Facing the COVID-19 Pandemic: Digitization and Economic Resilience in Latin America

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TITLE:
The State of Digitization in Latin America facing the COVID-19 Pandemic

EDITOR: CAF

Mauricio Agudelo – Coordinator of the CAF Digital Agenda
and the CAF Digital Ecosystem Observatory

AUTHORS:

TELECOM ADVISORY SERVICES LLC
Raúl Katz
Juan Jung
Fernando Callorda

The insights and methodologies presented in this paper are the exclusive responsibility of the authors; they do not represent the official position of the CAF.

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This study has been prepared within the framework of the CAF Digital Ecosystem Observatory. It aims to reflect on the impact of the COVID-10 pandemic and to propose solutions to mitigate its effects on Latin America and the Caribbean.

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INDEX

EXECUTIVE SUMMARY

The COVID-19 pandemic is unusual in that it poses a fundamental challenge to the global socio-economic system. Following the initial fear of contagion and the implementation of prophylactic measures, anecdotal evidence emerged suggesting that digital technologies could counteract the isolation resulting from social distance measures, increase awareness of virus prevention measures, and allow economic systems to continue to operate. The work presented in this paper relies on empirical evidence to highlight the important role digital technology could play in mitigating the pandemic's disruption while also evaluating Latin America's level of preparedness to face this challenge.

The empirical evidence generated worldwide indicates that digitization plays a critical role in mitigating disruptions associated with pandemics.

- The econometric analysis of the 2003 SARS-CoV virus' economic impact indicates that the countries with more developed connectivity infrastructure mitigated approximately 75% of the associated economic losses that resulted from the measures taken to control its spread (e.g. quarantining, social distancing, interruption of air traffic, use of face masks, etc.).

- There is substantial qualitative evidence confirming the contribution of digital technology to lessening the impact of the SARS-CoV virus (e.g. increase in 50% of videoconferencing traffic in Southeast Asia, development of e-commerce sector in China).

- Analysis of forecast data on downward impact on GDP of COVID-19 indicates that higher digitization economies will suffer less economic damage over the long run.

In this context, Latin America's intermediate-level of digitization can only partially mitigate the COVID-19 pandemic's effects.

- As witnessed at a global level, the exponential increase in Internet traffic is having an impact on Latin American networks by decreasing speeds and increasing latency. Country decreases in fixed broadband speed over the March 2020 amount to 7% in Mexico, 3% in Brazil and 13% in Ecuador while the decrease in mobile broadband speeds are more significant in Chile (-19%). Simultaneously, all countries are experiencing an increase in latency (source: Ookla / Speedtest). The models developed by *Telecom Advisory Services* demonstrate that fixed broadband speed has a 0.73% impact on GDP when speed increases 100%. If the speed decreases observed in the month of March becomes permanent, they are likely have a significant negative impact on the Latin American economies.

- Home Wi-Fi routers are congested as a result of the massive migration to tele-commuting, which results in an increase in remote access (80% increase in upload

traffic) and video conferencing. This trend has also contributed to the decrease in network speeds.

- While average Internet penetration in Latin American households in 2020 is projected at 78.78%, many countries have much lower penetration rates (Bolivia: 58.34%; El Salvador: 45.02%; Honduras: 39.33%). Further, the rural / urban divide indicates significant levels of marginalization, posing an obstacle for many sectors of the population that need to access the Internet to receive health information, download educational material, and purchase goods electronically.

- Internet use in most Latin American households is limited primarily to communication platforms (such as WhatsApp) and social networks. A composite index of household digital resilience (based on the frequency to download health and educational apps, conduct e-commerce operations, and utilize fintech platforms) reveals that the weighted average of Latin American nations is 30.70 (on a scale of 1 to 100), compared to a 53.8 weighted average of the OECD countries. The averages vary greatly even amongst countries within the region. For example, Chile has an index of 41.8 while Bolivia has an index of 6.2. In other words, Latin American Internet penetration rates do not translate uniformly into a high degree of digital household resilience.

- Despite high levels of technology adoption, Latin American enterprises lag when it comes to the assimilation of the Internet into their processes, particularly into their supply chains. For example, while over 85% of companies in the region have Internet access, its utilization in business processes varies widely. The number of companies that use electronic banking services ranges from 34.2% in Peru to 95.4% in Colombia. Only 15.2% of companies in Peru acquire inputs over the Internet compared to 66.00% of firms in Brazil. Furthermore, an assessment of the strengths and weaknesses of the various logistics players further highlights the shortcomings of the supply chain. Examples of these limitations include the low digitization of land transport and the lack of common standards for inter-organizational communication. Consequently, the production system is not well prepared to deal with the major supply chain disruptions stemming from the pandemic.

- With many workers unable to rely on telecommuting, the COVID-19 pandemic further disrupts the workforce. Our analysis of Chile's occupational statistics estimates the number of workers likely to be disrupted by the pandemic because they cannot go to their workplace and are not able to continue working from home. Of the eight million workers in the Chilean labor force, the analysis concludes that 20.6% of "essential" workers (e.g., health personnel, security forces, transportation and food chain workers, etc.) must continue to go to their workplace, and an additional 23% can continue to work remotely through the utilization of digital technology. Under these conditions, the remaining 4.4 million workers will not be able to go into the workplace or telecommute. Within this group, 1.6 million have – at most – primary education and 1.5 million fall within the 1st or 2nd income quintiles. These estimates for Chile are likely to be representative of other countries within the region given the similarity in the workforce structure.

- The State's resilience to the pandemic relies on its ability to continue delivering public services and performing all of its administrative processes. The calculation of a composite resilience index indicates that, as a result of the progress made during the last decade in developing e-government platforms, Chile, Uruguay, Mexico, Brazil, and Argentina appear well positioned to continue functioning under the COVID-19 disruption.

Having recognized the fundamental role that digitization can play in mitigating the effects of the pandemic, the Latin American public and private sectors, with the support of civil society, must collaborate and work together to promote the enhancement of certain components of the digital ecosystem.

- Accelerate the deployment of a large number of base stations for mobile broadband, reducing the permit requirements for the deployment of antennas.

- Temporarily allocate additional spectrum to mobile operators to face traffic spikes.

- Require video streaming service providers to reduce traffic volume generated from high definition content.

- Consider the need to increase unlicensed spectrum in the upper 5 GHz and 6 GHz bands in order to resolve Wi-Fi router bottlenecks.

- Promote platform development innovation in order to improve supply chains. Key activities include stimulating technology companies to develop platforms that can improve the efficiencies between logistics providers and transportation service providers.

- Encourage enterprises to further digitize business processes in order to increase the percentage of the workforce that can work remotely.

- Invest in the training of the most vulnerable population groups in order to decrease unemployment rates.

- Address some of the digital divide factors by providing devices (PCs, tablets, Wi-Fi modems, subsidized broadband service) to vulnerable consumers, and combine with distance learning training on e-education and telemedicine.

1. INTRODUCTION

This study has been prepared on behalf of the CAF Digital Ecosystem Observatory. It aims to examine the COVID-19 pandemic's impact and the role of digitization to mitigate its effects on Latin America and the Caribbean countries.

The COVID-19 pandemic is unusual in that it poses a fundamental challenge to the global socio-economic system. This challenge impacts advanced and emerging economies alike, forcing countries to reexamine social practices and production systems otherwise considered sufficient until the end of last year. In fact, as a result of this novel Coronavirus, most economists predict a global recession this year. The International Monetary Fund estimates that the global economy is projected to contract by –3 percent in 2020, a contraction much larger than during the 2008–9 financial crisis[1]. Similarly, Fitch slashed its 2020 forecasts, now estimating that the global GDP for 2020 will be US$850 billion lower than predicted in December 2019. While Fitch anticipates a 1.3% growth in global GDP this year (down from the 2.5% forecast issued in December), this number may be lower as the impact of the virus unfolds. Fitch anticipates a 5% decline in China's GDP for the first four months of 2020, unprecedented for the country. The ratings agency also expects GDP contractions in Italy (2%) and Spain (1%).[2]

Following the initial wave of the fear of contagion and the implementation of prophylactic measures, anecdotal evidence has emerged suggesting that digital technologies could, to a certain degree, counteract the isolation implied by social distancing measures, increase awareness of virus prevention measures, and allow economic systems to continue to operate. The exponential increase in Internet traffic (and the initial difficulty operators have had maintaining service quality), the reliance on telecommuting, and the need to maintain high-performing supply and distribution chains support this claim. Latin America has certainly made significant strides in developing its digital infrastructure over the past three decades, but even with these advances, we must ask ourselves the following questions to assess whether the region's digital ecosystem,[3] its infrastructure, and level of digitization will withstand the challenges posed by the pandemic:

- To what degree can digitization mitigate the disruption caused by the COVID-19 pandemic?
- To what extent are digital platforms currently used by consumers capable to disseminate Health care information, facilitating e-commerce transactions, and educating students?

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[1] International Monetary Fund (2020). *World Economic Outlook*, April.
[2] Fitch Ratings: "Coronavirus Crisis Is Crushing Global GDP Growth" (March 19, 2000).
[3]A digital ecosystem is defined as a set of interconnected components operating within a socio-economic context impacted by the massive adoption of information and communication digital technologies. The study of the digital ecosystem involves new modes of production, and different social behaviors related to the use and consumption of digital goods (see Katz, 2015; and Katz and Callorda, 2018).

- How can digital information flows efficiently support Latin American supply chains and production systems?
- Can telecommunications networks sufficiently support the massive surge in telecommuting?
- Can governments continue to operate effectively as they digitize administrative and management systems?

