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A Divide in the Making: Digitalisation in Latin America

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Abstract

This article addresses a much-debated subject: the extent to which the diffusion of digital related technologies contributes to development catching up processes of nations, with a particular attention to the Latin American region. Are these technologies contributing to increase efficiency levels? And, in the face of outstanding income and capability differentials, are productivity gaps between formal and informal sectors evolving alongside the diffusion of new technologies? Among and within nations, are we observing digital progress or a digital divide in the making?

The article starts with an analysis of the nature of digital technologies and their economic relevance and an evaluation of the essential digital requirements to increase the probability of peoples and organisations benefiting from such technical progress. Having set the analytical scene, we then address the relations between digitalisation and economic efficiency. We discuss the extent to which digital progress leads to economic gains in the context of the LA region. Our analysis covers two angles: how the region's digital progress fares against other regions, and we contrast the recent evolution of digital access to the productivity gap between the formal and informal sectors of selected LA countries. We finalise with analytical reflections about our findings to then turn our attention to related policy implications.

We found that developing nations, including Latin America, were able to significantly evolve and to extend the most basic form of digitalisation (internet access) to an important proportion of their population, while still lagging in costs, skills, and infrastructure relatively to higher-income countries. We detected that, in Latin America,

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the productivity gap of the informal sector in comparison to its formal counterpart has increased along the first two decades of the XXI century, despite of substantial progress in the expansion of digital access in all selected countries of the region. The region's digital progress was limited as the lowering of costs, the expansion of a fast and reliable infrastructure, and improvement in digital skills are journeys that Latin American societies are still insufficient for access to all.

1. Introduction

This article addresses a much-debated subject: the extent to which the diffusion of digital related technologies contributes to development catching up processes of nations, with a particular attention to the Latin American region. We depart from the realization that Latin America (LA) is a region marked by the significant differentials of capabilities and performance among countries, and economic sectors and agents, which constitutes one of the most important facets of the region´s structural heterogeneity (ECLAC, 2007, 2022). As the structuralist school argues, such differentials constitute a relevant constraint to be overcome towards a sustainable development trajectory.

In this sense, given their inherent features, could digital technologies contribute to the breaking up of long-standing development lock-ins and represent a new window of opportunity for catching up processes in Abramovitz (1986) sense? Are these technologies contributing to increase efficiency levels? And, in the face of outstanding income and capability differentials, are productivity gaps between formal and informal sectors evolving alongside the diffusion of new technologies? Among and within nations, are we observing digital progress or a digital divide in the making?

Economic transformations arising from digital technologies are immense. Yet the evidence and the literature about possible gains, especially those of efficiency nature, are not conclusive. From an empirical and development perspective, there are those who argue that Solow´s 1987:36 qualified intuition – "You can see the computer age everywhere but in the productivity statistics" – still stands (*ACEMOGLU et al* 2014). Others (VAN ARK *et al.*, 2020, BRYNJOLFSSON *et al.*, 2017) defend that time lags are the most important reason for the slow emergence of productivity effects derived from the diffusion of digital technologies. Nevertheless, a certain skepticism prevails among other authors as they argue that during the recent period of rapid technological change, economic and social inequalities have been on the increase. As Qureshi (2022:1) argues,"over the period of the boom in digital technologies… many are being left behind, across industries, across the workforce, and across different segments of society". In developing nations these trends may be even more worrisome as digital progress falls behind trends in the developed world (UNIDO, 2019; ANDREONI *et al.*, 2021).

We review the main contributions and arguments put forward by specialists and compile and analyse the available evidence. The article starts with an analysis of the nature of digital technologies and their economic relevance and an evaluation of the essential digital requirements to increase the probability of peoples and organisations benefiting from such technical progress.

Having set the analytical scene, we then address the relations between digitalisation and economic efficiency. We discuss the extent to which digital progress leads to economic

gains in the context of the LA region. Our analysis covers two angles: how the region's digital progress fares against other regions, and we contrast the recent evolution of digital access to the productivity gap between the formal and informal sectors of selected LA countries. We finalise with analytical reflections about our findings to then turn our attention to related policy implications.

We are aware that digitalisation is a complex process changing not only efficiency parameters but also opening the way for new products, services, markets, modes of organising institutions and even ways of life. We also acknowledge that economic efficiency is influenced and mediated by other factors beyond the adoption of digital technologies.

With such caveats, our intention is to search for the direction of the evolution of digital adoption and efficiency curves over time. In doing so, we acknowledge and take into account one of the outstanding features of the LA region: the outstanding structural differences represented by a significant informality in labour relations and modes of functioning of business organisations. For that, we analyse the digital gap between the region *vis-à-vis* other parts of the world, and we experiment juxtaposing the local digital adoption trends with the evolution of the formal and informal sectors efficiency gaps. In short, even in the face of the continuous transformation of the digital phenomenon and the limited access to quantitative evidence, we expect that our article brings to the limelight important economic, social, and technological research and policy issues.

2. The digital revolution

Advanced digital technologies —an outstanding example of general purposes technologies (GPT)— are a group of technologies based on microprocessors with increasing capacity to generate, manipulate and interconnect information. As the neo-schumpeterian literature argues, the potential of transformation of the digital solutions is determined by their constitution as the result of the convergence and blending of different technologies and their manifestation as tangible and intangible assets.

