the licensing costs for the Beating the Blues app, which has been included in several of the meta-analyses reviewed. The licensing is based on an annual subscription per psychologist that allows the psychologist to refer an unlimited number of patients to complete iCBT. This type of pricing is relevant for the cost-benefit analysis because it more clearly reflects the marginal cost of adding an additional patient to iCBT once it has been developed. Though Beating the Blues is not currently available in Spanish, it is considered that similar pricing could be obtained for an iCBT if it were to be fully developed for the Latin American and Caribbean context, as long as it has the right scale of patients to treat.

Implementation costs for a full treatment of CBT range from US$137 in the case of telephone CBT to US$42 for guided iCBT. Across all modalities, a therapist's time accounts for more than 90 percent or more of these costs. Patient costs include the value of the time of the patient to complete the treatment (both in terms of therapy and transportation when therapy is in-person), transportation costs to a health facility (only for face-to-face CBT), and Internet costs (only for guided iCBT).[8] Since it is assumed that the government is the implementer, a deadweight loss equivalent to 20 percent of implementation costs is also included to account for distortions created when using public funding (Harberger 1997). These types of costs are included in order to incorporate society's perspective into the analysis.

Benefits include health gains from therapy. Based on the literature, it is considered that the health benefit for completing face-to-face or telephone CBT is 0.192 quality adjusted life years (QALYs),[9] whereas for guided iCBT it is 0.164 QALYs.[10] The monetary

8 The phone calls are included as part of implementation costs rather than patient costs, since this can be covered by the implementer, usually through a toll-free number. In contrast, Internet usage cannot be covered by the implementer and hence is included in patient costs.

9 QALYs are used as a summary measure of health outcomes for economic evaluation that combines effects of health interventions on mortality and morbidity into a simple index and allows for comparisons across different diseases (Whitehead and Ali 2010).

10 No benefits are considered in terms of savings to the health system due to reduced complications given the large share of untreated cases of depression, but if included this would increase the estimated benefits.

Table 3.4 | Cost-Benefit Analysis of Different Policy Options to Provide Cognitive Behavioral Therapy in Peru

	Face-to-Face	Telephone	Guided iCBT
Time requirements (hours)			
Psychologist time per patient	6	6	2
Patient time to complete treatment	6	6	8
Number of patients covered			
Patients starting treatment	15,680	15,680	47,040
Adherence	85%	85%	65%
Patients completing treatment	13,281	13,281	30,623
Benefit per patient who finished treatment (U.S. dollars)	1,302	1,302	1,111
Cost per patient who finished treatment (U.S. dollars)	247.7	179.9	73.1
Implementation cost	122.2	137.0	42.4
Deadweight loss cost	24.4	27.4	8.5
Patient cost	101.0	15.6	22.2
Benefit-cost ratio	**5.3**	**7.2**	**15.3**
Net present value (millions of U.S. dollars)	**15.3**	**16.3**	**38.7**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of three policy options for cognitive behavioral therapy. The target population includes adults with moderate to severe depression without access to mental health services. Results correspond to a one-year implementation. The benefit-cost ratio and the net present value consider the benefits and costs of those who complete treatment and also of those who drop out. It is assumed that dropouts receive benefits proportional to the number of sessions completed. Section 3.4.1 presents the main assumptions included in the analysis. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022). iCBT: Internet-based cognitive behavioral therapy.

value of this health gain is determined based on the country's GDP per capita. Based on these considerations, overall benefits per patient range from as high as US$1,302 for telephone and in-person CBT to US$1,111 in guided iCBT.[11]

Results

Turning to the results of the analysis, first, all modalities provide value to society because their benefits far outweigh the costs. In the case of the face-to-face option, US$5 of benefits are estimated per US$1 invested, and this ratio climbs to US$7 per US$1 for the telephone-based option and to US$15 per US$1 for guided iCBT. Second, of the three

11 The health benefits are calculated by using the relative effect sizes in the meta-analysis by Cuijpers (2019), the monthly QALYs gained with CBT treatment from Wu et al. (2020), and an effect duration of three months. An episode of major depressive disorder lasts on average around six months, so this is a conservative estimate. As a reference, Ross et al. (2019) estimate the QALYs gained from in-person CBT relative to no treatment at 0.715 over one year, which will translate to around 0.18 QALYS in three months. A more detailed discussion of the estimation of health gains can be found in Cristia et al. (2022).

modalities, guided iCBT provides the largest net present value, at US$38.7 million in one year, which is about two times larger than that generated by telephone-based or face-to-face options. The net present value of guided iCBT could be even larger, since there is evidence that a well-trained nurse or community health worker could take the role of the therapist under this modality for a lower cost (Titov et al. 2010). In addition, digital reminders could be added to increase adherence for little additional cost (Furukawa et al. 2021). Finally, while face-to-face CBT provides close to US$15.3 million of net present value, which is substantial, it is the lowest of all alternatives. This highlights the fact that remote versions of CBT, in particular, add value to society by reducing transportation and opportunity costs, and, in the case of iCBT, even increasing the number of patients treated.

The results and main takeaways of the cost-benefit analysis comparing different modalities of care hold when using parameters for different countries in the region, as can be seen in Table 3.5.

The previous section also reviewed unguided iCBT, a type of therapy that does not require any therapist time. This modality has great scaling potential because the

Table 3.5 | Cost-Benefit Analysis of Different Policy Options to Provide Cognitive Behavioral Therapy in Selected Countries

	Face-to-Face	Telephone	Guided iCBT
Number of psychologists			
Peru	70	70	70
Chile	41	41	41
El Salvador	3	3	3
Jamaica	1	1	1
Benefit-cost ratio			
Peru	5.3	7.2	15.3
Chile	8.0	10.8	20.0
El Salvador	3.8	3.9	9.1
Jamaica	5.5	7.7	16.4
Net present value (millions of U.S. dollars)			
Peru	15.3	16.3	38.7
Chile	25.2	26.1	60.2
El Salvador	0.4	0.4	1.0
Jamaica	0.2	0.2	0.5

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of three policy options for cognitive behavioral therapy. The target population includes adults with moderate to severe depression without access to mental health services. Results correspond to a one-year implementation. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022). iCBT: Internet-based cognitive behavioral therapy.

main limiting factor, the availability of therapists, becomes irrelevant. However, it faces two critical constraints. First, adherence to treatment under this modality tends to be much lower compared to other modalities that do require therapist time. For example, the share of patients who finish treatment has been estimated at 26 percent for unguided iCBT compared to 65 percent for guided CBT. Second, it is critical to determine strategies to promote take-up of the unguided iCBT modality. At this point, there is substantial uncertainty regarding how many individuals would use this option even if provided for free on a website or app. Still, considering the potential of unguided iCBT to provide therapy to anyone with access to technological resources, it would seem worthwhile for governments in the region to explore this option and experiment with different strategies to promote take-up.

A key consideration that is not captured by the cost-benefit analysis is who benefits from the different types of CBT. For iCBT, patients need to have Internet, a smartphone or computer, and some basic digital literacy. A few workarounds could be undertaken to foster more equitable access. For instance, agreements with telecommunications companies could allow for low/no-cost Internet to use iCBT. Also, for little additional cost, technical workers could be available to help set up the program for those who have difficulties. Still, probably the biggest constraint is Internet coverage to reach a wider set of people, particularly in lower-income countries. For populations living in areas with no Internet coverage, telephone CBT could be a viable alternative despite having larger costs than guided iCBT.

In sum, for equity considerations, a health system would have to incorporate a mix of delivery systems to reach the most people in need of care. In fact, a health system might use different types of CBT as part of a stepped care model. Such a care model implies that patients start receiving simpler and less costly forms of treatment, and then those who might not respond to treatment can gradually receive more complex care. For example, a website open to the public could provide self-assessments for depression and, based on the results, refer individuals to the appropriate form of CBT. Patients with mild symptoms could be referred to an unguided iCBT modality. If they do not respond to treatment, and for cases of moderate to severe depression, they could be referred to guided iCBT. Finally, those who have no symptom changes could be referred to telephone-based or in-person CBT. There is evidence that this type of stepped care model can be effective and reduce overall costs (Mohr et al. 2019). In short, a stepped care model could expand the reach of mental health services and reserve limited resources for those who need care the most.

These results make a strong case for iCBT in Latin America and the Caribbean. However, most of the evidence is from high-income countries, and while multiple iCBT options exist, to our knowledge no iCBT alternative has been tested in the region. Therefore, developing and testing a digital public good that supports an iCBT

intervention contextualized to the region seems like a high-return investment option. While fully developing iCBT for the region could be costly, it is likely to be cost-effective if implemented at the right scale, given the large unmet demand for depression care in the region.

3.4.2 Tackling Diabetes: Social Returns of Lifestyle Interventions Based on Text Messages

As mentioned in the previous section, there are digital interventions that have shown effectiveness in the prevention and management of diabetes, but there is considerable heterogeneity in terms of their components and effects. This section illustrates the potential social returns of digital interventions for this condition by focusing on an intervention that sends messages to promote healthy eating and physical activity to pre-diabetic patients. These patients would experience substantial health benefits if they were to adopt lifestyle changes that would reduce the probability of progressing to diabetes. Moreover, because the program only uses SMS, it is inexpensive and easy to implement and scale up, particularly because cell phone coverage is wider than Internet coverage in Latin America and the Caribbean. Finally, there is evidence from different contexts showing that the program induces a reduction in the onset of diabetes of between 5 and 30 percent after two years (Ramachandran et al. 2013; Wong et al. 2013; Nanditha et al. 2020).

The analysis estimates the social returns of implementing this intervention as an add-on service to patients who have been identified as pre-diabetic by the public health system in four selected countries in the region. Hence, this analysis is based on the current capacity of the health system to identify pre-diabetic patients. It then assigns them to receive around 18 SMS tailored messages every month for two years, which is the average dose and duration of the intervention.[12] For this analysis, the target population includes persons 20 to 79 years old who use public health services, are detected as pre-diabetic, and have access to a mobile phone. In the case of Peru, this amounts to a pool of about 115,000 persons.[13] Given the large range in effects of the intervention in the literature, a weighted average of the effects was used for the present analysis, that is, a 10.8 percent reduction in the onset of diabetes after two

12 See Ramachandran et al. (2013) for some examples of messages and the theoretical framework behind their development.

13 This is estimated considering a prevalence of pre-diabetes (impaired fasting glucose) of 13 percent (IDF 2021), an assumption that the detection rate in the public health system of pre-diabetic patients of 7.5 percent, which is about half that in the United States (CDC 2020), a share of persons using public health services of 78 percent (World Bank and WHO 2022), mobile phone coverage of 67 percent (Sharma and Lucini 2016), and a total population ages 20 to 79 years old of 22 million (World Bank and WHO 2022).

years of intervention.[14] In addition, to account for uncertainty in the take-up of the intervention, four different levels of take-up are considered: 5, 25, 50, and 75 percent of the targeted population.

Results

Table 3.6 presents the main results of the cost-benefit analysis for Peru under these scenarios. Again, both implementation and patient costs are considered. Implementation costs include content creation (the development and adaptation of messages), SMS, nurse time to provide a brief orientation to patients, training for nurses, and administrative costs. Implementation costs per patient vary from US$35.30 to US$7.60, depending on the number of enrolled patients, since there are two main fixed costs, content creation and training. Training costs per patient are somewhat large (between US$1.40 and US$20.60) and constitute a large share of implementation costs (between 18 and 58 percent) because they include training one nurse in each of the country's 8,148 public primary care centers.[15] The main driver of this cost is nurse wages for participating in the two-hour training. However, having this intervention in all primary care centers is key to promoting the intervention to pre-diabetic patients once detected. The cost of sending and managing the SMS messages is only around US$3.80 regardless of the take-up scenario. As in the previous example, a deadweight loss equivalent to 20 percent of implementation costs is included to account for distortions created when using public funding (Harberger 1997). It is estimated that patient costs, which reflect the time patients need to sign up for the program and read the messages, are only US$2.30.

Regarding benefits, the analysis considers health gains from the reduction in the onset of diabetes, as well as healthcare savings from fewer diabetic patients requiring care from the health system.[16] Considering both, benefits of around US$204 per enrolled patient are estimated. Overall, a net present value of between US$900,000 and US$17 million, and a benefit-cost ratio ranging from 4.6 to 17.9, are estimated for Peru, depending on the level of take-up. Results show that this intervention can provide value to society, but the value increases with the scale of enrolled patients because the program has some fixed costs. Results are similar across countries (Table 3.7), but, as

14 Drawing from Ramachandran et al. (2013), Wong et al. (2013), and Nanditha et al. (2020), the analysis used a weighted average by sample size to estimate the effects on diabetes onset.

15 The variation in per capita training costs stems from the fact that these are fixed costs. Hence, as the number of patients who receive this service increases, the per capita costs decrease.

16 Health gains are obtained based on 0.071 QALYs gained from the delay in the onset of diabetes from Wong et al. (2013), which valued at the GDP per capita of Peru, translate to around US$481. The health system savings were obtained based on the average cost of treatment of a diabetic patient in Peru from IDF (2021), which are US$1,395. Both benefits are for patients who did not transition to diabetes due to the program, who account for 10.8 percent of enrollees based on the weighted average of effects. Total benefits are estimated and then divided by the number of enrolled patients to obtain the benefit per patient in Table 3.6.

Table 3.6 | Cost-Benefit Analysis of an SMS Intervention for Prediabetic Patients in Peru

	Share of Patients Who Participated in the Intervention			
	5%	25%	50%	75%
Number of patients covered	5,763	28,814	57,627	86,441
Benefit per patient (U.S. dollars)	203.9	203.9	203.9	203.9
Cost per patient (U.S. dollars)	44.6	16.1	12.6	11.4
Implementation costs	35.3	11.5	8.6	7.6
SMS	3.8	3.8	3.8	3.8
Content creation	5.2	1.0	0.5	0.4
Nurse orientation to patients	1.0	1.0	1.0	1.0
Nurse training	20.6	4.1	2.1	1.4
Administrative costs	4.6	1.5	1.1	1.0
Deadweight loss	7.1	2.3	1.7	1.5
Patient cost	2.3	2.3	2.3	2.3
Benefit-cost ratio	**4.6**	**12.6**	**16.2**	**17.9**
Net present value (millions of U.S. dollars)	**0.9**	**5.4**	**11.0**	**16.6**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of four take-up scenarios of a program that sends messages to promote healthy eating and physical activity. The target population includes people 20 to 79 years old who use public health services, are detected as prediabetic, and have access to a mobile phone. Results correspond to a two-year implementation. Section 3.4.2 presents the main assumptions included in the analysis. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022).

expected, the net present value is higher for countries with more larger populations such as Chile and Peru.

This cost-benefit analysis illustrates that digital health interventions can generate gains at low cost, bringing benefits to society such as improved population health and increased savings to the health system. This type of intervention could complement existing public health and society-level interventions in a country by providing timely and tailored messages to those at higher risk of developing chronic conditions. For these types of interventions, the content of the messages is critical. This could be easily overlooked in a digital intervention, but it is central to its effectiveness. Since developing high-quality content is a fixed cost and affects the intervention's impact, it makes sense to devote resources to this component.

Finally, there could be equity concerns for these types of interventions because they only benefit those with pre-diabetes who have a mobile phone and basic reading skills. To address equity, people without mobile phones would have to be reached by other means, such as household visits from community health workers. More generally, SMS-type interventions could be complemented with more intensive campaigns targeted at low-income groups so that the benefits are shared widely and, ideally, concentrated among disadvantaged populations. Related to this, it is also possible that by using

Table 3.7 | Cost-Benefit Analysis of an SMS Intervention for Prediabetic Patients in Selected Countries

	Peru	Chile	El Salvador	Jamaica
5 percent take-up				
Number of patients covered	5,763	5,633	1,149	403
Benefit-cost ratio	4.6	7.5	1.8	1.0
Net present value (millions of U.S. dollars)	0.9	1.5	0.1	<0.1
25 percent take-up				
Number of patients covered	28,814	28,167	5,746	2,017
Benefit-cost ratio	12.6	15.9	6.4	4.2
Net present value (millions of U.S. dollars)	5.4	8.1	0.7	0.2
50 percent take-up				
Number of patients covered	57,627	56,333	11,492	4,033
Benefit-cost ratio	16.2	18.5	9.3	6.8
Net present value (millions of U.S. dollars)	11.0	16.4	1.6	0.5
75 percent take-up				
Number of patients covered	86,441	84,500	17,237	6,050
Benefit-cost ratio	17.9	19.6	10.9	8.6
Net present value (millions of U.S. dollars)	16.6	24.7	2.4	0.8

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of four take-up scenarios of a program that sends messages to promote healthy eating and physical activity. The target population includes people 20 to 79 years old who use public health services, are detected as prediabetic, and have access to a mobile phone. Results correspond to a two-year implementation. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Note that the net present value for Jamaica when the take-up rate is 5 percent is US$2,000. Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022).

this cost-effective approach for one group of people, the health system could liberate resources and devote them strategically to increase health equity.

Finally, while this cost-benefit analysis focuses on diabetes prevention, there are multiple commonalities in addressing the risk factors underlying other NCDs in the region, and similar interventions could be adapted for this purpose. Given the low cost and wide coverage of cell phones in the region, there is a great opportunity to explore this and other types of digital interventions as a complement to existing types of care, which today are still largely underutilized.