The answers to these questions are based on four types of evidence:

- Empirical analysis of the link between highly-developed digital ecosystems and preparedness to face pandemics;
- Analysis of the state of digitization in the region, particularly in comparison to the level of development of advanced economies;
- Identification of countries in the region that are better prepared to face the pandemic as a result of their higher levels of digitization; and
- Quantification of changes in the production system (particularly teleworking, distribution chains, and e-commerce) resulting from the pandemic in order to understand the scope of the challenge being encountered by Latin American countries.

Focusing on these key topics, the first section of this paper analyzes the relationship between the level of digital infrastructure and economic resilience in the face of a health crisis of significant magnitude, using the case of the 2003 SARS outbreak on the countries most severely affected.[4] Following this analysis, our work then assesses the impact of COVID-19 in Latin America on five categories: infrastructure, households, production systems, the workforce, and governments. The analysis enables the identification of key issues and potential solutions for the Latin American region as a whole as well as individual countries.

2. THE RELATIONSHIP BETWEEN DIGITAL INFRASTRUCTURE AND ECONOMIC RESILENCE TO A PANDEMIC

This section investigates the role that digitization plays in mitigating the socio-economic impact of pandemics like the novel Coronavirus. The available data for the SARS outbreak of 2003 enables the development of an econometric model to estimate the extent to which Internet infrastructure mitigated the negative economic impact within the countries affected by the outbreak.

In 2003, the virus known as SARS-CoV spread from China to 26 other countries, resulting in approximately 800 deaths (Wilder-Smith et al, 2020; see Table A-1 in appendix). These countries made efforts to isolate the population that had contracted or had been exposed to the virus while establishing quarantining and social distancing practices. While these practices were more limited and less stringent than current measures taken to confront

[4] We define socio-economic resilience as the ability of the system to overcome crucial challenges – like a war or a pandemic – to return to prior existing levels of economic activity.

COVID-19, they implemented the same measures to reduce face-to-face interactions resulting in slower economic growth.[5]

According to Keogh-Brown and Smith (2008), SARS negatively impacted the economy in the first, second, and third quarters of 2003, with the most negative impact occurring when the disease peaked in the second quarter. During the outbreak, affected countries saw a notable decreases in economic activity. These decreases translated to an estimated economic loss in the range of US $30 – 100 billion (Fan, 2003; Knapp et al, 2004; Lee and McKibben, 2004; McKibben, 2004). According to Keogh-Brown and Smith (2008), the health, tourism, hospitality, airline, retail, restaurant, leisure, and entertainment sectors experienced the largest impact.[6]

Our objective is to understand whether the countries with greater digital technology development and adoption were better positioned to mitigate the negative economic impact of SARS. At the time of the SARS outbreak, experts anticipated that the Internet would play an important role by promoting teleworking during a period of confinement.[7] In fact, this confinement period led to the development of China's e-commerce sector as its citizens began to shop online.[8]

For the purpose of an empirical estimation, we assume that economies produce according to a Cobb-Douglas production function:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta}$$

whereby *Y* represents the Gross Domestic Product (GDP) and *K* and *L* represent, respectively, capital and labor stocks of the *i* economy in the *t* period. Unlike Solow's (1956) conventional model, we assume that total factor productivity, represented by *A*, is not an unknown residual, but rather a function dependent on the penetration of the telecommunications

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[5] Various countries required citizens to comply with legally-enforced quarantine mandates. In Hong Kong, police reinforcements verified quarantine compliance, while Singapore installed cameras in the homes of citizens forced to isolate. In cases where all infected individuals could not be identified, governments mandated quarantines at the city or regional level. For example, China enacted large-scale quarantines in various communities affected by the disease, closing schools, universities, and public areas and canceling the May 2003 holiday. China even closed its capital, Beijing. Hong Kong also imposed community quarantines, installing barricades to isolate specific areas within the city in order to prevent contagion. Based on World Health Organization (WHO) alerts and warnings, as of March 2003, all countries with imported SARS cases enacted airport controls to monitor passengers arriving from affected countries. Vietnam, Malaysia, Taiwan, New Zealand, and Australia tried to limit the arrival of travelers from affected countries as much as possible and required those passengers who did arrive to wear a mask for 10 days under threat of fines for non-compliance. Multiple governments recommended halting all non-essential travel to countries affected by SARS, although no explicit bans were ever put in place. Most airlines canceled flights to these regions. Many of these countries had not experienced a quarantine since the Spanish Flu of 1918-1919 (Mandavilli, 2003).

[6] Per data from the World Tourism Organization, international tourism fell 1.2% in 2003. In East Asia, the arrival of tourists dropped by 41% in the first three weeks of April when compared to the same period of the prior year. During the first four months of 2003, Beijing reported $1.3B in tourism losses.

[7] Bidaud, B. & Chetham, A. (2003). "Telcos Shouldn't Expect a Profit from the SARS Crisis", *Gartner Research*.

[8] *Ghosh, B*. (2016). "China's internet got a strange and lasting boost from the SARS epidemic", *Quartz*.

infrastructure. As mobile broadband was limited at the time of SARS, we use fixed broadband per household penetration rates to proxy for telecommunications infrastructure, which we will call *BB.* [9] To identify the effects of SARS, a dummy variable with the value of 1 is used to identify the countries affected by the pandemic in year 2003. For this analysis, we consider as affected all those countries that registered at least one positive case, according to Table A-1 in the appendix. It is important to note that SARS may have negatively impacted the economies of other countries not included in this list.

Considering the above points, and applying logarithms to linearize the production function, the basic empirical model is defined as:

$$\log(Y_{it}) = \mu_i + \alpha \log(K_{it}) + \beta \log(L_{it}) + \emptyset \log(BB_{it}) + \Upsilon SARS_{it} + \zeta BB_{MED} * SARS_{it} + \varepsilon_{it}$$

whereby the symbol μ_i accounts for time-invariant unobservable country-level effects and ε represents an error term, which we assume verifies the desired properties. As the parameter Υ captures the pandemic's impact on the GDP of the affected countries, we expect it to be negative ($\Upsilon < 0$). Lastly, the symbol ζ measures the relationship between countries with fixed broadband penetration levels above the median (identified as the dummy variable BB_{MED}) and countries impacted by the SARS epidemic. In this sense, a value of $\zeta > 0$ would suggest that countries with better connectivity infrastructure had the ability to offset, to some degree, the negative economic impacts of the disease. Table 1 describes the variables used to estimate the model, along with the source of data for each variable. The sample is comprised by 178 countries for the period of 2000-2017.

Table 1. Description of the variables in the model

Variable	Description	Source
Y	GDP at constant 2011 prices (US $ million)	Penn World Table, version 9.1
K	Capital stock at constant 2011 prices (US $ million)	Penn World Table, version 9.1
L	Number of workers	Penn World Table, version 9.1
BB	Fixed broadband per household	World Bank – World Development Indicators
BB_{MED}	Dummy variable that takes the value of 1 for those countries with fixed broadband rates above the median	Our own construction from variable *BB*
$SARS$	Dummy variable that takes the value of 1 for those countries with at least one positive SARS case in 2003 (Table A-1 in annex)	Keogh-Brown and Smith (2008)

Source: Telecom Advisory Services analysis

Table 2 summarizes the results of the empirical estimates. The estimates in columns (i), (ii), and (iii) were conducted using the Ordinary Least Squares (OLS) method, while the estimate in column (iv) was carried out by the Instrumental Variables (IV) approach to control for

[9] Fixed broadband penetration is considered an adequate proxy to measure the state of digitalization (see correlation between both indicators in Appendix A-2).

potential endogeneity. All estimates incorporate robust standard errors clustered by country, as well as fixed effects by country and a time trend. [10]

In the case of column (i), the model estimates do not include the effects of SARS (that is to say, the $\Upsilon = \zeta = 0$ restriction is imposed). In this estimate, the parameters associated with capital and labor reflect the expected magnitudes and signs, while the coefficient measuring the link of fixed broadband penetration with GDP takes value of 0.027, being highly significant. In other words, a 10% increase in fixed broadband penetration rates translates into a 0.27% growth in GDP, which is consistent with the results found in other academic studies. Column (ii) incorporates the dummy variable used to identify countries affected by SARS in 2003 in an effort to analyze whether this pandemic negatively impacted the economies of these countries. The results do indeed suggest that the pandemic had a negative impact, with the coefficient Υ equal to -0.039 and, significant at a 5% level. These numbers demonstrate that in 2003 the countries with the highest number of SARS cases saw significant economic downturn. In any case, we must evaluate this relationship cautiously. Given that it is a dummy variable, it does not identify heterogeneities in the countries and may also be capturing other events and circumstances that also led to the economic downturn. [11].

Table 2. Economic Impact of SARS

	(i)	(ii)	(iii)	(iv)
$log(K)$	0.387*** [0.055]	0.387*** [0.055]	0.388*** [0.055]	0.365*** [0.058]
$log(L)$	0.345*** [0.091]	0.347*** [0.091]	0.347*** [0.091]	0.352*** [0.091]
$log(BB)$	0.027*** [0.005]	0.027*** [0.005]	0.026*** [0.005]	0.040*** [0.011]
$SARS$		-0.039** [0.016]	-0.086*** [0.031]	-0.099** [0.046]
$BB_{MED} * SARS$			0.065* [0.036]	0.086* [0.052]
Fixed effects by country	YES	YES	YES	YES
Time-trend	YES			
Restriction	$\Upsilon = 0$, $\zeta = 0$	$\zeta = 0$	-	-
Under identification contrast				34.404***
Weak identification contrast				103.52 (critical value 5%: 11.04)
Hansen test (over identification)				0.571
R^2	0.95	0.95	0.95	0.81
Observations	2.497	2.497	2.497	2.460
Estimation method	OLS	OLS	OLS	IV

Note: Robust standard errors in parentheses.. *p<10%, **p<5%, ***p<1%

[10] Similar results when applying fixed effects by year (available upon request).

