

Information and Communication Technologies and Their Impact on Competitiveness in Latin America

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Abstract: One of the biggest challenges facing countries today is how to make their economies and industries competitive in the face of significant international rivalry and a globalized environment. Countries are making considerable efforts to boost the factors that make them more competitive, not least of these being the adoption of Information and Communication Technologies (ICTs), a determining factor in global industrial trends. Unfortunately however some countries have lagged behind in terms of ICT implementation, with the Latin American region being a specific example. This article seeks to identify whether there are significant differences between Latin American countries and their main trading partners with respect to ICT adoption, and also with respect to the Global Competitiveness Index (2019) produced by the World Economic Forum. The findings refer to the fact that there is a significant difference in how clusters of various Latin American countries are underpinning competitiveness through ICTs when compared to their main partners.

Keywords: ICT; Industry 4.0; Competitiveness; Latin America; Communication Technology

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Introduction

In today's globalized world, countries endeavor to meet their domestic needs while simultaneously defending their profitability in the international marketplace relative to other countries. This level of competitiveness allows them to raise productivity, which in turn translates into enhanced income, a stronger economy and an improved quality of life for citizens (Yamashita, 2018).

In order to measure competitiveness, various indices analyze the capacity to produce goods and provide quality services efficiently, both of which raise productivity and income levels. According to the competitiveness index of the World Economic Forum, several factors can influence the level of national competitiveness. These can include the macroeconomic environment, financing costs, entrepreneurial diversity, labor quality and transparency when doing business. As well as these factors helping to determine national competitiveness, they also differentiate highly-competitive countries from their less-competitive regional neighbors (WEF, 2019a).

This article seeks to identify whether there are significant differences in the Adoption of Information and Communication Technologies pillar of the 2019 Competitiveness Index produced by the World Economic Forum for the Latin American region. In the analysis, comparisons are made with some of the main regional trading partners, these being nations enjoying high levels of international competitiveness. To carry out the analysis, three clusters have been generated that group nations according to their level of competitiveness, enabling a statistical analysis of this pillar in the main economies of the region to be established.

Theoretical Framework

Competitiveness for the World Economic Forum

Although it may appear that competitiveness is a recent idea which emerged during the previous century contemporaneously with internationalization and globalization, in actuality there is a long history of countries comparing their strengths and weaknesses in the pursuit of economic improvement. David Ricardo (1817), considered that the competitive advantages enjoyed by a nation were directly related to the primary goods and labor that it possessed, since at that time both were considered essential to improvements in production. Thus, competitiveness was initially perceived as a way of achieving superiority among peers, and as a phenomenon it was evaluated using various criteria (Peñaloza, 2005).

In his work 'Competitive Advantage' (1980), Michael Porter explains that all companies have competitive strategies, and these are focused on the specific market environment in which they compete. The logic of Porter's (1980) vision of competition is that the environment limits strategic options, so environmental paradigms determine the ability of a business to compete.

Boza and Pérez (1996) suggest that competitiveness can be achieved in three areas: in-company, at industrial-sector level and at the macro-economic level. In the first area, competitiveness is seen as the ability to supply goods and services equally or more efficiently than rival companies in the field (Gómez, 1994). In the industrial sector, competitiveness is understood as the ability of national companies to achieve sustained success against foreign competitors (Enright, Frances, & Scott, 1994). A nation or company is competitive if,

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under free-market conditions, it can maintain or increase participation in national or international markets and/or maintain or improve the income of its citizens or its human capital (Peñaloza, 2005).

However, as industry has evolved, the nature of competitiveness has also changed, incorporating such elements as the adoption of technology and capacity for innovation and sustainability: this is in part due to the depletion of natural resources available for exploitation. Unlike the competitive advantages inherited or inherent in a geographic space, elements are now visible that are the result of specialized processes: an efficient educational system, the development of financial confidence, and a broad capacity to provide support services for investment (Ekici, Kabak, & Ulengin, 2019). This in turn has led to the need for those indices which measure competitiveness to evolve in line with the needs of industry and the requirements of the market, and given rise to the Competitiveness Index. This has been compiled and published by the World Economic Forum for over 40 years and is widely regarded as one of the most reliable indices currently available.