3.5 Reducing the Burden of Non-communicable Diseases Using Digitalization: Findings and Recommendations

It is clear that technology is opening up excellent opportunities to tackle critical health challenges in a cost-effective and scalable way. This is an important message for Latin American and Caribbean countries that are looking for strategies to strengthen health

systems in the wake of the COVID-19 pandemic in a tight fiscal environment. At the same time, systems and citizens face a growing burden of non-communicable diseases and mental health disorders. Are there digital health investments that governments can make today to both curb this growing burden and start countries on the path of sustainable digital transformation?

Based on a review of the evidence and an analysis of the potential social returns of specific interventions, this chapter has examined how digital interventions can be implemented to prevent and treat depression, diabetes, and cardiovascular diseases in the region.

Six conclusions emerge from the analysis that are critical for Latin American and Caribbean health systems going forward.

First, digital task-shifting is a key intervention to augment the productivity of health workers. Task-shifting has been shown to be effective in scaling access to healthcare, and the use of digital tools may continue to augment the abilities of front-line health workers and increase access to specialized care. Guided iCBT can greatly expand access to cognitive behavioral therapy, a highly effective treatment for depression and other mental health ailments, even in settings with a limited supply of specialists. Results from the literature review also demonstrate that digital applications could augment the abilities of community health workers to screen for cardiovascular diseases. Integration of these types of digital interventions into primary healthcare platforms and integrated chronic care models can improve access, quality, and efficiency.

Second, digital applications can help tackle non-communicable diseases and mental health issues. Given the burden of NCDs in Latin America and the Caribbean, countries should consider prioritizing their investments in digital health to tackle these diseases. NCDs represent a growing epidemiologic and economic burden, but they can be detected and prevented from progressing with low-cost digital interventions. There is a large body of evidence showing that rapid, vertical interventions can improve health outcomes related to these conditions. Adding simple, evidence-based interventions to existing health platforms may significantly improve the scope and effectiveness of treatment, even if only a small percentage of the population is intervened. Targeted patient communication using demand-side nudges has demonstrated important results in terms of prevention, screening, and management. Digital applications can provide valuable tools for patient self-care to address risk factors for multiple chronic conditions and increase physical activity, lower weight, and improve diet. More importantly, digital tools for prevention and management of diabetes and cardiovascular diseases that focus on managing risk factors such as weight and physical activity can be adapted for other conditions for which addressing these risk factors is essential to achieve health benefits. Given that some of these digital applications are low-cost and can reach a high scale, they have the potential to influence population health, even if the effects

are small. To reap the most benefits, however, these interventions should be designed and adapted, putting patients and their needs at the center.

Third, it is critical to deliberately invest in digital applications with an eye on equity and inclusion. Digital applications can help provide more equitable access to health services if intentionally built to do so. Remote types of care such as telemedicine, telephone-therapy, and iCBT can increase access to health services for populations living in areas with no specialists, with limited mobility, or where stigma can hinder access to seeking care. Access to these different types of care could be prioritized to improve equity. For example, iCBT could be used for populations in areas with good Internet coverage in order to free up resources to provide telephone-based therapy in areas with no Internet coverage or in-person care availability. Use of SMS may be more universally available, and human-based interventions can be used to complement care where service is unavailable. Using technology to free up resources to intentionally provide care in hard-to-reach areas could improve equity. It is critical to consider who benefits from digital applications and how different modalities of care can be combined to improve equity.

Fourth, it is essential to build strong digital foundations. Regardless of which digital intervention is selected, going to scale will force countries to reflect on the digital foundation underlying those interventions. For example, scaling up CBT through teletherapy may require changes to existing national norms. In fact, only 13 of the 26 IDB member countries currently have national norms that authorize telemedicine (Bagolle et al. 2022). Additionally, deploying iCBT may require countries to review how they regulate digital therapeutics or software as a medical device to ensure patient safety and effectiveness. In addition to knowing how to use digital applications, health providers may also need to build capacity in other areas, such as how to provide empathy through a screen. Issues of cybersecurity, privacy, and connectivity are not minor, even for the vertical interventions reviewed as part of this chapter. Having a holistic and integrated approach to vertical interventions, such as following the "Principles for Digital Development," may provide higher returns on investment and lay the groundwork for a digital ecosystem where multiple digital applications can be deployed, reducing inefficiencies and unnecessary duplication.[17] Finally, additional value may be harnessed from vertical interventions by pairing them with horizontal interventions such as electronically prescribing treatment for patients in teletherapy, allowing them to access their treatment at a nearby pharmacy or online, and instituting priority scheduling of primary care visits for persons screened for hypertension based on their risk score.

Fifth, countries and other actors need to invest in research and development for the provision of digital public goods. Throughout this chapter, evidence has been presented

17 See the Principles for Digital Development at www.digitalprinciples.org.

on digital applications that could provide value in the fight against NCDs and mental health disorders. Given that most of the evidence comes from high-income countries, there is a need to design, adapt, test, and implement digital applications for the Latin American context. This should include strategies to improve take-up of digital applications among different populations, as this is critical to obtain the most societal value from them. This process is necessary to develop solutions that are ready to deploy and scale. For example, while multiple iCBT alternatives exist for high-income countries, there is a need to adapt or develop and test an alternative for the Latin American context. The findings and products from this adaptation process can be geared toward the creation of digital public goods for Latin America and the Caribbean that reduce the fixed costs of development in multiple contexts. Having a set of certified and validated digital public goods for the use cases highlighted in this chapter for the region could jump-start their implementation.[18] International organizations such as the IDB can take the lead in developing and evaluating digital public goods in this area in Latin America and the Caribbean.

Finally, it must be kept in mind that there are no silver bullets to solve the challenges presented in this chapter. Addressing NCDs and mental health disorders requires action on multiple fronts, including public health campaigns, taxes on unhealthy foods, strengthening primary care, integration between networks of care, and continuous improvement in the quality of services grounded in best clinical practice. In other words, multi-faceted and integrated care is and will remain essential to address current challenges in the region. While the digital applications highlighted here can expand worker productivity, address risk factors, improve access to services, and empower self-care among patients, none is a silver bullet that is going to solve the multiple health challenges faced by Latin America and the Caribbean overnight.

18 The Digital Public Goods Alliance (2022), a multi-stakeholder initiative promoted by multiple international organizations and development agencies, provides standards on what a digital public good entails.

4

Digitalization Is Just the Beginning: Maximizing the Potential of Online Transactional Services

Paula Algarra | Benjamin Roseth | Julieth Santamaria | Razvan Vlaicu

Transactional public services permeate nearly every aspect of life. From birth to school, work, retirement and death, transactional services are what allow citizens and businesses to connect with government institutions to obtain benefits and permits, and to fulfill obligations. They also enable governments to ensure a lawful distribution of services and regulatory compliance. In Latin America and the Caribbean alone, central governments manage up to 5,000 different transactional services and conduct between 5 and 20 such services per person every year (Roseth, Reyes, and Santiso 2018).

Despite their essential function, transactional services in Latin America and the Caribbean are often difficult. On average, they require 5.5 hours of active time for citizens, ranging from 2 hours in Chile to 11 hours in Bolivia (Roseth, Reyes, and Santiso 2018). Furthermore, half of all transactions require two trips or more to government offices and a quarter of them require three or more trips. They are also a focal point for corruption: a third of Latin Americans paid a bribe to access a transactional public service in 2017 (Transparency International 2017). Moreover, a 2016 survey of firms in Mexico found that "speeding up transactions" was the prime motive for bribery (INEGI 2016).

Transactional burdens can mean more than just headaches. They can constitute barriers to access to services: complex bureaucratic procedures lead to suppressed uptake of social programs (Linos et al. 2021). They can also reduce revenues, as the complexity of tax transactions is correlated with tax evasion (Cox and Eger 2006; Pau, Sawyer, and Maples 2007; Richardson 2006; Saad 2014). Transactional burdens can exacerbate informality, as regulatory barriers suppress business formalization rates (Djankov 2009). Finally, they can result in excess expenditure: for example, the

government of Mexico spent the equivalent of 25 percent of the national education budget on the delivery of transactional services in 2017, US$9 for each service (Roseth, Reyes, and Santiso 2018).

Digitalization can help alleviate these transactional burdens. On average, digital public services are 74 percent faster than their in-person equivalents, and they are 95 percent cheaper for public institutions to deliver (Roseth, Reyes, and Santiso 2018). They are less prone to corruption, as they automate decision-making and reduce or eliminate interactions between citizens and public servants (Banerjee et al. 2020). Digital public services can facilitate the uptake of critical public services by proactively inviting citizens to access them and offering simplified application procedures (Cuesta et al. 2021).

Digitalization became more relevant than ever during the COVID-19 pandemic, offering citizens a means to access the services they needed—and public servants to deliver them—without putting their health at risk. In Jamaica, for example, the Electronic Business Registration Form was used to create 800 businesses in 2020, compared to 10 created in 2019 (Roseth, Reyes, and Yee Amézaga 2021).

The countries of Latin America and the Caribbean are lagging behind countries worldwide in the provision of digital transactional services. On the United Nation's Online Service Index, only Brazil, Argentina, and Chile are among the top 30 countries in the world. These lags were laid bare during the pandemic. In April-July 2020, when strict lockdowns were imposed in nearly every country, and prior to the availability of vaccines, 50 percent of Latin Americans who accessed transactional public services did so in person (Roseth, Reyes, and Yee Amézaga 2021). However, due to widespread office closures and the lack of digital services, 20 percent of Latin Americans were unable to access a service they required. Furthermore, those citizens who were able to access services online frequently had poor experiences. More than half of the users of digital public services reported that completing their transaction online was difficult, and 27 percent of them stated that they would never use digital public services again. This poor experience with many digital transactions affected users unequally: older and less-educated users systematically reported more frustration than those younger and more educated.

Why is Latin America and the Caribbean behind in providing digital public services? The explanation encompasses both demand and supply. On the demand side, a number of shortfalls impede citizens from accessing digital transactions. This includes incomplete Internet access: 35 percent of Latin American and Caribbean adults are not Internet users.[1] There are also gaps in financial inclusion, which is an important barrier

1 According to the International Telecommunications Union. The percentage is a simple average of data from 2019 or 2020 for the 12 countries with data available for one of those two years: Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Mexico, Panama, Peru, and Uruguay. See https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx (accessed on June 30, 2022).

considering that many transactions require making payments online. In fact, as of 2017, only 30 percent of adults in the region had a credit card and only 12 percent had a debit card.[2] Additionally, there are low levels of digital skills (Roseth, Reyes, and Santiso 2018; Linos et al. 202l; Roseth, Reyes, and Lafuente 2021). Finally, endemic low levels of trust in Latin America and the Caribbean impede the adoption of digital services, even for citizens who have the requisite Internet access and digital skills, as many are dubious about the protection of their personal data online (Porrua and Roseth 2022).

Similarly, there are multiple challenges facing governments—the supply side—in the provision of digital transactions. To start, most Latin American and Caribbean governments have insufficiently resourced digital government agencies faced with meeting broad mandates with small teams (Roseth, Reyes, and Lafuente 2021). In addition, digital talent gaps are extreme throughout Latin American and Caribbean governments, and they are not limited only to digital agencies: 40 percent of more than 700 Latin American public managers surveyed in 2019 reported severe deficits of computer programming skills among their team members. Furthermore, nearly two-thirds of Latin American and Caribbean digital government agencies reported that budget shortfalls impede them from hiring the staff they need. This shortage of skills partially explains the lack of many of the digital government building blocks that are essential to create digital transactions. As of 2017, 10 of 25 Latin American and Caribbean governments did not have a complete catalog of all transactional services; 13 did not have an interoperability platform; and 19 did not have a digital identification system. As of 2021, 22 did not have a national entity responsible for cybersecurity management (IDB and OAS 2020).

The underinvestment in developing digital skills and foundational systems points to a broader issue in the region: a lack of prioritization. Why have governments not prioritized digitalization of their transactional services? Beyond political economy dynamics—that is, the ongoing power struggle between different interest groups vying to influence policy—another, more technocratic, answer pertains to return on investment. In an atmosphere of fiscal limitations, exacerbated by elevated social spending necessitated by the pandemic, it is easy to discard potential expenditures that do not have a clear fiscal or economic return. Given that the digitalization of government transactions is a relatively new endeavor, it is understandable that policymakers would approach budget requests for digitalization projects with skepticism.

Against this backdrop, this chapter analyzes how digitalization can improve the efficiency of governments in providing transactional services. It presents a literature review and a set of cost-benefit analyses that show cases where digitalization has

2 According to the World Bank. The percentages are a simple average of data from 2017 for the 17 countries with data available: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Haiti, Mexico, Nicaragua, Panama, Peru, Paraguay, El Salvador, and Venezuela. See https://databank.worldbank.org/source/global-financial-inclusion (accessed on June 30, 2022).

worked well and cases where it has not. Based on this analysis, policy recommendations are presented to provide guidance to governments seeking to take advantage of the possibilities opened up by digitalization to improve transactional public services. The central message is that the digitalization of government transactions can be an economically "profitable" endeavor—given certain conditions—with moderate initial investments, low marginal costs, and positive returns that grow proportional to take-up. As such, the main recommendation emerging from this initial analysis is to focus on usability and outreach to maximize take-up of digital transactions.

4.1. How Digital Tools Can Enhance Government Services

The digital transformation of government services promises, among other things, to reduce the costs faced by citizens and businesses when performing transactions. Each transaction requires several steps, so this cost reduction can be achieved through the implementation of different digital tools at each step of the process. The remainder of this section presents a broad summary of the steps required by citizens to complete transactions and how the use of technology has (or has not) improved the delivery of citizen services.

4.1.1. Improving Awareness of Service Deadlines

The first step in any government transaction, as obvious as this may sound, is for citizens to be aware that the service exists and that it needs to be completed. Often, government transactions are tied to specific deadlines or time frames, making it especially important that citizens become aware of their responsibility to complete them in a timely manner. Failure to complete certain government transactions on time can result in fines or loss of access to services and benefits, among other consequences. This is where technology comes into play. Notifications via text messages, WhatsApp messages, emails, phone calls, and advertising on social media are the most frequent uses of technology to improve this aspect of service delivery.

The literature that evaluates the benefits of sending notifications has cited text messaging as particularly important. Whether to remind citizens to complete a government transaction, notify them that a new service is available, or make them aware of the steps to carry out the transaction, text messaging is one of the least expensive notification tools to implement. This is not only because the cost of each text message is low, but also because there are low administrative costs associated with the rollout of this type of intervention. This notification mechanism has been used in various sectors, including health, education, social protection, and, of course, for a broad range of citizen transactions.

In the justice sector, where deadlines have severe implications for citizens, different notification mechanisms have been implemented with some positive effects. For example, Hastings et al. (2021) conducted a study in Arkansas in the United States in which they sent reminders one or three days before citizens under community supervision had to attend appointments with probation or parole officers. They found the highest impact in the intervention group that received a reminder one day before the appointment. That group showed a decrease of 29 percent in missed appointments and 21 percent in cancellations, compared to the control group. On the other hand, Cumberbatch and Barnes (2018) conducted an experiment in Staffordshire in the United Kingdom in which they sent text messages to victims and witnesses in minor criminal cases two to three days before appearing in court. They found that this intervention did not change the no-show rate, suggesting that personalized SMS did not alter the decision of people who do not want to attend in the first place, although the authors did not specify the mechanism behind this finding.

Another way to remind individuals about pending transactions or appointments involves making phone calls, which are more costly than reminders but can potentially generate larger effects. For example, Ferri (2020) studied the case of New York City, where individuals convicted of a misdemeanor or a crime of lesser severity, after arrest, can leave the precinct on the condition that they appear days or weeks later before a judge (for an arraignment). In this experiment, reminder calls were made one to three days before the day of the appearance. The study found that the reminders reduced no-shows by 37 percent. Interestingly, this study found that the interventions may have benefited the vulnerable population the most, as the reduction in no-show rates was larger among people of color. The reduction was also larger among people with longer periods between arrest and arraignment.

Reminders have also been used in many other sectors where governments provide services. For example, Cuesta et al. (2021) used SMS to remind low-income women from Uruguay of the importance of having a Pap smear and found positive effects. Dale and Strauss (2009) also found positive effects when SMS were used to encourage voter turnout in the 2006 election in the United States. Blanco and Vargas (2013) found that such reminders also help increase the take-up of social benefits among the displaced population in Colombia.

4.1.2. Facilitating the Authentication of Transactions

Government transactions require supporting documentation, or at the very least, a form of identification to authenticate the person who is doing the transaction. That in itself remains a major problem in some countries in Latin America and the Caribbean. For example, Paraguay and Bolivia are among the countries with the largest shares of unregistered populations in the region (20 and 19 percent, respectively) and

therefore possibly the largest shares of their population without a form of identification. In 10 of 25 countries in the region, more than 10 percent of the population is unregistered.[3] Barriers such as geographic location and transportation costs to get to the registration office may be among the factors that explain these large numbers of unregistered people.

Identification cards are necessary to conduct essential transactions such as opening a bank account, applying for government benefits, or voting. However, they are costly to obtain. Currently, in most Latin American and Caribbean countries, applying for or renewing an ID card requires making a trip to a government office. The procedure is often time-consuming. Roseth, Reyes, and Santiso (2018) report that the time needed to complete an ID-related transaction in person ranges from 1.5 hours (in Chile) to 7.1 hours (in Bolivia). There is also suggestive evidence in the literature about how these long waiting times may provide opportunities for corrupt government employees to extract bribes in exchange for performing the service faster (Chong, Velasquez, and Yañez-Pagans, forthcoming).