[11] For example, and as noted by Keogh-Brown & Smith (2008), SARS coincided with another critical international event, the 2003 Iraq War.

In order to evaluate whether the economic impact within SARS-afflicted countries was heterogeneous in terms of the development of their connectivity infrastructure, column (iii) presents an estimate including the interaction between the SARS variable and BB_{MED}. The results of this interaction variable indicates a positive and significant coefficient of 10%, suggesting that countries with the most-developed broadband infrastructures were able at least partially to offset the negative effects of the pandemic. In other words, although all impacted countries did experience some negative economic effects, these were significantly less in countries with high fixed broadband penetration rates. This finding suggests that Internet usage mitigated the economic damage by keeping the economy up and running through virtual economic activity such as enabling some workers to telecommute.

As already mentioned, it is important to exercise caution when reviewing these results. The direct comparison between the Υ and ζ variables shown in column (iii) allows us to estimate the extent to which good connectivity infrastructure mitigates economic loss. In this sense, the ratio between both variables suggests that **good connectivity infrastructure could have mitigated approximately 75% of the economic loss.**[12]

Lastly, column (iv) replicates the estimate of column (iii), but applies the IV method to control for potential endogeneity associated with the broadband variable. [13] As usual with this type of estimations, the greatest challenge is finding suitable instruments; that is to say, that have explanatory power over the potentially endogenous variable (fixed broadband penetration), but not directly over the model-dependent variable (GDP). In this case, we will be using the fixed telephony penetration variable with a five-year lag. [14]

The fact that broadband deployments largely depend on pre-existing phone lines[15] justifies this choice. In this case, a 5-year time delay is applied to the variable to eliminate any possible impact of contemporary shocks and to avoid concerns related to reverse causality. It is important to note that the contrasts carried out and reported in Table 2 verify the quality of the instruments; the hypotheses of null or weak identification are rejected, confirming that they do explain the potentially endogenous variable, while the Hansen identification test provides evidence about the exogeneity of the instruments. The IV estimation results

[12] Calculated as the quotient between the BB_{MED}*SARS coefficient and the SARS coefficient.

[13] The presence of endogeneity can result from a number of factors. For instance, it may be the result of the omission of variables that simultaneously affect GDP and the level of broadband penetration. To the extent that these unobserved variables do not variate over time, the incorporation of fixed effects allows for their control. Secondly, endogeneity may be a result of the presence of reverse causality; just as broadband penetration impacts GDP, GDP also impacts penetration levels. Lastly, the existence of measurement errors in the variables could also contribute to endogeneity.

[14] The instrument is introduced at both in levels and in interaction with the SARS variable and, replicating what was done with BB_{MED} , a dummy is added to identify countries that had fixed penetration rates above the median 5 years ago.

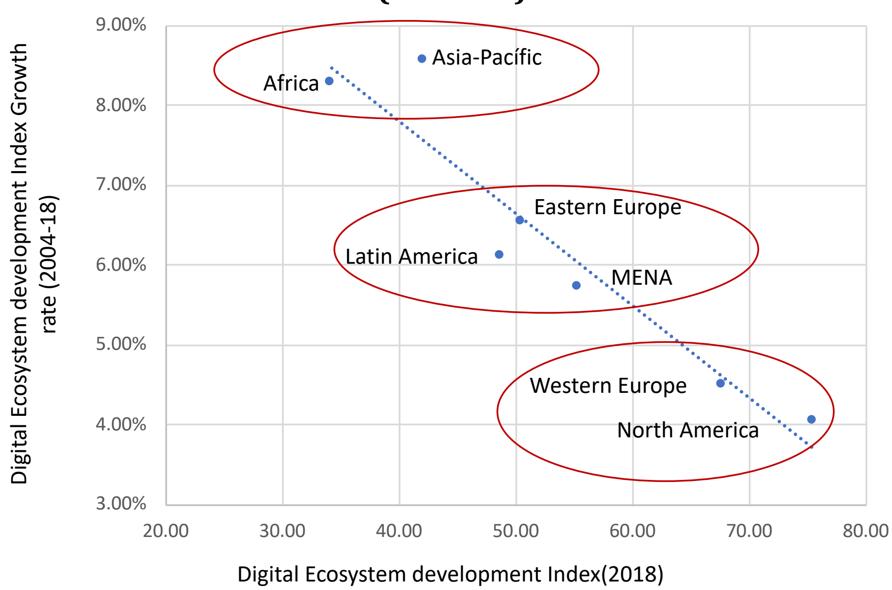
[15] In this sense, following the work of Czernich et al (2011), the fact that an existing infrastructure, such as fixed telephony, is required for broadband deployments makes existing phone lines an appropriate instrument. Czernich followed this strategy, using pre-existing fixed and cable telephone line data to measure national broadband penetration levels. Similarly, Bertschek et al (2013) perform an econometric analysis using ADSL availability as an instrument for the broadband variable.

confirm the results previously reported for the OLS case; those countries with the largest broadband infrastructure expansions had the ability to offset, at least partially, the negative effects of the pandemic. This conclusion provides a core foundation underlying our analysis of how Latin America will be affected by the COVID-19 pandemic based on its digital infrastructure.

3. THE STATE OF THE DIGITAL ECOSYSTEM IN LATIN AMERICA

The Latin American region has an intermediate digital ecosystem development level when compared to other regions of the world (see Graphic 1 below). With an index of 49.92[16] (on a scale of 0 – 100), the region is more advanced than Africa (35.05) and the Asia Pacific region (49.16). Despite significant advances, however, Latin America lags behind Eastern Europe (52.90), the Arab States' MENA region (55.54), Western Europe (71.06), and North America (80.85).

Graphic 1. Digital Ecosystem Development Index vs. Growth Rate (2004-18)



Source: Telecom Advisory Services analysis

Further, the annual growth rate of Latin American index is lower than in other regions. As shown in Graphic 1, the Digital Ecosystem Development Index for Latin America and the Caribbean presents the lowest compound annual growth rate when compared to other emerging regions, with an CAGR of 6.21% between 2004 and 2018, compared to Eastern Europe (6.89%), Africa (8.27%), and Asia and the Pacific (9.39%). Based on its level of digital development, Latin America should experience a faster growth rate. As expected, industrialized countries depict lower annual growth rates when compared to the rates of the emerging world: digitization grows at an annual rate of 4.28% in Western Europe and 3.94%

[16] These indexes reflect the values of the CAF Digital Ecosystem Development Index. The Latin American Index includes the countries in the Caribbbean.

in North America. The disaggregation of the index by pillar makes it possible to identify the challenges that the Latin America region faces as it deals with the disruption of the pandemic.

4. DIGITAL INFRASTRUCTURE RESILIENCE

The deployment of prophylactic measures to confront COVID-19, such as the closure of workplaces and home quarantine, has led to a spike in telecommunications network usage[17] resulting from increased reliance of e-commerce, more intense social connectivity, telework and distance learning, and accessing information. Ample evidence already exists that points to this usage increase as well as the resulting decline in certain network quality indices. According to Ookla / Speedtest, the average Internet speed and latency indices of four Latin American countries saw major changes in the last two weeks of March (see Table 3).

Table 3. Latin America: Deployment of Internet Networks Against COVID-19[18]

Indicators	**Time periods**	**Brazil**	**Chile**	**Ecuador**	**Mexico**
Average fixed broadband speed (Mbps)	February 2020	52.57	92.96	27.35	36.55
	Week of March 9	54.42	104.29	24.85	38.08
	Week of March 16	52.89	90.87	22.34	37.14
	Week of March 23	51.88	91.25	23.95	36.80
	Week of March 30	52.3	98.65	23.47	36.06
	Week of April 6	52.5	98.72	22.61	35.74
Fixed broadband latency (ms)	February 2020	17	38	23	41
	March 2020	18	39	29	43
	Week of March 9	17	21	17	27
	Week of March 16	19	24	19	28
	Week of March 30	19	25	19	29
Average mobile broadband speed (Mbps)	February 2020	24.20	19.51	20.65	26.99
	Week of March 9	25.04	19.94	19.94	26.62
	Week of March 16	24.30	16.23	20.51	26.74
	Week of March 23	23.72	15.56	19.45	28.26
	Week of March 30	25.11	16.22	20.77	28.60
	Week of April 6	25.23	16.30	20.77	29.68
Mobile broadband latency (ms)	February 2020	46	41	40	50
	March 2020	47	43	39	48
	Week of March 9	48	40	38	50
	Week of March 16	48	46	38	51
	Week of March 30	49	48	40	50

Source: Ookla/Speedtest

The data in Table 3 from the month of March to the first week of February show high broadband speed and latency volatility, reflecting peaks in Internet access combined with

[17] For example, in the third week of March, the Internet download speed in the United States declined 4.9%. In New York, the decline was 24% (Source: Ookla/Speedtest). The decline resulted from the unusual increase in traffic. For example, the ATT and Verizon networks, traffic increased by 27% and 22%, respectively.

[18] Through crowdsourcing, the Ookla / Speedtest platform measures Internet speed and latency based on the compilation of tests carried out by users on their own devices. These values depend on the number of observations made. Regarding users' concern of the erosion of Internet metrics, the number of fixed broadband tests increased between 50% and 150% in March, compared to the 20% increase in the number of mobile broadband tests.

changes in behavior and traffic flow as more people began to working from home. The analysis of data from February through the last week of March shows:

- **Fixed Broadband Speed**: gradual weekly decreases in Brazil and Mexico; notable speed increases in Chile in March, and speed decrease in Ecuador from February to the first week of April;
- **Fixed Broadband Latency**: Gradual increase (and erosion of service quality) in Brazil (11.7%), Chile (19.0%), Ecuador (11.8%), and Mexico (7.4%);
- **Mobile Broadband Speed**: Stable speed in Brazil, speed decrease in Chile, and speed increase in Mexico; and
- **Mobile Broadband Latency**: stable in all countries, albeit at an extremely high level

The increase in fixed broadband speeds in Chile, and mobile speed in Mexico, combined with the increase in latency in all four countries, occurs as a result of the unusual increase in traffic.