Pervasive connectivity leads the digital economy to new levels: the digitalised economy[2]. The effectiveness of digital technologies, such as Internet of Things (IOT), Artificial Intelligence (AI), Big Data, Blockchain, among others, relies on the fastness and low latency of internet connections. Communication technologies have advanced in the past and will evolve in the coming years along these two parameters to enable ever-increasing innovations in all productive and social dimensions, making almost ubiquitous the presence of the internet in the life of peoples and organisations.

The growing economic importance of digital technologies can be observed in the

[2] By "digital economy" is meant the use of global digital platforms as a business model. The term "digitalised economy" refers to the incorporation of digital technologies (particularly artificial intelligence solutions) into the production, organization, and consumption patterns of the whole economy (ECLAC, 2021).

evolution and the prospects of growth in the volume of data produced globally. Between 2010 and 2025, the world generated data evolved from 2 to 180 *zettabytes*. In line with such growth, data storage capacity is expected to grow at an annual rate of 19.2% between 2020 to 2025 (STATISTA, 2021a). In the same vein, WEF (2018) estimates that in 2021, the global internet data traffic exceeded 125 times the volume of traffic registered in 2005.

Such growth has a direct correspondence with the economic relevance of digital technologies. Correspondingly, information and communications technology (ICT) goods related spending —such as software, digital services, data centres systems, communication services— increased from about US$ 2.5 trillion in 2005 to US$ 4.47 trillion worldwide in 2022. Moreover, at the end of the second decade of the 21st century, about a quarter of global business could have been related to the digital economy (MIĆIĆ 2017).

The exponential growth of digital technologies is revealed by the number of publications, patents, and expansion of market size of different solutions. In Artificial Intelligence (AI), above 400 thousand publications were produced between 1996and 2018, while 116.6 thousand patents were registered in the same period. Correspondingly, AI market size is expected to increase more than tenfold between 2017 and 2024, reaching US$ 191 billion. The market size of IOT is also expected to growth in a similar scale, from US$ 130 billion in 2018 to US$1.5 trillion by 2025, representing about half of the total revenue generated by the most relevant advanced digital technologies. The production of papers, patents, and the market size of blockchain, robotics, 3D printing, and big data are to follow a similar trajectory (ARONA, 2021).

Despite this huge advance, in 2022 slower global growth and higher inflation, as well as the persistent tension between the US and China, disproportionally hit the consumer-internet companies. From January 1st to November 11th, 2022, the Nasdaq 100 Technology Sector Stock Index fell more than 35%[3] while the Dow Jones Industrial Average, made up of less techie firms, was down by around 10%. Moreover, it is estimated that American tech companies has already shed more than 140,000 jobs in 2022 alone. It is to be seen whether these recent trends are just a hip cup, an adjustment process after a strong expansionary period, or whether the economic forces in play may lead to a loss of steam of some digital business models.

2.1. New economic activities and business models

Digital technologies have been around us for a long time. But, since the 1980s, with the fast improvements in the capacity of microprocessors, they have been progressively transforming economies and societies. In the productive sector, digital solutions coupled with fast and reliable connectivity induce the emergence of new business models, the so-called "platformisation" and/or "servitisation" of business or changes in existing

[3] https://www.marketwatch.com/investing/index/ndxt?countrycode=xx

organisations. According to ECLAC (2022), worldwide there were around 600 operational IOT platforms in 2021, a threefold increase since 2015, providing solutions to a variety of markets, from manufacturing to mobility. Thus, digital goods and services are blended alongside and/or even substituting long-standing ones (OECD *et al*, 2020).

Internet connections and digital platforms play a key role in approximating, in real time, demand to supply, thus reducing transaction costs, increasing efficiency gains in the use of assets, creating new markets, and enabling new business opportunities. At the enterprise level, the advantages presumed by the implementation of digital technologies are associated with a greater aggregation of value along value chains, the reconfiguration of competitive drivers, the modernisation of traditional sectors and/or the creation of new market opportunities. At the production level, horizontal integration can be brought by innovations such as machine learning or IOT that enable instant machine-to-machine communication as well as real time forward and backward logistics.

In a nutshell, technical progress is offering the capacity to manipulate an ever- increasing amount of information at a correspondingly lowering amount of time while costs per unit of information are falling and new applications are exponentially growing, and the prospects are for the continuation of such trajectory.

But all is not so rosy for the digital firms. By late 2022, three business models are showing problems: the movers (which shuttle people or things around cities), the streamers (which offer music and tv online) and the creepers (which make money by watching their users and selling eerily well-targeted ads). Over the past year the firms that epitomise these business models—Uber and DoorDash; Netflix and Spotify; Snap and Meta (which has fallen out of the trillion-dollar club) —have lost two-thirds of their market capitalisation on average. These businesses models suffer of similar problems: too much faith in network effects, low barriers to entry and a dependence on other firms' platforms. Moreover, concerns about content moderation played its part in the hostile take-over of Twitter. The effects of these new trends, as well their persistence, will take time to be duly assessed.

2.2. The capability challenge

The digital qualification of people and organisations are a decisive factor to foster the fulfilment of the potential promises of a digital economy. For that, significant and permanent investments in the transformation of the qualification profile of workers, citizens and organisations are necessary: effective digitalisation requires digital citizens, digital organisations, and digital governments.