Digital tools have the potential to cut transaction costs and reduce undue human discretion. Biometric authentication, which involves the use of physical characteristics such as fingerprints or iris scans, promises to bring about abrupt changes in the way governments identify citizens. For citizens, these authentication systems reduce waiting times at government offices, decrease the number of documents required to process a transaction, and increase trust in the government because of the transparency and accountability of the systems. In their most sophisticated form, through digital identification, these systems can even eliminate the need to go to a government office. From the government's perspective, biometric authentication produces savings by eliminating ghost beneficiaries and generating greater accountability for officials involved in service delivery, especially for aid disbursement programs. Muralidharan, Niehaus, and Sukhtankar (2016, 2020) examined an application of the use of biometric authentication to access social programs and found evidence that supports these benefits. Those studies will be described in detail in the cost-benefit analysis.

4.1.3. Increasing Take-up and Completion of Transactions

Once citizens are aware of the need to conduct certain transactions and have the documentation necessary to do so, then the actual transaction has to be completed. Governments in the region are advancing towards completing the digitalization of transactions, but more work is needed. Digitalization implies not only offering parts or all of the service online, but also integration between administrations, simplification of the

3 See the World Bank ID4D dataset (https://id4d.worldbank.org/global-dataset).

steps and language of the transaction, and better technological infrastructure, among other elements. The more elements that are part of the digitalization, the greater the potential to provide better services. For this reason, and as the studies summarized below will show, not all digitalization efforts will produce the desired effects. The level of effectiveness almost always depends on a mix of elements that leads to more or less advanced digitalization of government services.

Chong, Velasquez, and Yañez-Pagans (forthcoming) report evidence of the benefits of digitalization based on an impact evaluation of computerized renewal of ID cards in Bolivia in 2009. Traditionally, the renewal process was carried out manually by police officers who had to assemble registration files from archive offices in order to complete the transaction. In addition to the transaction being time-consuming, the authors report that the difficulty of finding the physical files encouraged corruption. After this transaction process was computerized, the study found that applicants randomly assigned to a digital renewal process were 23 percentage points more likely to complete the transaction, on average, than those randomly assigned to the manual process. The time of completion, conditional on successful completion, was 40 percent faster for the digital group of applicants compared to the manual group. The digital renewal process also reduced or even closed gaps in completion for disadvantaged applicants from rural areas, indigenous people, or persons with lower education or socioeconomic status. Based on survey data from the applicants, there is also evidence that the digital tools reduced petty corruption by police officers, who had previously found it easier to target the aforementioned more vulnerable applicants.

Land registration is another area where there is documented evidence of the benefits of digitalization. Beg (2021) studies a reform in Pakistan during 2011–2015 where the government computerized and centralized rural land records, replacing a manual, decentralized land records system that created tenure insecurity. The author found that the improved reliability and verifiability of ownership and tenancy rights through better record-keeping and fewer opportunities for bureaucratic corruption stimulated land market transactions. Though the study found no change in land sales or purchases, there was an increase in rental market transactions and in the scale of farms, particularly for highly productive farmers, indicating an improved allocation of resources. Deininger and Goyal (2012) studied a similar intervention during 1999–2005 in the Indian state of Andhra Pradesh. They found that the digitalization of land registration increased access to credit and the number of registered mortgages, indicating an expansion of credit to new borrowers. The changes primarily benefited urban areas, as rural areas maintained alternative land records at the village level. The effects are explained by the lower cost of updating registry information and the easier access to property information by third parties such as mortgage lenders.

Digitalization has also reached business registration transactions. The evidence suggests that making this service available online can be an effective way for developing countries to bring firms into the formal sector. Klapper, Miller, and Hess (2019), for example, find that after Guatemala introduced electronic business registration in 1999, the number of registrations jumped by 40 percent. After the Dominican Republic introduced a digital one-stop shop for firm registration, the registration rate climbed to 33 percent in 2018 from 5 percent in 2014. This is significant for a country where only 10.2 percent of micro-firms are formal and 65 percent of employees are informal. Preliminary evidence shows that the lower registration costs are associated with higher registration rates among micro-firms (Bobic et al. 2022). Bruhn et al. (2018) report that in Serbia, the number of new businesses increased by up to 34 percent following the introduction of online business registration in 2005. The online option reduced the cost and the regulatory burden on firms and improved the business environment. It is worth noting that in the case of Serbia, registration rules were made more flexible and minimum capital requirements were lowered. Importantly, registration decisions were transferred from the judiciary, which suffered from a low level of trust with the business community, to a new administrative agency. These factors illustrate the key role of the institutional environment in driving the benefits of digitalization: digital tools work better when regulations are well-designed, and when the institutions involved are trusted by the public.

4.2. The Costs and Benefits of Selected Digitalized Services

This section assesses the costs and benefits of two interventions that involve the use of technological tools to improve one or more steps of government transactions. The first involves sending citizens text messages and making available an online platform to renew ID cards, and the second involves implementing a biometric verification system for the payment of subsidies. These interventions were selected based on two criteria: (i) the benefits of the interventions were evaluated using a causal inference methodology and shown evidence of effectiveness, and (ii) the interventions could be replicated in other contexts, that is, the technological infrastructure required is available in most countries.

The analysis looks at the costs and benefits of these interventions for both citizens and governments in order to assess the returns from a societal perspective. Toward this end, the costs and benefits associated strictly with the interventions are taken into account; in other words, the analysis computes values comparing a scenario with the intervention and a scenario under the status quo. As in other chapters, estimates are presented for the case of Peru and include a robustness analysis for three additional countries (Chile, El Salvador, and Jamaica). The analysis is centered on two metrics that are standard in project evaluation: (i) benefits per each dollar invested (benefits divided

by costs); and (ii) net present value (benefits minus costs). The time period analyzed is one year. This is a conservative parameter, as the digitalization of government transactions typically entails significant fixed costs and low marginal costs, meaning that benefit-cost ratios are generally less favorable in the first year compared to later years.

It is important to note that in estimating these indicators, the analysis considered the most important costs and benefits that can be monetized. However, certain benefits are difficult to monetize, even though they are also decisive to drive government digital transformation projects. These include the democratization of access to government services, an increase in citizen satisfaction, and increased transparency. It is also assumed here that the implementation of these interventions does not imply changes in the underlying technological structure or human talent of the public institution. Therefore, numbers reported in this section should be interpreted with caution because they are only indicative of the potential return on investment, and are not definitive estimates. The final goal of this analysis is to illustrate how cost-benefit analysis can be used to assess potential social returns and as a basis to prioritize digitalization projects.

4.2.1 Promoting Identification Card Renewals through Text Messages and Online Transactional Portals

Text message notifications can be an effective way to promote awareness about and uptake of public services. In turn, the digitalization of government transactions is becoming more common as a way to increase coverage and reduce the costs of transactions. This section develops a cost-benefit analysis of an intervention to promote renewals of ID cards. In particular, it uses an experimental evaluation by Reyes, Roseth, and Vera-Cossio (2021) that assesses the effectiveness of two ways to increase the timely renewal of ID cards in Panama: text messages, and text messages plus access to an online platform to start the transaction to renew the ID.

Reyes, Roseth, and Vera-Cossio (2021) partnered with the Tribunal Electoral in Panama to send text messages to a randomly selected group of citizens whose ID cards were set to expire between January and August 2020, reminding them of their expiration date. The researchers found that sending text messages increased the probability of renewal from 59 to 72 percent during the time of the study and the probability of on-time renewals from 25 to 39 percent. Including in the text messages a link to start the process to renew the ID card online increased the probability of renewal by 9 percentage points (from 59 to 68 percent). Note that the size of this effect is 4 percentage points lower than that of the intervention group that received only the text messages. As explained in the paper, the platform was so poorly designed that most users who clicked the link abandoned the process midway, most

commonly when prompted to upload a photo of themselves. Many users attempted to take a "selfie," though the instructions stated that selfies would not be accepted. Though some people who abandoned the online process later conducted the renewal in person, many did not, resulting in the overall lower take-up rate compared to the SMS-only group. Given that the quality of the online portal could have impacted the effectiveness of the intervention, two scenarios for the cost-benefit analyses are considered here: a real scenario, in which the online portal has some defects that may affect the user experience (this scenario uses the renewal rates as documented in Reyes, Roseth, and Vera-Cossio 2021); and a hypothetical scenario, where the online portal works flawlessly and in an intuitive manner, allowing more citizens to complete the transaction online more rapidly.[4]

In addition to the effects on renewals, Reyes, Roseth, and Vera-Cossio (2021) studied the impact of these interventions on access to government services. In particular, they took advantage of a newly available program implemented in April 2020 that provided monthly digital vouchers to all Panamanians without a formal job. The transfer was delivered directly to ID cards. As a result, beneficiaries could spend their subsidy in various venues and stores, making ID card renewal even more critical during the COVID-19 pandemic. The study showed that ID card renewals increased the likelihood of receiving the subsidy by 4.3 percentage points for those who received only text messages, and by 2.9 percentage points for those who, in addition, received a link to renew their ID card online, the latter effect not being statistically significant.

Turning to the cost-benefit analysis, it starts by assessing the benefit of receiving text messages exclusively (the first arm of intervention). To that end, a value of the benefit for citizens of having an updated ID card is assumed. It is difficult to provide a monetary value for this benefit because (i) no estimates from the literature can be directly used; (ii) the valuation of this benefit could be different between individuals depending on the type and number of services they can access or request thanks to having an updated ID card; and (iii) specific to this study, it would be necessary to know the value of having a renewed ID for those who are in the margin of changing their decision to renew their ID card or who are susceptible to the intervention. Based on conversations with experts in this area, an average valuation of US$20 per person was chosen for the benchmark scenario, though it is recognized that there is large uncertainty about this valuation.[5] Because the analysis is being conducted for a one-year window, and considering that in Peru adults have to renew their ID cards every eight years, it is estimated that about 2.6 million Peruvian adults would annually benefit from this intervention if it were to be implemented nationwide. This leads to an estimated

4 The results of the cost-benefit analysis for this hypothetical scenario are generated assuming that 80 percent of individuals who start the online process to renew their IDs end up renewing them.

5 Cristia et al. (2022) present additional results assuming an average valuation between US$10 and US$50.

Table 4.1 | Cost-Benefit Analysis of Different Policy Options to Promote ID Card Renewal in Peru

	SMS	SMS + Online Platform (Real)	SMS + Online Platform (Hypothetical)
Benefit per capita (U.S. dollars)	4.9	4.0	4.0
Benefits for citizens	2.5	2.1	2.2
Benefits for implementer	2.5	1.9	1.9
Cost per capita (U.S. dollars)	2.3	2.4	1.3
Costs for citizens	1.7	2.1	0.9
Costs for implementer	0.6	0.4	0.4
Benefit-cost ratio	**2.1**	**1.6**	**3.1**
Net present value (millions of U.S. dollars)	**7**	**4**	**7**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of promoting renewals of ID cards through SMS and an online platform. The target population includes registered persons over 18 years old who are scheduled to renew their IDs. Results correspond to a one-year implementation. The SMS intervention involves sending SMS reminding people to renew their IDs. The SMS + Online Platform (Real) intervention involves sending SMS reminding people to renew their IDs and also includes a link to start the renewal process online. Results in this case correspond to a "real" intervention evaluated by Reyes, Roseth, and Vera-Cossio (2021). Results included in the SMS + Online Platform (Hypothetical) intervention use statistics presented in Reyes, Roseth, and Vera-Cossio (2021) but assume that 80 percent of all individuals who start the online process to renew their IDs end up renewing their IDs. Sections 4.2 and 4.2.1 present the main assumptions included in the analysis. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022).

benefit to targeted citizens of about US$2.50 per capita for those who are sent the reminder (Table 4.1).

In addition, to compute the benefits for those citizens who received the link to the online portal, gains from conducting the transaction online are incorporated, including monetized time savings and transportation costs.[6] Savings come from those citizens who would have carried out the transaction in person, but who after having access to the online process chose to start the process online. This resulted in less time spent on the transaction, and a 50 percent decrease in the cost of transportation.[7] Thus, the per capita benefit of receiving reminders and having the possibility of renewing online is between US$2.10 and US$2.20, depending on the quality of the portal, where higher quality is translated into higher benefits.

Turning to the benefits for the implementer, governments benefit from citizens updating their ID cards because it provides them with more reliable data, which can help the government better target social programs and reduce fraud (Al-Khouri 2008,

6 These estimates were computed based on data on the time spent conducting a transaction online versus in person as reported in Roseth, Reyes, and Santiso (2018), the average wage of a Peruvian citizen (data from SEDLAC 2019), and the probability of renewal resulting from sending text messages and making an online platform available (Reyes, Roseth, and Vera-Cossio 2021).

7 Usually, an ID card renewal requires four trips: a roundtrip ticket from the person's home or office to the government office to request the ID card renewal, and another round-trip ticket to pick the card up.

2014). Additionally, in countries where voting is mandatory, the government benefits from its citizens renewing their ID cards because this can bring about greater electoral participation (Vercellotti and Andersen 2009). All these benefits are also difficult to quantify. For simplicity, it is assumed that the per capita benefits the government receives are similar to the per capita benefits citizens receive.

Regarding the costs to the citizen, the analysis looked at those costs faced by different types of individuals. First, it took into account those citizens who renewed their ID card because they received the text message and/or the link, but who would not have done so in the absence of the intervention. In other words, the intervention encouraged a number of citizens to renew their ID card and, thus, they had to allocate resources such as time and transportation to carry out the transaction. This cost varies depending on whether the citizen decided to pursue the transaction in person or online (and whether the latter option was available to them). Second, the time spent trying to carry out the transaction online was considered for those who started the transaction online but were not able to complete it. Altogether, the cost per citizen is estimated at US$1.70 per capita for those who received text messages, US$2.10 for those who received the reminder and the portal link under the real scenario, and US$0.90 for those who received the reminder and the platform under the hypothetical scenario in which 80 percent of all individuals who started the renewal process online ended up renewing their IDs.

Turning to costs for the implementer, the analysis considered the costs of sending four text messages per targeted citizen and the overhead costs associated with management of the SMS intervention. It also considered additional costs that the implementer had to assume because of having a greater number of citizens completing their transactions at their offices or online. Finally, a 20 percent deadweight loss was included to account for tax-related distortions associated with raising resources to fund the additional government spending. Table 4.1 summarizes the results of the cost-benefit analysis.

Based on the estimates in the analysis conducted for this chapter, sending SMS reminders to citizens may generate returns of about US$2.10 per US$1 invested, or a total return to society of about US$7 million in one year. Considering the small investment required by the government, the simplicity of the intervention, and the intervention's estimated returns, this seems like a cost-benefit intervention that other countries could adopt. Moreover, the fact that the intervention achieved a large increase in the share of individuals who renew their ID cards suggests that it is alleviating a constraint for individuals and adding value. It is important to recognize that the intervention does not affect the tangible incentives related to renewing an ID card—that is, the benefits of having a renewed ID card—but rather only reminds individuals about the dates associated with renewal.

Similar low-cost interventions could also be implemented for other transactions in which individuals need a reminder about what needs be done. However, it is important to recognize that these types of interventions will generally only be effective when the constraint is that individuals are forgetting about a process that they would like to do if they are reminded of it. That is, if individuals are already aware that they can conduct a certain transaction and they choose not to follow through, reminders may not be an effective solution. This general idea is examined by Dong, Meisari, and Rinaldi (2021), who explored whether sending text messages could boost business formalization in Indonesia. In the experiment, small businesses received one message to notify them of the possibility of registering their business using a new online registration service (i.e., a link to a registration portal). However, the intervention had null effects on business registration. This suggests that the barriers to business formalization are not associated with salience (which would have been overcome with text messages) or with transaction costs (which would have been overcome with the online service).

With respect to the combination of SMS reminders and online renewals, the analysis for this chapter finds that the benefit-cost ratio depends on the ability of the online platform to bring about a solution for the citizen. Based on the estimates, if, hypothetically, the platform works as expected, the benefit-cost ratio is approximately US$3.10 per US$1 invested, generating a total return for society of US$7 million in one year. However, in the real scenario, in which many people experienced problems using the platform to start the renewal process, providing access to conduct the transaction online could be counterproductive and would lead to lower benefit-cost ratios compared to receiving text messages alone. This implies that government services must be designed with the citizen at the center of the service and keeping in mind that the digital skills of many Latin American and Caribbean citizens are still limited.

Table 4.2 explores the results already presented for Peru for the cases of Chile, El Salvador, and Jamaica. In the case of SMS reminders, the benefit-cost ratio for the four countries ranges from 2.0 to 3.8. In the case of the real intervention that involved sending SMS and links for starting the ID renewal process online, the benefit-cost ratios are lower, ranging from 1.2 to 2.3. In turn, the benefit-cost ratios for the hypothetical intervention, which involved sending SMS and links and ensuring that 80 percent of all individuals who start the renewal process online end up renewing their IDs, are the highest and range from 2.9 to 5.1. Note that there is more variation in the net present value because this parameter depends heavily on the population. This explains why for the SMS-only intervention the net present value for Jamaica is only US$100,000 and for Peru it is US$6.8 million. These results highlight the importance of developing online platforms that provide a good experience for citizens.