The Competitiveness Index is based on 12 pillars or categories to which indicators are attached. These categories systematically analyze the economic, political and social decisions and strategies implemented by nations. In its 2019 version, the Index includes the importance of healthy institutional environments and the health, competencies and skills of the labor market. It also covers the relevance of macro-economic stability, the existence of a public infrastructure that allows trade interactions, the characteristics of the financial system and goods and services market and business dynamism and innovation capacity. For the second consecutive year it also takes into account the adoption of information and communication technologies (ICT) (WEF, 2019a).

These 12 pillars not only serve to measure competitiveness, but also allow countries to identify their areas of opportunity, which, with investment and attention, could considerably impact the development of their markets in relation to other regional or international actors (WEF, 2019a).

The recognition by a nation of its placement in the competitiveness index allows objective evaluation of how national economies relate to each other. It also places nations economically, and this is true for both public and private sectors, and, in addition, encourages greater commitment from private companies. Competitiveness is fundamental to a nation's growth, because good productivity drives investment, both public/private and internal/ external. Improved investment in turn buoys the economy and encourages growth, and leads to an improved quality of life for the population (Bucher, 2018).

The adoption of ICTs as a factor of competitiveness

For Fuentes-Solís, Soto & Paredes (2019), previous studies mainly refer to technological innovations in a particular industrial sector and in the context of developed countries. There are not enough studies about the innovation process considering the TIC variable on developing countries. Considered one of the most dynamic and

fastest-growing regions in the world, those countries which form part of Latin America have paid significant attention to how their competitiveness relates to that of other nations and to how they project themselves on the world stage. Since the 1980s, Latin American industry has undergone major changes and variations, and although these have changed and provided the necessary conditions for growth, industry in the region continues to be affected by political uncertainty and the elevated level of risk that still exists in the region. Both of these factors impact negatively on the confidence of foreign investors (Morales & Rendón, 2000).

In addition to economic factors, Latin America has significant social problems that inhibit market growth and development. Amongst these social problems are a traditional education system that does not focus on the development of skills and innovation, vast economic inequality affecting populations in the region, and low levels of information technology adoption and implementation, with the latter generally remaining in the hands of few private companies (Ramirez, 2011).

ICTs, unlike other types of technology, lend themselves to adoption in all economic areas. These include both industry and social markets, since information and communication are a fundamental part of any economy (Psychoyios & Dotsis, 2018). Computer networks are essential for business and entrepreneurial activities, with the internet in particular being essential for the production and consumption of goods and services and forming a fundamental part of the daily lives of many people. This is why the adoption and development of ICTs is a key factor in national competitiveness, because it revolutionizes the financial environment and the market for goods and labor (Escuder, 2019).

Developed countries have invested heavily in the implementation and development of ICTs, seeking to move from an industrial or commodity economy to a global one based on the generation and transmission of knowledge. According to the World Economic Forum (WEF, 2016a), digitization, access to and use and development of ICTs allows countries to have greater opportunities to generate citizen welfare, as these have a direct impact on populations.

The Network Readiness Index (NRI) measures a country's capacity to exploit the opportunities offered by ICTs to improve competitiveness and welfare. However, the NRI includes not only access to and use of ICTs, but also digital resources and associated skills. The NRI facilitates the identification of areas in which intervention through investment policy, smart regulation and government incentives could increase the impact of ICTs on the development and growth of nations, and is a parameter that serves to identify the level of the digital divide in the region (WEF, 2016b).

Unfortunately however, the connectivity index also reveals regional markers of inequality not previously considered, such as those related to internet access, education or digital literacy, and economic capacity to access technology. It also flags up how marginalized groups are disadvantaged in terms of capacity to actively participate with their governments through digital platforms (Aguaded, 2002).

According to the World Economic Forum (WEF, 2016a), the NRI identifies how nations take advantage of the opportunities generated by connectivity. This has a clear relationship with the level of competitiveness they can achieve in comparison to other countries in their region. In order to determine this factor, the NRI analyzes the country's environment, the willingness of stakeholders to use ICTs and the effective use or social implementation of ICTs.

It should be made clear that a nation's economic power does not necessarily reflect its level of connectivity or social impact. The real improvement in competitiveness will depend on taking advantage of these digital technologies to innovate in new ICT-based business models (Coria, Pérez, Mendoza, & Martínez, 2011). Thus, developed countries such as Japan are being overtaken by other nations such as Finland, Sweden or Singapore. These countries are notable because they have a high demand for digital products and services and a broad base of rapidly growing digital consumers who are able to benefit from the economic impact of digitization. Unfortunately, for the production-based economies of Latin America, technology-based industrial power does not seem to play a key role in the new international economy. It is therefore essential for studies to be carried out on the role of the region in this new reality (WEF, 2016c).