Such qualification starts with a sound basic education in national languages and mathematics. But it certainly must go beyond basic education. The very education and vocational training systems must be overhauled to also incorporate digitalisation in its conceptual design and practices.

New technologies require computational thinking-based solutions that aim to streamline daily living conditions and/or work processes by identifying patterns to achieve more

efficient and comfortable ways of living, producing and solving problems. To enable a trajectory along these lines, OECD *et al* (2020) calls for substantive investments in the "digital literacy" of the population, going beyond the formation of a workforce capable of dealing with new digital technologies but also reaching the development of values promoting their innovative usage. In short, the effective adoption of a digital technology implies investments in organisational capital and skills (GAL *et al*., 2019). And, correspondingly, the more extensive and intensive a digitalisation drive is, higher the needs for adaptation and/or requalification of workers and consumers.

In terms of the business organisation, the evolution has been towards the incorporation and exploration of the voluminous flow of data generated by digital platforms. When duly processed —with the support of AI— the "big-data" provide more reliable, and real-time information for decision-making andgreater agility to production processes, leading to superior competitive performance. In its turn, a digitalised business sector cannot survive without a digitalised market and society. The quality and the costs of digital devices and related infrastructures are necessary conditions for its efficient and effective deployment. Thus, the disseminationof frontier digital technologies demands permanent, and fast access to broadband internet through which people can use digital services, even in areas away from large urban centres. Above all, digital education, and capabilities, at the level of all and every organization, and at the level of households and individuals, are of the essence. Likewise, in the civil society, even if individuals hold the latest communication devices and enjoy access to the necessary digital infrastructure at reasonable costs.

Moreover, digitalisation may contribute to the breaking of formal barriers between the work and non-work or home and off-home spaces. The necessary flexibility to navigate in and around these spaces demands digital capabilities from citizens combined with complementary soft skills to entitle them for new and emerging social interactions. Thus, to follow the constant technological changes of the digital paradigm, competencesas creative reasoning, adaptability, and the ability to know how to learn become of fundamental importance.

3. Digitalisation in Latin America

3.1. The inter-region perspective: is the region catching up or lagging behind?

Consistently with our narrative, it should be expected that the adoption of frontier technologies would be unequally experienced by countries due to their structural conditions. It would be expected then that structural conditions of developed countries would facilitate their digitalisation drive *vis-a-vis* developing regions. For this matter, this section examines four digital enabling factors: (i) the extent of internet access; (ii) the quality of the ICT infrastructure; (iii) the relative ICT costs and (iv) the digital capabilities from an international comparative perspective. It finalises with an exercise to contrast indicators of economic performance and digital uptake, also from a comparative country level perspective.

The percentage of the population with access to the 4G mobile network in 2020, by

region is shown in Table 1. This evidence is straightforward: the LA region does not lag much behind other regions in terms of mobile access to digital technologies.

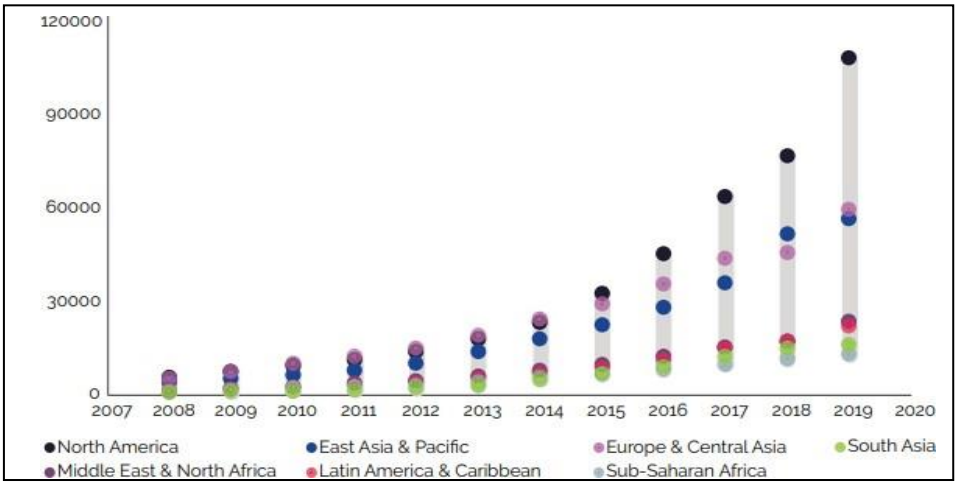
Table 1- Percentage of population with 4G mobile network coverage

Region	2020
North America	99,7%
Europe & Central Asia	97,4%
Middle East & North Africa	90,5%
East Asia & Pacific	88,1%
Latin America & Caribbean	80,4%
South Asia	80,7%
Sub-Saharan Africa	58,3%

Source: Own elaboration based on ITU Digital Development data, World Telecommunication/ICT Indicators Database (2021)
Note: Continent classification by World Bank Country Classification (2020)
*Annual data for each region were calculated from the average % of the population for each country

Figure 1 provides comparative information about the average download speed of fixed broadband networks, by region, for the 2007-2019 period. This is an indicator of the quality of the ICT infrastructure essential for the provision of advanced digital services such as IOT-based solutions. The data suggests that, along these years, the average internet download speed in South Asia, Latin America and sub-Saharan Africa is evolving but constantly and increasingly lagging those of other regions, such as Europe, the Middle East, North Africa, East Asia, Pacific Asia and, especially, North America. The uneven evolution of internet speed implies different capacities to potentially enjoy the benefits of digitalisation by different societies (WEF *et al.*, 2018). This second set of evidence shows that the current widespread access to a relatively advanced mobile network is not enough; the quality of the infrastructure allowing such digital access also matters.