Table 4.2 | Cost-Benefit Analysis of Different Policy Options to Promote ID Card Renewal in Selected Countries

	Peru	Chile	El Salvador	Jamaica
SMS				
Citizens covered (millions)	2.6	1.3	0.2	0.0
Benefit-cost ratio	2.1	2.3	3.8	2.0
Net present value (millions of U.S. dollars)	6.8	3.5	0.6	0.1
SMS + online platform (real)				
Citizens covered (millions)	2.6	1.3	0.2	0.0
Benefit-cost ratio	1.6	1.2	2.3	1.5
Net present value (millions of U.S. dollars)	4.0	0.3	0.3	0.0
SMS + online platform (hypothetical)				
Citizens covered (millions)	2.6	1.3	0.2	0.0
Benefit-cost ratio	3.1	3.0	5.1	2.9
Net present value (millions of U.S. dollars)	7.1	3.3	0.5	0.1

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of promoting renewals of ID cards through SMS and an online platform. The target population includes registered persons over 18 years old who are scheduled to renew their IDs. Results correspond to a one-year implementation. The SMS intervention involves sending SMS reminding people to renew their IDs. The SMS + Online Platform (Real) intervention involves sending SMS reminding people to renew their IDs and also includes a link to start the renewal process online. Results in this case correspond to a "real" intervention evaluated by Reyes, Roseth, and Vera-Cossio (2021). Results included in the SMS + Online Platform (Hypothetical) intervention use statistics presented in Reyes, Roseth, and Vera-Cossio (2021) but assume that 80 percent of all individuals who start the online process to renew their IDs end up renewing their IDs. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022).

4.2.2. Biometric Identification to Improve Public Service Delivery

As discussed above, an important step to facilitate access to public services is identity verification. Two studies by Muralidharan, Niehaus, and Sukhtankar (2016, 2020) analyze the effects of implementing biometric systems to identify recipients of government subsidies. In the first study, they examine the provision of smartcards to deliver two of the largest social programs in the state of Andhra Pradesh in India: one for those able to work (known as NREGS), which offered each rural household up to 100 days of paid employment each year; and another for those who could not work (known as SSP), which distributed unconditional monthly payments. Smartcards often included a digital photograph and a chip with biographic, biometric (fingerprint), and bank account information. Although the program was initially launched in 2009, the integration of systems and coordination with local banks took a long time. In 2010, seeing little progress, the government decided to relaunch the program using lessons learned from districts that had successfully integrated the necessary systems. The authors studied the randomized deployment of this program from 2010 to 2012 and found that NREGS

beneficiaries collected their payments faster (22 fewer minutes or a 20 percent reduction), leakage in the SSP program decreased by between 3 and 13 percentage points, and coverage of the programs remained unaffected. They also reported that between 90 and 93 percent of beneficiaries preferred the new system.

Inputs from this program are used here to perform a cost-benefit analysis considering several components. First, the analysis considers benefits to citizens that include savings in time to claim benefits, increases in payment amounts due to a reduction in corruption, and greater coverage in the NREGS program. Second, it includes benefits to the implementer related to increased fiscal savings, since the government disbursed fewer funds because of the reduction in payments to ghost beneficiaries. Third, it incorporates costs to citizens related to the initial biometric registration that beneficiaries had to perform (including processing fees, transportation, and time spent conducting the transaction). Fourth, it considers costs to the implementer that involve the production and distribution of smartcards. Additionally, the analysis includes the costs associated with digitalizing benefit distributors, which have to acquire a point of sale system and train their staff in the use of the system. Finally, the analysis notes that by linking the smartcard to a bank account, the government has to pay fees to compensate the banks for the creation of the accounts and receipt of the subsidy.

The results from the cost-benefit analysis indicate that implementing biometric systems is profitable. As shown in Table 4.3, there is a return to society of US$3.9 per US$1 invested and a net present value of US$7 million for the case of Peru, assuming one year of nationwide rollout for all eligible beneficiaries. The intervention reduces corruption on two fronts: it generates more accountability for those that distribute the subsidies, and it eliminates payments to ineligible people or to people who do not exist.

Table 4.3 | Cost-Benefit Analysis of a Biometric Identification Intervention for Service Delivery in Peru

Benefit per capita (US. dollars)	17.5
Benefits for citizens	12.1
Benefits for implementer	5.4
Cost per capita (U.S. dollars)	4.5
Costs for citizens	1.8
Costs for implementer	2.7
Benefit-cost ratio	**3.9**
Net present value (millions of U.S. dollars)	**7.1**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of a biometric system to improve public service delivery of a cash transfer program. The target population includes subsidy beneficiaries in rural areas. Results correspond to a one-year implementation. Sections 4.2 and 4.2.2 present the main assumptions included in the analysis. Detailed information on the methodology and assumptions is presented in Cristia et al. (2022).

Table 4.4 | Cost-Benefit Analysis of a Biometric Identification Intervention for Service Delivery in Selected Countries

	Peru	Chile	El Salvador	Jamaica
Citizens covered (millions)	0.5	0.2	0.1	0.1
Net present value per capita (U.S. dollars)	13.0	16.2	3.6	4.6
Benefit-cost ratio	**3.9**	**2.9**	**1.5**	**1.4**
Net present value (millions of U.S. dollars)	**7.1**	**2.8**	**0.5**	**0.5**

Source: Prepared by the authors.
Note: This table summarizes the results of a cost-benefit analysis of a biometric system to improve public service delivery. The target population includes subsidy beneficiaries in rural areas. Results correspond to a one-year implementation. In general, results generated for Chile, El Salvador, and Jamaica are produced following a procedure similar to the one applied for Peru, though in some cases alternative procedures were followed due to data limitations. Detailed information on the methodology and assumptions for all countries is presented in Cristia et al. (2022).

The analysis also explores the benefits and costs of the program when implemented in Chile, El Salvador, and Jamaica (Table 4.4). In Jamaica, the return to society is US$1.40 per dollar invested, and the net present value is US$500,000. In El Salvador, the benefit-cost ratio is US$1.50 per dollar invested, generating a return to society of US$500,000 in one year. Chile, on the other hand, has a benefit-cost ratio of US$2.90 per dollar invested and a return on investment of US$3 million in one year. Despite the gains documented here, however, implementing these programs is highly complex and requires coordination with multiple stakeholders. Flawed or incomplete implementation may diminish the benefits.

The second analysis by Muralidharan, Niehaus, and Sukhtankar (2020) looks at the case of biometric identification for the delivery of the largest social program in the state of Jharkhand, India. In this study, the authors found results that do not align with those from their 2016 study. In this case, smartcards replaced "ration cards" that allowed beneficiaries to purchase a fixed monthly quantity of grain and other commodities at a subsidized price in government-run stores. Contrary to the 2016 study, the authors did not find evidence of fiscal savings. Neither did they find changes in coverage of the program, though they did identify a small decline in corruption explained by the increase in accountability to which grain distributors were subjected. Moreover, the authors found that the program generated a 17 percent increase in citizens' transaction costs, since the number of times citizens had to go to the government stores doubled. Failures of the biometric authentication system and the lack of manual alternatives for authentication were the main factors explaining this increase in costs.

4.3. How Digitalization Adds Value: User Experience and Service Take-up

The evidence presented above shows how digital technologies can be used to improve the delivery of transactional public services. Furthermore, they show that, under certain

conditions, such services can engender strong returns on investment. In general, the costs associated with providing digitalized services follow a clear pattern: relatively high fixed costs and low marginal costs. That is, it is typically necessary to make a start-up investment to digitalize a process and implement the technological solution to be used, but the marginal cost for additional users who take advantage of the service is close to zero. Consequently, the more users of a service the lower the average unit cost, and the higher the benefit-cost ratio.

This paradigm of significant fixed costs and low marginal costs reframes the question of how to maximize the return on investment of transaction digitalization projects. The key question becomes: How can the providers of digitized transactional services win over the maximum number of users? The answer hinges on the three key moments analyzed above: awareness, authentication, and completion of the transaction. As the literature and cases analyzed above demonstrate, the chain can break at any of these links that constitute it.

Of particular concern is the poor user experience common to digital transactions at both the authentication and transactional stages. As shown both in the case of biometric identification for a social program in India and the case of the app for online renewal of the national ID card in Panama, poor user experience design can have adverse effects on uptake—and thus on benefit-cost ratios. Unfortunately, complicated user experiences with digital transactional services are the norm in Latin America and the Caribbean. In a survey of citizens in 11 countries conducted in mid-2020, users of digital public services reported that completing their transaction online was difficult—with 27 percent of them stating that they would never use digital public services again (Roseth, Reyes, and Yee Amézaga 2021). Such a low level of satisfaction is unlikely to be sufficient to prompt a shift in underlying preferences among citizens of the region, who, even in the midst of a pandemic that imposed severe health risks on accessing services in person, tended to prefer face-to-face attention.

To increase uptake of digital transactional services, and thus maximize the potential return on investment, delivering institutions must focus on the user. While there are many different sets of guidelines to produce high-quality digital services, two specific actions modeled after Roseth, Reyes, and Santiso (2018) are presented here:[8]

1. *Study the citizen experience*. It is impossible to improve the citizen experience with digital transactions without first understanding how this experience unfolds. The most common piece of guidance in this regard promoted by advanced digital governments is to design *with* users, not *for* users. The assumption underlying this

8 See the GDS Service Standard (www.gov.uk/service-manual/service-standard) from the United Kingdom and the U.S. Web Design System (https://designsystem.digital.gov).

recommendation is that those charged with creating digital services are fundamentally incapable of guessing what a user's experience is going to be. Information on the user experience can be gathered in a variety of ways, starting with what is known as "user research"—that is, working closely with users to observe how they interact with a service from beginning to end. Other ways of studying the citizen experience include automated data collection from websites on matters such as access times, number and location of clicks, and services initiated but not completed (known as the "bounce rate"). It is also important to conduct interviews and focus groups to hear from users in order to map out their experience with a specific service, and to carry out population surveys, which are best suited to gather an aggregate picture of user experiences.

2. *Redesign services with the citizen experience in mind.* Too often, digital services are online replicas of face-to-face procedures. This leads to counterintuitive forms, unnecessary information requests, and an overall complex experience online. Rather than digitalizing an in-person transaction, digital services should start from scratch with the question: "What is the best way to satisfy the user's needs, while fulfilling government requirements, using an online format?" In answering this question, it is fundamental to turn to users themselves, iterating version after version until the service is ready to go live (and then continuing to study and iterate). As part of this process, all the technological and design tools available—from drawing on existing information from other government databases to employing different buttons and page formats—should be brought to bear to make the citizen experience as amenable as possible.

4.4. Conclusions

This chapter has illustrated how digitalization can be a potent tool to address many of the challenges facing transactional public services in Latin America and the Caribbean. It has further shown that the region has significant room for improvement in terms of digitalization, and posited that one reason why the region has not advanced further is lack of clarity on the return to investment and how to maximize it.

The key messages from the chapter are:

- Text message reminders can be effective tools to promote the uptake of both digital and in-person transactional services, given that a barrier to uptake is salience. If the barrier to uptake is not salience—for example, if businesses do not want to formalize out of fear of the tax burden—then text messages will not be effective.
- Digitalizing transactions can increase the take-up of public services if (i) transactional costs are a barrier to take-up of the in-person service; and (ii) the digital user

experience is fluid. If transactional costs are not a barrier to uptake, as in the business formalization example cited above, then digitalization will not be an effective remedy. If the user experience is difficult, as is often the case in Latin America and the Caribbean, then uptake is likely to be weak.

- The return on investment of projects that digitalize transactional services hinges on take-up. Given typically significant start-up costs, transaction digitalization projects can result in negative returns if there is low take-up. However, given low marginal costs, projects resulting in high take-up rates can have very positive benefit-cost ratios.

Investing in proper prioritization and implementation of digital transactions can set off a positive chain reaction: more individuals use the online services (and fewer use face-to-face services), improving the return on investment and thus providing governments with motivation to digitalize more transactions. As more transactions come online with common and universally friendly interfaces, citizens may eventually shift their default to seeking services online, with both citizens and governments reaping ever greater returns on the overall investment in the digitalization of government transactions. A transition towards user-centric online services will not only provide solid fiscal and economic returns, but also bring Latin American and Caribbean governments more in line with the demands of 21st-century citizens.

5

A Tall Task, Not a Quick Fix: Using Digitalization to Tackle the Challenges of Fiscal Management

Anastasiya Yarygina | Andrés Muñoz | Lisseth Escalante

Insufficient tax collection, inefficient public spending, fiscal opacity, and corruption are just some of the longstanding and daunting challenges to effective fiscal management faced by the countries of Latin America and the Caribbean. In recent years, countries have undertaken substantial fiscal reforms and adopted more modern and integrated management systems in order to improve their fiscal performance and contribute to macroeconomic stability, economic growth, and sustainable development. But is the region advancing sufficiently to overcome its historical challenges? And to what extent can digitalization, rather than being viewed as a quick fix, push that progress ahead more rapidly, comprehensively, and sustainably?

First, it is important to look at the progress that has been made. On the income side, governments have achieved important advances, including restructuring tax systems, particularly with the consolidation of the value-added tax, and combatting evasion more effectively by strengthening tax administrations (Corbacho Fretes Cibils, and Lora 2013; OECD et al. 2016; Arenas de Mesa 2016). Consequently, between 1990 and 2019, tax collection in the region increased from 16 to 23 percent as a share of GDP (OECD et al. 2021). The use of digital technology has been noted as an important enabler of these advances (Morán and Pecho 2017).

On the expenditure side, central governments in the region increased spending from 18 percent of GDP in 2000 to almost 21 percent of GDP in 2018 (ECLAC 2020). Moreover, governments have redirected their spending to key sectors such as education, health, and social protection, and successfully implemented social assistance and conditional cash transfer programs. These investments have generated improvements in social indicators and coverage of public services, and have also helped reduce poverty and, to a lesser

extent, inequality. In addition, virtually all countries in the region have undertaken reforms of public financial management through the use of digital technology, allowing for the generation of reliable and timely financial information, strengthening the quality of macro-fiscal management, and contributing to economic growth (Pessoa and Pimenta 2015).

Despite this progress, a tall task looms. Many fiscal challenges remain unsolved, specifically those cited earlier, and there is evidence that some of them are becoming more acute. The COVID-19 pandemic has exacerbated many structural problems, reducing tax revenues in the region by 11 percent between 2019 and 2020,[1] increasing public expenditure by up to 4.6 percent of GDP over the same period, and raising public debt levels from 58 percent of GDP in 2019 to 72 percent of GDP in 2020, the highest level recorded in the last three decades (OECD et al. 2021; ECLAC 2021; IDB, forthcoming; Cavallo and Powell 2021). The combination of the structural problems prevalent in the region and the fiscal consequences of the pandemic means that governments will need to do more with fewer resources, be more transparent, especially in the use of resources earmarked for emergency and recovery, and collect taxes more efficiently, although with as little friction as possible, in order to sustainably finance their increased expenditures.

On the positive side, digitalization of the public sector offers significant advantages and opportunities for Latin American and Caribbean tax administrations to help reverse fiscal deterioration and solve the challenges described above. Recent tax innovations based on the use of digital technology methods and tools are replacing traditional tax management practices in the region and around the world in a number of areas, including tax facilitation and control, targeting of public spending, and automation of public purchases. These new methods and tools are helping to overcome current constraints, particularly bureaucratic management processes, imprecise and obsolete technological approaches, vertical organizational cultures with production functions based on specialization and fragmented silos, and innovation-averse mindsets. Tackling these and other challenges that linger in public financial and tax administrations would reduce the barriers and costs to access the relevant, timely, and reliable information necessary to improve decision-making and achieve development objectives in the region.

5.1. Entrenched Fiscal Challenges: Tax Collection, Expenditure, and Transparency

5.1.1. Insufficient Tax Collection

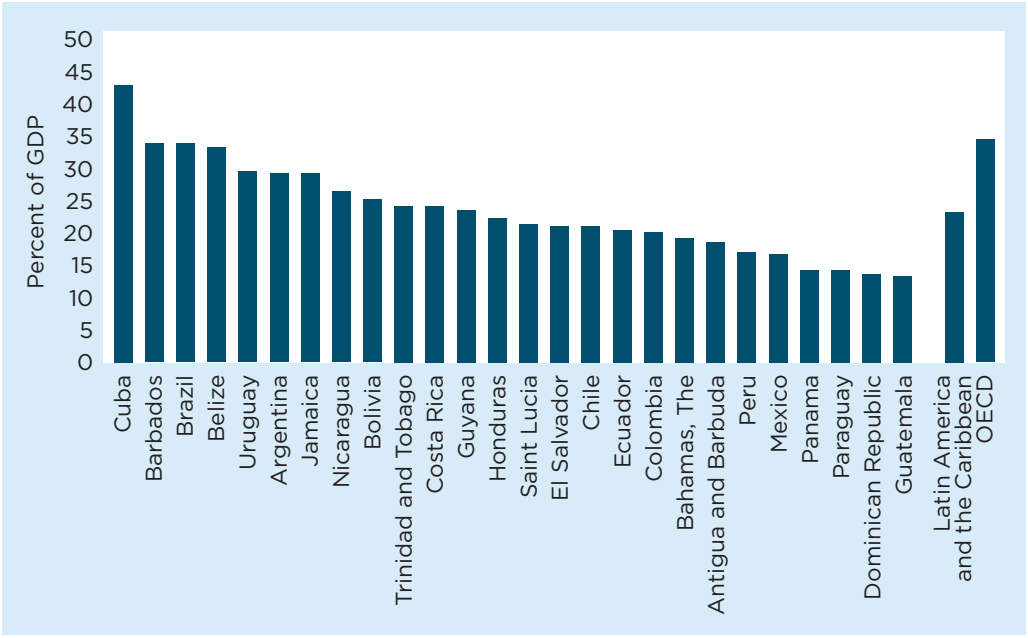
Taxation levels in Latin America and the Caribbean are low compared to more developed regions of the world (Figure 5.1). Moreover, countries of the region collect less

1 Based on reports from tax administrations of 18 countries across the region, as calculated by the Inter-American Center of Tax Administrations.

taxes than expected given their level of economic development (Corbacho, Fretes Cibils, and Lora 2013; ECLAC 2018; OECD et al. 2021). There are many reasons for this underperformance, with tax evasion being one of the main ones. Tax evasion in Latin America and the Caribbean in 2018 was estimated at US$325 billion, representing 6.1 percent of GDP on average across the region, including evasion of the value-added tax at 2.3 percent of GDP and income tax evasion at 3.8 percent of GDP (ECLAC 2021). For income taxes, evasion rates are above 45 percent, and for the value-added tax they are approximately 30 percent (OECD et al. 2021; Barreix and Zambrano 2018). Minimizing evasion would make it possible, among other things, to close the region's infrastructure gap, which is projected at 3.12 percent of the region's annual GDP until 2030 to meet the United Nations Sustainable Development Goals (Brichetti et al. 2021).

