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The **future** **of work**

in Latin America
and the Caribbean



What is the impact
of automation on
employment and
wages ?



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What is our series *The Future of Work in Latin America and the Caribbean* about?

The Social Sector Manager at the Inter-American Development Bank, **Marcelo Cabrol**, presents our series of interactive notes in this audio.



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1 | Introduction

Automation and the use of technology to replace tasks previously performed by human beings is an economic and social phenomenon that has accompanied humanity throughout history, especially since the first industrial revolution. Since then, the role of technology has grown exponentially in all sectors of the economy, destroying some occupations, creating new jobs, and changing the tasks that human beings are performing. You need not look far: technology has made it possible for millions of people to work remotely during the COVID-19 crisis, thus preventing that millions of workers would lose their jobs. But **what impact will this have on workers in Latin America and the Caribbean?**

In 2013, an important discussion started around the world regarding the possible effects that could result from the adoption of [artificial intelligence and robotics](#). By this time, these new technologies had begun to demonstrate the growing ability of machines to perform previously unthinkable tasks such as cooking hamburgers, writing legal documents, performing medical diagnoses and managing investment portfolios, leading to discussions about the role of machines versus humans. These developments sparked a heated debate between experts who predicted a major impact on employment and others who envisioned more optimistic scenarios, as discussed in [previous issues of this series](#).

Experience from previous industrial revolutions indicates that the estimates predicting the end of employment are often too pessimistic. Historically implementing new technology does not simply destroy jobs that have been replaced by machines, it [also creates jobs](#) that require new, previously non-existent tasks and skills¹. For this reason, it is crucial to focus on how we can support the transition that labor markets experience, in order to minimize negative consequences and maximize the benefits. If we want to illustrate the positive side of these transformations, we need only to consider that the consequences of the current health crisis would have been even more serious if we did not have the technology to work remotely. This vision encourages discussions that focus not on the end of work, but on the transformation of the future of work. That said, the available evidence does show that the incorporation of robots in the United States and Europe has in fact had a negative effect on employment levels and workers' salaries²⁻³.

Given that the introduction of robots in Latin America and the Caribbean is still insignificant compared to high-income countries, one might assume that the region has been unaffected by this surge in technology. However, this view does not take into consideration two important details.

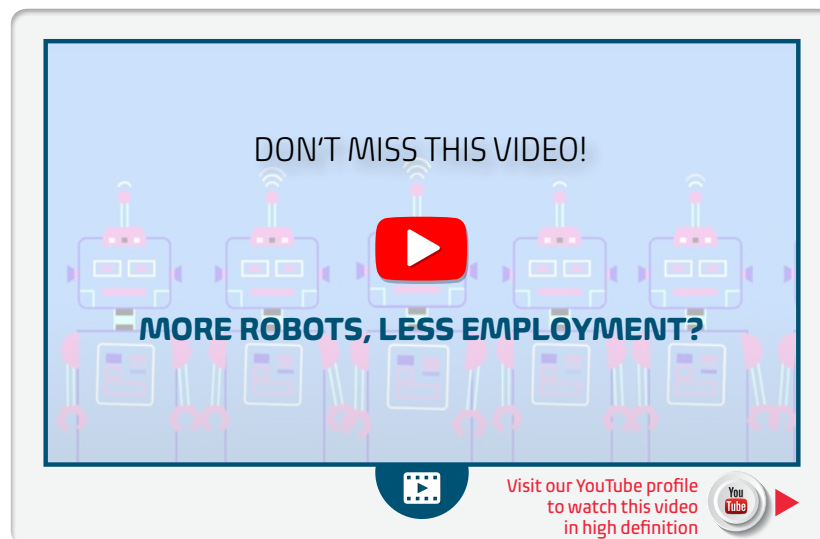
First, technological change is a key component in a world that is becoming increasingly more interconnected. This document explores how international trade is a channel through which



automation in developed countries affects labor market outcomes in the region. For example, the introduction of robots in the United States between 2011 and 2016 has negatively affected employment levels and workers' salaries in Colombia and Brazil, while employment levels in Mexico, which is closely connected to the US economy, have increased. Furthermore, amidst these various effects, it was noted that small businesses, older adults and women were most affected by this phenomenon during the years analyzed.

Second, although the effects of the pandemic are still difficult to predict, there is no doubt that COVID-19 will intensify the use of technology. A

year ago, it was unthinkable that entire companies would need to work remotely, or that the number of workers in a company could be limited due to social distancing. As explored in the [previous issue of this series](#), mandatory isolation has come hand in hand with a huge demand for applications in order to be able to work remotely and have virtual meetings, use shared documents or even expand online sales. Downloads of these applications increased twentyfold between January and March of this year, increasing from 750,000 downloads per month to 15 million. This new reality may incline the balance in favor of robots, given that they cannot be infected with coronavirus.





2 | Why this?

The Latin American and Caribbean region is marked by high economic and social inequality. The richest 10% of the population earns 22 times more than the poorest 10%, making the gap between rich and poor more than double of the one in developed countries. The average Gini coefficient in the region is 0.46, compared to 0.32 in developed countries⁴. This marked inequality makes the region more vulnerable during crises and technological disruptions, since these disproportionately impact the poorest. As a result, Latin America and the Caribbean is one of the regions most affected by COVID-19. Almost half of the workers in our region work in the informal sector and lack a social safety net. According to the Inter-American Development Bank's [COVID-19 Labor Markets Observatory](#), unemployment and working poverty levels have increased to such an extent that almost 24 million jobs were lost in June of this year, which is the largest loss ever recorded in the entire history of the region.