Figure 1 – Average download speed (in kbps) of fixed broadband networks by region – 2007 to 2019



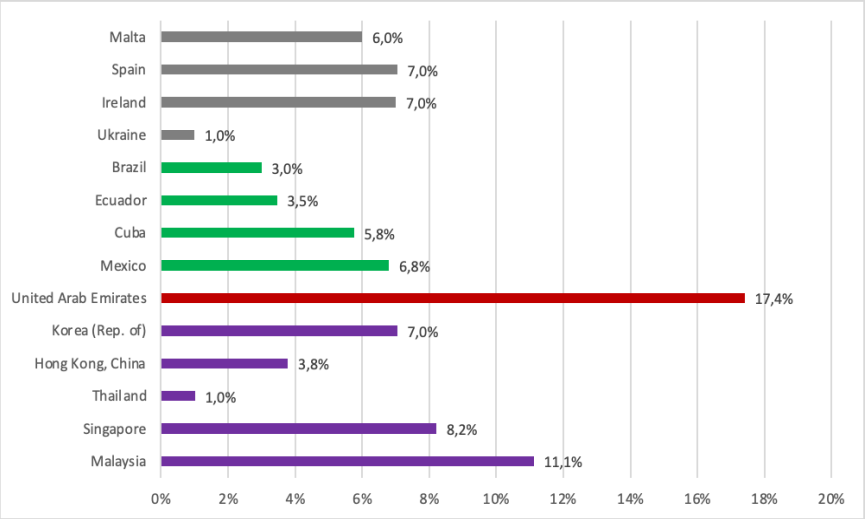
Source: ECLAC et al (2020).
Note: 1 kilobit per second (kpbs) = 100Mbts

The third set of evidence is related to the cost of access. In high-income economies, the monthly cost of 1.5GB connection speed is, on average, below 2% of the gross national income (GNI) per capita. In middle-income economies a similar access cost ranges from 5 to 10% of the GNI per capita and, in low-income economies, such connections can represent more than 20% of the prevailing GNI per capita (UNCTAD, 2021). Still from the same perspective but from a slightly different angle, ECLAC (2022:183) estimates that, in Latin America, the cost of a basic digital basket "can represent up to 33% of the average income of households in the poorest quintile". This evidence indicates that even if universal access is enabled and a quality infrastructure is available, the relative costs of devices and services constitutes a significant barrier to the potential digital benefits.

The fourth and final set of evidence to be examined is related to the capabilities of the population. If the influence of the previous set of factors (access, infrastructure, and income) was positive, one remaining factor can be decisive in setting up the proper conditions for any person to benefit from the digital era: his/her knowledge and skill base. In this respect, according to OECD (2017), by 2012 even wealthy countries were struggling to foster the proper skills for this new digital era: by then, only 6% of the population of all OECD countries had advanced digital skills.

If the situation was already critical by 2012, as the years passed, digital skill inequalities among countries remain an international well marked feature. And not all developed nations fare well. As shown in Figure 2, in 2020, the percentage of the population of selected countries, from various regions, with advanced digital skills, varies considerably. In one extreme, the percentage is higher for the United Arab Emirates (17.4%) and Malaysia (11.1%). Between 7% and 8% of the population from Spain, Ireland, Singapore, and Mexico have advances skills while such figure isaround 5% for Hong Kong, Cuba, and Malta. Brazil, Ecuador, Thailand, and Ukrainehave 3.5% or less of their population with those digital skills. Regardless of the proportion for each country, this evidence indicates that developing and accumulating digital capabilities is a challenge for all selected countries.

Figure 2 – Percentage of total population with advanced digital skills. Selected countries, 2020

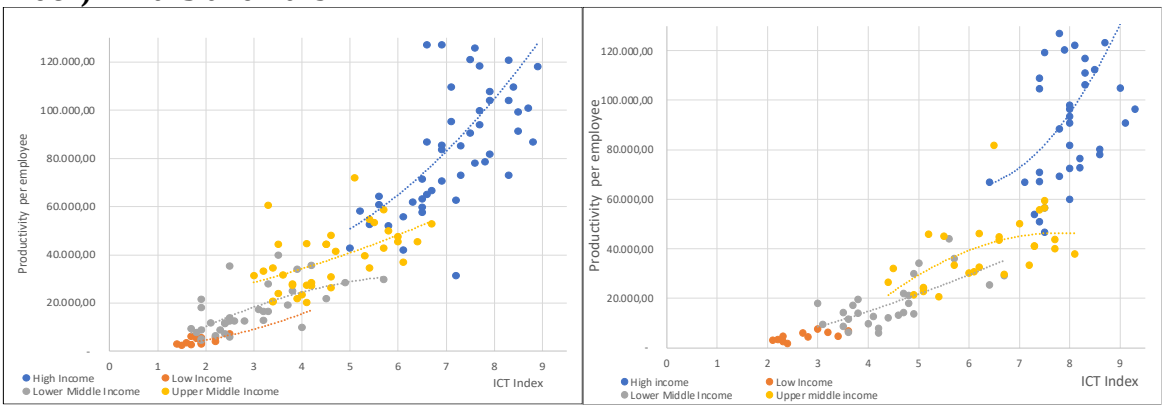


Source: Own elaboration based on ITU *et al.* (2021b)

