

# The Impact of Digitalization on the Economies of Latin America

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**Abstract:** The article is devoted to the analysis of changes in the economic development of Latin American countries under the influence of digital transformation. The characteristics of the involvement of Latin American countries in the process of digital transformation at the present stage are given, which showed insufficient activity in the implementation of digital technologies. Requiring greater participation of the state, private business, as well as the need to increase digital skills among the population. An analysis of the use of digital technologies in strategic sectors of the economy: mining and agriculture was carried out, which showed that this trend can lead the countries of the region to a new level of economic development. Further prospects for the development of the digital economy are likely to be associated with the active attraction of private capital and venture financing.

## 1 INTRODUCTION

Digital development in Latin American countries (LATAM) in the first decade of this century progressed at a moderate pace, significantly lagging behind the digitalization of developed countries. The increase in demand for information and communication technologies (ICT) during the pandemic period, especially the crisis of 2020, led to the strengthening of the role of digital technologies in the global economy and confirmed that the level of digital development in a country plays a significant role in its economy, serving as a driver of economic growth. The development of the digital economy leads to a global transformation of the economic environment and requires new approaches to production organization, relying on new technologies (Koshevenko, 2018). The possible effects of the digital transformation process have been extensively examined in the works of renowned scientists, such as Koshevenko S.V., Jiao H., Wang L., Shi Y., Palamarchuk O., Korkach I., Kosyakova I.V., Gagarinskya G.P., Abdulova T.G., Serna Gomez J.H., Diaz-Piraquive F.N., Muriel-Perea Y. de J., Diaz

Pelaez, etc. In addition, various aspects of this issue are being studied by experts at UNCTAD (United Nations Conference on Trade and Development [UNCTAD], 2022), OECD (Organisation for Economic Co-operation and Development [OECD], 2021); in a World Bank (World Bank, 2022) report Global Development Report 2022: "Financing for a Just Recovery" which discusses the central role of finance in economic recovery after the pandemic. Most experts emphasize the role of the state in promoting digitalization (Jiao, H. et al., 2022). Digital transformation of business today is one of the main tasks of an integrated system for the development of small and medium-sized businesses (Palamarchuk, 2023), (Zrybnieva et al., 2023), which in turn plays an important role in the economies of countries. Progress in adapting digital transformation in enterprises has been asymmetrical across both industries and regions of the world (Serna Gomez et al., 2021), (Kosyakova et al., 2023).. The digital divide between countries in the region largely depends on broadband access and infrastructure investment and requires structural technological transformation (Mirković et al., 2020). LATAM economies, facing stagnation due to the 2019

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pandemic, have actively engaged in creating conditions for accelerating digital transformation. At present, a number of Latin American digital companies are experiencing remarkable growth, linked to the activation of digital entrepreneurship in the region and innovation implementation (Andonova et al., 2023). Despite the significant growth in the share of digital goods in total GDP, only five countries in the region - Argentina, Colombia, Costa Rica, Peru and Uruguay - have made legal changes on the issue. In the current stage, the digital transformation of LATAM economies is associated not only with institutional and structural changes but also with decisive measures in the innovation and technology sector: the digitalization of key sectors, including agriculture, thus ensuring economic growth based on technological upgrading of the economy (Yakovlev, 2022).

The scientific novelty of this research lies in the examination of the expected change in the position of LATAM countries in the global economy in connection with digital transformation. The scientific task of this work is to analyze underexplored places and trends in the economies of LATAM countries, enabling economic growth and structural transformation.

## **2 MANUSCRIPT PREPARATION**

During the research to understand the common principles, various materials and methods were employed. The primary research method utilized was content analysis of regulatory documents governing the state regulation of digital transformation in the economies of Latin American countries. Statistical data from various sources, including CEPALSTAT, Statista, World Bank, International Trade Centre were also used. In the course of the research on the issues of digital transformation, logical, comparative, and statistical analysis methods were applied.

## **3 RESULTS AND DISCUSSION**

### **3.1 Digitalization as an Important Development Trend in Latin American Countries**

Currently, the theme of digital transformation is garnering increasing attention. Latin American countries are actively participating in the global transition to a digital economy. This transition begins

with the proliferation of personal computers, broadband and mobile internet subscribers and culminates in the intensive use of digital technologies at the state, business, and individual levels. According to the Global System for Mobile Communications Association (GSMA), a 10% increase in mobile internet penetration has the potential to boost GDP by 1.2%, and a 10% increase in digitalization can lead to a GDP growth of 1.9%. According to statistical data, from 2016 to 2022, nearly all countries were in a deep recession or showed minimal growth, and the Covid-2019 pandemic exacerbated this process.