Within this context, automation may contribute to increasing inequality. Prior to the COVID-19 crisis, the low adoption rate for new technologies in Latin America and the Caribbean meant that this phenomenon has not yet had a major impact on inequality. In response to the pandemic, however, new technologies have played a leading role as viable alternatives to facilitate job recovery or protection. In just six months,

COVID-19 has led to more advances in digitization than in the past decade. All predictions about the future of work have accelerated: the future is here and digitization is advancing by leaps and bounds in response to our need to minimize physical proximity and face-to-face interactions. Consequently, the potential threat of technology bringing greater inequality to the region depends on the actions that are taken by governments, companies and citizens today.

The experience in developed countries shows that technology favors those who are best prepared to embrace change, and that the pandemic has encouraged technological transformation. People who perform the most routine and easily “codable” tasks are the ones who suffer most directly from automation-related job loss⁵. However, workers who are most dependent on face-to-face contact have now also joined this group⁶. Beyond the figures being studied by economists around the world, it is essential to point out the immense cost that these effects can have on the affected workers and their families; and all the more so because many of them come from demographic groups that were already at a disadvantage prior to COVID-19. Without proper support measures, automation can trigger social unrest, increase crime and violence, and cause the whole society to suffer.



The effects of international trade

Despite low technological adoption rates in Latin America and the Caribbean, increased automation in other economies is having an impact on the region. Until recently, countries in Latin America and the Caribbean had been left on the sidelines of the debate surrounding the profound changes the labor market is experiencing in developed countries due to the incorporation of robotics and artificial intelligence. One of the main reasons for this is that, at least up until the coronavirus, technology adoption has been slower in the region compared to more developed countries. However, this study shows that the new technologies adopted in these countries are having an impact on the region's labor markets via other channels that had been left out of the discussion up to this point, such as international trade. This reality upholds the views of Richard Baldwin, the economist who suggested that we use the term [globots](#) as opposed to robots, in reference to their global impact.

Thus, process automation in developed countries brings both opportunities as well as risks for the region. On one hand, automation can help increase productivity in countries that are traditionally affected by low productivity levels⁷. On the other hand, introducing these new technologies brings greater risk of inequality and unemployment for those who perform [tasks that can be easily automated](#), especially if these also require face-to-face contact with people.

But the impact of robots is not limited to the direct effect on fewer jobs and lower wages in Latin America and the Caribbean; it can also be

seen through international trade. The international trading of goods and services that characterizes globalized economies makes it necessary to take automation into account not only for a given country, but also within a global framework. This is particularly relevant when it comes to the trade of components for assembly, materials and intermediate services within the global value chain. For example, smartphones designed in the United States contain parts from Mexico and Germany, and are made in China. International trade plays an important role when it comes to the development of countries within the region. In Mexico, for example, exports to the United States (75% of Mexican exports) represent nearly 25% of their GDP.

Both the direct impact of automation and the indirect impact of international trade can be viewed from a positive perspective. In terms of direct impact, while it is true that certain jobs will become obsolete because a machine will be able to perform them more efficiently, other jobsⁱ will be created in return that will require skills that only a human being can possess, such as creativity, empathy and imagination. Additionally, technology has allowed many workers to remain active and keep their jobs amid the health crisis. On the other hand, the higher the number of robots incorporated into advanced economies, the greater the production capacity of industries within those countries. This could increase the demand for intermediate goods produced by developing countries, thus indirectly benefiting employment within these countries.

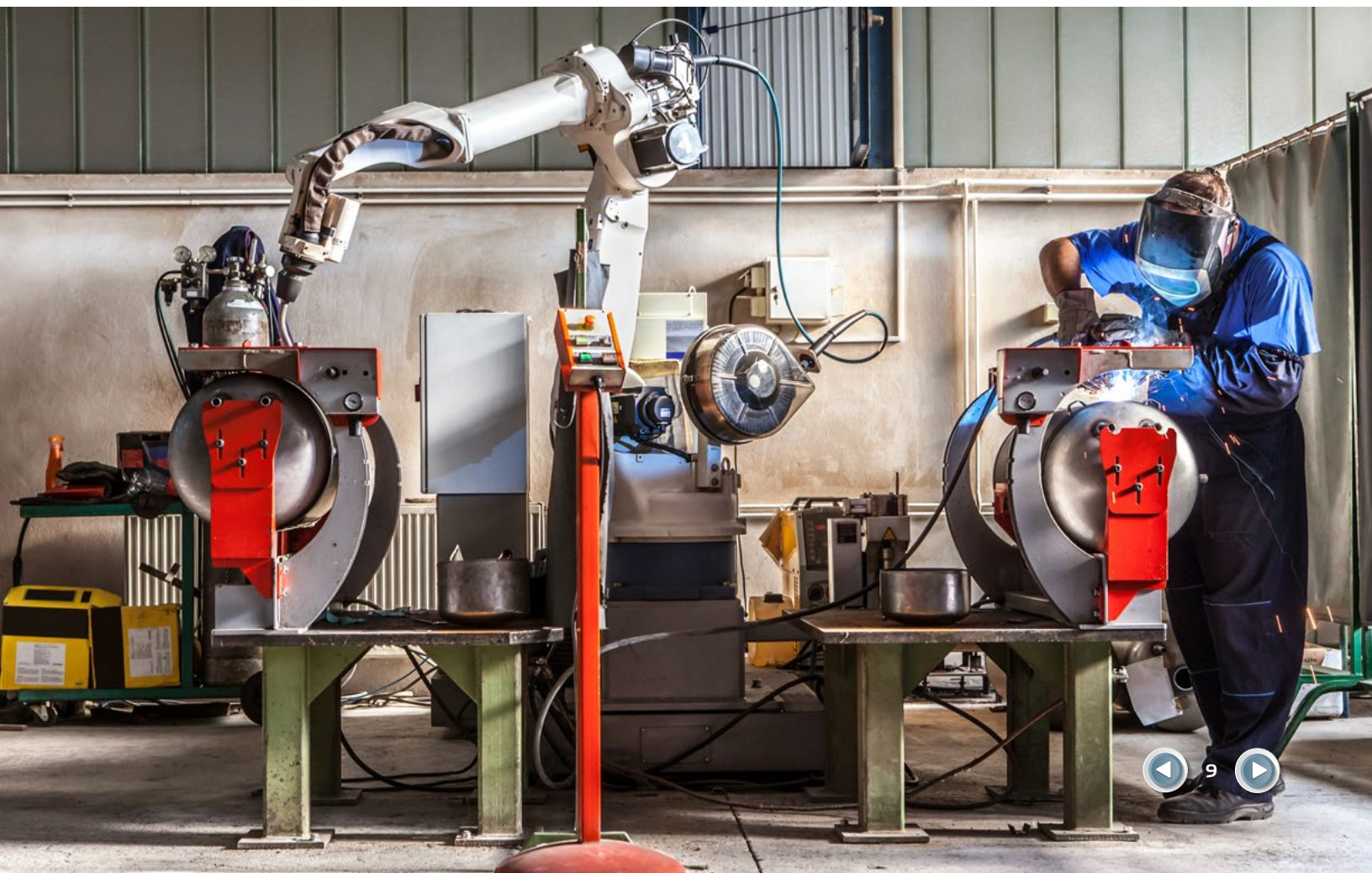
i. The OECD estimates that more than a billion jobs – one third of the world's workforce – will likely be transformed by technology in the coming decade. By 2022 alone, the World Economic Forum predicts that 133 million new jobs will be created in developed economies in response to the demands of the fourth industrial revolution.