Extensive empirical evidence underscores the impact of broadband speed on economic development. Numerous studies of the so-called "return to speed" have quantified the relationship between broadband speed and GDP and productivity (Rohman, and Bohlin, 2012; Kongaut and Bohlin, 2014; Briglauer and Gugler, 2018; Carew et al, 2018; Ford, 2018; Grimes et al., 2009; Mack-Smith, 2006). Recently, the authors of this report (Katz and Callorda, 2019) conducted a separate study on the impact of fixed broadband speed on the GDP of 159 countries between 2008 and 2019. Dividing these countries into groups with average speeds under 10 Mbps, average speeds between 10 Mbps and 40 Mbps, and average speeds greater than 40 Mbps, the authors demonstrated the "return to speed" effect. In other words, the results provide evidence that broadband speed does, in fact, impact GDP (see Table 4).

Table 4. Impact of Fixed Broadband Download Speed on GDP

GDP Impact	Speed < 10 Mbps	Speed 10 Mbps - 40 Mbps	Speed > 40 Mbps
Ln Download speed$_4$	-0.00206 (0.00136)	0.00264 (0.00138) ***	0.00730 (0.00211) ***
Ln Employment t$_t$	0.00664 (0.00189) ***	0.00525 (0.00168) ***	0.00458 (0.00165) ***
Ln Inversion t$_{t-4}$	0.01459 (0.00216) ***	-0.00616 (0.00382)	-0.00085 (0.00481)
Fixed effects by country	Yes	Yes	Yes
Fixed effects by trimester	Yes	Yes	Yes
Control for GDP growth$_{-1}$	Yes	Yes	Yes
Control for broadband penetration	Yes	Yes	Yes
Number of countries	116	105	49
Observations	2.113	1.792	575
R-Square	0.9516	0.9262	0.9438

Note: robust standard errors in parentheses *p<10%, **p<5%, ***p<1%

Source: Telecom Advisory Services analysis

The results in Table 4 indicate the economic impact coefficient of fixed broadband speed increases significantly as download speed increases. However, the coefficient is not significant at speeds below 10 Mbps. If the speeds increase 100% for countries with a download speed equal to or greater than 40 Mbps, the coefficient is 0.73025. Accordingly, the reverse scenario is also valid: a decrease in download speed has an inverse economic impact. While the data related to the decrease in download speeds as a result of the pandemic are limited to the month of March, we must consider the potential significant negative economic impact if this situation continues.

Given this situation, it is imperative that policy makers and market participants act to limit the negative effects that an increase in traffic has on the quality of the networks and ultimately on the economy. Measures that require the deployment of infrastructure to accommodate a systemic increase in traffic take too long to complete. That said, three interventions that require considerably less time can be implemented:

- **Deployment of a large number of base stations for mobile broadband**: Every operator normally deploys base stations for mobile broadband when facing spikes in traffic. To speed up this process, the permits and requirements needed to deploy antennas should be relaxed in order to allow operators to react quickly.
- **Temporary allocation of additional spectrum to mobile operators**: Additional spectrum allows operators to handle heavier traffic loads without the need to deploy additional infrastructure. As an example, the US regulatory agency has temporarily granted mobile operators the use of spectrum in pre-determined regions of the country.[19]
- **The requirement of streaming service providers to reduce the traffic volume generated**: Streaming video services consume a large amount of network traffic.[20] Some operators have already responded: Google announced the reduction in YouTube video definition quality, Disney delayed the launch of its Disney+ streaming service in France, and Microsoft slowed the pace of its Xbox gaming platform updates.

One of the most immediate effects of the pandemic has been the shuttering of offices, schools, and factories to prevent contagion, which has led to a dramatic increase in telecommuting. Beyond the impact that working from home has had on telecommunications networks, it has also impacted video conferencing applications (used to facilitate work communication) and data traffic within the home. For instance, Chinese users' traffic on Cisco's Webex platform has increased 22 times since the start of the pandemic, while the number of users in Japan, South Korea, and Singapore has increased between 4 and 5 times.[21]

This natural increase in the number of devices using video conferencing platforms and cloud computing now connected at home has created a bottleneck in Wi-Fi routers that operate on

[19] *FCC (2020). FCC Grants Temporary Spectrum Access to Support Connectivity on Tribal Reservation During Covid-19 Pandemic*.
[20] Per Sandvine, Netflix, for example, comprises 12.6% of total Internet download traffic.
[21] Srinivasan, S. (2020). Cisco Webex: *Supporting customers during this unprecedented time* (March 20).

non-licensed spectrum. Based on traffic measurement statistics, this technology has experienced peaks as a result of increased telecommuting (see Graphic 2 below).

Graphic 2. Global Wi-Fi Traffic Growth (December 2019 – April 2020)

Source: Assia (2020)

As depicted in Graphic 2, data collected from 125 million Wi-Fi routers around the world show an 80% increase in PC uploads to the cloud since the end of March, with additional peaks from video conference calls observed. This increase has saturated the unlicensed spectrum bands (generally 2.4 GHz and 5 GHz). Regulators should therefore consider increasing unlicensed spectrum in the upper 5 GHz and 6 GHz bands (as now being considered in the United States).

To conclude, digital infrastructure is crucial for economic resilience. In order for networks to accommodate the increased communication needs resulting from COVID-19, operators, regulators, and Internet platforms must take action.

5. RESILIENCE OF DIGITAL HOUSEHOLDS

Household Internet penetration is essential in facing the pandemic. Residential digitization allows citizens to carry out many daily tasks that previously required physical contact. Latin America had a 68.66% Internet penetration rate in 2018, estimated to reach 78.78% in 2020.[22] This number highlights the first obstacle in utilizing digital technologies to tackle COVID-19, revealing the marginalization of the other 22% of the population who likely cannot access services that could replace activities typically requiring physical contact. This marginalization varies by country (see Table 5).

[22] Source: Telecom Advisory Services extrapolation based on the 2017-2018 data provided by the Interntional Telecommunications Union.

Table 5. Latin America: Internet Penetration (2018-2020)

	2018	2019	2020
Argentina	77.78 %	81.42 %	85.24 %
Barbados	84.03 %	86.37 %	88.77 %
Bolivia	48.22 %	53.04 %	58.34 %
Brazil	74.22 %	81.64 %	89.80 %
Chile	82.33 %	82.33 %	82.33 %
Colombia	66.68 %	71.40 %	76.47 %
Costa Rica	74.09 %	76.88 %	79.79 %
Dominican Republic	74.82 %	82.31 %	90.54 %
Ecuador	60.67 %	64.27 %	68.09 %
El Salvador	37.20 %	40.92 %	45.02 %
Guatemala	71.50 %	78.65 %	86.52 %
Honduras	34.06 %	36.60 %	39.33 %
Jamaica	60.58 %	66.64 %	73.30 %
Mexico	65.77 %	67.75 %	69.79 %
Panama	62.01 %	66.45 %	71.20 %
Paraguay	64.99 %	69.16 %	73.60 %
Peru	52.54 %	56.65 %	61.08 %
Trinidad & Tobago	81.58 %	86.06 %	90.79 %
Uruguay	70.21 %	72.20 %	74.24 %
Venezuela	79.20 %	87.12 %	95.83 %
Latin America (weighted average)	68.66 %	73.52 %	78.78%
OECD (weighted average)	83.93 %	86.07 %	88.33 %

Note: The latest data provided by the ITU are from 2017 or 2018 depending on the country. The data from 2019 and 2020 have been extrapolated based on last year's growth rate with information from the ITU.
Source: International Telecommunications Union; Telecom Advisory Services analysis

The weighted average for the Latin American region demonstrates the progress that Latin America has made in recent years to increase Internet adoption. We must note, however, that national averages mask the significant adoption disparities within each country. Urban areas, for instance, have much higher Internet adoption levels than rural areas. Per the ITU World Telecommunications / ICT Indicators database, 20.6% of the urban population of Bolivia had home Internet access in 2014, compared to just 1.7% of the rural population. Brazil (65.1% urban vs 33.6% rural) saw similar trends in 2017, as did Ecuador (46.1% urban vs. 16.6% rural).

Beyond Internet penetration rates, it is worth considering the number of devices within the home that can access the Internet. Computer penetration rates in Latin America hover at 44.89% (according to the *ITU World Telecommunications / ICT Indicators database*, meaning that most households cannot accommodate multiple family members needing computer access.

Although aggregated Internet adoption levels show significant progress, a more in-depth analysis reveals that the ways in which users utilize the Internet hinders their ability to offset the impact of the pandemic. Broadband Internet in Latin America is typically used primarily to communicate and connect socially[23] (see Table 6).

