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Assessing Digital Technology Development in Latin American Countries: Challenges, Drivers, and Future Directions

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Abstract: This research analyzes the digital readiness of Latin American countries by assessing the following key factors: digital infrastructure, human capital, internet use, adoption of digital technology by businesses, and digital government services. These factors are critical to the development of digital technology in the region. The analysis identifies countries that are leaders in digital development (Brazil, Mexico, Chile, Colombia, and Argentina), countries with an average level of digital technology development (Peru, Uruguay, Costa Rica, Paraguay, Panama, and the Dominican Republic), and those with slower progress (Bolivia, Ecuador, Venezuela, Guatemala, El Salvador, Honduras, Cuba, and Nicaragua). Based on this assessment, the study proposes and evaluates positive, negative, and neutral scenarios for the future of digital technology in Latin America over the next five years. The study concludes that a neutral scenario is the most likely, suggesting that, while advanced countries will maintain stable growth, lagging countries will experience accelerated, albeit still moderate, digitalization. This has key implications for regional competitiveness and digital inclusion. The study used methods of analysis, synthesis, classification, grouping, statistics, indexing, and scoring. This study uses the most recent data available (2022–2024) to provide an updated and comprehensive assessment of digital transformation in Latin America, reflecting post-pandemic dynamics and emerging digital trends such as AI and fintech growth.

Keywords: digital economy; digitalization; information and communication technologies; Latin America; digital technologies

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1. Introduction

Amidst a rapidly changing world and the pervasive integration of digital technologies, digitalization has become a key driver of economic growth, presenting a critical imperative for modern states seeking to improve and transform society. The digital economy and economic growth are closely linked today due to the increasingly large-scale access of companies to global markets, reduced transaction costs, and increased labor productivity, which allows them to become more effective participants in international economic relations. However, digitalization processes are currently occurring differently in all regions of the world. Thus, more active dynamics are observed in developed Western countries, as well as in the newly industrialized countries of east and southeast Asia. In Latin America, although positive trends have emerged in this area, the countries of the region are significantly lagging behind the advanced countries of the world in terms of digitalization.

Digital technologies are rapidly advancing globally, impacting various areas, including production, e-commerce, e-government, education, telemedicine, the use of big data

and artificial intelligence, climate tech, etc. AI technologies are spreading rapidly and by all accounts will have a profound impact on all areas of life. As such, being prepared for their implementation is critically important. The processes of digital transformation and digitalization in Latin America are uneven, both in individual technologies and in individual states of the region. This has led to the fact that, by now, the region is experiencing the phenomenon of the so-called "digital inequality." Some countries are far ahead of their neighbors, who previously neglected digital development. This situation further exacerbates economic inequality in the region, the problem of which is quite acute in Latin America. Most Latin American companies cannot leverage the benefits of market digitalization, resulting in decreased efficiency [1]. Several factors influence the region's ability to capitalize on production digitalization [1], and, while Latin America has made notable progress in digital access, significant challenges remain that require targeted interventions to fully realize the benefits of digitalization for all sectors of the economy [2]. These include the economic structure of the countries, their technological capabilities, and the level of industrialization. The availability of a skilled workforce, digital infrastructure, and the adoption of proactive policies to promote innovation and the digitalization of domestic manufacturing companies are also crucial [3].

Dependence on technological giants and vulnerability from a digital security perspective are pushing countries in the region to take measures to develop national competencies in advanced technologies, address the issue of ensuring digital sovereignty in critical sectors of the economy, create favorable conditions for doing business in the digital sphere, and improve legislative regulation [4]. In this sense, it is important for Latin American countries to not only study the experience of developed countries in terms of digitalization (USA, Singapore, Germany, Great Britain, Sweden, Switzerland, etc.) but also of specific countries in the region that have successful digital implementation and transformation in different areas, resulting in good management of their economies.

This study addresses these research gaps by providing a novel, region-specific assessment of digital development across Latin American countries. It introduces a new methodology that integrates multiple international digital indices with six critical regional factors—digital infrastructure, human capital, internet usage by citizens, using digital technologies in business, digital government services, and economic. By applying this multi-dimensional framework to the most recent data (2022–2024), the study offers updated insights into digital disparities, captures post-pandemic dynamics, and proposes future development scenarios tailored to the region.

While numerous studies have investigated various facets of the digital economy on a global scale (e.g., Lestantri et al. [5], Carlsson [6], Brynjolfsson et al. [7], Wei [8], Fernández-Portillo et al. [9]), these analyses often fail to adequately address the unique challenges and opportunities for digital development in Latin America. Although existing research focused specifically on Latin America has explored key aspects of digitalization (e.g., Simonova L.N. [3], Katz and Callorda [10], Zárate et al. [11], Flores-Fuentes et al. [12], Paiva [13], Hofman et al. [14], Gallego and Gutiérrez [15], Cordella and Paletti [16], Dempsey [17], Garcia [18], Katz [19], Kosevich [20], Pena [21], Razumovskiy et al. [22], Verma [23]), there remains a significant gap in understanding the level of digital technology development at the national level and in thoroughly exploring potential development options and scenarios. Furthermore, despite some studies examining future trends, such as AI, machine learning, sustainability, and inclusive digital development (e.g., Guerrero-Quiñonez et al. [24], García [25], Bautista, M.G., et al. [26]), these analyses often lack a comprehensive analysis of the underlying factors enabling digital development in the region.