ICTs in the Latin American region

Latin America, despite its proximity to developed countries such as the United States and its high level of trade partnerships with technologically highly-developed Asian nations (such as Japan, Korea and China), has been slow to develop in terms of access to and application of ICTs in its economies (Álvarez & Osorio, 2018). It was not until after 2000 that the region's businesses and industries began to go digital, with change occurring unevenly between countries and among types of industry. Adoption of technological tools by business depended on the size of the organization and its investment capacity (Collazos, Muheidden, & Heredia, 2018).

There has been a clear digital divide in the region as a whole, as well as between a country's homegrown microenterprises and foreign industries. Local MSMEs tend to have the lowest adoption levels, and therefore fail to take advantage of the benefits of these technologies. Despite the fact that two decades have passed since digitalization began in the region, take-up rate, compared to other regional economies, remains underdeveloped (Neira, García, & Seguel, 2018). The Global Competitiveness Index 4.0 is based on the level of implementation or adoption capacity that industries in individual nations have, and in which ICTs are fundamental (Table 1).

Table 1: Global Competitiveness Index 4.0 (selected countries)

Place	Country	Index
2	United States	83.7
13	South Korea	79.6
14	Canada	79.6
28	China	73.9
33	Chile	70.5
48	Mexico	64.9
54	Uruguay	63.5
57	Colombia	62.7
61	Costa Rica	62
65	Peru	61.7
66	Panama	61.6
71	Brazil	60.9
78	Dominican Rep	58.3
80	Jamaica	58.3
83	Argentina	57.2
90	Ecuador	55.7
97	Paraguay	53.6
98	Guatemala	53.5
101	Honduras	52.7
103	El Salvador	52.6
107	Bolivia	51.8
109	Nicaragua	51.3
133	Venezuela	41.8
138	Haití	36.3

Source: author's own (WEF, 2019b)

As can be seen in Table 1, the Latin American region lags behind more developed nations when it comes to adopting new industrial processes. According to Peña-Vinces (2008), a more global market vision is required, one that leaves behind traditional models of competitiveness and joins a platform of action in which knowledge and the adoption of technologies is fundamental.

The World Economic Forum's Global Competitiveness Index (GCI) 2019 (WEF, 2019a), warns that the adoption of ICTs favors competitiveness, which can mean a clear difference between those countries that are already developed and those that are currently developing. For the GCI, the third pillar of ICT adoption refers to elements such as the number of mobile cellular telephone subscriptions, the number of broadband contracts with providers, and the number of analog and fiber optic internet access contracts. This information allows the size of a country's telecommunications infrastructure to be measured, and the percentage of internet users to be known. Unfortunately, as noted above, regional inequality, a particular concern in Latin America, can clearly affect levels of competitiveness when comparisons are made with other international economies.

Methodological framework

In the theoretical framework, it has been argued how the adoption of ICTs is one of the determining pillars for measuring competitiveness between those countries that make up the World Economic Forum GCI (WEF, 2019a).

Pillar three measures the adoption of ICTs, and includes criteria such as cell phone subscriptions, broadband for cell phone subscriptions, adjusted bandwidth for internet subscriptions, fiber optic internet subscriptions, and number of internet users. Each country is assigned a ranking based on these criteria.

In terms of theory, ICT adoption has been regarded as one of the fundamental pillars for evaluating competitiveness between those countries included in the World Economic Forum (WEF, 2019a) GCI study.

As previously stated, pillar three criteria, i.e. ICT adoption, comprises cell phone subscriptions, broadband for cell phone subscriptions, adjusted bandwidth for internet subscriptions, fiber optic internet subscriptions, and number of internet users. These criteria are employed to evaluate each country on a scale of 0 to 100, with the highest rating indicating that the country in question has significant ICT acceptance.