Table 6. Latin America: Facebook Penetration (2018-2020)

	2018	2019	2020
Argentina	68.07	71.26	74.60
Barbados	55.94	57.50	59.10
Bolivia	53.59	58.95	64.85
Brazil	66.67	68.00	69.36
Chile	69.33	69.33	69.33
Colombia	58.19	62.32	66.74
Costa Rica	63.72	66.13	68.62
Dominican Republic	49.68	54.65	60.11
Ecuador	58.74	62.23	65.93
El Salvador	51.18	56.30	61.93
Guatemala	39.39	43.33	47.66
Honduras	36.05	38.74	41.62
Jamaica	38.46	42.31	46.54
Mexico	62.53	64.41	66.35
Panamá	48.09	51.53	55.22
Paraguay	46.79	49.79	52.98
Perú	62.19	67.05	72.30
Trinidad & Tobago	50.91	53.71	56.66
Uruguay	68.45	70.39	72.38
Venezuela	45.05	49.55	54.50
Latin America (weighted average)	61.29%	63.83%	66.51%
OECD (weighted average)	62.78%	64.48%	66.28%

Note: the latest available data are from 2018; 2019 and 2020 data have been extrapolated based on the expected growth of Internet adoption within each country.
Source: Internet World Stats; Telecom Advisory Services analysis

Despite communication through social networks (e.g. Whatsapp or Facebook Messenger), Internet users' limited adoption of services allowing for a "virtualization" of physical activities reduces the power of digitization to reduce the adverse impact of the pandemic. In order to measure the ability of connected homes to carry out activities over the Internet, we created a "digital household resilience index" that combines four factors:

- **Number of healthcare apps downloaded annually per inhabitant**: We assume that users who download health apps are more likely to use the Internet to obtain information related to healthcare, the pandemic, COVID-19 testing points, etc. (Source: *App Annie*[24]).

[23] However, we are not discrediting the use of WhatsApp to communicate information related to health emergencies. For example, note the extensive use of WhatsApp by the World Health Organization and the British government.
[24] App Annie is a private company with offices in San Francisco, Amsterdam, Beijing, Hong Kong, London, Moscow, New York, Seoul, Shanghai, and Tokyo that operates a market intelligence platform focused on the adoption of apps around the world.

- **Number of educational apps downloaded annually per inhabitant**: We assume that users who download educational apps are more likely to have the ability to educate children at home (Source: *App Annie*).
- **Number of fintech platforms per million inhabitants**: We assume that the density of a country's fintech platforms aligns with a demand to carry out financial transactions (Source: *Crunchbase*).
- **E-Commerce as a percentage of total retail commerce**: We assume that e-commerce indicates an ability to continue activities like purchasing food and consumer items without leaving the home (Source: *Euromonitor).*

The higher the adoption levels of each of these four categories, the better prepared the population will be to face isolation and quarantine conditions (see Table 7).

Table 7. Indicators of digital platform use (2020)

	Use of the Internet for health apps (1)	**Use of the Internet for educational apps (2)**	**Density of fintech platforms (3)**	**Density of e-commerce (4)**
Argentina	9.27	52.62	0.87	6.73%
Bolivia	3.41	7.11	1.33	0.94%
Brazil	10.59	65.22	1.07	7.84%
Chile	12.08	87.35	2.98	3.70%
Colombia	6.79	50.73	2.36	6.15%
Dominican Republic	5.58	16.89	0.95	4.21%
Ecuador	3.97	9.09	1.14	3.29%
El Salvador	5.50	13.34	0.57	3.03%
Guatemala	1.99	7.13	0.18	2.86%
Honduras	3.56	10.83	0.57	2.42%
Mexico	4.44	48.19	0.57	4.57%
Panama	10.41	24.75	0.91	8.03%
Paraguay	5.94	12.59	1.22	4.97%
Peru	5.56	52.35	2.46	1.86%
Latin America (weighted average)	**7.59**	**51.02**	**1.16**	**5.70 %**
OECD (weighted average)	**15.19**	**76.07**	**5.05**	**11.52 %**

Nota: Certain countries were excluded from this list due to unreliable source data.
Sources: (1) App Annie (2) App Annie, (3) Crunchbase, (4) Euromonitor; Telecom Advisory Services analysis

Combining each of these four indicators to create a "digital household resilience" index allows us to assess whether the population of a given Latin American country has the potential to reduce the adverse impact of the pandemic on the household (see Table 8).

Table 8. Index of Household Digital Resilience

Country	Index
Argentina	33.87
Bolivia	6.23
Brazil	40.59
Chile	41.14
Colombia	31.69
Dominican Republic	16.38
Ecuador	11.53
El Salvador	12.78
Guatemala	8.70
Honduras	9.83
Mexico	25.63
Panama	28.63
Paraguay	16.90
Peru	23.33
Latin America (weighted average)	30.70
OECD (weighted average)	53.78

Source: Telecom Advisory Services analysis

The first observation from the indices shown in Table 8 is the difference between Latin America and OECD countries, which indicates that households in OECD countries are – from a digital perspective - better prepared to face the pandemic. The second observation is the heterogeneity of the index within the region. Argentina, Brazil, Chile, and Colombia have higher household digital resilience rates compared to the rest of the countries. At an aggregate level, households in countries with an index lower than 30, have limited ability to educate students, complete financial transactions, and benefit from e-commerce. If this index could be broken down by social group, we would expect to see that the more vulnerable populations within each country are disproportionally affected.

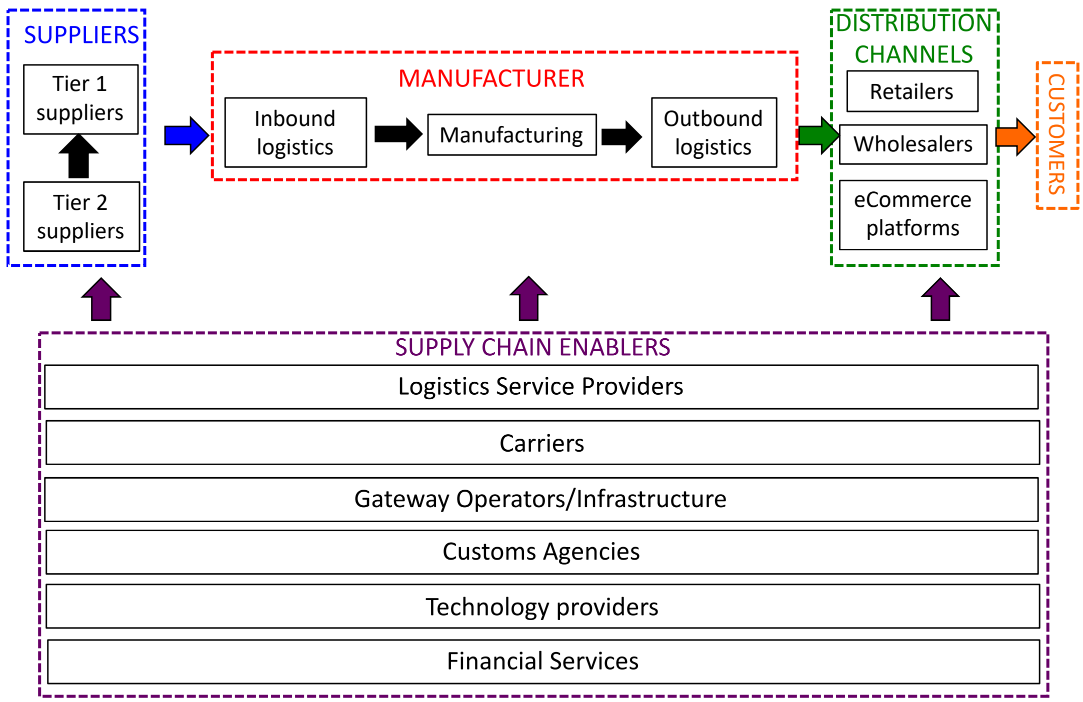
6. RESILIENCE OF PRODUCTION

The digitization of production is fundamental in keeping the economy running despite COVID-19 disruptions. To analyze "production resilience," we consider two dimensions: (i) the digitization of production processes, and (ii) the degree to which work can be conducted remotely. In the first case, we evaluate the extent to which production systems can continue to operate under current conditions, paying particular attention to supply chain and distribution channels. In the second case, we analyze the economy's preparedness to migrate to telecommuting.

6.1. Digitization of supply chains

For this analysis, we look at the supply chain encompassing not only the firms' acquisition of inputs but also the multitude of processes and intervening stakeholders who facilitate the flow of products and information throughout the chain (Calatayud and Katz, 2019). In order to operate seamlessly, these chains require logistical support from financial and technology service providers, as well as support from the public sector to facilitate the development of infrastructure and establish a healthy business climate conducive to high-performance of logistics (see Figure 1).

Figure 1. Main players in the logistics chain



Source: Calatayud, A. & Katz, R. (2019)

As presented in Figure 1, the main actors who participate in supply chain logistics include:

- **Suppliers of first- and second-level inputs**: The first-level suppliers provide inputs directly to large manufacturing companies. The second-level suppliers provide inputs to the first-level supplier companies, thus indirectly meeting the needs of large manufacturing firms.
- **Manufacturing companies**: Manufacturing companies are typically large companies that operate within a variety of different industries, like the automotive, food, or textile industries. These companies transform inputs supplied by first-level suppliers into their final products.
- **Wholesalers and retailers**: These companies exist within the trade sector, delivering the manufacturing companies' products to consumers.
- **Logistics service providers, transport companies, and infrastructure operators**: These players facilitate the physical movement of inputs and final goods through various modes of transportation (like road, sea, air, rail) and also provide storage, packaging, and inventory management services.
- **Customs**: These public sector institutions intervene in the movement of goods, particularly imports and exports, to ensure that these goods comply with national and international tariff, security, sanitary, and phytosanitary regulations.

- **Technology providers**: These providers offer systems and technologies to support the digital management of processes and their automation of the chain.
- **Financial services providers**: Banks and financial entities comprise this category, facilitating access to investment and working capital financing for supply chain companies through instruments such as loans, factoring, guarantees, and leases.