The crisis brought by COVID-19 will change our current reality. There are two forces that converge in favor of the adoption of new technology. First, the disruption that the pandemic has caused in all economic sectors has the potential to make changes regarding skills that are in demand, as well as the occupations and tasks performed by workers, especially those that involve physical proximity. Second, although the region was in the beginning stages of new technology adoption, the need for social distancing has prompted companies and individuals to invest heavily in technology that allows them to work remotely, offer goods and services online, and perform tasks in an automated fashion, without the human factor.

Lastly, the pandemic has changed the overall balance of the labor markets.

The technological revolution brings challenges and causes significant tension, both in developed as well as developing countries. The adaptation and reinvention of workers affected by new technology is not easy, and it is the main factor for determining the degree of technological unemployment and inequality generated within a country. In Latin America and the Caribbean, it is necessary to make strategic decisions in order to have public policies and public-private alliances that allow citizens to develop the [skills that are required in the XXI century](#).







3 | What's up?

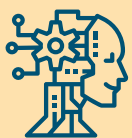
Here come the robots! Ever since a study conducted at the University of Oxford predicted that nearly half of jobs in the United States were at risk of being automated in the next two decades, various analysts have dedicated themselves to understanding what the future of work will look like. Journalist Andres Oppenheimer addresses this issue in his book *The Robots are Coming!*, in which he reflects on the technological advancements in various professions: *They're Coming for Bankers*, *They're Coming for Lawyers* and *They're Coming for Doctors*. Basically, the author warns that technological advances are a threat to all professions.

Automation refers to the process by which new technologies, such as robotics and artificial intelligence, replace people in performing tasks and activities. As we have seen in the previous issues of this series on *The Future of Work in Latin America and the Caribbean*, the last decades have been marked by the development of new technologies that are advancing and spreading at an exponential rate. These have been disruptive innovations, and have the potential to transform the world of work in a number of economic sectors⁸.

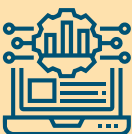
BOX 1. WHAT DO WE MEAN BY ROBOT, ARTIFICIAL INTELLIGENCE AND DIGITAL PLATFORMS?



ROBOT. The International Federation of Robotics defines the term industrial robot as an “automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes,” as defined by the International Organization for Standardization.



ARTIFICIAL INTELLIGENCE. Ever since Alan Turing developed his Turing Test, scientific researchers have worked to develop a computer able to function like a human brain. Over the years, scientists seeking to mechanize the human decision-making process have done so based on neural networks and algorithms; these are the people who created what is now known as artificial intelligence.



DIGITAL PLATFORMS. These facilitate direct connections between customers who require a service and workers who are willing to provide that service. Digitally enabled independent work is defined as “work that is intermediated through an online marketplace that improves search capabilities, lowers coordination costs, and provides richer signaling through mechanisms such as reviews or ratings” (Tellis, 2016).



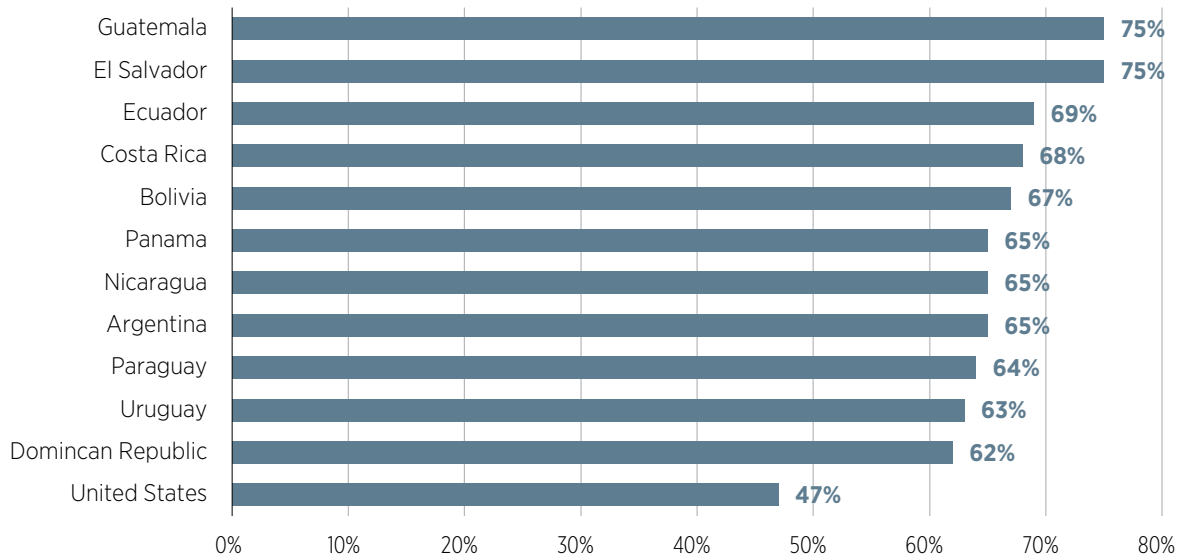
These technologies can be a double-edged sword: on the one hand, they are a great opportunity to increase productivity and growth, while on the other hand, they can lead to technological unemployment and increase both inequality and polarization if governments, companies and individuals do not respond appropriately. MIT economists Daron Acemoglu and David Autor identified two effects that the adoption of industrial robots have had on employment, which go in opposite directions⁹. The first is that it makes workers more productive and allows them to develop new tasks that have greater added value. The clearest examples of this are technologies that have allowed sectors of the economy, educational system and governments to continue to operate remotely in the midst of the pandemic. The second effect has to do with the displacement of workers when they are replaced by machines which, up to this point, has been the most feared consequence. Several authors have analyzed available evidence from the United States and various European countries which indicates that, although there have been gains in terms of productivity, the impact of replacing humans with machines is more significant, which is why there has been a decrease in workers' wages and a negative effect on overall employment. The results suggest that the effect of the displacement is greater than productivity gains, leading to decreases in wages and the aggregate employment level¹⁰⁻¹¹.