Despite the fact that some developing countries are investing in digital technology, Latin America still lags behind in this area. The objective of this article therefore is to identify whether the ICT adoption variable makes a significant difference when country clusters are analyzed for competitiveness. Although the competitiveness index is comprised of many different pillars, sub-pillars and variables, the ability to identify specifically whether ICT adoption is a significant marker of difference in these clusters would be of significant value. The finding may have relevance in terms of strategic decision-making for those states in Latin America interested in improving their international competitiveness.

In the case of Latin America, few studies have analyzed the ICT adoption pillar. The lack of articles is even more significant because this information is essential for researchers studying ICT adoption and international competitiveness. Although there are approximations, studies usually focus on national or sectoral levels. For example, Tapias-García (2005) carried out a study in which he presents an explanatory model of the competitive dynamics of Colombian companies and national economies, a study which included the theory of technological capabilities and the notion of national innovation systems. Another example of a study analyzing competitiveness and information and communication technology is that carried out by Segovia Bermeo and González (2014). This study analyzes how technology increases the visibility of the tourism sector, despite cultural and organizational elements which limit competitiveness. Finally, in Peru, Acevedo-Borrego and Linares-Barrantes (2014), investigated the communication and information technology industry itself, questioning both technological dynamics and improvement of service quality. They recognize that there are indeed supranational efforts towards an information society, and while acknowledging that the digital gap is important for development of the sector, business actors lack the tools to monitor how change happens and the commitment to effect it.

The objective of this article is to test whether significant differences exist between three blocks of countries in Latin America and their main trading partners, and how such differences, should they be discovered, relate to the ICT Adoption variable of the Global Competitiveness Index 2019 (WEF, 2019a) produced by the World Economic Forum.

Statistical Methods

The methodology of the study consisted of analyzing the Information and Communication Technology Adoption (ICT Adoption) variable of the Global Competitiveness Index 2019 produced by the World Economic Forum (WEF, 2019a), and using this analysis to generate three blocks of countries according to their placement in the index. The criteria used to select these nations were as follows: the nation should form part of the Latin American region, and have trading partners such as China, South Korea, Canada and the United States, all of which exhibit a high level of competitiveness.

A cluster analysis was used to generate these blocks of countries, with an ANOVA analysis subsequently being applied to identify whether there was a significant difference in the levels of ICT application between the three clusters.

Data from the main trading partners of countries making up the three clusters is included in the study due to the strong relationship these nations enjoy with countries in the Latin American region: this data allows us to show a contrast in the results. According to the Foreign Trade Information System (SICE, 2020), Canada has a close trade relationship with several Latin American countries, for example Honduras, Panama, Colombia, Peru, Costa Rica, Chile and, of course, Mexico, with the latter also forming part of the United States-Mexico-Canada Agreement (AEUMC or USMCA). In addition to this, the

United States also has trade agreements with Chile, Peru, Colombia and Panama, and, along with Central America and the Dominican Republic, is a signatory to the CAFTA treaty.

In Asia, China also enjoys extensive trade relations with Latin American countries through treaties such as the Asia-Pacific Economic Cooperation Forum, to which South Korea is also a signatory. China is also party to the Asia-Pacific Trade Agreement, as well having Free Trade Agreements with Peru, Chile and Costa Rica. South Korea is, at the time of writing, currently negotiating with Mexico, Canada and Colombia, and has already consolidated treaties with the United States, Chile and Peru (EENI, 2020).

Although various agreements exist, no analysis of their competitiveness has to date been undertaken, and the distinction made in this regard by ICT adoption in the Latin American region poses a problem. There are no academic references about the relevance of ICT adoption and how it relates to Latin-American regional competitiveness.

Hypothesis

The empirical research aims to answer the above-mentioned concern, for which the following research hypotheses are proposed:

H1: The Global Competitiveness Index (GCI) is a relevant criterion allowing for the generation of clusters of Latin American countries and their main trading partners.

H2: The adoption of ICTs by highly competitive countries is higher than that of moderately competitive countries.

H3: The adoption of ICTs by moderately competitive countries is higher than that of less competitive countries.

H4: Adoption of ICTs by highly competitive countries is higher than that of less competitive countries.