This analytical framework implies that in order for a production system to function resiliently in the face of the pandemic, all supply chain actors must have a high level of digitization. Manufacturing companies must not only be sufficiently digitized in order to handle purchase orders, but they also must be prepared to collaborate with logistics companies in order to trace goods in transit and/or interact with customs and port operators to make the transportation of products more efficient. We will examine each of these aspects separately.

As already analyzed in our prior studies, despite Latin American companies having high Internet connection levels, their supply chain operations lag in their adoption of technology in business processes (see Table 9).

Table 9. Latin America: Digitization of the Supply Chain (2018)

	Percentage of companies connected to the Internet	Percentage of companies using electronic banking	Percentage of companies using the Internet to acquire inputs
Argentina	94.93 %	79.60 %	45.80 %
Brazil	96.40 %	88.00 %	66.00 %
Chile	86.16 %	84.37 %	28.80 %
Colombia	92.81 %	95.39 %	37.00 %
Ecuador	93.89 %	47.06 %	13.90 %
Mexico	94.61 %	76.60 %	13.47 %
Perú	94.00 %	34.20 %	15.20 %
Uruguay	93.39 %	68.35 %	38.43 %

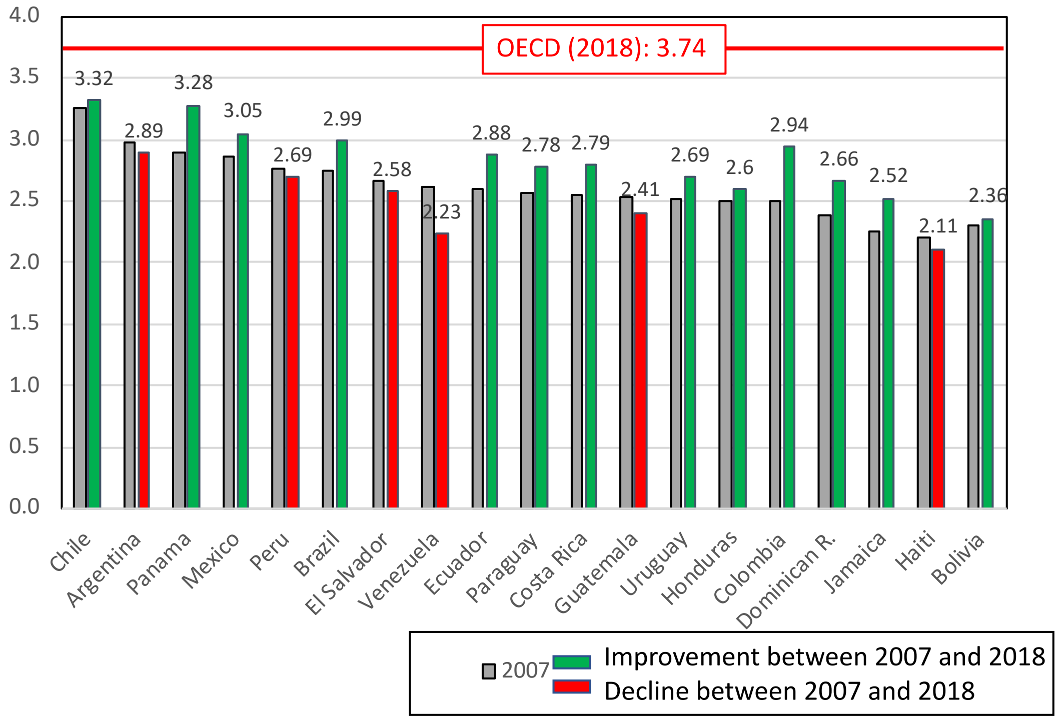
Note: The difference between countries is mainly due to differences in survey sampling approaches (e.g. inclusion or not of microenterprises)

Sources*:* INDEC. *Encuestas Nacional sobre Innovación y Conducta Tecnológica* (2004-2011) - extrapolated results; Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação. Pesquisa sobre o uso das Tecnologias de Informação e Comunicação nas empresas Brasileiras – TIC empresas (2017); Ministerio de Economía, Fomento y Turismo. División de Política Comercial e Industrial. *Encuesta Longitudinal de Empresas (2017);* Ministerio TIC y Cámara de Comercio de Bogotá. Observatorio de la Economía Digital de Colombia (2017)*;* Ecuador. Instituto Nacional de Estadística y Censos. *Empresas y TIC:* Modulo de TIC de las Encuestas de Manufactura y Minería, Comercio Interno y servicios (2015); Perú: Instituto Nacional de Estadística e Informática. Encuesta Economía Anual; Companies' information and communication technology information; Telecom Advisory Services analysis

The statistics in Table 9 indicate that, despite high levels of Internet adoption among Latin American businesses, a significant portion of companies (mainly SMEs) have not incorporated Internet technology into their supply chains. Our research indicates that digitization disparities exist not only between smaller and larger companies, but also between industrial sectors as well as between countries. As an example, the automotive sector has a higher level of digitization than other sectors. But even within the automotive sector, companies in Mexico have the most advanced technological strategies and adoption (partly due to their integration with the United States market), followed by companies in Brazil. The automotive sectors in Argentina and Colombia lag the Mexican and Brazilian ones. In the first case, digital transformation of the sector is lagging due to the macroeconomic volatility of the country, which in turn constrain infrastructure investment. In the second case, a smaller local market results in reduced digital transformation requirements.[25]

Even for companies that have internally digitized their supply chains, inter-organizational communication barriers exist between participants of the logistics chain. Over the past decade, most countries in the region have made performance improvements to various components of the supply chain (e.g., port infrastructure, highways, airports). The international logistics rankings (see Graphic 3) reflect these improvements.

Graphic 3. Index of Latin America Logistics Performance (2007 – 2018)



Source: World Bank. Logistics Performance Index (2007-18)

Despite the progress shown in Graphic 3, performance levels within the region lag far behind the levels of more advanced economies. The region's land transportation industry has low levels of digitization highlighting an important bottleneck hindering the efficiency of the supply chain. For example, the Latin American trucking industry is extremely fragmented. It is comprised primarily of small companies, which tend to have typical SME-related digitization barriers: low investment capacity, limitations on technological implementation

[25] For more detailed sector analysis, see Calatayud, A. and Katz, R. (2019).

capability, and restricted access to capital. For example, of the approximately 150,000 ground transport providers in Mexico, only 10 are large enough to carry out a digital transformation program.[26] Of the 3,500 ground transport providers in Colombia,[27] only an estimated 100 companies can adopt digital technologies.[28] To address these limitations, technology companies are developing matching platforms in order to improve the efficiency of logistics providers and transport services.[29] These firms offer digital marketplaces to address the coordination failures occurring between logistics service providers and ground transporters.

Another example of bottlenecks in the logistics chain is related to government monitoring of foreign trade. Recent years have seen advances in the simplification and digitization of customs processes, including some countries' development of a "single window" to process documentation for foreign trade. Despite these advances, Latin American countries continue to lag behind international best practices. We see evidence of this lag in the time required to process foreign trade documentation by customs agencies (see Table 10).

Table 10. Time required to process foreign trade documentation (2018, in hours)

	Exports	Imports
Argentina	30	192
Brazil	12	48
Colombia	60	64
Mexico	8	18
Paraguay	24	36
BENCHMARKS		
Netherlands	1	1
Singapore	2	3

Source: World Bank. Doing Business 2018

As depicted in Table 10, Latin American countries significantly lag behind international best practices in foreign trade document processing.

To summarize, the limited digitization of within companies – mainly SMEs – along with logistics chain bottlenecks represent obstacles to the development supply chain resilience to deal with COVID-19.

6.2. Digitization of distribution channels

The barriers to digitization seen in the region's supply chains extend to its distribution channels. Table 11 shows the percentage of Latin American companies that have developed company websites or have deployed digital sales channels.

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[26] Mexico Secretary of Communications and Transportation (SCT), Subsecretariat of Transport (2017), *Estadística Básica del Autotransporte Federal 2017*.
[27] Colombia Government, *Registro Nacional de Despacho de Carga*.
[28] Colombia Government. National Department of Planning (2017), *Documento Técnico, Misión de Logística y Comercio Exterior*, p. 35.
[29] These include CargoX, Fretebras, Busca Cargas and Truckpad in Brazil, as well as Humber, Circular and Avancargo in Argentina.

Table 11. Latin America: Digitization of distribution channels (2018)

	Percentage of companies with websites	Percentage of companies that have deployed electronic sales channels
Argentina	63.60 %	18.52 %
Brazil	59.52 %	22.00 %
Chile	78.80 %	10.60 %
Colombia	67.21 %	38.00 %
Ecuador	Not Available	9.20 %
Mexico	49.79 %	8.68 %
Perú	Not Available	7.20 %
Uruguay	52.75 %	35.41 %

Note: Information for some countries has been estimated based on correlation with Internet adoption levels.
Source: UNCTAD; Telecom Advisory Services analysis

While many companies have developed websites to increase visibility in the market, far fewer companies have the ability to receive orders electronically. The fastest way to resolve this barrier is to leverage and accelerate the development of e-commerce platforms and B2B marketplaces outside the scope of existing companies.

6.3. Transformation of the Workforce

When looking at the increase in Wi-Fi traffic and its impact on telecommunications networks, we alluded in chapter 3 to the massive eruption of telecommuting. Along these lines, it is also pertinent to examine teleworking's impact on the labor market and its social implications. What is the magnitude of the changes caused by the pandemic as measured by the number of workers who now work from their homes? Can we establish some perspective as to which sectors are most- and least-affected? In theory, knowledge workers (e.g., researchers and software developers) would adapt most-easily to this new way of working. It is important to know, then, the number of workers who – due to their occupations – cannot work from home. In March alone, over 20 million workers collected unemployment insurance in the United States. What does this situation look like in Latin America?