These studies were seeking to provide more evidence on the effects of robots, in response to a previous agenda that began in 2013 when two academics from the University of Oxford (Carl Frey and Michael Osborne¹²) attempted to find out how many workers could be at high risk of being replaced due to technological advances. The results of the study led to controversy when they estimated that almost half of workers in the United States (47%) were at risk of being replaced by robots by 2030. Based on this research, a number of economists and institutions around the world began to analyze the number of workers who were at risk of being automated. The resulting figures for the United States and Europe only fueled the fear of robots. In 2015, for example, Citibank stated that in developed countries (with a focus on the OECD), an average of 57% of jobs were at risk¹³. One year later, McKinsey concluded that 50% of tasks performed by workers in 46 countries (80% of the global workforce) could be performed by a new technology¹⁴. These methodologies assigned a probability to each occupation based on the possibility of a robot being able to perform that task. When applying this approach to countries in Latin America and the Caribbean, the results that were obtained for the region are not encouraging¹⁵. In the most extreme cases, as in Guatemala and El Salvador, it is estimated that three out of every four jobs could be replaced by machines.

New technologies are a great opportunity to increase productivity and growth, but they can lead to technological unemployment and increase inequality and polarization



FIGURE 1. PERCENTAGE OF WORKERS IN OCCUPATIONS WITH A HIGH RISK OF BEING REPLACED BY ROBOTS



Source: Micco and Soler, (2020). *Estimaciones del riesgo de automatización en América Latina y el Caribe*. IDB

Other methodologies

Will robots end up taking over jobs in Latin America and the Caribbean? Probably not. Although the COVID-19 pandemic has accelerated the adoption of technology, reasonable doubts exist regarding the pessimistic predictions that tell us that our region could see the end of employment.

Developing countries have a slower technology adoption rate than more advanced economies.

Only 0.6% of robots produced globally end up in Latin America and the Caribbean. While the United States has 131 robots for every thousand

workers, Chile and Colombia have only 10 and 3, respectively. One reason is, the cheaper the labor and the more expensive the machines, the less incentive there is to automate tasks. For example, there is already a [robot worker](#) capable of laying a thousand bricks an hour, but with the money that a company would need to invest in order to buy this machine (\$400,000), they could pay the salaries of 10 bricklayers for 10 consecutive years in a country like Mexico, as explained in the [first issue of this series](#).

There are reasonable doubts regarding the pessimistic predictions that tell us that our region could see the end of employment

**BOX 2. JUST HOW ROBOTIZED IS THE REGION?**

So far, adoption of robots has been limited in Latin America and the Caribbean. The implementation of robots depends not only on their capabilities, but also on the cost-benefit analysis carried out by companies. For example, robots have been widely used by the automotive industry in OECD countries since 1980, but their use has spread to other industries and developing countries in recent years. The highest robot density (number of robots per thousand workers) is found in Korea, Japan, Germany and the United States. Compared to these nations, the countries in Latin America and the Caribbean are lagging behind: out of the 387,000 robots sold globally in 2018, only 0.6% ended up in this region.

Country	2012	2013	2014	2015
Argentina	105.02	117.71	136.73	151.82
Brazil	622.73	710.22	809.31	920.42
Chile	3.29	4.20	6.73	8.49
Colombia	2.69	3.71	5.44	8.13
Mexico	384.67	639.36	883.24	1424.93
United States	14900.47	16450.84	18382.89	20276.00

Note: Figures represent thousands of robots. **Source:** International Federation of Robotics (2016).

When looking at the most in-demand occupations in Latin America, the conclusion is that jobs that will continue to require human abilities do exist. As addressed in the [third issue of this series](#), occupations can be classified into four categories: routine vs. non-routine, and manual vs. cognitiveⁱⁱ. The highest-paying jobs are concentrated among those groups of workers who perform non-routine, cognitive tasks, such as designing a website or an advertising campaign. This categorization of occupations as routine or non-routine and manual or cognitive conveys an essential idea: it is not the occupation itself that it is important, but rather

the types of tasks that are performed within that occupation. In this vein, in two studies carried out by the OECD¹⁶⁻¹⁷, experts argued that employment automation figures are overinflated since they assume that all workers within an occupation are performing the same tasks with the same importance when, in reality, workers' job structures vary significantly within an occupation. Thus, even within the same occupation, it is not likely that all workers will be exposed to automation to the same extent. In fact, a McKenzie study estimates that only 5% of occupations include tasks that could be 100% automated.

ii. On one extreme, manual occupations with a large number of routine and repetitive tasks, such as those performed by factory workers, have a higher probability of becoming automated. On the other extreme, many cognitive occupations that are not repetitive, such as architects or photographers, are at lower risk for automation because they involve tasks that require creativity, leadership and other soft skills that robots have not developed yet.