Several factors contribute to tax evasion in the region, including mistrust of the public sector, corruption, lack of a civic-minded culture, and high levels of informality. Despite considerable heterogeneity in the use of technology in tax administrations across the region, certain weaknesses persist, such as working in silos and not effectively developing and implementing a strategic vision. For example, the governance structures of tax administrations in many countries do not allow data to be shared

FIGURE 5.1 | Tax Revenues by Country, 2019



Source: Prepared by the authors based on OECD et al. (2021).
Note: The figure shows tax revenues as percentage of GDP in 2019. OECD: Organisation for Economic Co-operation and Development.

smoothly and efficiently either within the administration or with third parties. Also, some tax administrations lack digitalization and integration systems for the capture, storage, and analysis of data. In addition, some have obsolete or limited technology and employ multiple systems and databases, leading to unnecessary replication, information insecurity, and lack of privacy. Staff recruitment typically prioritizes economic and legal areas, generating gaps in human resources with strong data analysis skills (CIAT 2020).

Furthermore, the region struggles with a persistent problem of high tax compliance costs. Despite improvements in recent years, Latin America and the Caribbean remains above the world average in terms of the number of hours firms devote to paying taxes (325 hours per year for the region versus 234 hours per year for the world average) (PricewaterhouseCoopers 2020). In addition to complex tax systems and numerous preferential treatments, key factors contributing to this problem include a lack of comprehensive attention by tax administrations to facilitating voluntary compliance and a limited focus on reducing taxpayer compliance costs.

5.1.2. Inefficient Public Expenditure

Despite the increase in public expenditure and the greater allocation of resources to key areas of social development, Latin America and the Caribbean still faces problems in public resource management that restrict the economic efficiency needed to promote faster economic growth and limit efforts to improve levels of equality (IDB 2015). One key policy area is the targeting of public expenditure.[2]

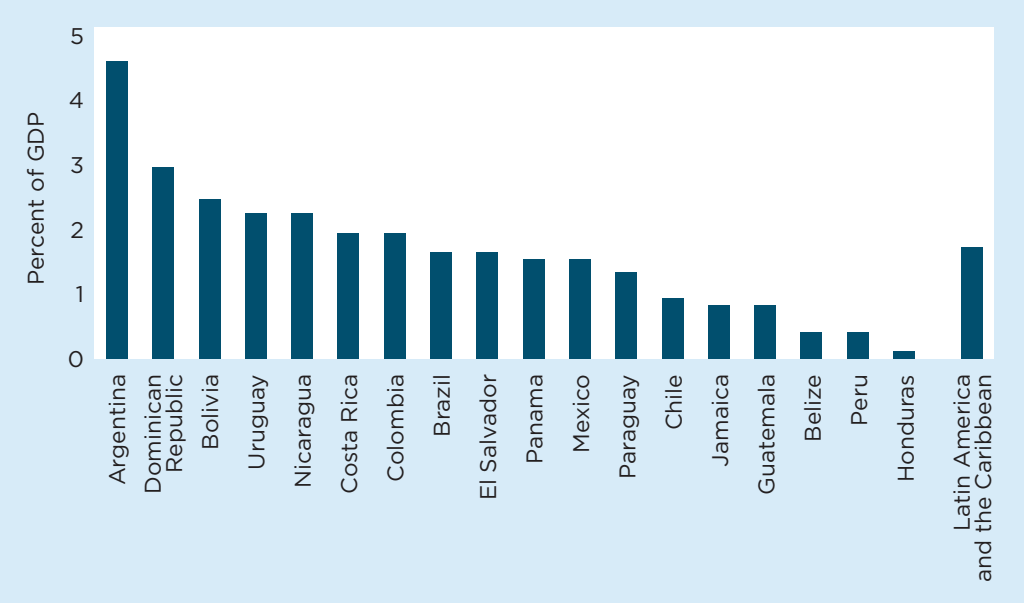
Targeting of subsidies is an important challenge for social assistance programs in the region. The lack of precise targeting of public spending prevents social assistance programs from achieving the goal of reducing inequality and contributes to ineffective and inefficient public expenditure. In fact, it is estimated that inefficiencies associated with poor targeting of social transfer programs, tax expenditures, and energy subsidies amount to 1.7 percent of GDP (Figure 5.2). In particular, although social programs in the region are highly progressive (IDB 2015), they still suffer from leakages that benefit high-income populations. On average, approximately 40 percent of the beneficiaries of these programs are not poor—leaving at least 30 percent of the poor who could have been protected without adequate coverage (Pessino and Alaimo 2018; Robles, Rubio, and Stampini 2015).

5.1.3. Lack of Fiscal Transparency

Fiscal transparency remains a challenge in Latin America and the Caribbean despite the fact that many countries have made progress in producing and publishing financial

2 For other aspects of public expenditure challenges, such as financial management and public investment management, see Izquierdo and Pessino (2018), Pimenta and Seco (2021), and Armendáriz and Contreras (2017).

FIGURE 5.2 | Leakage in Targeted Expenditure by Country, 2015



Source: Prepared by the authors based on Izquierdo and Pessino (2018).
Note: The figure shows leakage to the nonpoor in energy subsidies, social programs, and tax expenditure as a percentage of GDP in 2015.

statement reports, especially after the Asian crisis of the late 1990s (IDB 2015; Cotarelli 2012; Irwin 2012). National and regional tax governments still fail to produce, publish, and disseminate their economic, fiscal, and financial data in a complete and timely manner. For example, tax jurisdictions could publish data on public purchases, contracts, payments, and wages to public employees, or even on tax payments by citizens, as is done in some Scandinavian countries. This lack of transparency limits the capacity of citizens to know how public resources are being used and what results are being achieved. Likewise, it restricts opportunities to evaluate the effectiveness and efficiency of programs, hinders the analysis of sectoral and fiscal administrations, and limits the generation of valuable feedback for public policy decisions.

Corruption of public officials remains an issue for countries in Latin America and the Caribbean. According to the Transparency International's 2021 Corruption Perception Index, 18 of 32 nations surveyed in the region have stayed in roughly the same relative ranking for the past five years (Congressional Research Service 2022). Similarly, only five countries from the region are among the top 30 countries ranked worldwide in terms of budget transparency, compared to 15 member countries of the Organisation for Economic Co-operation and Development (OECD) (International Budget Partnership 2019). With an average score of 51, Latin America and the Caribbean ranks slightly above the world average (45) on the Corruption Perception Index, while more

developed countries and countries in Eastern Europe and Central Asia have average scores of 72 and 55, respectively.

Public procurement systems in the region also have problems related to a lack of transparency, contributing to increased risks of collusion between bidders and corruption. Given the volume of public sector purchases, these problems can have devastating effects on the efficient use of public resources. While it is estimated that the world's governments spend approximately US$13 trillion on contracts annually, information on public sector contracts is often unavailable for public scrutiny.[3] Although there is much uncertainty about the potential savings that could result from eliminating inefficiencies (including corruption), it is clear that these savings could be substantial. In fact, one estimate is that inefficiencies account for up to 20 percent of the value of transactions in the region, with corruption being responsible for an additional 20 percent (Harper, Ramirez, and Ayala 2016; Moñux et al. 2016; Schapper and Veiga Malta 2011).

As of 2020, 80 percent of Latin American and Caribbean countries had implemented e-procurement systems, often in the form of a central platform supported by different modules focusing on different tasks and steps in the procurement process. In addition, 93 percent of these countries used e-procurement systems to notify contract awards and announce tenders. Additional functionalities include online catalogs (71 percent of countries), electronic submission of bids (64 percent), and electronic reverse auctions (64 percent) (OECD 2020a). Although the region is moving towards a state where electronic contracting is fully supported by its purpose-designed portals, progress has been uneven, and several Caribbean countries are lagging. In addition, there is still room to leverage new technologies to integrate and inter-operate public procurement with other financial management systems. Most of the platforms are not fully connected to the financial and tax sector, which makes it difficult to track suppliers and put the entire procurement process online (including payments online through electronic invoicing) (Calderon, Betancourth, and Muñoz forthcoming).

5.2. Can Emerging Digital Technologies Help Tackle the Region's Fiscal Management Challenges?

Digital transformation and many of the new emerging digital technologies are highly promising in terms of their potential to contribute to fiscal progress and economic growth (Gupta et al. 2017). Tax administrations around the world are leveraging the use of digital technologies to comprehensively transform their activities, processes, skills, culture, and business models. This process is expected to increase efficiency and

3 See the Open Contracting Data Standard at https://standard.open-contracting.org/latest/en/ (accessed on June 15, 2022).

effectiveness and bring greater balance in facilitating tax compliance and control of taxpayer obligations (OECD et al. 2016; CIAT 2020; IDB, forthcoming).

The digital transformation of tax administrations is focused on (i) deepening knowledge about taxpayers and their transactions in order to reduce evasion; (ii) improving taxpayers' interactions with the tax administration in order to reduce compliance costs and promote voluntary compliance; (iii) restructuring processes to achieve better performance in terms of lower administrative costs and better quality in the provision of services; and (iv) changing the business model towards a new operating paradigm that generates value in the broader economic, political, and social ecosystem, including the promotion of formality, competitiveness, and transparency.

In addition, given that tax administrations are organizations whose business processes are based on data, digital transformation requires the conceptualization and implementation of data management strategies based on principles that promote data entry into the system only once (data-only-once), and where data are managed and processed in a centralized manner (single source of truth), transported and stored on digital support systems (paperless), and received and processed in real time (real-time data) (Reyes, Santin, and Cadena 2021). Many of these principles could be implemented in the context of effective integration and interoperability ecosystems.

Specifically, new digital technologies allow for increasing access to relevant information on taxpayers and their transactions at lower cost, with greater reliability and security, in a timely and more precise manner, and with more sophisticated and faster analytical processing. Moreover, data science and artificial intelligence using reliable data can provide tax administrations with information and insights about taxpayers and their transactions that were difficult to generate in the past. For example, leveraging big data from electronic invoices and other sources makes it possible for tax administrations to implement pre-filled tax returns, facilitating tax compliance and improving control.[4] Other technologies, such as applications on mobile devices, make it easier for taxpayers to make inquiries and conduct transactions with tax administrations and to prepare, present, and monitor their tax obligations. Such technologies can also assist tax auditors in their field work. In turn, Application Programming Interfaces (API) allow for the secure connection of Enterprise Resource Planning (ERP) systems of tax administrations with taxpayers (firms), making transactions more flexible and reducing

4 An electronic invoice is an invoice in electronic form that serves the same purposes as a paper invoice in all situations and for all actors (issuers, recipients, and interested third parties). It records an entity's commercial transactions in electronic form, fulfilling the principles of authenticity, integrity, and legibility in all applicable situations and for all the actors in the process in the commercial, civil, financial, logistical and, undoubtedly, tax spheres (Barreix and Zambrano 2018). A pre-filled tax return is a tax declaration that a tax administration prepares for a taxpayer using the taxpayer's own information and information from third-party sources, such as banks and employers. For more information see Section 5.3.1.

the cost of compliance.[5] Finally, Internet of Things technology enables more effective control of taxes related to handling and monitoring of freight.

To give just one example of the potential of digital technologies, it is estimated that reducing the gap in their adoption by tax administrations by half could increase value-added tax collection by 1.7 percent of GDP in developing countries (IMF 2018). Specifically, it is estimated that the use of big data and data analytics could recover around 20 percent of the loss in public revenue, which was estimated at a global level to be between US$4 trillion and US$5.5 trillion in 2015 (Cunningham, Davis, and Dohrmann 2018).

Likewise, data science, blockchain, the Internet of Things, smart portals, and cloud computing, along with their respective functionalities such as automation, digitization, integration and interoperability, analytics, and visualization, can support the technical and allocative efficiency of public spending, promoting the ability of public sectors to finance goods and services. Additionally, these functionalities reduce the costs of monitoring public agencies and public servants that manage public resources, facilitate fiscal transparency and accountability, and reduce the risk of wasteful spending and corruption.

Similarly, digital technology can effectively support efforts to promote fiscal transparency. Through the provision of more information on management and the use of public resources and transactions, it is possible to foster citizen participation and scrutiny in the design of fiscal policy and in budget planning and execution. Better transparency of public revenues and expenditures can enhance public knowledge and citizen participation in government decisions and business opportunities, strengthening democracy and governance.

E-procurement systems can provide greater access to information instantly and securely to open opportunities to a broader universe of participants in competitive bidding and help ensure compliance with procurement principles and rules (IDB 2015). Digital technology also facilitates the uniform publication of this information, better understanding of it, and comparison of it across jurisdictions, leveraging complementary data standards such as the Open Contracting Data Standard (OCDS) and Open Fiscal Data Package (OFDP).

In particular, recent efforts at institutional modernization and digital transformation of public procurement seek to strengthen management models based on the principle of value for money, which helps to improve spending efficiency, increase savings and

5 ERP refers to a type of software that organizations use to manage day-to-day business activities such as accounting, procurement, project management, risk management and compliance, and supply chain operations. A complete ERP suite also includes enterprise performance management software that helps plan, budget, predict, and report on an organization's financial results. See Oracle, "What Is ERP?," https://www.oracle.com/erp/what-is-erp/ (accessed on February 22, 2022).

effectiveness, increase publicity and transparency, and promote competition.[6] This implies the implementation of second-generation electronic purchasing platforms with digital tools that facilitate contract monitoring and management (i.e., data analysis to predict the performance of bidding processes and risk profiling), support reference price calculation and establishment of e-market places, expand access to public procurement catalogs in the cloud, and enable consultation and visualization of public procurement contracts in a regional and territorial context.

Finally, through various mechanisms digital technology can contribute to a range of better results, including (i) reduction of intermediaries in management processes, which reduces the opportunity for data manipulation and loss; (ii) greater speed in the flow of information and accuracy of data for the development of timely and well-targeted policies and actions; (iii) greater veracity, immutability, and traceability of transactions, which can facilitate fiscal monitoring; (iv) more and better coordination between various actors and information sources involved in the management of public resources; (v) better analytical capacity as a result of greater volume and versatility of data and the application of machine learning methodologies and technologies, thereby improving decision-making; and (vi) reduction of information asymmetries between agents and principals, providing more information for public scrutiny and citizen participation. It is important to note that various digital solutions entail more than one digital technology mechanism. These mechanisms are often interdependent, increasing their potential impact.

5.3 Digital Solutions for the Fiscal Sector: The Way Forward?

This section presents a review of evidence on the effectiveness of four specific digital solutions: pre-filling of tax returns, electronic tax filing, electronic procurement, and intelligent fiscal ecosystems. While there are many other digital solutions with potential to improve fiscal sector outcomes (e.g., applications on mobile devices and blockchain), these four interventions were selected for review because of their potential to generate impacts in the areas where the fiscal sector faces its main challenges, the existence of the necessary digital technology infrastructure, and the ability to adopt and expand these solutions to future upgrades.

Overall, the results of the review show that:

- The pre-filling of tax returns leads to better compliance.
- Electronic filing reduces taxpayers' compliance costs.

6 The Inter-American Development Bank has supported the implementation of e-portals to advertise public procurement contract opportunities in many countries, including Colombia, the Dominican Republic, Guatemala, Honduras, Panama, and Peru.

- Electronic procurement leads to improvements in the efficiency and quality of public procurement projects.
- The smart use of administrative data through intelligent fiscal ecosystems translates into improved targeting by social programs and subsidies, better spending efficiency, and reduced tax evasion.

The following sections present the results of each review, which are then summarized in Table 5.1.