To calculate this estimate for a single country, we used statistics from Chile's National Socioeconomic Characterization Survey (CASEN) carried out by the Ministry of Social Development in 2017. Conducted every two years, each survey compiles information on more than 200,000 individuals who (using expansion codes) represent the entire population of Chile. Because each respondent answers questions about their occupation, we were able to focus on the individuals employed at the time of the survey, purposely excluding the unemployed from the sample. By examining each of the 387 occupations listed in the dataset, the analysis assessed the likelihood of: a) occupations whose workers are likely to remain in the workplace location (for example, health professionals will likely continue to work in hospitals), and b) occupations that cannot rely on telecommuting (for example, a factory operator cannot continue working if staying at home). The probabilities for (a) were based on the official rules issued by governments for the so-called "essential" occupations, while the likelihood of (b) was based on our own understanding of work an occupation entails (see Table 12 for an example of the analyzed base).

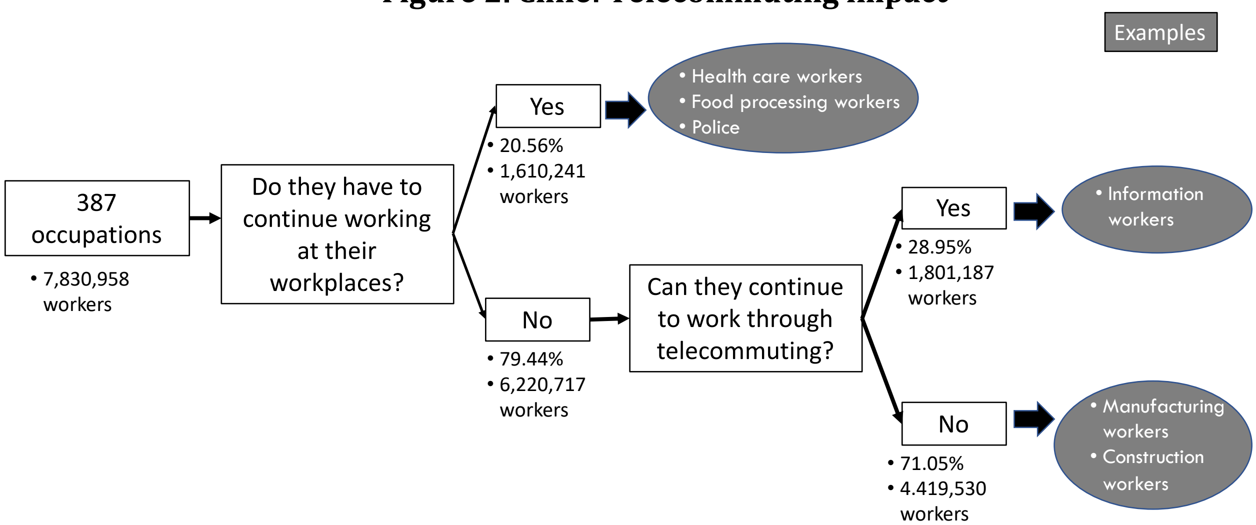
Table 12. Example of Teleworking Probability scores

CIUO-88	Empleo	Teleworking Probability	Business in Quarantine
3442	Tax accountants	100.00%	0.00%
3443	Social Security agents	100.00%	0.00%
3444	Licensing and permit issuing government employees	50.00%	0.00%
3449	Public administration agents overseeing customs, taxes, and the like (that are not classified under other headings)	50.00%	0.00%
3442	Treasury employees	100.00%	0.00%

Source: CASEN Survey 2017; Telecom Advisory Services analysis

Once completed, the probability analysis yields the percentage of the workforce that can work from home, the percentage that must continue to go to their workplace, and the percentage that cannot telework (see figure 2).

Figure 2. Chile: Telecommuting impact



Source: CASEN Survey 2017; Telecom Advisory Services analysis

The results from Figure 2 leads to the following insights:

- Based on the total workforce registered in 2017 (including informal employment, but excluding the unemployed), Chile had 7,830,958 employed workers.
- Of the 7,830,958 total employed workers, 1,610,241 (20.56%) must continue to go to their workplace (e.g., health personnel, security forces, food processing workers, etc.).
- Due to the quarantine, the remaining 6,220,717 workers (79.44%) cannot go to their workplace.
- Of these 6,220,717 workers, 1,801,187 (28.95%) can continue to work by telecommuting from home. This is the number that caused the spike in network usage as analyzed in Section 3.
- Of these 6,220,717 workers who cannot go to their workplace, 4,419,530 (71.05%) cannot work remotely from home.

- In sum, of the 7,830,958 total workers in Chile, 56.44% are either not allowed to go to work or cannot continue to work by telecommuting.

Similarly, the CASEN database allows us to analyze each of the three categories based on level of education and income. Table 13 shows the results of this analysis.

Table 13. Chile: Estimated impact of COVID-10 on the workforce

Statistics - Chile 2017	Total	Probability of being obliged to go to work	Workers in quarantine	Probability of workers in quarantine that work from Home Office
Total Population	7,830,958	20.56%	6,220,717	28.95%
Without a basic education	715,636	23.70%	546,022	5.46%
Basic education	1,582,376	24.31%	1,197,777	8.25%
Medium education	2,925,729	23.14%	2,248,804	19.09%
Higher education	2,560,806	14.44%	2,191,105	56.32%
1st income quintile	859,226	22.40%	666,731	9.26%
2nd income quintile	1,477,662	23.20%	1,134,800	13.20%
3rd income quintile	1,739,900	22.56%	1,347,441	19.83%
4th income quintile	1,900,947	21.44%	1,493,412	29.26%
5th income quintile	1,833,716	14.97%	1,559,130	56.80%

Source: CASEN Survey 2017; Telecom Advisory Services analysis

It is especially important to consider the social implications of these numbers. While some members of the workforce will continue to work, a large proportion of the total workforce will face unemployment when the companies they work for cease operations, with each company choosing whether or not to continue paying its employees (as permitted by labor law). These social implications are even more serious when examining the number of affected workers with low education and/or low income (see Table 14).

Table 14. Chile: The discriminatory impact of COVID-19 on job type

Statistics – Chile 2017	Percentage that stay employed	Workers who must go to work	Telecommuting workers	Workers unable to work
Total Population	43.56%	1,610,241	1,801,187	4,419,530
Without a basic education	27.87%	169,614	29,828	516,194
Basic education	30.55%	384,599	98,872	1,098,905
Medium education	37.81%	676,925	429,245	1,819,559
Higher education	62.63%	369,701	1,234,063	957,042
1st income quintile	29.59%	192,495	61,732	604,999
2nd income quintile	33.34%	342,862	149,758	985,042
3rd income quintile	37.91%	392,459	267,170	1,080,271
4th income quintile	44.42%	407,535	436,918	1,056,494
5th income quintile	63.27%	274,586	885,610	673,520

Source: CASEN 2017; Telecom Advisory Services analysis

The data in Table 14 supports the following conclusions:

- Of the 7,830,958 total workers in Chile, 44% will remain employed because they either will continue to work in the workplace (21%) or have the ability to work remotely (23%). Due to the difficulty in maintaining a safe social distance, the 21% who continue to go into the workplace have a higher risk of contagion.
- More than 56% of the workforce faces employment disruptions. This percentage is consistent with the estimate of Hevia & Neumeyer (2020) who calculated the number of affected employees per company based on PIAAC data. The authors estimated that 53% of the workforce in Latin America could risk unemployment because they work for companies with 5 or fewer employees and with limited access to emergency funding.
- Of the 1,801,187 workers who can work remotely, 1,234,063 have higher education degrees and 1,322,528 are in the 4th or 5th income quintiles.
- Of the 4,419,530 workers who cannot go into the workplace and cannot work remotely, 1,615,099 have – at most – a basic level of education and 1,509,041 falls within the 1st or 2nd income quintiles.

Beyond the immediate social implications of this situation, it is imperative that market participants focus on restructuring the production sector's operational processes to allow more workers to work remotely and prioritize the training and education of the most vulnerable social groups.

7. RESILIENCE OF THE STATE

The State's resilience to the pandemic relies on its ability to continue its operations and deliver public services. When looking at the delivery of public services, there are services that are less impacted by the level of digitization (for example, public health and safety). On the other hand, the digitization of other services like foreign trade processing may enhance the ability to reduce the negative impact of COVID-19.

The e-government index (see Table 15) provides insights on the level of digitization of public services and, consequently, their resilience.

Table 15. Latin America: Index of e-Government Development

Country	Index Value
Argentina	0.73
Bolivia	0.53
Brazil	0.73
Chile	0.74
Colombia	0.69
Dominican Republic	0.57
Ecuador	0.61
El Salvador	0.55
Guatemala	0.50
Honduras	0.45
Mexico	0.68
Panamá	0.61
Paraguay	0.53
Perú	0.65
Uruguay	0.79
Latin America	0.66
OECD	0.83

Source: Telecom Advisory Services analysis

Combining this index with the performance of customs efficiency (according to the Logistics Performance Index) allows us to create a composite index of State resilience to the pandemic's disruption (see Table 16).