All countries face digital challenges but in different "proportions". Even with some progress, especially in relation to internet access, developing countries face higher digital costs, lower quality digital infrastructure and limited digital skills. Most countries in North America, in Western Europe and in East Asia (South Korea, Japan) and a few Arab nations are relatively more "advanced" not only for their sophisticated economic structure and greater wealth but also because they are relatively further ahead in their capacity to capture the benefits of technical progress, even with challenges of their own, especially in relation to digital skills. Do these striking differences reveal themselves in different economic gains?

In Figure 3 an attempt is made to contrast labour productivity (GDP per worker) to an ICT index[4] of countries grouped according to their income level (high, upper middle, lower middle and low)[5], for 2013 and for 2019. Three readings can be made. Firstly, the data suggests important country differences: countries with higher labour productivity also show higher ICT access levels and vice versa. Secondly, such association becomes more pronounced over time (2019 vs 2013). Thirdly and contrary wise, between these two years, while the productivity position of low and medium-low income countries remains unchanged, some digital progress can be observed. That is, their digital progress outpaces their productivity advance.

Figure 3 – Labour Productivity (GDP per worker in USD) vs. access to ICT (ICT Index) in 2013 and 2019



Source: Arona (2021) with data from The World Bank (2021) and GII INDEX. Notes: productivity is measured in PPC dollars of 2017 prices. Countries are classified according to World Bank Country Classification (2020).

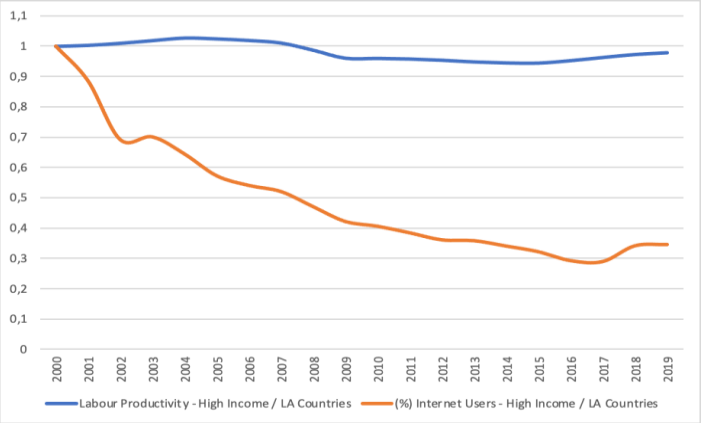
The comparison between digital progress and economic efficiency can be further and

[4] The ICT access index is one of the 80 indicators used by the Global Innovation Index. It is a composite index that weights five ICT indicators (with a weight of 20% for each one): (1) Fixed telephone subscriptions per 100 inhabitants; (2) Mobile cellular telephone subscriptions per 100 inhabitants; (3) International Internet bandwidth (bit/s) per Internet user; (4) Percentage of households with a computer; and (5) Percentage of households with Internet access (CORNELL UNIVERSITY *et al* (2020).

[5] The World Bank Country Classification (2020) divides countries into four income groups using the 2019 Gross National Income (GNI) per capita, calculated according to the World Bank Atlas Method. The groups are low income (GNI per capita of US$1,035 or less); lower middle income ($1,036 –4,045); upper middle income ($4,046 – $12,535) and high income ($12,536 or more).

closely observed in Figure 4 where two curves were drawn up for a 20-year period (2000-2019) comparing Latin American countries and high-income ones. The first curve relates the labour productivity of high-income countries to the labour productivity of LA countries[6]. The second curve relates the digitalisation of high-income countries to the digitalisation of LA countries, measured as the percentage of total population of each region with internet access[7].

Figure 4 – The productivity gap vs. the internet user gap between high income countries and LA countries in time (2000 – 2019)



Source: Own elaboration based on data from The World Bank *et al* (2021) and ITU *et al* (2021a).
Note: Labour productivity is measured in GDP per worker in PPC dollars at constant 2017 prices.

To provide a comprehensible visualisation of the evolution of the two series, both indicators were normalised. Therefore, the closer to 1 in the vertical axis, the greater the productivity gap or the digital gap between high-income countries and LA countries. Figure 4 stresses out what was previously suggested in Figure 3: while a very significant shortening of the digital gap occurred, the productivity gap was reduced byonly 2.1% between 2000 and 2019.

In summary, this section has shown that developing nations, including Latin America, were able to significantly extend the most basic form of digitalisation (internet access) to an important proportion of their population, while still lagging in costs, skills, and infrastructure relatively to higher-income countries. More comprehensive digital advances, in turn, goes in pair with efficiency levels and vice-versa.

With words of caution (digital progress is not only to be reflected in efficiency gains and productivity growth has sources and drivers far beyond the digital dimension) such divergent paths between digitalisation and efficiency opens the way for an initial set of

[6] The classification for high income countries follows the criteria legitimated by World Bank. Latin American countries that are considered by the World Bank as high-income were reclassified as LA countries.