Consequently, there is a considerable need for research on the advancement of the digital economy and digitalization in Latin America, including analysis of the key determinants of digital progress in the region and potential development scenarios for these.

This research makes several significant contributions, as follows:

- It develops a novel methodology by aggregating multiple international indices and region-specific factors into a comprehensive assessment model tailored to Latin American realities.
- It provides an up-to-date classification of Latin American countries' digital development based on the latest available data (2022–2024).
- It incorporates emerging trends, such as the adoption of AI strategies and fintech expansion, into the regional analysis.
- It proposes forward-looking scenarios for the evolution of digital technologies in the region, offering practical implications for policymakers and business leaders.

2. Methodology and Data

Data sources for the country analysis included databases such as the United Nations, the World Economic Forum, the Statista Portal, the World Bank, GSM Association Intelligence, the United Nations Economic Commission for Latin America and the Caribbean, the United Nations Development Programme, UNCTAD, and others.

The research methods employed include the index method, in which various international indices that in some way reflect digital processes in the region are considered, in this case, the indices were as follows: the IMD World Digital Competitiveness Ranking (WDCR), the Networked Readiness Index, The Inclusive Internet Index, and the Global E-Government Development Index. Each of these indices is based on the analysis of several indicators that subsequently influence the country's final index. We aggregated the indices in these rankings for Latin American countries and ranked them. The sum-of-places method was used to rank countries according to the level of the studied indicators. The sum-of-places method is a ranking technique used to assess and compare multiple objects or participants across various criteria. This method is particularly useful when it is necessary to combine the results of different assessments or ratings into a single final result.

It should be noted that all international indices are built on an analysis of various factors that change depending on the focus of the research. To obtain an objective and comprehensive assessment of digital technology development, it is necessary to consider the most complete picture possible. In this paper, the authors attempted to apply their methodology to assess the level of digitalization in the Latin American region, taking into account its specific characteristics. We identified the following groups of factors influencing the level of digitalization in Latin American countries: "digital infrastructure," "human capital," "internet usage by citizens," "use of digital technologies in business," "digital government services," and "economy." Each group, in turn, contains individual assessment indicators that influence the development of digital technologies (Table 1).

Table 1. Factor groups used to assess digital economy development in Latin America.

No.	Group	Factors
1	Digital infrastructure	Number of internet users
		Number of fixed broadband subscribers
		Mobile cellular subscribers
		Average fixed broadband Internet speed
		Price per 1 GB of internet traffic
		Households with a PC (laptop, desktop, or tablet)
		Number of assigned IP addresses per country
2	Human capital	Labor force with higher education
		Adult literacy rate, population aged 15+, both sexes
		Average monthly net wage
		Concentration of AI talent
		Cybersecurity workforce
		Cybersecurity workforce demand professionals
		Proportion of students in schools where teachers have technical and pedagogical skills to integrate digital devices into the learning process
3	Internet usage by citizens	Social media adoption rate
		Internet use for health apps
		Internet use for education apps
		Percentage of online shoppers
4	Using digital technologies in business	E-commerce sales revenue
		Density of fintech platforms
		Online banking penetration rate
		Social media advertising costs
		Number of agricultural machinery companies
5	Digital government services	Average processing time for online government services
		Percentage of people using digital channels for document processing
		Cybersecurity
6	Economy	Exports of information and telecommunication technologies (ICT) goods and services
		Import of ICT goods and services
		High-tech and medium-tech production

Source: developed by the authors.

A multi-stage classification process was used to assess each country's level of digitalization for each factor group.

First, each country's ranking for each factor was determined for a set of "m" countries and "n" factors, each indicator "j" for country "i" has a value "Xij." A second row, "Sj," is added to the matrix, where "Sjx = +1." The country with the best indicator is assigned position (1).

Second, the score for each country (Ri) within a group is calculated as Rix = ΣPij (where i = 1 to m), which is the average ranking across all factors within each group. Finally, the countries are ranked within each group according to this average ranking

using the following method: where Pij represents the indicator score for country i, the best-performing country in each group is defined as that with the lowest Ri value.

Third, after presenting the individual indicators in Tables 4–9, the final digitalization score for each country is calculated (Table 10) by summing the corresponding Ri scores, offering a comprehensive measure of each country's overall position within the Latin American region.

3. Results

Several international indices reflect digital technology development, most notably the Digital Competitiveness Index, the Network Readiness Index, the Inclusive Internet Index, and the e-Government Development Index. These indices are based on various analytical factors. Table 2 compares the rankings of 17 Latin American countries using these indices. It should be noted that the data for some countries is unavailable because of their small size or insufficient data collection. The Digital Competitiveness Index and the Network Readiness Index use a point system with a maximum score of 100. The Inclusive Internet Index and e-Government Development Index use a country's ranking out of 100 and 193 countries, respectively.

Table 2. Positions of Latin American countries in international index ratings.