As is evident, the leading countries in terms of GDP growth are Panama, Costa Rica, Uruguay, Chile, and Guatemala, while a decline in GDP is observed in Argentina, Mexico, and Ecuador.

Covid-19 has vividly demonstrated the acute need for accelerating digitalization worldwide. In many parts of the private sector, the implementation of digital technologies, which according to business leaders might have taken years, was achieved within weeks or even days, as the demand for digital technologies from customers surged. Latin America was no exception to this phenomenon: in mid-March 2020, internet traffic increased by more than 40% practically overnight. The reliability of the telecommunications infrastructure in the region, built over decades of investment, and the flexibility of many Latin American governments during the pandemic were among the factors that facilitated this transition.

On one hand, the impact of the coronavirus on the economy worsened Latin America's macroeconomic prospects for the coming years. On the other hand, the pandemic increased the use of online channels, leading to significant expansion of digital platforms. The crisis, compounded by the COVID-19 pandemic, accelerated the adoption of digital technologies and connectivity solutions and had a profound impact on digital indicators and connectivity measures. Digitalization of the economy and society is playing an increasingly important role in economic and social development. It influences virtually every sphere of activity, from agriculture to trade and education. The digital transformation of crucial sectors for most Latin American countries, such as the mining industry and the agricultural sector, can have a significant impact on economic growth and enhance the region's competitiveness.

Table 1: Summary table of country rankings in Latin America based on certain indices assessing the level of the digital economy.

No	Country	Digital Competitiveness Index (out of 64 countries)	Network Readiness Index (out of 134 countries)	Global Networking Index (out of 130 countries)	Inclusive Internet Index (out of 120 countries)	E-Government Development Index (out of 193 countries)	E-Commerce Development Index (out of 152 countries)
1	Chile	39	50	44	21	34	60
2	Mexico	56	63	59	46	61	91
3	Argentina	61	60	58	43	32	85
4	Brazil	51	59	52	36	54	74
5	Uruguay	-	47	49	53	26	81
6	Costa Rica	-	54	56	51	56	61
7	Colombia	59	72	65	44	67	66
8	Peru	57	80	73	60	71	90
9	Panama	-	77	75	65	84	83
10	Dominican Republic	-	75	82	78	82	67
11	Ecuador	-	85	90	61	74	101
12	Paraguay	-	92	88	63	93	82
13	El Salvador	-	95	98	74	107	110
14	Bolivia	-	101	94	-	97	104
15	Honduras	-	102	104	91	138	99
16	Guatemala	-	106	105	87	121	108
17	Venezuela	64	108	-	79	118	80

Note: Author. (2023). From World Digital Competitiveness Ranking and NRI 2022 Report Compilation [Data Compilation]. IMD World Competitiveness Center and Network Readiness Index. [https://www.imd.org/centers/world-competitiveness-center/rankings/world-digital-competitiveness/#\\_2021-digital-results-section-357063](https://www.imd.org/centers/world-competitiveness-center/rankings/world-digital-competitiveness/#_2021-digital-results-section-357063) and [https://networkreadinessindex.org/wp-content/uploads/reports/nri\\_2022.pdf](https://networkreadinessindex.org/wp-content/uploads/reports/nri_2022.pdf)

We conducted an assessment of the level of development of the digital economy in Latin American countries using a range of indices, including the Digital Competitiveness Index, Network Readiness Index, Global Networked Interaction Index, and others (Table 1).

One of the key indicators describing the situation in the field of information technology in a country is the internet penetration rate (the percentage of internet users relative to the total population). Currently, the region with the highest internet penetration is Northern Europe (96%), followed by Western Europe (93%) and North America (90%) (figure 1). South America holds the sixth position in internet penetration (72%), while Central America is in the tenth position (67%). One of the key indicators describing the situation in the field of information technology in a country is the internet penetration rate (the percentage of internet users relative to the total population). Currently, the region with the highest internet penetration is Northern Europe (96%),