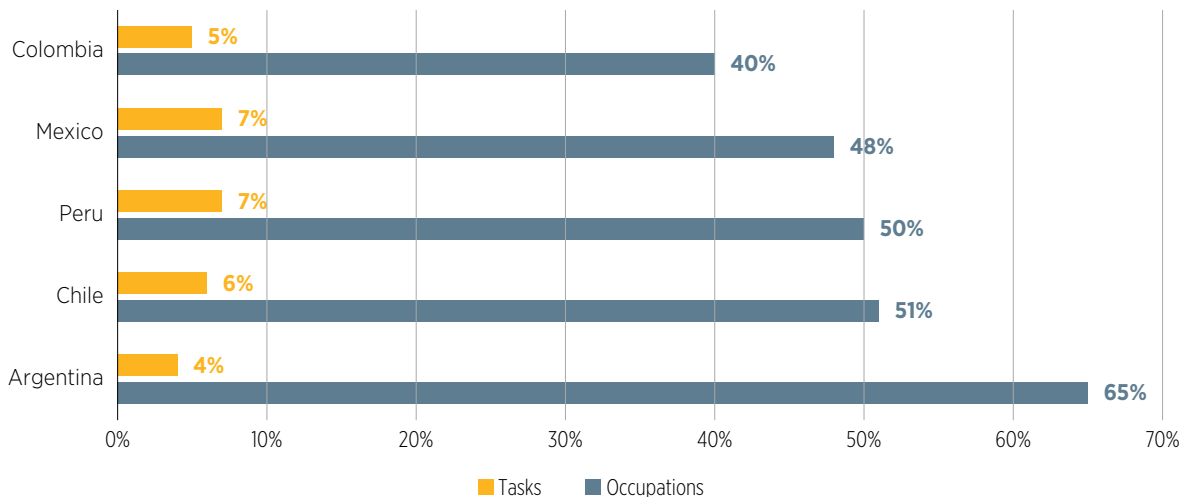


In other words, the so-called “task approach” is based on the idea that job automation ultimately depends on the tasks that a worker performs on a daily basis, and not on their occupation itself.

Not only does this approach provide more realistic predictions for the future, but the numbers it provides are more encouraging for workers in the region. If robots were to arrive in Latin America and the Caribbean today, with the technology that is currently available, only 6% of the workforce would be displaced. Figure 2 illustrates the dramatic difference that can be seen when comparing these two approaches, with Argentina being the country with the widest gap. As an example, this

approach recognizes that a company may have two workers who are classified as salespeople, but it is possible that one is dedicated to processing customer purchases, while the other is in charge of finding the product that best meets the customer’s needs and expectations and highlighting the benefits of the purchase. An occupation-based approach would say that both salespeople are equally as likely to see their jobs become automated. By contrast, a task-based approach would indicate that the salesperson who only processes customer purchases is more likely to lose their job, since a machine could carry out their responsibilities more simply and efficiently.

FIGURE 2. PROBABILITY OF JOB AUTOMATION ACCORDING TO VARIOUS APPROACHES



Source: Micco y Soler, (2020). *Estimaciones del riesgo de automatización en América Latina y el Caribe*. IDB

These reasons may not be enough if technology allows robots to perform more and more tasks every day, and at a lower cost. Not surprisingly, this is the path that characterizes technology: in just ten years, the capacity for storing information has grown exponentially, while its cost has fallen dramatically. There is no doubt that the same thing is happening with tasks that can be performed by machines: 20 years ago, cell phones were only

used to make calls, while today millions of people use their smartphones to perform hundreds of tasks every day.

Historical perspective is important, since the threat of unemployment has always gone hand in hand with technological innovation. Of course, predictions about declining employment have not always come true. At the beginning of the 19th century, a sophisticated version of the stocking



frame led to the looting of textile mills in British cities such as Liversedge and Middleton, as a part of what is known as the Luddite movement, and Parliament declared the destruction of these machines because they were a national offense. The truth is that each new technology has displaced a group of workers, but has also created new jobs that did not exist previously. Employment migrated from farms and factories to offices with cubicles and call centers.

Everything indicates that this pattern will continue, and that the jobs eliminated by robots will be balanced out by new jobs that will be created, jobs that we are still unable to imagine. The OECD estimates that more than a billion jobs – one third of the world's workforce – will be transformed by technology in the coming decade. In much less time, by 2022, the World Economic Forum estimates that 133 million jobs will be created in developed economies in response to the demands of the fourth industrial revolution¹⁸. In another recent study conducted among businesses that have adopted robots in Canada, they found that the total number of workers within the

company increased with automation, although it changed the overall structure and led to employee turnover.

Not only do jobs evolve, but so do the skills needed to perform them. For this reason, it seems reasonable to consider that the fourth industrial revolution will not bring the end of employment, but rather a transformation of the world of work as we know it, towards new occupations and tasks that we cannot yet imagine.

Beyond workers being replaced by robots, a complementarity effect also exists. The proliferation of 'cobots,' that is, collaborative robots, has recently been observed within many sectors and contexts. This term refers to robots that require human intervention in order to operate within an environment in which a worker and cybernetic technology perform complementary tasks. Loup Venture predicts that by 2025, 34% of all industrial robots will be 'cobots.' This means that instead of replacing workers, at least a third of robots will complement human work, thus freeing up workers' time for more creative activities.



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4 | What's new?

There is limited evidence regarding the direct effects of automation within the region. However, in a globalized economy, direct impacts are not the only impacts that should be of concern.