	Country	Digital Competitiveness Ranking 2023		Network Readiness Index 2023		Inclusive Internet Index 2022		E-Government Development Index 2024	
		Max 100	Place out of 17 Ctry.	Max 100	Place out of 17 Ctry.	Max 100	Place out of 17 Ctry.	From 193 Countries	Place out of 17 Ctry.
1	Chile	64.84	**1**	53.18	3	17	**1**	31	2
2	Mexico	51.26	2	49.59	6	36	3	65	7
3	Argentina	46.33	5	49.78	5	37	4	42	3
4	Brazil	49.7	4	54.67	**1**	23	2	50	4
5	Uruguay	-	-	54.5	2	-	-	25	**1**
6	Costa Rica	-	-	50.99	4	-	-	61	6
7	Colombia	45.09	6	48.28	6	48	6	68	9
8	Peru	50.17	3	45.89	7	42	5	58	5
9	Panama	-	-	43.03	10	54	7	79	10
10	Dominican Republic	-	-	43.49	8	55	8	85	12
11	Ecuador	-	-	43.05	9	-	-	67	8
12	Paraguay	-	-	41.91	11	56	9	80	11
13	El Salvador	-	-	38.07	14	72	12	115	14
14	Bolivia	-	-	39.35	13	-	-	99	13
15	Honduras	-	-	35.7	16	77	13	142	17
16	Guatemala	-	-	35.84	15	68	10	122	15
17	Venezuela	22.55	7	39.98	12	70	11	131	16

Source: compiled from the World Digital Competitiveness Ranking 2023, the Network Readiness Index 2023, the Inclusive Internet Index 2022, and the E-Government Development Index 2024 [27–30].

Next, the sum of places method was applied, and the average rating score was calculated, according to the results of which all countries of the region were distributed (Table 3). As a result of the study using the index method, it was concluded that Uruguay, Chile, Brazil, and Argentina occupy higher positions in the ratings.

Table 3. Average point totals across international index rankings and position in the region.

Country	Max 17	Place out of 17 Countries
Uruguay	1.5	1
Chile	1.8	2
Brazil	2.8	3
Argentina	4.3	4
Mexico	4.5	5
Peru	5.0	6
Costa Rica	5.0	7
Colombia	6.8	8
Ecuador	8.5	9
Panama	9.0	10
Dominican Republic	9.3	11
Paraguay	10.3	12
Venezuela	11.5	13
Bolivia	13.0	14
Guatemala	13.3	15
El Salvador	13.3	16
Honduras	15.3	17

Source: compiled by the authors.

It should be noted that each of the above-analyzed rankings has its specific characteristics. The authors developed their method for assessing the level of digitalization in Latin American countries and conducted an assessment of indicators grouped into six categories: "digital infrastructure," "human capital," "internet usage by citizens," "use of digital technologies in business," "digital government services," and "economy". In Tables 4–9, the country's position among the studied Latin American countries for the analyzed indicator is indicated in parentheses. The last columns show the average score of each country's position and rank by a group of factors. Thus, factors influencing the level of digital infrastructure development were identified, including the number of internet users, the number of fixed broadband subscribers, the average speed of fixed broadband internet, the price per 1 GB of traffic, and several others (Table 4).

Table 4. Factors associated with digital infrastructure.

	Country	Number of Internet Users (in Millions)	Number of Fixed Broadband Subscribers (100 People)	Mobile Cellular Subscribers (100 People)	Average Fixed Broadband Internet Speed	Price per 1 GB of Internet Traffic $	Households with a PC (Laptop, Desktop, or Tablet)	Number of Assigned IP Addresses per Country (Thousand)	Total Score	Rank in Group
1	Brazil	187.9 (1)	22.9 (4)	99 (12)	170.4 (2)	1.0 (14)	55.9 (4)	91,592.6 (1)	**5.4**	**1**
2	Mexico	107.3 (2)	20.5 (6)	95 (14)	79.3 (11)	4.8 (3)	63 (2)	30,106.6 (2)	**5.7**	**2**
3	Colombia	39.5 (4)	17.0 (8)	130 (8)	145 (6)	3.5 (4)	43.9 (7)	17,649.6 (4)	**5.9**	**3**
4	Argentina	40.6 (3)	25.4 (2)	132 (6)	88.0 (10)	1.5 (12)	n.d.	19,585.6 (3)	**6**	**4**
5	Chile	17.9 (7)	23 (3)	134 (5)	265.6 (1)	0.7 (16)	n.d.	10,644.5 (5)	**6.2**	**5**
6	Costa Rica	4.8 (13)	22.5 (5)	170 (1)	96.7 (7)	2.7 (7)	68.9 (1)	2327.9 (10)	**6.3**	**6**
7	Panama	3.5 (16)	18.1 (7)	137 (4)	151.9 (5)	6.7 (1)	55.1 (6)	1823.3 (11)	**7.1**	**7**
8	Peru	25.8 (5)	10.4 (12)	132 (6)	166.9 (3)	2.1 (10)	n.d.	3593.1 (7)	**7.2**	**8**
9	Uruguay	3.1 (17)	32.4 (1)	150 (2)	156.0 (4)	1.6 (11)	n.d.	2471.5 (9)	**7.3**	**9**