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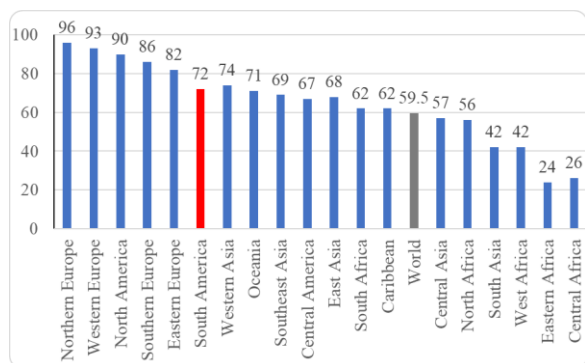


Figure 1: Internet penetration rate in the world 2021, by region, in%

Note: Statista Search Department, (July 2022). Number of internet users worldwide from 2009 to 2021, by region. Statista. <https://www.statista.com/>

statistics/265147/number-of-worldwide-internet-users-by-region/

South America holds the sixth position in internet penetration (72%), while Central America is in the tenth position (67%). The average internet penetration rate in the Latin American region is 69.5%, which is higher than the global average (59.5%).

The analytical division of the British magazine, The Economist Intelligence Unit, compiles the global Inclusive Internet Index annually. This index assesses countries based on four criteria: the presence of infrastructure, accessibility of internet services, diversity of content provided, and the readiness of the population for digitalization. In 2021, a total of 120 countries worldwide were surveyed, including 20 Latin American countries. The leaders in this ranking were Singapore, South Korea, the United States, France, the United Kingdom, New Zealand, Spain, the Netherlands, Taiwan, and Switzerland (Economist Impact, 2022). Among the Latin American countries, the rankings were distributed as follows (Table 2). The best-performing country in the region, Chile, ranks 21st in the global index.

An important factor is the presence of digital skills among the population, which are necessary for effective work with advanced digital technologies. Several industries, such as automotive manufacturing, healthcare, and financial services, have already become digital. As of 2021, the greatest shortage of skilled professionals is experienced by 55% of Colombian and Peruvian entrepreneurs, slightly less, ranging from 41% to 52%, by business owners in Argentina, Brazil, Mexico, Costa Rica, and Panama (Atlantico,2021). According to available data, the percentage of firms connected to the internet reaches 90%. However, the proportion of those using the internet for production purposes is much lower: in Brazil, it's 66%, in Argentina and Uruguay, it's around 40%, which are the highest figures (Atlantico,2021).

Table 2: The Inclusive Internet Index for selected countries in the Latin American region.

Country	Rank among countries in the region	Place in the world ranking
Chile	1	21
Brazil	2	36
Argentina	3	43
Colombia	4	44
Mexico	5	46
Costa Rica	6	51
Uruguay	7	53

Peru	8	60
Ecuador	9	61
Paraguay	10	63
Panama	11	65
Trinidad and Tobago	12	68
Salvador	13	74
Dominican Republic	14	78
Venezuela	15	79
Jamaica	16	81
Guatemala	17	87
Honduras	18	91
Nicaragua	19	92
Cuba	20	95

*Note:* Author. (2023). From Economist Impact. (2022). Inclusive Internet Index. Retrieved October 9, 2022, from <https://impact.economist.com/projects/inclusive-internet-index>.

Digitalization of the economy largely depends on the efforts of the government and private investors. In Latin America, telecommunications traditionally relied solely on private investments. To allow the private sector to cover the expenses of eliminating digital inequality, business justifications and financial incentives for investors are needed. Currently, the role of the government has significantly increased, and there is an influx of venture financing, with many European and North American tech companies showing interest in investing in the technology sector. Traditionally, the lack of venture capital was a critical obstacle to the development of technological entrepreneurship in the region. Companies of all sizes and sectors have historically faced obstacles in securing capital for their investment projects. The situation began to change in 2015, and a new context for financing digital entrepreneurship emerged in Latin America. Financing options are becoming more diverse with the emergence of venture capital funds, angel investor networks, crowdfunding platforms, corporate enterprises, and accelerators. In 2021, venture investments in Latin America exceeded \$15 billion for the first time, increasing by 274% compared to 2020 (LAVCA, 2022). International investments in Latin American startups have increased thanks to the arrival of new investors in the region, including Japan's SoftBank, China's Didi Chuxing, and America's TPG. Large Latin American corporations are also participating in technology entrepreneurship by creating corporate ventures.