5.3.1. Pre-filled Tax Returns

A pre-filled tax return is a tax declaration that a tax administration prepares for a taxpayer using information provided by the taxpayer and information from third-party sources, such as banks and employers. The pre-filling of tax returns was first implemented in Denmark in the late 1980s (Doxey, Lawson, and Stinson 2021). Later the policy was adopted in several countries, including some tax jurisdictions in Latin America and the Caribbean. Pre-filling in the region started with income tax returns. In 2017, Chile was a pioneer in adapting pre-filled value-added tax returns (Seco and Muñoz 2018), followed by Ecuador (Gonzalez, Romero, and Padilla 2019). The potential benefits of pre-filling include reduced compliance costs (time savings in filling tax forms), fewer involuntary mistakes, lower management costs, less time in post-assessment verification programs, more certainty of properly filling out the report, a better perception by taxpayers of tax administration services, and increased tax revenue (Goolsbee 2006; OECD 2006). However, the administrative effort to guarantee these benefits is substantial. To achieve expected results, pre-filled tax returns should contain comprehensive, accurate, and rapidly reported information (OECD 2006).

Recent studies are starting to shed light on the effects of pre-filling tax returns. The limited existing evidence suggests that pre-filling tax returns leads to better compliance because it improves accuracy in the deductions requested by taxpayers, reduces compliance costs, and seems to generate increases in tax revenues, though this result is more tentative. A study from Denmark analyzed a tax enforcement field experiment that included over 40,000 taxpayers. Specifically, the authors compared the evasion rates between third-party reported income and self-reported income in taxpayers' declarations. They found that the evasion rate, measured as the proportion of audit adjustments in tax liability, was 0.2 percent for income pre-filled by the tax agency compared to 17 percent for income self-reported by taxpayers. Moreover, when authors compared the share of people evading taxes from labor income and self-employment income components, they found that 2.6 percent of taxpayers evaded taxes related to labor income, which comes almost entirely from third-party reporting, compared to

45 percent of taxpayers evading taxes related to self-employment income, of which only 11 percent comes from third-party reporting (Kleven et al. 2011).

A study in Finland showed that pre-filling deductions for taxpayers' income declarations led to an increase in the number of taxpayers claiming deductions by 24 percent (Kotakorpi and Laamanen 2016). Another study in Denmark found that pre-filling deductions in tax returns is associated with an increase in the number of tax deductions claimed by 100 percent, and in the value of tax deductions claimed by 15 percent (Gillitzer and Skov 2018). The pre-filling of tax returns was also evaluated in several laboratory experiments, yielding inconclusive evidence of their impact (Bruner et al. 2015; Fonseca and Grimshaw 2017; van Dijk et al. 2020; Doxey, Lawson, and Stinson 2021; Fochmann, Müller, and Overesch 2021). In the context of Latin America and the Caribbean, a report by the Economic Commission for Latin America and the Caribbean notes that pre-filling value-added tax returns in Ecuador reduced compliance time from 30 to 6 minutes per taxpayer for each value-added-tax return (Gonzalez, Romero, and Padilla 2019).

5.3.2. Electronic Filing

Electronic filing (e-filing) over the Internet is a faster, easier, and more accurate alternative to filing tax returns than filing via traditional paper forms.[7] The United States was the first country to implement this option in the 1980s (Azmi and Kamarulzaman 2010). In recent years, the adoption of e-filing has risen sharply, but with a large variation among regions. The number of countries that had online systems for filing and paying taxes more than doubled between 2004 and 2019 (PricewaterhouseCoopers 2020), with OECD countries having the highest rate of adoption (97 percent) and the sub-Saharan Africa region the lowest (17 percent). The adoption of e-filing systems has several potential benefits, including time savings, no duplication of documents in hard copies, automatic detection of reporting errors, increases in efficiency of data processing, and confidentiality of information to protect privacy.[8] However, there are some challenges for tax administrations and taxpayers when implementing this type of system. For example, low literacy levels may require more time and effort for taxpayers to learn the new system, and the tax administration must guarantee confidentiality, privacy, and reliable technology infrastructure to handle large amounts of information (Azmi and Kamarulzaman 2010; PricewaterhouseCoopers 2020).

Several studies that evaluated the impact of e-filing find evidence of reductions in taxpayer compliance costs. An experimental evaluation in Tajikistan in which around 2,000 firms were randomly assigned to receive training on taxation and e-filing found

7 See U.S. Internal Revenue Service, "Exempt Organizations e-file: Benefits of e-file," available at https://www.irs.gov/charities-non-profits/exempt-organizations-e-file-benefits-of-e-file (accessed on June 17, 2022).
8 See Federal Tax Service of Russia, "What Are the Advantages of e-Filing?" available at https://www.nalog.gov.ru/eng/e_filing/watae/ (accessed on June 17, 2022).

that the firms saved about 40 percent of time spent on monthly tax-related activities, equivalent to US$5.5. According to this study, with an estimated cost of e-filing adoption of US$37, the benefits would offset costs after seven months of implementing e-filing (Okunogbe and Pouliquen 2022). Another study in Uganda compared presumptive taxpayers who started using the e-filing system after the e-filing reform with corporate income taxpayers who were still not using the e-filing system. The results suggest that the number of presumptive taxpayers and the presumptive tax revenue more than doubled after the e-filling reform (Jouste, Nalukwago, and Waiswa 2021). A cross-country analysis of e-filing adoption found that an e-filing system with an e-payment option reduces tax compliance costs in the short and medium term, measured by the number of tax payments, by 17 percent in the first year and 53 percent after five years. The system also reduces the time necessary to prepare tax returns by 10 percent in the first year and by 29 percent after five years (Kochanova, Hasnain, and Larson 2016).

5.3.3. Electronic Procurement

Electronic procurement (e-procurement) refers to the use of information and communication technologies to enable more efficient and transparent exchange of information, and interactions and transactions between government and suppliers of goods and services.[9] In 2017, the amount of public procurement represented 12 percent of GDP for OECD countries and 6 percent of GDP for Latin American and Caribbean countries (OECD 2019a, 2020a). In particular, public procurement represents on average 17 percent of total government expenditures in Latin American and Caribbean countries. The potential benefits of implementing e-procurement include cost and time savings; savings due to process automation and standardization; facilitation of instant exchange between suppliers and buyers; and improved transparency, traceability, accessibility, and accountability of the public procurement system (OECD 2019a, 2020a, 2020b). However, e-procurement also faces challenges (OECD 2015), such as barriers for suppliers due to low levels of digital skills and opportunities generated by the system, a low innovative organizational culture, insufficient integration with other electronic government systems, and high administrative costs.[10]

The evidence on the impact of e-procurement suggests that these platforms can improve the efficiency and quality of public procurement projects. An evaluation

9 See OECD, "Government at a Glance: Latin America and the Caribbean 2020 – Electronic Government Procurement," available at https://www.oecd-ilibrary.org/sites/0fe2c3fd-en/index.html?itemId=/content/component/0fe2c3fd-en (accessed June 16, 2022).

10 See OECD, "E-Procurement," available at https://www.oecd.org/governance/procurement/toolbox/principlestools/e-procurement/ (accessed June 16, 2022).

of e-procurement platforms showed that e-procurement adoption increased the quality of completed projects by 25 percent in India and reduced late completion of projects by 17 percent in Indonesia (Lewis-Faupel et al. 2016). In Latin America and the Caribbean, an evaluation of the COMPR.AR e-procurement platform in Argentina showed that adoption of the platform reduced prices paid by 4.4 percent, shortened procurement processes by 11 days, and increased by 0.3 the number of bidders (i.e., one more bidder for every three calls for bidders) (De Michele and Pierri 2020). Another study in Chile found that e-procurement was associated with a reduction in prices of procured goods and services by 2.6 percent, and with savings in administrative costs of 0.3 percent (Singer et al. 2009). In terms of costs, the estimated cost of an e-procurement platform implemented in Ukraine in 2016 was US$5.3 million, including 26 percent for setup, 12 percent for implementation, and 62 percent for operational expenses (Vissapragada 2017).

5.3.4. Intelligent Fiscal Ecosystems

An intelligent fiscal ecosystem is an integrated system of institutional, legal, and information governance norms that allow for secure real-time information exchange between public administrations, departments, agencies, and private third parties based on their previous authorized information access. Its purpose is to enable each public entity to improve the efficiency of its expenditure and tax collection, and to implement multiple other actions that could be beneficial for citizens (Pessino, forthcoming).

Some Latin American and Caribbean countries have implemented intelligent fiscal ecosystems. Chile incorporated a social registry called the Social Registry of Households (*Registro Social de Hogares*) that allows for the interoperability of the databases of many public administrations. In 2016, the system managed to link data from 43 state agencies and 345 municipalities, providing updated information on 12 million people, equivalent to 72 percent of the population of Chile.[11] In Argentina, an information system implemented in 1997 (*Sistema de Identificación Nacional Tributario y Social*) improved targeting of social programs (Fenochietto and Pessino 2011). This system centralizes socioeconomic information through a continuous exchange of data between public and private entities in real time, generating valuable inputs for policy decisions that allow for improving social program targeting and spending efficiency and reducing tax evasion. This system generated public spending savings of US$134 million in Argentina by 2001 (World Bank 2006). Currently the system contains the records of more than 42.8 million individuals, 8.7 million deaths, and 1.43 million firms, with the associated

11 See "Case Study No. 2," available at https://www.dfat.gov.au/sites/default/files/integrating-data-information-management-social-protection-a1-chile.pdf.

Table 5.1 | Evidence on Four Digital Fiscal Interventions

Digital Intervention	Potential Benefits	Evidence on Effectiveness	Evidence on Costs
Pre-filled tax returns	Increased tax collection, reduced compliance costs, less involuntary mistakes	• Amount of pre-filled claimed deductions: +15 percent (Gillitzer and Skov 2018). • Compliance time: –80 percent (Gonzalez, Romero, and Padilla 2019). • Evasion rate of pre-filled vs. self-reported income: 0.2 percent vs. 17 percent (Kleven et al. 2011). • Taxpayers claiming pre-filled deductions: +24 percent (Kotakorpi and Laamanen 2016); +100 percent (Gillitzer and Skov 2018)	—
Electronic filling (e-filling)	Time savings, no duplication of documents in hard copies, automatic detection of reporting errors, increased efficiency of data processing	• Compliance cost: –US$5.5 (Okunogbe and Pouliquen 2022). • Compliance time: –40 percent (Okunogbe and Pouliquen 2022); –29 percent five years after adoption (Kochanova, Hasnain, and Larson 2016). • Presumptive tax revenue: +171 percent (Jouste, Nalukwago, and Waiswa 2021). • Presumptive taxpayers: +173 percent (Jouste, Nalukwago, and Waiswa 2021).	Estimated cost per additional e-filing adoption: US$37. The benefits offset costs after seven months (Okunogbe and Pouliquen 2022).
Electronic procurement (e-procurement)	Cost and time savings, improved transparency, traceability, accessibility, and accountability of public procurement contracts.	• Administrative costs: –0.3 percent (Singer et al. 2009). • Late completion of projects: –17 percent (Lewis-Faupel et al. 2016). • Number of bidders: +0.3 (De Michele and Pierri 2020). • Prices: –2.7 percent (Singer et al. 2009); –4.4 percent (De Michele and Pierri 2020). • Purchasing duration process: –11 days (De Michele and Pierri 2020). • Quality of completed projects: +25 percent (Lewis-Faupel et al. 2016).	E-procurement platform total cost: US$5.3 million in Ukraine in 2016 (Vissapragada 2017).
Intelligent fiscal ecosystems	Increased efficiency of social spending, reduced tax evasion.	• Savings from information system: US$134 million in Argentina at the end of 2001 (World Bank 2006).	—

Source: Prepared by the authors.
Note: This table shows a summary of evidence reviewed for four digital fiscal interventions: pre-filled tax returns, electronic tax filing (e-filing), electronic procurement (e-procurement), and intelligent fiscal ecosystems. For each intervention, the summary shows evidence on effectiveness measured by different outcomes. For example, pre-filled tax returns include evidence on the amount of pre-filled claimed deductions, compliance time, evasion rate, and taxpayers claiming pre-filled deductions. A positive sign indicates an increase in the outcome measured. A negative sign indicates a decrease in the outcome measured. Section 5.3.1 presents the review for pre-filled tax returns. Section 5.3.2 presents the review for electronic tax filling. Section 5.3.3 presents the review for electronic procurement. Section 5.3.4 presents the review for intelligent fiscal ecosystems.

social, fiscal, socioeconomic, and health coverage attributes based on the information from different databases of the central government and provinces.[12]

5.4. Taking on the Tall Task: The Digitalization Transformation of Public Finances

Latin American and Caribbean governments must solve three of the region's most pressing fiscal challenges: How to increase revenue collection, increase the efficiency and quality of public spending, and improve fiscal transparency and reduce corruption. Accelerating the digital transformation of public finances will help address these issues and in so doing facilitate achieving the fiscal sustainability required for robust and inclusive economic growth, even in the wake of the economic downturn generated by the COVID-19 pandemic.

International evidence and experience suggest that designing and implementing an effective digital transformation strategy require developing tailor-made models, tools, and solutions, as well as promoting comprehensive reforms that encompass aspects beyond those related to technological investments. Such strategies should recognize the different starting points and contexts of the different jurisdictions as well as the degree of maturity of the institutions involved. Moreover, governments need to prioritize reforms that facilitate a step-by-step, sustainable digital transition trajectory that ensures greater equality and fiscal efficiency over the long term. In other words, digitalization needs to be viewed not as a quick fix, but as a structural and lasting reform.

Towards that end, digital transformation initiatives must be framed within a comprehensive vision of modernizing and strengthening fiscal institutions that addresses regulation and governance, human resources, and technological infrastructure. Digitalization needs to be seen not as a mere application of information technologies to generate and manage public resources, but rather as a sustainable digital transformation in which technology leads institutional modernization. In the case of tax administration, that means interventions that reorganize operations and design effective incentives to improve the capabilities of tax administrations and the people who work in them. In turn, that requires simultaneously rethinking and advancing legal, regulatory, and administrative modifications, undertaking process reengineering, adjusting organizational structures, changing organizational cultures, and strengthening digital skills. That's a tall task, but the progress to date in Latin America and the Caribbean in adopting fiscal reforms and modernizing fiscal management systems suggests that it's a task the region can, and must, take on if it is to finally overcome the fiscal challenges that have long constrained its economic and social development.

12 See Presidencia de la Nación Argentina, Consejo Nacional de Coordinación de Políticas Sociales, Dirección Nacional del SINTyS, "SINTYS: 20 años" (December 2018), available at https://www.argentina.gob.ar/sites/default/files/libro_20_anos_sintys_0.pdf.

6

Policy Recommendations: How to Promote the Digitalization of Public Services to Tackle Development Challenges

Julián Cristia | Razvan Vlaicu

The COVID-19 pandemic deepened economic weaknesses, heightened social inequities, and exposed gaps in digital infrastructure across populations in Latin America and the Caribbean. As countries in the region continue to work to reduce these digital access gaps, they also need to ensure that people can take full advantage of the opportunities opened up by high and rising access to digital resources. This is because digital resources, such as devices and the Internet, are "general purpose technologies"—meaning that they do not generate value per se but rather open up possibilities to deploy specific services that will create value. The private sector in the region and around the world is taking advantage of these possibilities by developing and promoting the adoption of applications that are revolutionizing sector after sector, including communications, retail, finance, advertising, entertainment, healthcare, and education, among many others.

Is the public sector also generating these applications to take advantage of the opportunities created by digitalization? Though there are some advances on this front, as documented in this report, there are still many untapped opportunities for the public sector to develop and deploy applications that generate large value to society. As governments play a key role in implementing foundational projects that can expand access, affordability, and reliability of the Internet and related services, they should also work to implement application projects that can take advantage of the possibilities opened by digitalization to deliver better public services to citizens.

This final chapter presents six concrete, actionable policy recommendations that could help governments advance the agenda to implement high-value digital application projects.

The first two recommendations deal with the *selection and design* stage of digital projects:

1. **Prioritize digital projects taking into account expected benefits and costs**. Because governments face important capacity and budgetary constraints, and given that there is a multitude of potential digital projects that could be implemented, governments should prioritize digital projects by taking into account their expected benefits and costs. The ultimate goal is to ensure that investments in a portfolio of application projects will maximize the aggregate value for society generated by these investments.
2. **Determine the optimal human-technological mix in digital projects and avoid "tech bias**." There is a tendency to emphasize technological components in digital projects because of the potential that technology holds. However, in many cases, this potential is not realized unless people are part of the mix for the provision of digital services. A guiding principle is to exploit the comparative advantages of technology and people for specific tasks (technology for routine tasks, people for more complex and varied tasks). It is important to experiment and test different solutions to find the right human-tech mix in specific applications.

The next three recommendations seek to guide governments during the *implementation* stage:

3. **Invest in the development of reliable and intuitive digital applications**. Software is the central piece of many digital projects and hence resources should be devoted to ensuring that software works reliably and users find applications easy to use. This is particularly relevant for software that could potentially be used by many users, since an intuitive and easy-to-use application reduces the barriers to widespread adoption, especially among populations with low digital skill levels.
4. **Achieve scale by exploiting governments' unique position and implementing effective promotional strategies**. Governments have several prerogatives that they can take advantage of to achieve implementation on a large scale, including implementing software solutions to enhance internal processes and mandating the adoption of digital services among firms and citizens. Additionally, it is critical to implement activities to promote the use of digital applications that can be optimized by running iterative, continuous experiments, exploiting the rich data generated by applications, and drawing from insights from behavioral economics, machine learning, and digital communication.
5. **Improve equity by prioritizing applications compatible with cell phones or smartphones and targeting promotional efforts to disadvantaged populations**.