Table 4. *Cont.*

	Country	Number of Internet Users (in Millions)	Number of Fixed Broadband Subscribers (100 People)	Mobile Cellular Subscribers (100 People)	Average Fixed Broadband Internet Speed	Price per 1 GB of Internet Traffic $	Households with a PC (Laptop, Desktop, or Tablet)	Number of Assigned IP Addresses per Country (Thousand)	Total Score	Rank in Group
10	Ecuador	15.3 (8)	16.1 (9)	92 (15)	93.8 (8)	3.2 (5)	61.9 (3)	2911.4 (8)	**8**	**10**
11	Paraguay	5.6 (12)	12.8 (10)	107 (10)	92.7 (9)	2.3 (8)	35.9 (8)	1270.7 (13)	**10**	**11**
12	Venezuela	17.9 (6)	9.6 (13)	72 (18)	59.8 (12)	n.d.	n.d.	7342.4 (6)	**11**	**12**
13	Bolivia	9.1 (10)	9.3 (14)	101 (11)	42.5 (17)	5.1 (2)	n.d.	1209.1 (14)	**11**	**12**
14	El Salvador	4.6 (14)	10.7 (11)	147 (3)	55.8 (14)	1.5 (12)	n.d.	704.6 (16)	**12**	**14**
15	Guatemala	11 (9)	5.1 (16)	119 (9)	52.3 (15)	2.2 (9)	24.3 (9)	705.3 (15)	**12**	**14**
16	Dominican Republic	n.d.	n.d.	84 (16)	36.1 (18)	0.7 (15)	55.5 (5)	1780.3 (12)	**13**	**16**
17	Honduras	7.0 (11)	4.5 (17)	79 (17)	50.5 (16)	3.1 (6)	n.d.	493.7 (17)	**14**	**17**
18	Nicaragua	4.4 (15)	5.4 (15)	97 (13)	59.5 (13)	n.d.	n.d.	441.8 (18)	**15**	**18**
19	Cuba	n.d.	n.d.	68 (19)	4.5 (19)	n.d.	n.d.	266.5 (19)	**19**	**19**

Source: compiled by the authors based on materials from Statista, World Bank [31–35].

Digital economy development requires an educated workforce with strong digital skills. The growth of higher education has a positive impact on overall well-being, and the development of the digital economy enhances this effect, especially at the provincial and city levels, suggesting that people with higher education can significantly benefit from the development of the digital economy [36].

Accordingly, this study considered factors related to human capital: the level of higher education, the literacy rate, the number of cybersecurity personnel, and others (Table 5). It is also important to note that individuals with higher education are more likely to contribute to the development of the digital economy, while those without it often use the internet primarily for communication (social media).

Table 5. Factors related to human capital.

	Country	Labor Force with Higher Education (% of the Total Workforce)	Adult Literacy Rate, Population Aged 15+, Both Sexes	Average Monthly Net Wage (in US Dollars)	Concentration of AI Talent (100 p.)	Cybersecurity Workforce (Thousand)	Cybersecurity Workforce Demand Professionals	Proportion of Students in Schools Where Teachers Have Technical and Pedagogical Skills to Integrate Digital Devices into the Learning Process	Total Score	Rank in Group
1	Paraguay	94.0 (1)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	**1**	**1**
2	Panama	n.d.	n.d.	803.1 (3)	n.d.	n.d.	n.d.	72.2 (2)	**2.5**	**2**
3	Mexico	77.5 (13)	95.3 (4)	674.5 (5)	6.8 (1)	536 (2)	116 (2)	76.5 (1)	**4**	**3**
4	Uruguay	83.0 (7)	98.7 (2)	1088.6 (1)		n.d.	n.d.	49.5 (8)	**4.5**	**4**
5	Chile	82.5 (8)	n.d.	701.3 (4)	1.5 (4)	n.d.	n.d.	62.2 (3)	**4.8**	**5**
6	Dominican Republic	83.5 (6)	n.d.	n.d.	n.d.	n.d.	n.d.	59.4 (4)	**5**	**6**
7	Brazil	81.1 (9)	93.2 (7)	409.9 (9)	0.4 (5)	749 (1)	232 (1)		**5.3**	**7**
8	Argentina	79.5 (10)	99 (1)	459.7 (7)	2.1 (3)	n.d.	n.d.	40.9 (9)	**6**	**8**
9	Costa Rica	74.6 (15)	97.8 (3)	947.0 (2)	n.d.	n.d.	n.d.	54.5 (6)	**6.5**	**9**
10	Peru	84.2 (5)	94.4 (6)	412.8 (8)	n.d.	n.d.	n.d.	54.1 (7)	**6.5**	**9**
11	Colombia	77.4 (14)	95.0 (5)	370.7 (11)	4.7 (2)	n.d.	n.d.	55.5 (5)	**7.4**	**11**
12	Cuba	86 (2)	72.9 (9)	36.8 (13)	n.d.	n.d.	n.d.	n.d.	**8**	**12**
13	Ecuador	79.3 (12)	n.d.	502.3 (6)	n.d.	n.d.	n.d.	n.d.	**9**	**13**
14	Bolivia	79.4 (11)	n.d.	402.7 (10)	n.d.	n.d.	n.d.	n.d.	**10.5**	**14**
15	Venezuela		n.d.	186.1 (12)	n.d.	n.d.	n.d.	n.d.	**12**	**15**
16	Nicaragua	86 (2)	65 (10)	n.d.	n.d.	n.d.	n.d.	n.d.	**12**	**15**
17	El Salvador	85.4 (4)	89 (8)	n.d.	n.d.	n.d.	n.d.	n.d.	**12**	**15**
18	Guatemala	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.		
19	Honduras	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.		

Source: compiled by the authors based on materials from Statista, World Bank [37–41].