[7] The country classification was obtained from The World Bank Country Classification (2020). To estimate the productivity gap between the categories, a ratio was established between the annual average labour productivity of high-income countries and the annual average labour productivity of the Latin American countries.

reflections. Firstly, in recent years, digital progress has certainly been achieved by all countries. But such progress seems to be qualitatively different between high and even middle-high income countries, and those situated in low or middle low-income brackets. Secondly, these marked disparities also imply differences in the capacity of countries to enjoy the benefits of the digital era. In short, it seems that the relative "development position" of most developing nations has not changed over time.

After the country level comparative analysis, a new question arises: if we go into each developing country, with their internal striking economic and social differences, are we also going to find digital gaps? This is the subject matter of the following sub-section.

3.2. The intra-region perspective: digitalisation in the face of structural disparities

In this section we maintain our focus on the contrast between indicators of digital progress and those associated with economic performance. But, for the latter, we propose an outstanding feature of most Latin American countries structural conditions as the reference to develop the efficiency indicator: the relative importance of the informal sector.

For the purposes of this paper, we assume that productivity differentials are inherently related to the type of occupation of workers. That is, we suppose that high productivity economic activities also have a significant proportion of formal jobs. In contrast, as argued by ECLAC (2007), informal jobs (non-professional salaried workers, unpaid family work and employees in micro enterprises) are more likely to be associated with low productivity economic activities.

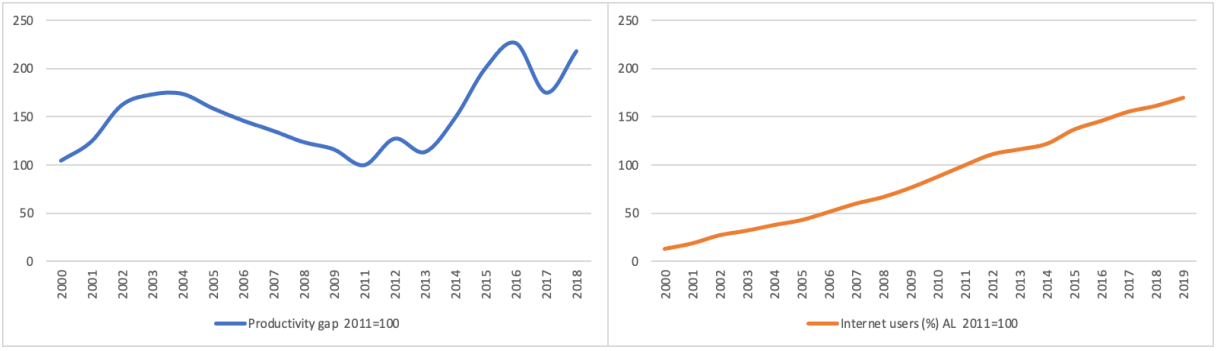
According to Maurizio (2021), by the end of the 2010s, the region's rate of informality was around 50 percent. In the face of such reality, it became relevant for us to discern the productivity indicator between formal and informal sectors and to relate one to the other[8]. By doing so we arrived at a country level productivity gap, and it is such productivity gap that is then contrasted to a proxy indicator of digital progress (internet users)[9]. We then plotted the two curves over the 2000-2018 period, as shown in Figures 5A and 5B, respectively. To allow a better visualisation of their evolution over time, both indicators were transformed in index numbers, with 2011 serving as the base year.

[8] Methodological notes: Labour productivity estimates are based on UN/ECLAC data in 2010 US dollars.2. The informal sector includes the following categories: domestic service, non-professional salariedworkers, unpaid family work, and employees in microenterprises (with fewer than five workers). Labour productivity of the informal sector was estimated based on the average income of informalworkers. Such income is considered a good proxy for the value added generated by the informal sectors, due to the nature of the activities carried out in those sectors.

[9] Internet users: ITU *et al* (2021a) estimates for the proportion of individuals to total population (above 5 years old) using the Internet, based on data from national household surveys.

Figure 5 – The evolution of internet users and the formal/informal sector productivity gap in selected Latin American countries, 2000-2019

A. Formal/Informal Productivity gap **B. Internet users (% population)**



Source: Own elaboration based on ECLAC and ITU *et al.* (2021a) data.
Notes: Data on the proportion of internet users is an annual average for 8 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru). These are also the countries for which the average productivity gap was estimated.
The data was extracted from household surveys which may not be uniform across Latin American countries or even within a country over time.

Given the evidence of the previous section, the positive evolution of the indicator of digital access (internet users in relation to total population) of the selected Latin American countries (Figure 5B) comes as no surprise. The curve depicting the percentage of internet users grows steadily along time. In the base year (2011) about 41% of the inhabitants of 8 selected Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, and Peru) were internet users, while back in 2000 this figure stood at only 5.5% of their total population. In contrast, to the first year of the series, by 2019 the percentage of the internet population had increased 14 times, to 70.5%. For the whole Latin America (and Caribbean) region ECLAC (2022) estimates that in 2021 the internet users as a percentage of total population were close to80%, just 8 percentage points below the European Union. It is quite clear then that, regarding access to internet usage, Latin American countries experienced a significant progress in the recent past.