This strategy is motivated by the fact that there has been a rapid increase in smartphone adoption, especially by low-income populations, among whom access to cell phones was already high. Therefore, focusing on digital projects that require access to these devices could help ensure that large segments of the population benefit from the services provided. However, this strategy has to be coupled with an explicit effort to promote adoption among disadvantaged populations to ensure that digital projects also increase equity.

The final recommendation seeks to guide the *monitoring and evaluation* stage:

6. **Exploit technological opportunities for faster and more efficient monitoring and evaluation of digital services**. Evaluating the effectiveness of specific digital services and how to promote their adoption is key to producing cost-benefit analyses that can inform decisions about which projects to prioritize. Fortunately, the fact that data on digital services can be collected and processed in real time with minimal additional expense opens up excellent opportunities for faster and more efficient evaluation and monitoring of public programs. In turn, rapid, iterative cycles of design-implementation-evaluation can be implemented, which increases the efficiency of research and development activities and accelerates the quest for effective solutions.

The remainder of this chapter discusses the evidence, experiences, and conceptual issues behind these policy recommendations.

Recommendation 1: Prioritize Digital Projects Taking into Account Expected Benefits and Costs

While governments potentially can implement a wide range of digital projects, they have limited implementation capacity and budgets. This means that only a small subset of potential projects can typically be implemented in a certain period. So the question arises: Which projects should be prioritized? One important consideration involves selecting projects that add large value to society. To successfully carry out that selection process, there are standard economic tools, such as cost-benefit analysis, that allow for quantifying the value that projects may generate. In such an analysis, the expected costs of a project are subtracted from the expected benefits to determine the project's net present value. This measure represents how much value a project can generate for society.

Of course, performing a cost-benefit analysis of a project can be complex because it requires information on parameters that in some cases can be hard to estimate. But

even in these cases, this analysis is useful because it provides a conceptual framework that helps establish the key parameters that will determine the value that a project generates. In particular, a desirable digital project impacts many individuals, provides a considerable benefit to each individual impacted, and has a low per capita cost. All these parameters are directly incorporated into a cost-benefit analysis. Moreover, as explained in more detail in recommendation 6, uncertainty for many important parameters can be reduced by running iterative small experiments and by collecting data from pilot projects. As data from these research and development activities are accumulated, the cost-benefit analysis is refined and can be used to make decisions later on. Additionally, in some cases, the differences in expected value added across projects could be so large that a ranking of projects by their net present value would be maintained even across alternative values for key parameters.

Importantly, analyzing the costs and benefits of potential projects may help identify those that generate excellent results and should be implemented at scale across the region. That is, instead of just trying to ensure that governments implement projects that "work" (in the sense that they affect the outcomes that they intend to impact), assessing the costs and benefits of potential projects helps identify projects with uncommonly high expected social value. That is, governments should seek to follow the example of venture capital firms, which try to identify projects with uncommon potential in order to invest in them. They are not just looking for average projects with positive returns; they seek to identify and invest in the next Airbnb, Facebook, or Uber. Similarly, governments should use appropriate analytical tools to identify digital projects that could generate large value to society.

One example of a type of project with great potential entails using technology to deliver information to students about educational returns. Because students may not realize the important economic returns that education brings, providing them with this information could motivate them to make better educational decisions. For example, Mexican students experienced important gains in academic achievement after they participated in an information session in computer labs in which they interacted with a simulation software that provided information on educational returns. Also, large-scale programs implemented in the Dominican Republic and Peru, in which students watched videos emphasizing the importance of continuing to study, generated large decreases in the dropout rate and improvements in academic achievement.

Hence, these types of programs generate improvements in targeted outcomes. But how much value can they generate for society? To answer this question, a cost-benefit analysis was conducted for this report on the above-mentioned education program implemented in Peru. The analysis considered the direct implementation costs of the project over two years as well as the additional educational costs that the project indirectly induced because beneficiary students stayed in school longer. In terms of

benefits, the analysis included the expected increase in adult earnings due to the better educational outcomes produced by the program. Results indicate that this type of project is an excellent investment option for governments in the region. The project is expected to generate a net present value of US$553 million per year of implementation in Peru. Importantly, the implementation costs are only US$1.1 million per year. Because there are few public initiatives in this area, there is a great opportunity to implement this type of program at scale across the region. This example shows how a careful analysis of costs and benefits helps identify excellent projects and provides a clear economic rationale for their prioritization for scale-up.

The prioritization of public digital projects could operate at different levels. At the sector level, ministries or agencies should assess the costs and benefits of relevant potential projects to determine, together with additional criteria, which projects should be prioritized for implementation. For example, the Ministry of Education could include in its prioritization exercise specific digital projects such as providing students with information on educational returns, providing access and promoting the use of a math learning app, or sending text messages to parents to promote student attendance. Similarly, a Ministry of Health, Ministry of Labor, or the agency responsible for tax collection at the national level, could assess relevant digital projects when designing their action plans. This intrasectoral project prioritization could be complemented with an overall analysis of potential digital projects in different sectors to be coordinated by the agency responsible for the country's digital agenda. This overall assessment of potential digital projects could play a key role in ensuring that projects that generate extraordinary value for society, such as the educational project described above, are indeed prioritized for implementation.

Recommendation 2: Determine the Optimal Human-Technological Mix in Digital Projects and Avoid "Tech Bias"

An important task in the design of digital projects involves defining the relative importance that the technological and human components will play in the provision of the service. That is, some services can be provided solely by employing people, while others rely exclusively on technology, and yet others involve choosing intermediate models that combine people and technology with different intensity.

An example of these potential delivery options involves mental health. In 2019, 21 million of people in Latin America and the Caribbean suffered from depression, a condition that takes a large toll on these people, their families, and communities. Moreover, women bear a disproportionally large burden of this condition as they account for 65 percent of the affected population. Fortunately, evidence has been mounting in recent decades showing that a substantial share of people suffering from depression recover if they receive a type of psychological therapy called cognitive behavioral therapy.

The traditional way to provide cognitive behavioral therapy involves sessions between a therapist and a patient totaling about six hours, during which the patient receives counseling about how to adopt certain effective practices related to thinking patterns and behavior. The provision of this traditional, in-person therapy also generates benefits to society that largely outweigh the associated costs. Specifically, a traditional cognitive behavioral therapy program that could be implemented in Peru for one year employing 70 psychologists generates an expected net present value of US$15 million with a benefit of US$5 per US$1 spent.

Moreover, evidence suggests that these positive results could be improved even more by incorporating technology. In particular, a program that combines two hours of sessions with psychologists (instead of six hours) and uses an app to provide support to patients generates similar results in terms of recovery from depression for those patients who finish treatment. The advantage of this solution, which combines elements of both human and technological contact, is that the amount of time that each psychologist needs to devote to each patient is reduced and, hence, three times more patients are supported with the same number of psychologists. The disadvantage is that the percentage of patients who finish treatment is lower compared to the traditional full-human solution (65 percent versus 85 percent, respectively). Still, because the increase in the number of treated patients is far larger than the reduction in the share of patients who finish treatment, the mixed human-tech solution outperforms the full-human solution. In fact, the analysis presented in chapter 3 finds that this mixed human-tech solution could generate a net present value of US$39 million and US$15 of benefits per US$1 invested. That is, the mixed human-tech solution could produce a net present value and a benefit per dollar invested three times larger than the full-human option.

Could a full-tech solution that involves only the use of an app and no direct time with psychologists deliver even more value? The evidence suggests that this type of app-based program reduces the prevalence of depression among patients who finish treatment. And this could be a game changer considering that the app could provide services to *any* number of patients. But there are downsides to the full-tech solution. One key problem is patient compliance. In studies in which clinically depressed patients were assigned to receive cognitive behavioral therapy from an app, without support from psychologists, only 26 percent of patients finished treatment. Moreover, it seems likely that completion rates would be even lower if the program were to be implemented under real conditions at large scale. Another problem is that actual treatment take-up (that is, the share of patients who start treatment) could be lower for a full-tech solution compared to a mixed human-tech solution. Though there is less evidence on this issue, it may be the case that patients perceive the full-tech solution as less effective and that the share of potential patients who start treatment could be lower if they are offered the full-tech solution compared to if they are offered a mixed human-tech

solution. Because of these challenges, there is high uncertainty about the capacity of full-tech solutions to produce large reductions in depression in the region.

In summary, based on current evidence, it seems that a mixed human-tech solution for depression treatment could be more efficient than the full-human solution and also the full-tech solution. Still, research in this area from carefully implemented experimental evaluations in the region could generate useful evidence to adopt the most efficient approach to tackle depression.

In the case of education, the evidence suggests that technology inputs such as videos and learning platforms with exercises complement the work of teachers. However, the role of teachers in primary and secondary schools is still critical because of their capacity to guide students and provide them with the pedagogical and social support that technology cannot provide. Hence, again, a mixed human-tech solution seems to be the best option.

In the case of regular transactions that citizens need to conduct with governments, such as obtaining identity cards, some of the processes involved can be automated, which could reduce time and monetary costs. However, fully automated solutions in which citizens can only interact with platforms may be suboptimal considering that citizens may need to devote substantial time to learn how to interact with a platform that will be used rather infrequently. A better solution might involve combining automated platforms with strong human-led support via phone, web chat, emails, or WhatsApp messages. Combining an intuitive platform with easy access to human-led customer support may help minimize the total costs for governments and citizens involved in regular government transactions.

More generally, it is critical to realize that the goal is not to deploy technological solutions per se, but rather to identify how governments can increase the value that a public service provides to citizens subject to governmental budget and capacity constraints. If the service is treatment of depression, the question is whether we can best treat people with a traditional approach, mixed human-tech solution, or full tech solution. If the service is education, the question is whether students learn best with a tech tool (e.g., a digital app), tech plus human, or human only. If the service involves a transaction with the government such as getting information from the tax bureau, the question is what combination of tech and human components can produce the information that citizens need in the shortest time at the lowest transaction cost. For many services, it is likely that there will be a bliss point between human and tech components. The general strategy could involve automating routine tasks through technology and assigning to humans non-routine tasks that may involve understanding complex situations and providing user support. In any case, when thinking about specific services, investing in research and development is going to be critical to identify the optimal levels of tech and human components for each service.

Recommendation 3: Invest in the Development of Reliable and Intuitive Digital Applications

Software is at the heart of most digital projects, and developing software that is reliable and easy to use is critical for user adoption and project effectiveness. To start with, software reliability is a necessary condition to achieve a good user experience. When an app, website, or system fails, users become frustrated, and this not only affects the use of the service in that instance but also reduces the probability that users will interact with the service in the future or recommend it to other potential users.

A good example of the importance of software reliability was the launch of the website www.healthcare.gov by the U.S. government. The website was launched on October 1, 2013, as part of the Affordable Care Act, one of the most important health reforms in the United States in the last 40 years. The website was expected to provide a one-stop place where citizens could identify which health plans qualify for government subsidies, compare their prices, and purchase a selected plan. But its launch was marred by problems. About 250,000 users visited the website during the first two hours after the launch but they faced major obstacles to navigate it. The system crashed repeatedly because the capacity of the website to handle traffic was outpaced by the number of visitors. In fact, on the launch day, only six users were able to purchase their health plan. The government reacted and introduced major changes in the way the overall digital project was managed and, by the end of 2013 about 1.2 million people had been able to purchase insurance through the website. In the following months, the government implemented several additional technical and organizational changes that further enhanced the reliability of the website. Thanks to these improvements, millions of users were able to purchase health plans through the website and by 2016 the number of nonelderly uninsured adults in the United States had fallen by 41 percent compared to 2010.

Another example of the importance of offering reliable software is the case of the Veteran Online Application, which entailed revamping a website that U.S. veterans could use to more quickly and easily apply for healthcare benefits. After the launch of the website, users had problems accessing the online application, and less than 10 percent of applications for healthcare benefits were submitted online. The main problem was that the online application only automatically opened in Internet Explorer and required the installation of Adobe Acrobat Reader on the computers of users. Once this problem was identified, a new online application for healthcare was launched in June 2016 that resulted in an increase in daily online applications from 62 to about 500.

Though both the experiences of the Affordable Care Act and the Veteran Online Applications had happy endings, the lesson is clear: software reliability is a necessary condition for the success of digital projects.

However, users do not only need reliable software, they also need software that is intuitive and easy to use. This explains why private companies make large investments in developing digital services that are so intuitive to use that training is not needed. In fact, one of the factors driving the high adoption of smartphones in the last decade all around the world is how easy it is to use these devices. Producing easy-to-use software reduces the costs for users to learn how to use it and improves their experience. In turn, this user experience improvement induces higher levels of adoption of the software, which then increases the total benefits generated by the digital project. And, importantly for public digital projects, making software easier to use reduces barriers for adoption among low-income individuals who typically have lower digital skills.

The importance of investing in the development of intuitive platforms is highlighted in an experimental evaluation in Panama that explored digital methods to promote the renewal of identity cards. In Panama, citizens need to renew their identity cards every eight years and provide updated information, including a recent photograph. Unfortunately, many citizens do not renew their identity cards, which causes problems for both them and the government. This prompted a simple intervention that involved sending four text messages to citizens reminding them to renew their identity cards. This simple and inexpensive intervention increased the share of the population renewing their identity cards during the period of the study from 59 to 72 percent.

Additionally, a subset of citizens who received these text messages also received a message with a link to a website where they could start the process of renewing their identity cards online. The idea was that the reminders would alert citizens about the need to renew their identity cards, and the link to the website would help them do the process online, saving them time and transportation costs. However, this second intervention backfired. The renewal rate for people who received the text messages and the link to the website was 68 percent—that is, 4 percentage points lower than the rate for those who just received the text messages. The reason for this decline in the renewal rate might have been that many users who received the link tried to use the website without success, became frustrated, and did not complete the process even in person.

The bottom line is that the public sector needs to invest sufficient resources to ensure that the digital services provided are user-friendly. The basic strategy to produce user-friendly software involves adopting what is called a "user-centered design approach." Under this approach, the development of applications requires constant and iterative input from real users to ensure that the final product is easy to use. It is important to note that the economic decision to invest in a more intuitive platform involves comparing the increase in the fixed cost due to the adoption of a user-centered design approach against the added benefits arising from greater expected adoption of the digital services provided (and a better user experience). Though this calculation should be made on a case-by-case basis, taking into account that the scale of

implementation for many public digital services could be expanded considerably when providing easier-to-use software, it would likely be sensible to make these additional investments in many public digital projects.

Another common strategy followed to increase software usability requires taking out functionalities that could be useful for some users but that would add complexity and worsen the user experience for less sophisticated users. In other words, in many cases "less is more." This strategy is well exemplified by the approach adopted by Steve Jobs when he managed the design of the iPod. Jobs asked Apple's engineers to create a user interface for the iPod that would allow users to access any function with only three clicks. In some cases, this required redesigning the interface, but in other cases, the engineers had to drop non-critical functionalities. Following this approach allowed Apple's team to design a device that had excellent usability and widespread adoption.

However, though an approach that emphasizes simplicity improves the experience of less sophisticated users, it could worsen the user experience of more sophisticated users who want additional functionalities. To avoid this trade-off, in some cases there is an alternative strategy that could satisfy both less and more sophisticated users. This strategy involves providing a streamlined navigation route that is intuitive and simple to use and that does not provide many options for users. This would improve the user experience for less sophisticated users. However, the application could also contain a section that provides a rich set of customization options and additional functionalities to cater to more sophisticated users. An example of this strategy is the Australian Trade Mark Search. This website includes two modes for searching trademarks: a quick search using relevant words and/or uploading an image, and an advanced search with detailed options and advanced features to refine the search. Hence, there are strategies to design applications that are intuitive and that also have many additional non-core functionalities.[1]

Recommendation 4: Achieve Scale by Exploiting Governments' Unique Position and by Implementing Effective Promotional Strategies

What is the central factor that underlies the incredible market valuation of tech companies such as Amazon, Facebook, Google, and Microsoft? The answer is scale. Many other

1 For additional information on best practices in the design of reliable and intuitive digital applications, see the design principles recommended by the governments of the United States (www.playbook.cio.gov), United Kingdom (www.gov.uk/guidance/government-design-principles), Canada (www.canada.ca/en/government/system/digital-government/government-canada-digital-standards.html), Australia (www.dta.gov.au/help-and-advice/about-digital-service-standard), and New Zealand (www.digital.govt.nz/standards-and-guidance/digital-service-design-standard).

companies are successful in offering goods and services that consumers find valuable, but what sets these tech giants apart is their success in achieving a particularly high scale of operation. In concrete terms, one in three U.S. households holds an Amazon membership, and, worldwide, 2.9 billion people visit Facebook and 4.3 billion people use Google every month, while 75 percent of computers run on Windows. So among the factors that explain the success of digital companies, scale is king.

On the public side, governments need to recognize the central role of scale to ensure that digital projects generate large value for society. That is, as long as a project generates a positive net value per beneficiary, the total value generated by the project is directly proportional to the number of project beneficiaries. For example, a learning app that is used by a million users is expected to generate a value for society far greater than one that is used by a thousand users. Though this is true for any project, the key role of scale is especially important for digital projects for two reasons. First, as opposed to traditional services, there are many costs in the provision of digital services that are fixed with scale, that is, they do not depend on the number of beneficiaries (e.g., software development costs). This implies that as the scale of implementation increases, benefits increase rapidly as more citizens are impacted, but costs increase more slowly because some important costs are fixed. Consequently, the total net present value increases quickly with scale.