It should be noted that during the reform period, the role of the state increases (Revinova. & Chavarri Galvez, 2021). Almost all countries in the Latin American region have adopted strategies for the

development of the digital economy. While some countries (Panama, Brazil, Ecuador, Peru, Colombia) had short-term plans (up to 2022) and currently require additional investments and support from both the government and the private sector, four Latin American countries (Argentina, the Dominican Republic, Paraguay, and El Salvador) have developed digitalization plans up to 2030. However, there are countries that still do not have digital development programs, and not all countries have specialized agencies for digitalization at the ministerial level.

There are compelling arguments for accelerating economic recovery through digitalization in the region. Investments are needed to bridge the digital divide and reduce inequality, especially given the striking correlation between connectivity and poverty in the region. A favorable investment environment should encourage financial, regulatory, and technological innovations and promote collaboration through competition, shared infrastructure, and new models of spectrum access and use. Special regulatory frameworks are also needed for rural areas. Similarly, the digital transformation of government and social services can drive the acceleration of citizen access and enhance trust in the capabilities of digital tools to increase transparency. A coordinated

approach to stimulating investments and promoting implementation can bring significant benefits, as seen in the examples of Panama and Brazil, where investment promotion efforts were accompanied by steps to digitize government administration and state-owned companies.

### 3.2 Digitalization of Agriculture

The Food and Agriculture Organization of the United Nations (FAO) registered a sharp increase in food prices by an average of 40% from May 2020 to May 2021. This was a record figure in recent years, and prices continued to rise in 2022. The agro-industrial complex (AIC) holds crucial significance for Latin American countries as it is one of the traditional pillars for the entire Latin American region's economy. Additionally, the segment of the manufacturing industry related to the AIC, involved in processing agricultural raw materials into finished products, is also of great importance. AIC enterprises play a fundamental role in most countries in the region, including Argentina, Brazil, Colombia, Mexico, Peru, Chile, and others.

Table 3: Level of R&D expenditures in LATAM countries (% of GDP) by year.

Country	R&D expenses (% of GDP) by year							
	2013	2014	2015	2016	2017	2018	2019	2020
Chile	0.39	0.38	0.38	0.37	0.36	0.37	0.34	0.34
Mexico	0.43	0.44	0.43	0.39	0.33	0.31	0.284	0.296
Uruguay	0.32	0.34	0.36	0.41	0.48	0.40	0.50	-
Colombia	0.27	0.31	0.29	0.27	0.24	0.24	0.32	0.29
Costa Rica	0.56	0.57	0.45	0.43	0.42	0.40	-	-
Peru	0.08	0.11	0.12	0.12	0.12	0.13	0.20	0.20
Panama	0.06	0.14	0.12	0.14	0.15	-	-	-
Brazil	1.20	1.27	1.34	1.26	1.26	1.2	1.2	-
Argentina	0.62	0.59	0.62	0.56	0.54	0.50	0.47	0.52
Ecuador	0.38	0.44	-	-	-	-	-	-
Paraguay	-	0.08	0.10	0.12	0.15	-	-	-
Guatemala	0.04	0.03	0.03	0.02	0.03	0.00	0.00	-
Honduras	-	-	0.01	-	0.04	-	-	-
Salvador	0.06	0.09	0.14	0.15	0.18	0.20	0.20	-
Venezuela	0.32	0.34	-	-	-	-	-	-

Note: World Bank. (2023). World Development Indicators. World Bank Data. <https://databank.worldbank.org/source/world-development-indicators/Series/GB.XPD.RSDV.GD.ZS> (access date: 09/28/2023).

It's also noteworthy that Brazil has posed a significant challenge in food production in the 21st century. The uniqueness of Brazilian agriculture lies in its simultaneous traditional and innovative nature, based on digital technologies. The innovation in Brazil's AIC is characterized by the radical modernization of the national AIC, which has enabled Brazil to become a global food superpower (Brazil's Ministry of Agriculture, Livestock and Supply, 2021). Significant growth in food production in Brazil, Argentina, Peru, and other Latin American countries has been achieved by changing the agrarian landscape and transitioning agriculture onto a path of intensive growth. These results were made possible through the adoption of new technologies and advanced methods of conducting agricultural business, including the development of mechanization, chemical industry, genetic technologies, and more efficient utilization of available labor and financial resources. There is active support for the technological transformation of regional AICs in the context of the ongoing process of digitizing the global economy. According to experts' assessments, digitalization can increase productivity significantly and substantially transform the face of the agricultural sector in Latin America. According to argentinian expert Carlos Becco, the process of adapting the agro-industrial complex to modern stringent requirements and the new process will be recognized as a digital revolution in the agricultural sector, which will change the fundamental principles of agribusiness (Perazo, 2021).