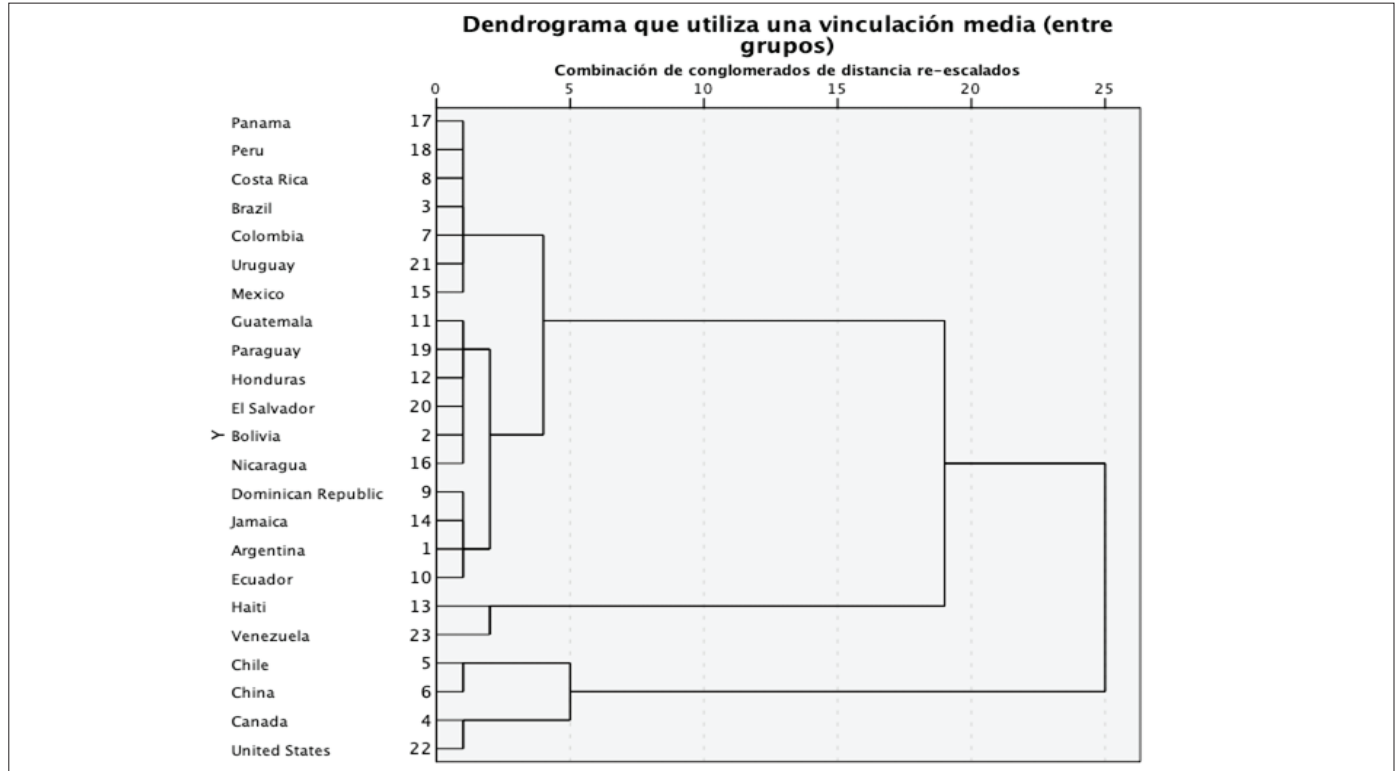
Results

To carry out this research, and as mentioned above, a cluster analysis was conducted in which countries were grouped according to the global competitiveness index generated by the World Economic Forum (2019).

Through the cluster analysis, it was found that, based on the Global Competitiveness Index (GCI), countries fall into three distinct groups. This is based on the cluster dendrogram produced by the SPSS-20 statistical software using the inter-group linkage cluster method. The system yielded three clusters of combinations as illustrated in the dendrogram (Figure 1), and these are summarized (Table 2) with a significance level of 0.000.

Based on this finding, H1 is accepted.

Figure 1. Dendrogram of average linkage between groups (rescaled distance)



Source: author's own

Table 2. Clusters of Latin American countries and their main trading partners.