One word of caution, though. As argued previously, internet access is just one of the components of the process of digitalisation, which would have to include other dimensions such as affordability, reliability and speed of infrastructure and skills, as argued by Katz et al. (2013). For most developing countries, and those from Latin America are no exception, progress in these dimensions (which would represent a more comprehensive perspective of the process of digitalisation) is lower and slower than the increase of the internet population. For example, although a large proportion of the population has access to the internet, the quality of such access may be limited by hardware (basically mobile phones, which are hardly suitable for multitasking) and the costs of connection to higher speeds.

In contrast to the path of internet usage, the evolution of the productivity differentials between the formal and the informal sectors (Figure 5A) follows a different pattern. After increasing in the beginning of the 2000 there was a decrease in the productivity gap

between 2004 and 2011 when the gap was quite like that on the first year of the series. From then onwards the productivity gap increases sharply and steadily. The actual gap behind these trend lines is even more staggering. Along the years, between 2000 and 2018 the average labour productivity of the informal sector, for these selected Latin American countries, was situated between 8% and 9% of the productivity levels of the formal sector. Ohnsorge *et al*. (2021) argue that, in one of the dimensions of informality, that associated to the business sector, a significant reliance on unskilled labour and the lack of managerial abilities, in association with limited economies of scale, and restricted access to infrastructure and services by micro and small firms, create a difficult scenario for the reaping of efficiency gains provided by digital assets.

4. Can digital technologies unleash Latin American development?

In this final section we reflect about the main findings and arguments made along the text and to discuss the related policy implications, or policy challenges. For the former, two issues will be discussed about the comprehensive nature of digital progress and its relation to economic efficiency. For the latter, we want to enunciate what are the digital-related policy challenges facing Latin American countries.

Economic transformations arising from digital technologies is potentially immense. In view of that, our paper discusses whether digital technologies may represent a new window of opportunity for catching up processes in developing countries with a special focus on the contrast between the evolution of digital adoption and efficiency levels.

Moreover, considering the outstanding income and capability differentials prevailing in most developing countries and specially in Latin America, we tried to appreciate whether the productivity gaps between formal and informal sectors are evolving alongside the diffusion of digital technologies.

In search for answers to our questions, we reviewed the main contributions and arguments put forward by specialists and we compiled and analysed the available evidence. Our proposal is an exploratory exercise, and we are fully aware of three interrelated factors may play a relevant role in determining the potential outcomes of digitalisation. Firstly, digital technologies changes not only efficiency parameters but also pave the way for new products, services, markets, modes of organising institutions and even ways of life. Secondly, economic efficiency is influenced and mediated by other factors beyond the adoption of digital technologies. Thirdly, to be reflected in statistics, a long period of time from the very first introduction of digital technologies to their widespread dissemination would be required. In this sense, the full effects of digital technologies wouldn't be achieved until a sufficient stock of assets of new technologies is accumulated including the realisation of waves of complementary innovations.

With such caveats, our interest lies more on the direction of the evolution of digital adoption and efficiency curves over time. For that, and based on available data, we analysed the digital gap between the region *vis-à-vis* other parts of the world, and we experimented juxtaposing the local digital adoption trends with the evolution of the formal and informal sectors efficiency gaps.

4.1. Our findings

Latin America is a region marked by the co-existence of significant differentials of capabilities and performance among economic sectors and agents. Our findings are not discrepant.

We found that developing nations, including Latin America, were able to significantly evolve and to extend the most basic form of digitalisation (internet access) to an important proportion of their population, while still lagging in costs, skills, and infrastructure relatively to higher-income countries. We detected that, in Latin America, the productivity gap of the informal sector in comparison to its formal counterpart has increased along the first two decades of the XXI century, despite of substantial progress in the expansion of digital access in all selected countries of the region. The region's digital progress was limited as the lowering of costs, the expansion of a fast and reliable infrastructure, and improvement in digital skills are journeys that Latin American societies are still insufficient for access to all. A consolidated progress along these lines would increase the likelihood of a positive contribution of digital technologies to economic efficiency.

These stylised findings lead to four reflections. Firstly, and in answer to our first question (*can digitalisation open new windows of opportunity for the development of LA countries?*) the Latin American digital progress is real; it has happened, a quite significant proportion of peoples and organisations have access to internet services. So, we can state that relatively to their past, there are significant advances. But, relatively to developed nations, such progress is limited as the latter are capable to engage in more comprehensive and deeper processes of digital adoption. In short, in absolute terms, there was progress; in relative terms, the digital development position of Latin American countries has not improved significantly. If such trend continues, it is fair to argue that, in despite of their immense transformation potential, digital technologies' contribution to development catching up is still insufficient.

Secondly, and in answer to our second and third questions (*over time, is the diffusion of new technologies evolving alongside efficiency levels? Are digital technologies contributing to shorten the productivity gaps between the formal and the informal sectors?*), it is reasonably arguing that the harnessing of digital dividends is greater for the formal sector in comparison to the informal sector due to the nature of the capabilities typically associated to the former. By reaping the efficiency-related benefits from the digital progress, the formal sector is likely to increase the productivity distance to the informal sector.

Thirdly, there are risks that the nature of the on-going trajectory of digitalisation in Latin American countries may accentuate the existing intra-country economic and social disparities. That is, in the absence of a wide improvement in the quality of digital access, with corresponding improvements in digital capabilities for those with current limited access, digitalisation may benefit mainly those with accumulated tangible and intangible assets. As a result, aggregated productivity is not fully affected by the potential positive effects of the digital technologies.