Automation in developed countries also has the potential to affect Latin America and the Caribbean. “Direct impacts” or “home automation” refer to processes that happen within a country, for example, when you consider an [ATM](#) doing the tasks of a person who works at a teller window giving and taking money. That said, within the global economy **it is essential to analyze how automation in developed countries affects emerging or developing economies.**

Why consider this new way of analyzing the topic? Today, globalization means that changes occurring in each country will also impact other nations. Today's economy is interconnected in a world where trillions of dollars' worth of products and services are traded every year. The growth of international trade has led to significant gains in productivity within Latin America and the Caribbean. Without trade liberalization, the income growth of these countries would have increased 30%-40% less, on average¹⁹. Additionally, the development of global trade has the potential to increase the region's influence, which is already a large market valued at \$5 trillion²⁰.

Globalization has also helped put developing countries on the map of world trade, and in

doing so, has brought significant impacts for the labor market. One of the most interesting effects has been the relocation of repetitive and labor-intensive jobs from richer countries to those that are less developed. Companies established in more developed countries chose to outsource the production or delivery of services to other parts of the world, motivated mainly by the comparative advantages that these countries offer due to their lower wages. US companies moved their customer service centers to the Caribbean, computer and smartphone manufacturing became centered in Asia and part of the automobile assembly process moved to Latin America, mainly in Mexico and Brazil. This process is known as offshoring, and it created an important place for many developing countries within the global production chain.

In this globalized context, robots, artificial intelligence and digital platforms have the potential to change the way companies manage their production in other parts of the world. At the same time, new technologies are reducing the costs of production in industrialized economies. Therefore, the concern is that by reducing the need for human labor, and thus the labor costs associated with production, automation may lead to products previously produced in developing economies being produced once again in developed countries. This would lead to the risk of emerging economies becoming deindustrialized



and having to one again concentrate their production on the extraction of raw materials²¹.

In fact, advanced economies are reversing offshoring to the point of having created the concept of “reshoring,” referring to the process in which offshoring is reversed. Advanced economies are decreasing their offshoring activities, which has a negative effect on employment in emerging economies²². Less than 20% of internationally-traded goods are labor-intensive; this number has declined sharply over the last decade. Global value chains are becoming more knowledge-intensive and more dependent on highly-skilled workers. The adoption of robots leads to reshoring, which benefits the workers in advanced economies²³.

But not all reshoring processes are successful, since economic variables play a role. In a recent example of reshoring, Adidas installed new prototypes for factories called “speedfactories” in Ansbach, Germany and Atlanta, United States, which are able to produce half a million pairs of shoes per year using only industrial robots. Traditionally, companies within this industry have relocated their production to places characterized by lower wages such as China, Vietnam and Indonesia.

Since the robots were not able to perform every task, these speedfactories hired approximately 160 people, showing that automation could reduce the need for labor. However, various factors such as logistics, taxes, location or distribution led to unexpected results, and the plants had to close – with production returning to Vietnam and China.

Is reshoring a threat to countries in Latin America and the Caribbean? In order to answer this question, allow us to present a novel analysis about the impact that the adoption of robots by US companies had on the labor markets in Brazil, Colombia and Mexico between 2011 and 2016. These three countries have significant trading relationships with the United States. Mexico sends 75% of its exports to their neighbor and receives 53% of their imports from them as well, which makes theirs the most interdependent economy with the United States. In Brazil's case, the United States is their second largest customer, to whom they send 12% of their exports, and it is also the main country from which they receive imports, with 15% of their total imports in 2016. For Colombia, the United States is the destination for 37% of their total exports, and the origin of 6% of their imports.

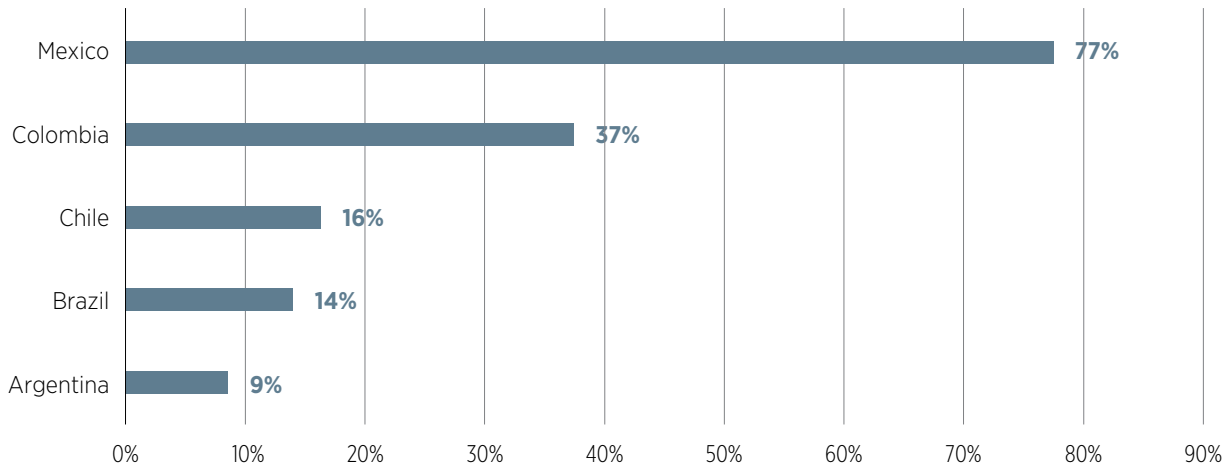
BOX 3. WHAT DO OFFSHORING AND RESHORING MEAN?

The concept of offshoring refers to the practice of establishing a business or parts of a company in another country, usually motivated by lower taxes or the lower cost of production factors such as labor or natural resources.

Reshoring is the process of returning the production and manufacturing of goods and services back to the home country where the multinational corporation that produces the good or service in question operates. Therefore, it is the conceptual opposite of offshoring.