Next, a group of this study also considered factors related to citizen internet use: internet adoption rates, the use of health and education apps, and the proportion of online

shoppers. These factors directly influence the development of information technologies in e-commerce, education, healthcare, and e-government by increasing service demand in these sectors (Table 6).

Table 6. Factors related to citizen internet use.

	Country	Social Media Adoption Rate	Internet use for Health Apps %	Internet Use for Education Apps %	Percentage of Online Shoppers	Total Score	Rank in Group
1	Chile	77.4 (1)	12.0 (1)	87.3 (1)	92 (3)	**1.5**	**1**
2	Costa Rica	73.8 (2)	n.d.	n.d.	n.d.	**2**	**2**
3	Uruguay	73 (3)	n.d.	n.d.	n.d.	**3**	**3**
4	Brazil	66.3 (9)	10.5 (2)	65.2 (2)	96 (1)	**3.5**	**4**
5	Colombia	70.3 (4)	6.7 (5)	50.7 (5)	88 (5)	**4.8**	**5**
6	Argentina	68.2 (8)	9.2 (4)	52.6 (3)	87 (6)	**5.2**	**6**
7	Peru	69.7 (6)	5.5 (8)	52.3 (4)	91 (4)	**5.5**	**7**
8	Mexico	70 (5)	4.4 (10)	48.1 (6)	93 (2)	**5.8**	**8**
9	Dominican Republic	63.5 (10)	5.5 (7)	16.8 (8)	82 (7)	**8**	**9**
10	Panama	57 (15)	10.4 (3)	24.7 (7)	n.d.	**8.3**	**10**
11	Paraguay	61.1 (11)	5.9 (6)	12.5 (10)	n.d.	**9**	**11**
12	El Salvador	61.1 (11)	5.5 (9)	13.3 (9)	n.d.	**9.7**	**12**
13	Ecuador	69.2 (7)	3.9 (11)	9.0 (12)	n.d.	**10**	**13**
14	Bolivia	60.5 (13)	3.4 (13)	7.1 (14)	n.d.	**13**	**14**
15	Venezuela	59.9 (14)	n.d.	n.d.	n.d.	**14**	**15**
16	Honduras	42.6 (19)	3.5 (12)	10.8 (11)	n.d.	**14**	**15**
17	Guatemala	50 (17)	1.9 (14)	7.1 (13)	n.d.	**14.7**	**17**
18	Nicaragua	52.2 (16)	n.d.	n.d.	n.d.	**16**	**18**
19	Cuba	48.2 (18)	n.d.	n.d.	n.d.	**18**	**19**

Source: compiled by the authors based on materials from Statista, the digitalization of Latin America ahead of the COVID-19 pandemic [42–44].

The speed and scale of digital technology adoption also depend on their use in business, which drives demand for IT services. This analysis included factors such as e-commerce revenue, the density of fintech platforms, online banking penetration, social media advertising costs, and others (Table 7).

Table 7. Factors of using digital technologies in business.

	Country	E-Commerce Sales Revenue (in Million US Dollars)	Density of Fintech Platforms	Online Banking Penetration Rate	Social Media Advertising Costs (in Million US Dollars)	Number of Agricultural Machinery Companies	Total Score	Rank in Group
1	Brazil	41,194 (1)	1.1 (7)	49.7 (1)	1940 (1)	274 (1)	**2.2**	**1**
2	Chile	7130 (4)	2.9 (1)	29.7 (3)	253.1 (4)	52 (3)	**3**	**2**
3	Colombia	7754 (3)	2.3 (3)	8.2 (9)	277.6 (3)	27 (4)	**4.4**	**3**
4	Peru	6408 (6)	2.4 (2)	25.3 (4)	105.1 (6)	17 (6)	**4.8**	**4**
5	Bolivia	1770 (10)	1.3 (4)	5.5 (13)	33.9 (12)	2 (17)	**5.1**	**5**

Table 7. *Cont.*

	Country	E-Commerce Sales Revenue (in Million US Dollars)	Density of Fintech Platforms	Online Banking Penetration Rate	Social Media Advertising Costs (in Million US Dollars)	Number of Agricultural Machinery Companies	Total Score	Rank in Group
6	Mexico	34,191 (2)	0.6 (11)	25.1 (5)	1880 (2)	17 (6)	**5.2**	**6**
7	Argentina	6971 (5)	0.9 (10)	13.2 (8)	180.3 (5)	116 (2)	**6**	**7**
8	Dominican Republic	1413 (13)	0.9 (8)	33.4 (2)	66 (8)	15 (8)	**7.8**	**8**
9	Venezuela	n.d.	n.d.	n.d.	n.d.	15 (8)	**8**	**9**
10	Ecuador	3192 (7)	1.1 (6)	5.8 (12)	98.5 (7)		**8**	**9**
11	Uruguay	1878 (9)	n.d.	19.4 (7)	28.1 (13)	20 (5)	**8.5**	**11**
12	Costa Rica	1519 (12)	n.d.	21.9 (6)	46.8 (10)	15 (8)	**9**	**12**
13	Panama	1552 (11)	0.9 (9)	6 (10)	45.8 (11)	15 (8)	**9.8**	**13**
14	Guatemala	2006 (8)	0.2 (14)	2.6 (16)	61.8 (9)	15 (8)	**11**	**14**
15	Paraguay	1277 (14)	1.2 (5)	5.8 (11)	19.9 (16)	2 (17)	**12.6**	**15**
16	Cuba	423 (18)	n.d.	n.d.	24.9 (14)	15 (8)	**13**	**16**
17	El Salvador	1091 (15)	0.6 (11)	4.4 (14)	16.2 (17)	15 (8)	**13**	**16**
18	Honduras	1083 (16)	0.6 (11)	3.1 (15)	22.1 (15)	15 (8)	**13**	**16**
19	Nicaragua	602 (17)	n.d.	1.4 (17)	15.6 (18)	15 (8)	**15**	**19**

Source: compiled by the authors based on materials from Statista, The digitalization of Latin America ahead of the COVID-19 pandemic [42,45–48].