Based on digitalization and cutting-edge technologies, several Latin American countries are in the process of forming a system of so-called precision agriculture. Priority technologies are being developed, including new genetically modified crops, small farm robots capable of growing and harvesting crops, and unmanned aerial vehicles that can monitor air humidity, soil conditions, and more. Furthermore, with the wave of digital transformation, there is an increase in the role of Latin American agribusiness, many of which are high-tech agrotech startups. The number of these agrotech startups in Latin American countries is continuously growing (Graziano da Silva et al., 2021). For the development of agribusiness, the most modern business models are used, including the "field to table" model, where agribusiness companies provide technology and initiate the creation of marketplaces that connect sellers and buyers (CIAT, 2020). An example of a successful agrotech startup is the argentinian company Auravant, which has become an effective player in digital agriculture,

largely due to the use of SaaS (Software-as-a-Service) business technology – cloud-based software that provides ready-made online solutions to users at exceptional speed (Levante EMV, 2021).

To harness the maximum benefits of this third revolution in biology, Latin American countries need substantial investments in science and technology (more than 1% of the agricultural GDP) and infrastructure (such as communication and the Internet), as well as sound policies and regulations. Unfortunately, national expenditures on research and development (R&D) in the region are relatively low (Table 3). It's worth noting that some Latin American countries, as well as developing countries in general, fall below the minimum threshold of 1% as recommended by international organizations, not to mention the 3-4% invested by developed countries.

### **3.3 Digital Transformation of the Mining Sector**

In addition to agriculture, the mining industry is of paramount importance for several Latin American countries, such as Peru, Chile and Bolivia. This sector also plays a significant role in the economies of Argentina, Brazil, Colombia, Mexico, and others. Given the ongoing transformation of global economic relations, Latin American countries have seen opportunities for technological advancement and digital modernization of key sectors in their national economies. In the mining sector, the challenge for Latin American countries is to decarbonize the production process through "green" hydrogen and advanced methods of resource extraction and processing. Latin American countries have the potential for hydrogen production based on renewable energy sources, although only a few, such as Argentina and Chile, are currently producing this type of energy (Suarez et al., 2023). In recent years, there has been a noticeable shift in international demand for copper and lithium, which are widely used in electronics and electric vehicle manufacturing. Additionally, the production of chargers for gadgets and lithium-ion batteries for new vehicles confirms the high demand for these products. Latin American countries are actively investing in the development of regional natural resource deposits. Numerous European and North American companies are actively investing in various programs. For the economic future of Latin America, the technological upgrade of the extractive industries on a digital basis is essential. The creation of new enterprises and the transformation of existing ones in the extractive sector are taking place with the use of automation,

artificial intelligence, machine learning, and big data (Yakovlev, 2021). Enterprises operating under this business model are already showing positive results due to the reduction in the carbon footprint, streamlining of individual production and sales stages, and expanding the capability to deliver finished products to customers. The digital transformation of business models has helped reduce operational expenses and increase profitability.

Currently, not all advanced digital technologies are being used in the mining companies of Latin American countries. However, the following types of digital technologies are widespread: automatic control of technological machines and equipment; digital business models in mining production; analytical data visualization; financial, material, and labour resource planning for mining enterprises; 3D printing, and more. In general, a larger number of digital technologies are characteristic of large-scale mining operations at individual quarries with high revenue.

## 4 CONCLUSIONS

The analysis showed that Latin American countries are developing in accordance with global trends and are transferring the economy to a digital track. The infrastructure for access to digital technologies is steadily developing, which is reflected in the increase in the number of PC, mobile and Internet users, the development of e-commerce, as well as the introduction of modern technologies into traditional industries such as agriculture and mining. It's evident that the role of the state in these processes is highly significant. However, at the same time, good results cannot be achieved without attracting private capital and venture financing. Despite the significant gap that Latin American countries still have compared to developed countries, there is a consistent increase in the digitization of their economies, which accelerated notably as a result of the pandemic.

## DATA AVAILABILITY

Data on the annual GDP growth of individual Latin American countries from 2016 to 2022, confirming the findings of the study, are available in <https://figshare.com/> with id <https://doi.org/10.6084/m9.figshare.24460210>

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