FIGURE 3. PERCENTAGE OF EXPORTS TO THE US



Source: Compiled by the authors using data from the UN Comtrade Database.

There are various mechanisms that determine how the adoption of robots in the United States affects Latin American labor markets. On the one hand, recent studies suggest that the fact that robots are getting cheaper facilitates the increase in robot density in developed countries, changing the comparative advantages of some industries. Higher productivity and lower production costs with robots encourages domestic production versus the alternative of producing in a country with cheap labor; this process is known as reshoring. By reversing the process that led to many com-

panies locating their production centers in developing countries, this new dynamic may affect employment in Latin America and the Caribbean. On the other hand, productivity gains in the industry adopting the robots increases the demand for materials from all the supplier industries, increasing the importation of those materials, and thus favoring employment in the region²⁴. This phenomenon can affect the position of developing countries within the global value chain, since automation diminishes the significance of low labor costs as determinants of competitiveness.

AUDIO 1

THE IMPACT OF AUTOMATION ON THE GLOBAL VALUE CHAIN

Laura Ripani, Principal Specialist in the Labor Markets division of the IDB, talks with **Christian Volpe**, Principal Economist in the Integration and Trade sector of the IDB about the implications of the growing infiltration of robots in developed countries.



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In order to study this international trade and automation phenomenon, the labor dynamics of workers in Brazil, Mexico and Colombia have been analyzed²⁵. For this purpose, employment has been grouped into 19 sectorsⁱⁱⁱ for the 2011 to 2016 period, using administrative information about workers and employers in the formal sector from each of the study countries (IMSS for Mexico,

RAIS in Brazil, and PILA for Colombia). This data is used to analyze the effect that robot introduction in the United States has on employment and on the average salary of workers, as well as how this introduction affects two labor dynamics: i) the possibility of workers losing their formal employment and ii) the probability that a worker without a formal job will find a formal position.

TABLE 1. EFFECTS OF AUTOMATION IN THE UNITED STATES ON LABOR MARKETS IN BRAZIL, COLOMBIA AND MEXICO

	EMPLOYMENT	WAGES	TRANSITION TO UNEMPLOYMENT	TRANSITION TO EMPLOYMENT
Brazil	-0.0137*** (0.0078)	-0.0941*** (0.0601)	0.7076*** (0.0898)	0.0203*** (0.0054)
Colombia	-0.0014*** (0.0004)	-0.0178*** (0.0063)	0.0012*** (0.0002)	-0.0007 (0.0007)
Mexico	0.0020*** (0.0004)	0.0195** (0.0063)	-0.0011 (0.0003)	0.0002** (0.0008)

Notes: The numbers in parentheses refer to standard errors, and the asterisks refer to significance levels *, ** and *** at 10%, 5% and 1% respectively.

Source: Compiled by the authors. For more details about the data for Colombia, see [U.S. Robots and their Impacts in the Tropics: Evidence from Colombian Labor Markets](#) (Kugler et al., 2020)

The findings of this new study indicate negative impacts on employment and wages for Brazil and Colombia over the corresponding years. The robots incorporated in the United States had a negative effect on employment in Brazil (-0.137%) and Colombia (-0.14%), as well as a reduction in wages (-9.41% in Brazil and -1.78% in Colombia) between 2011 and 2016. Furthermore, the study showed an increase in the likelihood that a formal sector employee in these countries would lose their job due to the impact of automation in the United States. Nevertheless, the probability of an unemployed worker being hired into the formal sector is low. In this sense, we can see that the

impact that robots are having on employment can already be seen in our economies, even without a direct, substantial robot presence.

Is this the reality for every country? The answer is no. When analyzing the effects in Mexico, we see an increase in both the level of employment (0.2%) and wages (1.95%). Furthermore, transitions from unemployment to employment increase by 0.02%. The story, therefore, is not as simple as it seems, nor as catastrophic. If robots increase productivity in developed countries, this can also create a higher demand for intermediate products and consumer goods that are produced

iii. Agriculture; Mining; Food and Beverages; Textiles; Wood and Furniture; Paper; Plastics and Chemicals; Glass and Ceramics; Basic Metals; Metal Products; Metal Machinery; Electronics; Automotive; Other Vehicles; Other Manufacturing Sectors; Provision of Electricity, Gas and Water; Construction; Educational Research and Development; Other Non-manufacturing Sectors.



BOX 4. THE AUTOMOTIVE SECTOR IN THE US AND BRAZIL AS AN ILLUSTRATION

If an American auto company in Detroit decides to automate its engine production, this technology would replace a significant number of workers. But where are these workers? Since these jobs have been outsourced for decades to countries like Brazil where the auto parts assembly process takes place, it is possible that the workers who lose their jobs would be Brazilian, not American. In other words, automation in the United States can lead to unemployment in Brazil since companies are bringing their production back north.

in developing countries, thus creating new jobs. Take the example of cars in Mexico: increased vehicle production in Detroit requires more chips for the new technological dashboards in cars, and

these chips are made in Mexico. As a result, more jobs are available in the chip factories, and wages are increased so that more people are willing to work in this field.

Do robots affect everyone equally?

Technological change is a highly unequalizing force in many developed countries. As a result, it is important to understand whether this is also the case for the region as a whole, both through direct and indirect effects. This is why it is important to observe whether the impacts are different among each population group. When analyzing various characteristics, it was found that the effects vary across each group, and those groups that historically have been more vulnerable are the ones that are most affected by technology.

Robots in the United States affect the wages of Latin American women. Even in Mexico where the overall effect has been positive, the impact on women has been negative, and as a result, men are especially favored. This is reflected in the [fourth article of this series](#), which uses a task-centered approach to estimate the impact of automation on male versus female employment in four countries within the region. According to this publication, women are at greater risk of losing

their jobs to a robot. This implies that if action is not taken in time, the fourth industrial revolution has the potential to widen the gender gap.