Factors related to digital government services, such as the duration of online service provision, the use of digital channels for document processing, and cybersecurity, are particularly important for accelerating digital government development (Table 8).

Table 8. Factors related to digital government services.

	Country	Average Processing Time for Online Government Services	Percentage of People Using Digital Channels for Document Processing %	Cybersecurity (100 Points).	Total Score	Rank in Group
1	Mexico	6.9 (4)	10 (4)	81.4 (2)	**3.3**	**1**
2	Peru	8.6 (2)	12 (1)	54.9 (9)	**4**	**2**
3	Colombia	7.4 (3)	10 (4)	63.1 (7)	**4.7**	**3**
4	Brazil	5.5 (7)	7 (9)	96.5 (1)	**5.7**	**4**
5	Argentina	4.8 (9)	12 (1)	49.2 (10)	**6.7**	**5**
6	Uruguay	3.7 (14)	10 (4)	74.7 (3)	**7**	**6**
7	Chile	2.2 (17)	11 (3)	68.3 (5)	**8.3**	**7**
8	Venezuela	5.3 (8)	9 (7)	25.8 (12)	**9**	**8**
9	Paraguay	6.7 (5)	2 (16)	56.3 (8)	**9.7**	**9**
10	Bolivia	11.3 (1)	3 (14)	14.6 (14)	**9.7**	**9**
11	Panama	4.2 (11)	8 (8)	32.9 (11)	**10**	**11**
12	Costa Rica	3.1 (16)	7 (9)	66.9 (6)	**10.3**	**12**
13	Dominican Republic	4.1 (13)	3 (14)	74.6 (4)	**10.3**	**12**
14	Ecuador	4.2 (11)	6 (11)	25 (13)	**11.7**	**14**
15	Guatemala	4.5 (10)	4 (13)	11.6 (16)	**13**	**15**

Table 8. *Cont.*

	Country	Average Processing Time for Online Government Services	Percentage of People Using Digital Channels for Document Processing %	Cybersecurity (100 Points).	Total Score	Rank in Group
16	Honduras	5.8 (6)	2 (16)	0.5 (18)	**13.3**	**16**
17	El Salvador	3.2 (15)	5 (12)	11.8 (15)	**14**	**17**
18	Nicaragua	n.d.	n.d.	7.4 (17)	**17**	**18**
19	Cuba	n.d.	n.d.	n.d.		

Source: compiled by the authors based on materials from El fin del trámite eterno: Ciudadanos, burocracia y gobierno digital and the Network Readiness Index 2023 [28,49].

This study also considered factors related to the economy: ICT exports and imports, high- and medium-tech production, and others (Table 9). These factors can serve as predictive indicators for future digital technology development in the region.

Table 9. Factors related to the economy.

	Country	Exports of ICT Goods and Services (Thousands of Dollars)	Import of ICT Goods and Services (Thousands of Dollars)	High-Tech and Medium-Tech Production (100 Points)	Total Score	Rank in Group
1	Mexico	72,081,775.7 (1)	71,002,472.4 (1)	57.9 (1)	**1**	**1**
2	Brazil	5,371,659.1 (2)	40,390,225.1 (2)	44.0 (2)	**2**	**2**
3	Argentina	2,794,223.5 (3)	11,170,867.1 (3)	34.2 (3)	**3**	**3**
4	Chile	763,118.4 (7)	11,145,886.7 (4)	28.7 (4)	**5**	**4**
5	Colombia	1,224,804.5 (5)	9,274,765.9 (5)	24.8 (5)	**5**	**4**
6	Costa Rica	1,997,062.1 (4)	2,751,317.4 (7)	14.5 (9)	**6.7**	**6**
7	Uruguay	1,199,231.6 (6)	1,981,524.1 (10)	17.1 (7)	**7.7**	**7**
8	Guatemala	663,785.6 (8)	2,353,552.0 (8)	n.d.	**8**	**8**
9	Peru	154,882.9 (12)	7,159,761.3 (6)	13.7 (10)	**9.3**	**9**
10	Dominican Republic	340,744.3 (10)	1,451,200.2 (12)	n.d.	**11**	**10**
11	El Salvador	411,092.0 (9)	1,197,166.3 (13)	n.d.	**11**	**10**
12	Paraguay	29,713.9 (16)	1,898,361.7 (11)	17.2 (6)	**11**	**10**
13	Ecuador	83,025.5 (14)	2,185,979.6 (9)	11.1 (12)	**11.7**	**13**
14	Nicaragua	295,697.9 (11)	320,339.9 (17)	16.4 (8)	**12**	**14**
15	Honduras	116,823.9 (13)	999,092.4 (14)	n.d.	**13.5**	**15**
16	Panama	n.d.	902,607.8 (15)	7.5 (13)	**14**	**16**
17	Bolivia	57,796.3 (15)	870,435.7 (16)	11.4 (11)	**14**	**16**
18	Venezuela	n.d.	n.d.	n.d.		
19	Cuba	n.d.	n.d.	n.d.		