Fourthly, at this point it is important to remind that there are other important elements

mediating the process of leveraging productivity. Such circumstances suggest that, even if a comprehensive process of digitalisation was to take place, such process alone may not constitute a sufficient strategy to sustain catching-up processes. But, in the absence of any efforts to induce improvements in the quality of infrastructure in digital skilllevels and in costs of access, the chances of a successful development catching up trajectory are meagre.

4.2. Policy alternatives

In light with the discussion in this paper, we conclude that public policies are of the essence to better capture the potential gains in productivity and economic growth from the adoption of digital technologies. Although policy objectives are clear, public policies face all types of constraints, from access to fiscal and financial resources to the capabilities of public institutions to effective implement and monitor policy directives. The policy direction: digital inclusion; the policy challenge: to choose, prioritize and implement actions.

Given the digital divide in Latin America, digital inclusion can be justified as the policy north. Advanced digital capabilities are confined to islands of progress; in the business sector they are represented by larger firms and those from high and medium-high-technology industries (FERRAZ *et al.*, 2019); in the civil society, by its formal segments. Small and lower technology businesses and peoples engaged in informal activities should then be the policy targets. But this is quite a challenge.

From a demand-side perspective, to build an inclusive digital society, ECLAC (2020) estimates that a basic basket of technological products, comprising a laptop, a smartphone and a tablet, can be provided to households that do not have digital devices at an annual cost of less than 1% of GDP. This basket should be complemented with a subsidy to payment for a fixed connection and a mobile connection for offline urban households and payment for a mobile connection for rural households, which would cost less than 0.4% of GDP. In both cases, costs vary significantly across countries. In the current fiscal stance in the region, these figures are quite demanding.

From a supply-side approach, fostering digital transformation in the business sector imply different types of policies (ECLAC, 2022). For firms near the international productivity frontier, polices should: (i) define and adopt Industry 4.0 standards to enable intelligent and autonomous data-driven equipment and technologies to function interoperable, transparently and securely, (ii) support the incorporation of cutting-edge digital technologies into production processes through science parks, incubators, accelerators and innovation laboratories, and (iii) promote digital entrepreneurship through financing mechanisms that facilitate the creation of emerging and technology-based companies.

For micro and small firms, actions should be oriented towards (i) providing technical assistance and low-cost financial incentives to firms unable by themselves to catch-up with their digitally advanced peers, and (ii) implement policies suited to the specificities of the target firms and industries in terms of production capabilities, management, and linkages with the local area.

For the informal sector, granularity and direct contact with potential beneficiaries are essential; thus, access to support programmes should include dialogue mechanisms based on direct interaction between policy implementers and their beneficiaries, rather than on formal protocols and written communications. Moreover, close collaboration is needed to implement policies that address a wide variety of issues, especially those concerning the quality of life of the population in the informal sector (e.g., food, health,and security). Finally, given the huge size of the informal sector in the region, policies must be applied with a massive scope if they are to produce significant effects. This implies that policy measures must be simple, easy to understand and with very low unitmanagement costs.

Even if well-designed comprehensive and coordinated policies, as well as implementation capable organisations were available, digital policies would have to compete for scarce fiscal resources with other equally justifiable policy demands. In this sense, policy choices are of political nature and the vision and commitments of political leaders is what matters, in the last instance. But attention! Developing countries face not only enormous challenges, but also a sort of "policy competition" with other nations: the US is mobilising right now USD 250 billion in just one of its programmes, the Innovation and Competition Act[10]. The Italia Domani, a recovery and resilience building programme, involves more than USD 200 billion for the support of new technologies[11].

From a broader social perspective, digitalisation policies should aim at the facilitation of citizens' access to public goods. Some examples are: (i) public services capable of extending social safety nets to protect vulnerable groups including those under atypical jobs and work on digital platforms adapting, if it is necessary, administrative procedures, benefits and contributions to their capacity; (ii) labour regulations based on the guarantee of the recognition and protection of workers' social and labour rights; (iii)regulatory initiatives and institutions aimed to simplifying registration procedures and encouraging the formalisation of micro firms and workers through formalization systems; (iv) investments in the expansion of job training and skill development infrastructure with proper alignment with the needs of productive areas.

In this respect, again, most countries have initiatives of this sort, with the most advanced solutions being implemented in the tax systems, for obvious reasons. But, for their nature, the health and education systems would be almost "natural" areas for a public commitment to digitalisation. However, the complexity involved in the digitalisation processes of education and health systems are highly demanding not onlyof significant resources invested over a long period but also capable institutions to implement the related policies.

In the last instance, the tackling of new policy challenges demand new approaches to the policymaking process. In this sense, from a normative perspective, at the political domain is where choices are made to guide a new policy agenda—i.e., actions towards digital inclusion of specific population segments. Decisions then must be resonated in policy directives and mandated executive agencies must have the resources and the capabilities

[10] https://www.congress.gov/bill/117th-congress/senate-bill/1260

[11] https://italiadomani.gov.it/en/home.html

to design, implement and monitor policy priorities. Policy initiatives often have more effective results when they are based on solid and long-term customised and well-coordinated programmes under a supportive institutional and economic environment.

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