In terms of age, the results are more negative for older age groups. This finding contrasts with what has been found for countries outside the region, where the impact that automation has on employment has been more negative for younger people²⁶. For example, a German study shows that the introduction of robots leads employers to stop hiring and to keep existing workers, which directly harms the young people who generally make up the incoming workforce. Likewise, a study in European Union countries shows that introducing robots into companies is especially harmful to the youngest population, compared to adults²⁷. In the case of Latin America and the Caribbean, the fact that older people are the ones who are most affected leads to several challenges. On the one hand, older people may find it more difficult to learn new skills and re-enter the work-



force, whether in the sector they were previously working in, or in another related sector. On the other hand, we need to take into account that nowadays people live longer than before, so older adults who leave companies as a result of robotization will need to maintain an income for longer, whether from work or from a pension. This raises a need to think about public policies that could be adopted to take advantage of the benefits of this “silver economy,” which represents older adults who still have the willingness and ability to contribute to the labor market.

Another interesting impact on the region is that **the people who are hit the hardest are those who work in smaller companies**, which are normally the least productive within the economy, an impact that is statistically significant in the cases of Colombia and Mexico. This data about the differential impact of automation on employment

according to type of company is both interesting and groundbreaking, since there is very little information in this regard for the region or for developed countries. In this context, it makes sense that companies that are less productive within the economy may be more adversely affected by technological development.

Finally, Brazil is the only country in the study with results that differentiate impacts by both education level and ethnic group. The results show that the people in this country with the lowest level of education are the ones who suffer the most from the impacts of automation in the United States. This fact is consistent with the literature on automation, which reflects that those in higher-educated groups have jobs that are more difficult to automate because they perform more complex tasks and activities. Likewise, people of color were also affected more adversely.





5 | What next?

Automation is a growing phenomenon that is permeating every sector and having a disruptive impact on the region's labor market. Although there are variations in the different assessments carried out regarding the potential impact that automation could have on occupations in the region, one common outlook – at least prior to the COVID-19 crisis – emphasized that there is still a window of time to make decisions, because Latin America and the Caribbean are still in the early stages of technology adoption. It is possible that this factor could change rapidly given that the pandemic is putting immense pressure on companies and individuals to adopt technologies that allow them to stay in business amidst the social distancing and quarantine requirements in what has been called “the new normal.” In turn, this crisis is resulting in an ongoing transformation of the tasks and skills required for certain occupations, as well as the emergence of new jobs that we could not have previously imagined.

In any case, and as this study shows, automation's penetration into the more advanced economies could have a negative impact on developing countries today, not only locally, but also through international trade. This finding reveals the urgency to make public policy decisions that maximize the benefits of new technologies while minimizing the risks they pose to the region. This article has defended a historical perspective approach that helps us understand that this technological revolution is not the first such revolution that humanity has faced, and as such, we are not

dealing with the “end of employment.” However, history also shows that countries and, more specifically, the labor markets that have faced these disruptions were not free from hardships, and even faced long periods of time where some of their citizens were negatively affected²⁸.

The labor market will be transformed along with the skills that are currently in demand, which are constantly changing. Prior to the pandemic, it was estimated that by 2022, 42% of the core skills used today to perform jobs would change (OECD). In addition to technological skills, interpersonal skills will also be in high demand within the job market, including those related to sales, human resources, caregiving and education. According to OECD estimations, more than 1 billion jobs (representing almost a third of the world's workforce) are likely to change over the next decade as a result of the technological revolution.

In this context of rapid change, it is essential to have measures in place so that we can face two of the greatest threats that could come as a result of technology: higher inequality and higher unemployment. The cost would be immense for countries that do not take the necessary measures. Estimates for G20 countries show that failing to respond to this new technological age's demand for skills could put \$11.5 trillion of potential GDP growth at risk within the next decade, according to Accenture estimates. The human cost would be even higher.



How to react to technological change

In order to react to technological change, we need to ensure that Latin America and the Caribbean countries are able to minimize the risks associated with the fourth industrial revolution.

Action must be taken to make the most of the opportunities it brings in order to build a more prosperous and egalitarian society. Firstly, it is important to have a policy agenda that makes it possible to identify those sectors that will be most affected by automation, considering both the direct effects (direct impact of home automation on domestic employment) as well as the indirect effects (which sectors will be affected by trade relations with countries such as the United States).

Secondly, career and training plans to adapt workers' skills must be developed so they can transition from occupations with a declining demand into those that are growing.

This was an extremely critical point prior to the pandemic, and now it has become even more relevant. There are three important points to highlight regarding upskilling and reskilling strategies. The first has to do with recognizing that the new skills required by technological change need to be acquired not only by people who have not yet entered the labor market, but also by those who are already working. The second is that every upskilling and reskilling program must respond to the needs of the production sector, which means involving this sector in a very active way in order to identify short, medium and long-term needs. Finally, the

interventions must be high-quality so they lead to significant changes in terms of workers' labor trajectories, employability prospects and wages.

Thirdly, countries need to be able to support worker transitions in a better way, both from the perspective of the set of social benefits that workers receive, as well as public employment services.

In this sense, concepts such as obsolescence insurance could be interesting,²⁹ which seeks to protect workers by expanding social security to cover the devaluation of their skills and pay for training chosen by the workers themselves, so long as it meets the standards of quality and relevance. In the same way, employment services must incorporate a large amount of available data into their operations in order to become smart units that make it possible to improve the overlap between job supply and demand, and to quickly identify changing trends.

These points highlight the need for training plans throughout a citizen's entire working life, and the need for the labor markets to have the necessary tools to cope with changes, which are happening exponentially faster than those experienced in previous industrial revolutions.

With timely responses, technology brings with it the tools needed to apply public policies that can cushion the possible negative effects of the fourth industrial revolution, while helping to maximize the benefits that this new era will bring to the region.



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