Source: compiled by the authors based on materials from the Network Readiness Index 2023, Commtrade [28,50].

The ranking of the studied Latin American countries by level of digitalization is presented in Table 10. Brazil, Mexico, Chile, Colombia, and Argentina are among the leading countries. We categorized Bolivia, Ecuador, Venezuela, Guatemala, El Salvador, Honduras, Cuba, and Nicaragua as countries that need to make efforts to improve their level of digitalization.

Table 10. Final assessment of countries' digital development in Latin America.

Country	Total Score	Rank in Group
Brazil	19	**1**
Mexico	21	**2**
Chile	24	**3**
Colombia	29	**4**
Argentina	33	**5**
Peru	39	**6**
Uruguay	40	**7**
Costa Rica	47	**8**
Paraguay	57	**9**
Panama	59	**10**
Dominican Republic	61	**11**
Bolivia	70	**12**
Ecuador	72	**13**
Venezuela	76	**14**
Guatemala	84	**15**
El Salvador	84	**15**
Honduras	95	**17**
Cuba	102	**18**
Nicaragua	102	**18**

Source: compiled by the authors.

The analysis identified three groups of countries based on their level of digital development: a leading group, comprising Brazil, Mexico, Chile, Colombia, and Argentina; a group with an average level of digital development, comprising Peru, Uruguay, Costa Rica, Paraguay, Panama, and the Dominican Republic; and a group with slower progress, comprising Bolivia, Ecuador, Venezuela, Guatemala, El Salvador, Honduras, Cuba, and Nicaragua. Furthermore, the assessment reveals a considerable gap in the level of digitalization among the countries of the region. While there are differences between the most and least developed countries, certain challenges are common to all groups, although they are more pronounced in the least developed countries. These challenges include a telecommunications and information technology infrastructure that limits access to and adoption of digital technologies, high internet service costs that restrict digital inclusion (Table 4), an insufficient level of digital skills among the population (Table 5), a lack of strong institutions that foster the creation and promotion of new technologies and innovations, limited technological development in educational processes and service delivery (Tables 6 and 8), the need for greater investment in financial technologies (fintech) to promote their adoption and overcome public mistrust (Table 7), and a marked dependence on imported ICT technologies, reflecting the low competitiveness of the national industry (Table 9). Overcoming these obstacles requires the formulation and implementation of specific public policies aimed at promoting inclusive and sustainable digital development in the region. The analysis reveals that the Latin American countries in the first group, which stand out for their advanced digital development, are characterized by the implementation of long-term public policies for digital development, active support for the development of innovative technologies, and the adoption of international best practices in the information technology and telecommunications sector. It should be noted that Argentina, Brazil, Chile, Colombia, and Uruguay are actively engaged in the development of AI, and that these same countries have released their national AI development strategies [51]. In the second group, made up of countries with an intermediate level of digital development, initiatives have been implemented to strengthen digital infrastructure, although these are still insufficient to reach the levels of the leading countries. Despite this, these countries

show internet penetration above the regional average, which offers promising prospects for their future development. Finally, the third group, made up of countries with a low level of digital development, is characterized by limited progress in this area, and it is projected that, without significant changes, their gap with respect to the most advanced countries will widen.

4. Discussion

The heterogeneity in the level of development of digital technologies in the countries of the Latin American region, recorded as a result of the author's research, has several explanations. Firstly, it is worth highlighting the degree of influence on the different states of the region of the economic and political crises, which have been especially acute in the last decade. Another key factor was the lack of interest in digital technologies among the leaders of several Latin American countries in the 2000s, when more active processes of development of digital technologies began in the world. For example, the "maturity levels" of digital government in the countries of the region are significant today [52].

The geographical features of the region, such as the inaccessibility and remoteness of mountainous areas in some Latin American countries (Peru, Ecuador), hinder the widespread dissemination of ICT. Based on the factors identified, key problems in digital technology development include poor internet service quality, with limited 4G and 5G access and high costs in many Latin American countries; low levels of e-commerce development; insufficient digital skills among the population; weak e-government development; and a lack of institutions for technology innovation.

Given the current heterogeneity in digital technology development across Latin America, and considering both internal factors (such as infrastructure investment, the formulation of digital strategies, and educational policies) and external factors (including global economic instability, commodity price fluctuations affecting government investment capacity, and shifting geopolitical dynamics influencing in the access of the technology and market), we analyze the development prospects of these technologies through three potential scenarios: positive, negative, and neutral (Table 11).

Table 11. Main scenarios for digital technology market development in Latin America.

	Scenarios		
	Positive	**Negative**	**Neutral**
Factors	Active development of the digital technology market in the leading countries of the region, as well as an active breakthrough in the development of digital technologies in the countries that are lagging behind today.	A slowdown in the development of digital technologies in the leading countries of the region and slow processes of development of digital technologies in the countries that are lagging behind today.	Stable rates of development of digital technologies in the advanced countries of the region are faster than current processes of development of digital technologies in lagging countries.
Digital infrastructure	Increasing the volume of funding for the development of digital infrastructure, stimulating IT companies, and adopting state programs for digitalization.	Reduction in funding for the development of digital infrastructure.	Maintaining current levels of funding for the development of digital infrastructure.