Second, for many traditional services, it typically takes a long time to achieve a high scale of implementation. For example, it took 14 years for Chile to extend the school day from four to seven hours for about 80 percent of students in primary schools. These delays in expanding access to services implied that many cohorts of students could not enjoy the benefits from this major educational reform. In contrast, many digital services are deployed quickly, and additional users can be added immediately at almost zero cost. Consequently, the possibility of rapidly increasing the scale of implementation opens up a lever that governments can exploit to achieve high levels of value added from digital projects in a short time frame.

Governments, as opposed to private companies, enjoy many unique prerogatives that facilitate achieving high levels of implementation for some digital services. This is because, in some cases, the government has almost full control of the scale of implementation (though in other cases, user adoption plays a role, as discussed below). To start with, governments can develop and adopt specialized software to improve the provision of government services at a high scale, with important implications for citizens. For example, governments can implement an "intelligent fiscal ecosystem," which involves connecting rich data sets from different government agencies so that these agencies share data. This type of project uses available data from citizens at a state or national level and allows for the implementation of different applications that can lead to better targeting of program beneficiaries and also to lower levels of tax evasion.

A related example involves governments preparing draft tax returns for citizens based on information reported by taxpayers or obtained from other administrative sources as well as from private companies such as banks and employers. Essentially, governments "pre-fill" tax returns. Later, taxpayers can review these pre-filled tax returns, implement corrections, and submit the final versions. Hence, in this example, as in the case of intelligent fiscal ecosystems, governments can implement interventions affecting a large number of people just by developing and adopting new internal software and using data already available.

Additionally, governments can establish mandates for selected citizens and firms to achieve higher adoption levels of digital services. For example, governments can mandate that private companies produce electronic invoices and that the resulting data be shared with the government in real time. In turn, these data allow for implementing a range of applications that could help reduce tax evasion and improve public procurement by identifying reference prices of goods and services. Similarly, governments can mandate that certain types of taxpayers, such as firms with more than a certain number of employees, file their taxes electronically, which can potentially increase tax revenue, decrease tax collection costs, and reduce compliance costs for taxpayers. Also, in terms of advancing the transparency agenda, governments can mandate that publicly traded companies post corporate documents such as quarterly reports and major events electronically. In the United States, the Securities and Exchange Commission has established the Electronic Data Gathering, Analysis, and Retrieval System, which provides companies and investors a centralized website (www.edgar.gov) that facilitates the public dissemination of information about public companies and mutual funds.

This section has so far reviewed digital projects in which the government essentially decides the scale of implementation. However, there are some digital projects for which the government cannot decide the scale of implementation, but has important means to promote adoption by exploiting the public delivery systems for services such as education and health. For example, as discussed previously, governments can instruct teachers and principals in public schools to show their students videos that provide information on educational returns in order to motivate students to continue their studies. Similarly, governments can promote the dissemination of updates on health protocols and procedures using digital channels targeting nurses and other personnel in primary health units. In these cases, governments seek to promote the adoption of digital services among their personnel with the final aim of increasing effectiveness and efficiency. Note that there are important foundational projects that governments should advance that include the implementation of comprehensive management and information systems for better public service delivery, including software for administration of resources (e.g., physical infrastructure, employees, consultants, payments) and

sectoral information systems (e.g., electronic health records and educational management information systems).

Finally, governments can provide access to a range of services to improve citizens' lives and then promote their adoption of those services. These services include access to learning platforms, videos and digital books, applications to promote healthy behaviors and mental health, and access to platforms to perform regular transactions with the government such as obtaining permits and documents. The use of these services can generate important benefits at low cost. For example, if parents use free digital books provided by governments through an app to promote reading among their children, this could generate important gains in foundational literacy. From a governmental perspective, providing this app with free books is feasible and requires a limited investment, but the key issue is how to promote its widespread use. More generally, a key question for a whole range of digital projects that could provide useful services for citizens is how governments can promote high levels of adoption of these services.

This is a critical challenge because it is well documented that the mere provision of access to digital resources produces limited improvements in targeted outcomes in the absence of effective complementary actions to promote the use of these resources. A paradigmatic example of this phenomenon is the implementation of the One Laptop Per Child program in Peru. As part of this program, low-income primary students in rural areas received personal laptops loaded with 200 age-appropriate e-books. The initiative produced a massive increase in access to reading materials, considering that in the absence of the program only 26 percent of students had access to more than five books at home. However, in spite of this increase in reading materials, an experimental evaluation found no effects on reading frequency or in language academic achievement. Moreover, students reported having read on average only three books from the laptops in 15 months of implementation. More generally, data from learning and health apps also point to limited levels of use in the absence of promotional activities. As the One Laptop Per Child example and the evidence from learning and health apps show, providing access to digital services tackles the problem of limited *supply* of important resources (e.g., books). However, there is also an underlying less visible problem of limited *demand* that needs to be tackled through promotional activities to ensure that the provision of digital services actually generates benefits.

Consequently, governments need to experiment and fund research to identify cost-effective promotional activities that induce high levels of adoption. Because platforms record rich data on the use of services, governments can monitor levels of use in almost real time and, importantly, implement quick, low-cost, and iterative experiments to generate evidence on optimal promotional strategies (as discussed in recommendation 6 below). These experiments can generate evidence on the effectiveness of using massive, digital communication methods, such as app notifications, emails, SMS, and

WhatsApp messages, and also human-led promotional activities such as webinars, workshops, and group-based support. In addition, these efforts can take advantage of an expanding body of knowledge from behavioral economics, machine learning, and digital communications.

The main objective of these promotional activities should be to raise awareness about the existence of these services and show citizens how to use them. But governments should exercise constraint in the use of promotional activities, especially for those that involve using digital channels such as SMS and WhatsApp messages. The problem is that if governments overuse these communication channels, users become frustrated and the effectiveness of the channel is reduced. At the end of the day, the key strategy to achieve high levels of use involves developing digital services that provide great value for citizens and, at the same time, implementing effective promotional activities to induce high take-up of these services.[2]

Recommendation 5: Improve Equity by Prioritizing Applications Compatible with Cell Phones or Smartphones and Targeting Promotional Efforts to Disadvantaged Populations

Many high-quality digital services are accessible for free by any person in the world with an Internet-connected device. These services cover a wide range of areas, including email services, content on websites, videos on YouTube, learning apps such as Duolingo, geolocation services such as Google Maps, and productivity applications such as word processors and spreadsheets. Hence, there is potential for digitalization to equalize access to some services and experiences across people with very different socioeconomic backgrounds.

Some digital initiatives have built on this idea and tried to promote digitalization as a driver for equity. One leading example is what is known as massive open online courses (MOOCs). Many institutions started offering these free online courses a decade ago as a way to equalize access to high-quality postsecondary education. This initiative could potentially help people develop relevant skills that can be valuable in local or even global markets (such as skills in producing software). Unfortunately, even though access was available to all people in the world, the evidence suggests that the actual use of these resources has been highly skewed towards people in high-income countries. In fact, 60 percent of enrollees in MOOCs offered by Harvard University and MIT were from countries with a very high United Nations Human Development Index score, compared to only 3 percent of enrollees from countries with a low score on that

2 For additional information on how public digital projects can achieve scale, see the "Design for Scale" section of the Principles for Digital Development Initiative (www.digitalprinciples.org/principle/design-for-scale/).

index. There are many possible explanations for these results, including differences in access to Internet-connected devices, varying levels of digital skills, barriers related to language, differences in secondary education graduation rates, and differences in awareness of the existence of these courses. Still, the bottom line is clear: an initiative that tried to equalize access to postsecondary educational services may have instead reinforced existing inequalities.

Does this mean that the provision of digital services is always going to exacerbate inequality? This is clearly not the case. It is just that governments and other organizations need to implement digital projects with equity in mind. From education and health to criminal justice, governments must take special care to ensure that the service provided benefits the most vulnerable. Digitalization is no exception. The poor tend to have lower access to some digital resources and also lower digital skills. Digitalization should not be seen as a license to ignore equity issues, but neither should it be criticized for being particularly likely to exacerbate inequality.

Governments have several potential lines of action to incorporate equity considerations in digital projects. To start with, governments should recognize that access to technological devices tends to be greater for more affluent populations. Consequently, one important approach for governments involves implementing actions to increase the geographic coverage, reliability, and affordability of Internet services. Another involves providing devices such as tablets to low-income populations with low baseline access. In other words, governments need to invest in digital foundational projects. At the same time, they need to invest in application projects, which is the focus of this report. Hence, the section that follows analyzes how governments can ensure that digital projects that use existing infrastructure benefit low-income populations.

One important strategy involves prioritizing digital projects that require users to have access to widely available technologies. In Latin America and the Caribbean, more than 90 percent of people have access to cell phones and there are only small socioeconomic gaps in access to this technology. Consequently, digital projects that only require citizens to have access to cell phones, such as informational campaigns using text messages, can generate gains for large segments of the population, including low-income groups. In addition, access to smartphones has been on the rise, and three out of four Latin Americans had access to this technology as of 2021, as documented in chapter 1. Moreover, though there are gaps in access to smartphones between low- and high-income populations, these gaps have been shrinking in recent years due to the rapid increase in access to smartphones among low-income populations. Hence, digital projects that require citizens to have access to smartphones could also generate important gains across wide segments of the population. In particular, projects implemented by downloading apps or content on smartphones (e.g., digital books or health apps), which do not require access to reliable Internet, could generate widespread benefits.

On the other hand, digital projects that require citizens to have access to computers or reliable Internet could exacerbate existing inequalities if there is no simultaneous effective effort to expand access to these devices. Levels of access to these technologies are not high in the region. For example, only 39 percent of households in Brazil and 45 percent of households in Mexico had access to computers or tablets at home in 2021. In short, at present, digital projects that require access only to cell phones or smartphones would more likely benefit large segments of the population than would projects that require home computers or tablets.

A second important complementary strategy involves targeting promotional activities to low-income populations to generate higher levels of adoption of digital services. This strategy is linked to the discussion in the previous section about the critical role of promotional efforts to ensure high levels of adoption of some digital services. The idea is simple: since many governmental programs target resources to low-income populations in order to address equity considerations, promotional activities of digital services should also target low-income populations.

This strategy is well exemplified by an educational project called Conecta Ideas implemented in Peru during the COVID-19 pandemic. The project provided primary students with access to a math learning platform that could be accessed from home with a smartphone. In collaboration with the government of Lima, a special promotional effort for the app targeted schools in the bottom quintile in terms of learning levels, as measured by national examinations before the pandemic. The promotion paid off: in 2021, 40 percent of students in public schools from the bottom quintile of the pre-pandemic learning level used the app, compared to only 5 percent of students in public schools from the top three quintiles. In other words, the prevalence of use of the math app was eight times higher among students in low-performing public schools compared to high-performing public schools. These differences in use are expected to have important consequences in reducing learning inequality, considering the strong evidence showing that the use of math learning platforms generates improvements in math academic achievement.

Finally, digital services can be complemented with non-digital activities to ensure that populations without current access to devices receive services. For example, in the case of Conecta Ideas, in addition to the math app, the implementation team provided teachers with learning materials that could be printed and distributed to students who did not have access to devices. In the case of a digital service for the provision of therapy for depression using an app, the government could complement this service with a phone-based model and with the traditional in-person model for those without access to smartphones. Moreover, when considering transactional services that governments provide, such as renewal of identity cards, services provided through digital platforms will be complemented with traditional in-person services.

Importantly, the provision of digital services, which have low per capita costs, frees up resources that can be steered towards providing better services to disadvantaged populations. Hence, there are promising strategies to ensure that digital projects not only generate efficiency gains but also improve equity. However, at mentioned previously, it is important to continue investing in foundational projects to maximize the number of people who can reap the benefits from the provision of high-quality digital public services.

Recommendation 6: Exploit Technological Opportunities for Faster and More Efficient Monitoring and Evaluation of Digital Services

As discussed in recommendation 1, it is critical to analyze the benefits and costs of potential digital programs in order to invest in those that can generate more value to society. However, to generate valid assessments of the costs and benefits of potential programs, governments should produce rigorous evidence on their impacts and the inputs needed to implement them. Hence, though it is useful to use cost-benefit analysis for an early decision regarding which projects seem to have greater potential and should be prioritized for further funding, governments should also invest in quickly assessing the impacts of specific digital services on targeted outcomes (e.g., student learning, mental well-being, time spent in transactions with governments, taxes collected), since this is a key input to produce a solid cost-benefit analysis. Moreover, because achieving high levels of scale is central to generating large value added, it is also important to conduct evaluations that can produce evidence on cost-effective ways to promote high take-up of the digital services provided.

The importance of investing in rigorous evaluations to produce evidence on the effectiveness of public programs has been increasingly recognized over the last two decades. In fact, multilateral organizations such as the Inter-American Development Bank and the World Bank, together with global nongovernmental organizations such as the Abdul Latif Jameel Poverty Action Lab and Innovation for Poverty Action, have been instrumental in promoting the production of high-quality evidence about the effects of public programs. Still, the use of evaluations to assess the effects of traditional public services remains limited partly because these activities are sometimes seen as costly, difficult to implement, and time-consuming. This is clearly not the case for the provision of digital public services. The fact that data can be collected and processed in real time with minimal additional expenses opens up excellent opportunities for faster and efficient evaluation of public programs. In fact, while an experimental evaluation of traditional services typically takes years to be designed and implemented and to produce results, many evaluations of digital services can be done in months or even

weeks. For example, a group of researchers, motivated by the impressive results of the intervention described earlier to provide information to students on educational returns, quickly deployed an experimental evaluation that entailed sending SMS with links to a website with information on educational returns to 200,000 parents in Peru. Results collected days after the intervention showed that only 0.2 percent of parents clicked the link and visited the website, suggesting the limited effects that could be expected from this intervention. Though the results were not what the researchers hoped for, the fact that in a very short amount of time they were able to test a promising idea, find that it did not work, and learn from the experience demonstrates the importance of how technology can facilitate rapid and efficient evaluation.

Two types of experimental evaluations should be conducted. The first looks at the impact of the use of a digital service. These evaluations measure how much improvement in the desired outcome the digital service is generating. For example, these evaluations can assess the effects of using a depression app on mental well-being, the effect of the use of a math app on student learning, and whether the use of e-filing affects the amount of taxes paid. This is critical information because it helps in estimating how much value a digital service can generate per beneficiary. Moreover, it can provide information to citizens regarding whether specific apps or solutions, in some cases developed by the private sector, are effective. A second type of evaluation looks at how governments can promote the use of digital services. Following the above-mentioned examples, these evaluations generate evidence on how to convince individuals suffering from depression to use an app that can help them, how to help teachers adopt a learning platform, or how to nudge firm managers to start filing taxes electronically. As described earlier in this chapter, understanding how to promote the take-up of digital services is key to ensure that digital services generate high value to society. In summary, the first type of evaluation seeks to determine the effects of using a digital service on a final relevant outcome, while the second assesses how to promote the take-up of digital services that have been shown to improve targeted outcomes.

The use of data is not only relevant for evaluation purposes but also for monitoring. In fact, a popular adage in business management is "if you can't measure it, you can't improve it." Therefore, it is not sufficient to determine that a certain digital service improved a desired outcome and that there are effective ways to promote its use; it is also important to continuously monitor the results and to have updated, relevant information about how implementation of the program is unfolding. Specifically, monitoring activities can provide relevant information for program administrators and other actors about how many people use the digital service, how frequently they use it, for how long, and how they use it (e.g., which days of the week or times of the day). This information, which typically can be collected and processed with minimal expense for digital services, can be analyzed by management teams on a continuous basis in

order to alert them to potential problems, as well as to highlight unexpected positive developments. In turn, obtaining this information and insight early on can trigger actions to tackle problems or take advantage of opportunities.

In sum, the fact that data on the provision of digital public services can be collected and used quickly and cheaply opens up excellent opportunities to implement rapid, iterative cycles of design-implementation-evaluation. This approach can reduce the costs and increase the expected benefits of research and development activities. That is, determining whether a potential solution works in a matter of weeks or months instead of years can be extremely helpful to accelerate the quest for effective solutions. This in turn provides strong motivation to fund research and development efforts. Of course, as discussed in recommendation 1 above, this quest for solutions should also be guided by an analysis of the potential costs and benefits in order to ensure that the solutions with the greatest potential are selected for further analysis. But it is also critical to seek to know as quickly as possible how to make these solutions work in practice and the real value that they generate for society.

Conclusions

There is a strong consensus about the potential of digitalization to tackle longstanding development challenges in Latin America and the Caribbean. Governments in the region are in a unique position to take advantage of these opportunities to improve the quality and value of the public services that they provide. In the last decade, there have been great advances in terms of expanding access to the Internet and take-up of digital services. However, governments, together with private companies and other actors, should continue to make a concerted effort to ensure that all people in the region have access to affordable and reliable Internet. While they move forward in increasing access to connectivity, governments also need to work on providing digital public services that can generate large value to society. This final chapter has presented and discussed six policy recommendations that can guide governments in their quest to employ digitalization for development. A central theme across these recommendations is the need to invest in the development and adoption of public digital services that can add large value to society and improve the lives of the population in Latin America and the Caribbean.

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