Country	Clusters generated according to the GCI		
	1	2	3
United States	0	0	1
South Korea	0	0	1
Canada	0	0	1
China	0	0	1
Chile	0	0	1
Mexico	1	0	0
Uruguay	1	0	0
Colombia	1	0	0
Costa Rica	1	0	0
Peru	1	0	0
Panama	1	0	0
Brazil	1	0	0
Dominican Republic	1	0	0
Jamaica	1	0	0
Argentina	1	0	0
Ecuador	1	0	0
Paraguay	1	0	0
Guatemala	1	0	0
Honduras	1	0	0
El Salvador	1	0	0
Bolivia	1	0	0
Nicaragua	1	0	0
Venezuela	0	1	0
Haití	0	1	0
	17	2	5

Source: author's own

The following is a list of the countries comprising each cluster (sig. 0.000) as well as the average of how each cluster performs in terms of competitiveness:

Group 1: Moderately competitive countries, with an average competitiveness index of $GCI\mu=57.79$ (Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico Nicaragua, Panama, Paraguay, Peru, Uruguay)

Group 2: Less competitive countries, with an average competitiveness index of $GCI\mu=39.08$: (Haiti & Venezuela)

Group 3: Highly competitive countries, with an average $GCI\mu =77.46$ (Canada, Chile, Korea, United States)

Considering the 3 country clusters, Pillar 3: ICT Adoption of the World Economic Forum (WEF, 2019a) was analyzed to see if there were significant differences (see Table 3).

Table 3. ANOVA for the 3 country clusters, taking ICT adoption as a reference

		Sum of squares	df	Mean squares	F	Sig.
3rd. Pillar ICT adoption	Inter-groups	3241.598	2	1620.799	12.680	.000
	Intra-groups	2684.281	21	127.823		
	Total	5925.878	23			

Source: author's own

In addition, averages were calculated for each country cluster for adoption of ICTs (see table 4).

Table 4. Descriptive statistics of the 3 country clusters, in relation to ICT adoption

		Confidence interval for the mean al 95%					
		N	Media	Standard deviation	Standard error	Lower limit	Upper limit
3rd. Pillar ICT adoption	1	17	49.7062	11.23826	2.72568	43.9280	55.4844
	2	2	37.4402	13.15487	9.30190	-80.7516	155.6321
	3	5	75.8179	11.07312	4.95205	62.0688	89.5669
	Total	24	54.1240	16.05138	3.27647	47.3461	60.9019

Source: author's own

Analysis

Hypothesis (H2) is accepted. It was found that the Pillar 3 (ICT) average of the first group of countries (moderately competitive) is =49.70 and the average of the third group of countries (highly competitive) is =75.81 (see Table 3 & Table 4). Considering that the closer the adoption of ICTs is to 100 the better, it could be concluded that the first group of countries is seeking to modernize by adopting ICTs, but that this is not being achieved at the same level as the third group (sig. 0.000).

For countries in the first group, the level of ICT adoption is a criterion that does not permit them to be ranked alongside those in the highly competitive group. Based on this finding, we sought to analyze what ICT adoption strategies Canada, China, Korea, the United States, and particularly Chile, are pursuing to strengthen their position as members of the highly competitive group. Chile could provide an interesting point of reference for other countries comprising the Latin American group, and could offer the opportunity for regional collaboration with a view to improving ICT integration, and ultimately, increasing competitiveness. Based on Castillo Vergara & Torres-Araniba (2019) cooperation is necessary to create new technologies, as well as products and processes, especially when it comes to emerging economies, where resources and innovation capacities are relatively limited. Chile can be a cooperative leader in Latin America region. Even though Chile has a high level of TICS, some areas are not well developed. For Sukno & Pascual del Riquelme (2019), E-commerce in Chile has been growing considerably in recent years, but it is far from reach its full potential.

The Digital Development Index (DDI) is a tool employed by Chile to measure the adoption of ICT's. It has been used bi-annually since 2011 to measure variations in the uptake of ICT's and the positive or negative evolution of these within the country's economic framework. The DDI considers three distinct areas of application pillars: home (massive), companies and the public sector (government and education). The objective of this index is to make comparisons with other countries in the region in order to implement improvements through the Secretariat of Digital Development of the Ministry of Economy (Cabezas, 2011).

Another example could be Canada, which has developed innovation hubs of large multinationals with the intention of improving investment in ICTs. This policy has yielded clear results, and in recent years, investment in ICTs has increased by almost 30% annually, making cities like Toronto fashionable places to be on the technology scene. The main areas of focus in this country are those related to the Internet of Things, cognitive and artificial intelligence solutions, cyber security, 3D printing, virtual reality and robotics. With this, Canada seeks to demonstrate that it is prioritizing the digitalization of its industry and has clear strategies for achieving this (TicBeat, 2018).