Table 11. *Cont.*

	Scenarios		
	Positive	**Negative**	**Neutral**
Human capital	Expansion of digital literacy training programs for the population.	The training of IT specialists remains at the same level.	The training of IT specialists remains at the same level.
Internet usage by citizens	Increasing the population's income and expanding internet access in remote areas.	Reduction in population income.	Maintaining the population's income at previous levels.
Using digital technologies in business	Stimulation of IT companies.	Legislative restrictions.	At the same level.
Digital government services	Stimulating demand for digital services among citizens and expanding the range of digital services.	Digital government services are not developing.	Digital government services remain at the same level.
Economy	Positive changes in the economy.	Negative changes in the economy, economic crises.	Lack of major changes in the economy.

Source: developed by the authors.

Under a positive scenario, a more vigorous advancement of digital technologies would be observed in the leading nations of the region (primarily Brazil, Mexico, and Chile), coupled with an accelerated surge in digitalization within those nations currently lagging (Bolivia, Ecuador, Venezuela, Guatemala, El Salvador, Honduras, Cuba, and Nicaragua). Conversely, a negative scenario would entail a deceleration in the pace of digital technology development within the leading countries, as well as a sluggish diffusion of digital technologies in those countries currently exhibiting slower progress. Recognizing the prevailing instability of the external environment and the profound transformations within the global economy, and acknowledging that both positive and negative development trajectories remain plausible to varying degrees for Latin America, we posit that a neutral scenario is the most likely. This assertion rests on the understanding that Latin America is fundamentally heterogeneous, with significant disparities in economic development, access to technology, political stability, and the quality of institutions. The greater digital advancement in countries such as Chile, Brazil, and Mexico, compared with nations like Honduras, Nicaragua, and Guatemala, suggests that future trajectories will continue to vary significantly. Under such a scenario, moderately active, yet stable, rates of digital technology development would characterize the leading nations of the region, alongside accelerated digitalization processes, relative to the present, in the lagging nations. In this instance, a precipitous increase in the diffusion of digital technologies throughout Latin America would not, on the whole, be evident; however, a reasonably consistent advancement in this domain within the region would be recorded.

The theoretical precepts and practically oriented conclusions derived from this research may augment comprehension of the digitalization processes transpiring within Latin American nations and may be of utility to both researchers engaged in the study of Latin American economic development, and to business representatives contemplating the implementation of projects in the domain of digital technologies within the region.

This research offers a preliminary assessment of digitalization in Latin America, but several limitations require further investigation. The somewhat limited dataset, stemming from the scarcity of comprehensive digitalization metrics in specific countries, necessitates

future research to explore alternative data sources, including qualitative surveys and interviews. Furthermore, the influence of factors such as culture, policy effectiveness, and institutional barriers, which are beyond the scope of this primarily quantitative analysis, warrants further examination to refine the theoretical understanding of digitalization in the region. We are dedicated to expanding our data collection efforts and refining the results. Future analyses should also delve into the dynamics of the identified factor clusters, examining the specific contributions of each cluster to the overall degree of digitalization in participating countries, thereby enriching the theoretical framework.

5. Conclusions

The development of digital technologies in Latin America presents a heterogeneous landscape, with apparent differences. To assess the development of digital technology, this study analyzed six groups of factors that reflect the current situation: "digital infrastructure," "human capital," "internet use by citizens," "use of digital technologies in business," "digital government services," and "economy." The result is that the least developed Latin American countries are between five and ten times behind the leading countries (Table 10), demonstrating a significant delay in this area. According to the classification of the country's leading the digitalization process (Brazil, Mexico, Chile, Colombia, and Argentina), there are common characteristics that they share, such as the implementation of public policies aimed at technological development, the strengthening of digital infrastructure, the promotion of public and private investment in the sector, and the promotion of internet access. In contrast, countries with lower digital development face structural limitations, such as low connectivity, limited digital training, deficiencies in government digital services, and a high dependence on imported technologies, which limit their competitiveness and innovation capacity.

Given this scenario, the study proposes three possible scenarios for the evolution of the digital ecosystem in Latin America: positive, negative, and neutral. According to the analysis, the neutral scenario is the most likely in the medium term (5 years), considering both the relative stability of the most developed countries and the possibility of moderate progress in those with greater lags. This scenario suggests a continuation of regional digital divergence, with significant implications for digital inclusion, economic growth, and social cohesion.

By introducing an original multi-dimensional assessment model and analyzing the latest post-pandemic trends, this study offers one of the most current and comprehensive evaluations of digital development trajectories across Latin American countries.

This study contributes to a better understanding of the current state of digitalization in Latin America and offers a valuable input for the design of strategies aimed at reducing the digital divide, boosting technological development, and promoting a more equitable and sustainable digital transformation in the region. The theoretical insights and practical conclusions of this study can be valuable both for researchers studying economic development in the region and for business professionals planning digital technology projects in the region.

Additionally, by incorporating recent data (2022–2024) and focusing on emerging areas like AI and fintech, this study offers one of the most current assessments of Latin America's digitalization trajectory.

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