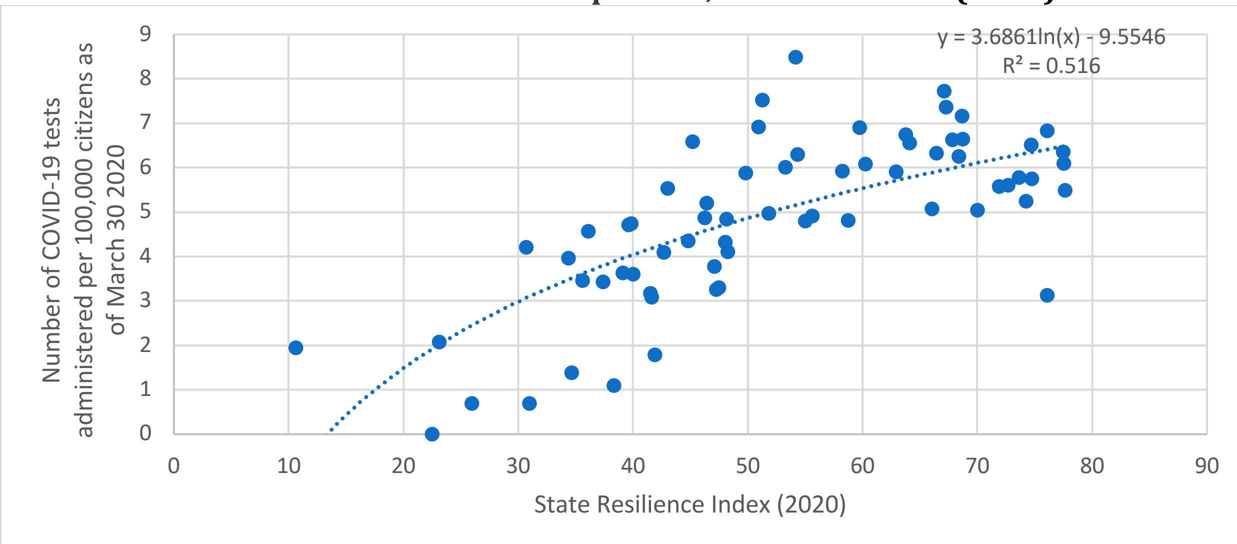
Table 16. State Resilience Index (2020)

Country	Index
Argentina	41.88
Bolivia	25.97
Brazil	41.64
Chile	54.98
Colombia	41.53
Dominican Republic	30.25
Ecuador	39.13
El Salvador	26.85
Guatemala	21.16
Honduras	18.83
Mexico	43.55
Panamá	39.85
Paraguay	30.47
Perú	37.36
Uruguay	47.07
Latin America	40..36
OECD	66.17

Source: Telecom Advisory Services analysis

As seen with household digitization resilience, Chile, Uruguay, Mexico, Brazil, and Argentina seem better positioned to face disruption. The positive relationship between the index presented in Table 16 and the number of COVID-19 tests performed per 100,000 inhabitants by March 30, 2020 demonstrates the States' resilience in addressing the disruption results from the pandemic.

Graphic 4. Relationship between the State Resilience Index and the Logarithm of Number of COVID-19 Tests per 100,000 Inhabitants (2020)



Source: Public information available by country, Telecom Advisory Services analysis

The correlation in Graphic 4 shows that the greater the resilience of the State, the greater the capacity to administer COVID-19 tests.

8. CONCLUSION

The COVID-19 pandemic is unusual in that it poses a challenge to the global socio-economic system. Following the initial implementation of prophylactic measures as well as the fear of contagion, anecdotal evidence suggests that digital technologies could counteract the isolation enforced by social distancing, increase awareness of virus prevention measures, and enable economic systems to continue to operate. The work presented in this paper uses empirical evidence to highlight the important role digital technology could play in mitigating the pandemic's disruption while evaluating Latin America's level of preparedness to face this challenge. It draws the following conclusions:

- The econometric analysis of the SARS-CoV virus' economic impact indicates that the countries with developed connectivity infrastructures had the ability to mitigate 75% of the associated economic losses resulting from the prophylactic measures taken to control its spread (quarantining, social distancing, interruption of air traffic, use of face masks, etc.).
- As we are already seeing on a global level, the exponential increase in Internet traffic is affecting Latin American networks. The analysis of data from February through the last week of March shows:

- **Fixed Broadband Speed**: gradual weekly decreases in Brazil and Mexico; notable speed increases in Chile in March, and speed decrease in Ecuador from February to the first week of April;
  - **Fixed Broadband Latency**: Gradual increase (and erosion of service quality) in Brazil (11.7%), Chile (19.0%), Ecuador (11.8%), and Mexico (7.4%);
  - **Mobile Broadband Speed**: Stable speed in Brazil, speed decrease in Chile, and speed increase in Mexico; and
  - **Mobile Broadband Latency**: stable in all countries, albeit at an extremely high level
- Furthermore, home Wi-Fi routers are saturated as a result of the massive migration to teleworking due to an increase in cloud computing (80% increase in upload traffic) and video conferencing.
- The digital divide prevents sectors of the Latin American population who need Internet access from receiving health information, downloading educational content, or purchasing goods electronically.
- The digital divide is only compounded by the fact that, in the majority of households, Internet usage is limited to communication tools and social networks. In other words, Internet penetration alone does not necessarily indicate a high degree of household digital resilience within Latin American homes.
- An evaluation of the region's production systems indicates a lack of technology assimilation in business operations, particularly within the supply chains. As a result, these systems are less prepared to handle the disruptions caused by the pandemic.
- Because a large proportion of the population cannot telecommute, COVID-19 presents an additional disruption of labor markets. Our assignment of probabilities of teleworking opportunities to Chile's CASEN survey indicates that of the total workforce, 20.56% must continue to go to their workplace (e.g., health personnel, security forces) and 23.00% will work remotely by utilizing digital technology. Under current conditions, 56% of workers will be in a position where they can neither go into the workplace nor transition to teleworking. Beyond the most immediate social implications, this reality demonstrates the pressing need to: a) restructure operations and business processes in the production sector so that a higher percentage of the population can work remotely, and b) prioritize training of the most vulnerable sectors of the population.
- The resilience of Latin American States to the pandemic will depend on their ability to continue the operation of their administrative processes and delivery of public services. The Composite Index of Government Resilience calculation indicates that, as a result of the many advances they have made over recent years, some nations - Chile, Uruguay, Mexico, Brazil, and Argentina - will more easily handle the disruptions than other Latin American governments.

To conclude, after recognizing the fundamental role that digitization can play in mitigating the effects of the pandemic, Latin American governments and civil society must collaborate to promote the enhancement of certain components of the digital ecosystem.

Having recognized the fundamental role that digitization can play in mitigating the effects of the pandemic, the Latin American public and private sectors, with the support of civil society, must collaborate and work together to promote the enhancement of certain components of the digital ecosystem.

- Accelerate the deployment of a large number of base stations for mobile broadband, reducing the permit requirements for the deployment of antennas.
- Temporarily allocate additional spectrum to mobile operators to face traffic spikes.
- Require video streaming service providers to reduce traffic volume generated from high definition content.
- Consider the need to increase unlicensed spectrum in the upper 5 GHz and 6 GHz bands in order to resolve Wi-Fi router bottlenecks.
- Promote platform development innovation in order to improve supply chains. Key activities include stimulating technology companies to develop platforms that can improve the efficiencies between logistics providers and transportation service providers.
- Encourage enterprises to further digitize business processes in order to increase the percentage of the workforce that can work remotely.
- Invest in the training of the most vulnerable population groups in order to decrease unemployment rates.
- Address some of the digital divide factors by providing devices (PCs, tablets, Wi-Fi modems, subsidized broadband service) to vulnerable consumers, and combine with distance learning training on e-education and telemedicine.

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APPENDICES

Table A-1. Countries affected by SARS

Country	Infected persons	Deaths	Mortality rate	Date of first case	Date of last case
Australia	6	0	0%	26-feb.-03	1-apr.-03
Canada	251	43	17%	23-feb.-03	12-jun.-03
China	5327	349	7%	16-nov.-02	3-jun.-03
France	7	1	14%	21-mar.-03	3-may.-03
Germany	9	0	0%	9-mar.-03	6-may.-03
Hong Kong	1755	299	17%	15-feb.-03	31-may.-03
India	3	0	0%	25-apr.-03	6-may.-03
Indonesia	2	0	0%	6-apr.-03	17-apr.-03
Ireland	1	0	0%	27-feb.-03	27-feb.-03
Italy	4	0	0%	12-mar.-03	20-apr.-03
Korea	3	0	0%	25-apr.-03	10-may.-03
Kuwait	1	0	0%	9-apr.-03	9-apr.-03
Macao	1	0	0%	5-may.-03	5-may.-03
Malaysia	5	2	40%	14-mar.-03	22-apr.-03
Mongolia	9	0	0%	31-mar.-03	6-may.-03
New Zealand	1	0	0%	20-apr.-03	20-apr.-03
Philippines	14	2	14%	25-feb.-03	5-may.-03
Romania	1	0	0%	19-mar.-03	19-mar.-03
Russia	1	0	0%	5-may.-03	5-may.-03
Singapore	238	33	14%	25-feb.-03	5-may.-03
South Africa	1	1	100%	3-apr.-03	3-apr.-03
Spain	1	0	0%	26-mar.-03	26-mar.-03
Sweden	5	0	0%	28-mar.-03	23-apr.-03
Switzerland	1	0	0%	9-mar.-03	9-mar.-03
Thailand	9	2	22%	11-mar.-03	27-may.-03
Taiwan	346	37	11%	25-feb.-03	15-jun.-03
United Kingdom	4	0	0%	1-mar.-03	1-apr.-03
United States	27	0	0%	24-feb.-03	13-jul.-03
Vietnam	63	5	8%	23-feb.-03	14-apr.-03

Source: *Keogh-Brown and Smith* (2008)

Graph A-2. Correlation between the Digitization of Production Processes Index and Fixed Broadband Penetration

```
. corr bbhh dig_prod
(obs=1,003)

             |     bbhh dig_prod
-------------+------------------
        bbhh |   1.0000
    dig_prod |   0.6890   1.0000
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