In contrast to these cases, Mexico is one of the countries that, according to the Mexican Institute for Competitiveness (IMCO), has a history of successes and failures in terms of ICT adoption. In recent years, according to the World Economic Forum, the use and adoption of ICT's in Mexico has actually decreased. For the IMCO, the country's greatest weaknesses are lack of adequate ICT infrastructure, inefficient ICT infrastructure, poor mobile bandwidth and the high cost of cellular telephony. Additionally, only 54% of the population and 76% of companies use e-government services, a figure which is below the Organization for Economic Cooperation and Development (OECD) average and which is also reflected in the low percentage represented by ICT's as a proportion of GDP. Unlike countries such as the United States (7.4%) or South Korea (6.9%), in Mexico ICTs account for only 5.6% of GDP, a figure which is below that of other countries in the region, for example Costa Rica (6.5%) (IMCO, 2019).

According to the United Nations Conference on Trade and Development (UNCTAD), Colombia is another country which is lagging behind its regional neighbors in terms of ICT adoption. Although Colombia has been making clear efforts to encourage the population to adopt ICT, these efforts have yet to bear fruit. For example, 93.8% of Colombians have mobile telephone subscriptions, which is below the average for other Latin American countries such as Mexico, Chile and Brazil, where the subscription rate is almost 100%. This is the same for broadband access: in Colombia only 5.7% of the population have internet access, with the regional average being 8.6%. The Inter-American Development Bank (IDB) highlights low levels of internet access in Colombia as an area in which significant improvement needs to be made (UNCTAD, 2017).

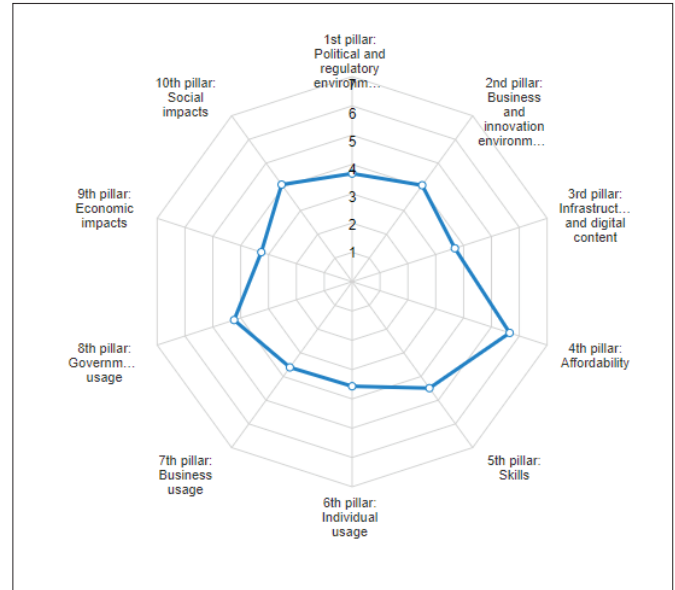
Hypothesis (H3) is accepted. It was found that the average for Pillar 3 (ICT) of the first group of countries (moderately competitive) is =49.70 and the average for the second group of countries (less competitive) is =37.44 (see Table 3 & Table 4). Considering total ICT adoption to be 100, it can be concluded that the first group of countries is making greater efforts to adopt the technology, although some regional players are still significantly behind in the process (Venezuela and Haiti) (sig. 0.000). It would be interesting if the member countries of group 1 could create synergies with those of group 2 through collaboration agreements and partnerships in order to raise the competitiveness of the region on the international stage. But collaboration to improve TICS implementations for competitiveness it is not an easy effort, innovation it is also required. About LATAM context, for Jimenez & Geldes (2019) it is important that in Latin America value networks are generated to promote inclusive development, learning trajectories and mainly cooperation. ICT can be an area to open up the field to innovation in Latin America. In the same line, Acevedo & Díaz-Molina (2019) argue that innovation is required to improve productivity and to apply technological advances to lead transformative ideas.

Hypothesis (H4) is accepted. The Pillar 3 (ICT adoption) average of the second group of countries (less competitive) is $\mu=37.4402$ and the average of the third group of countries (highly competitive) is $\mu=75.8179$ (see Table 3 & Table 4). It can be confirmed that there is a very significant variation, not only in competitiveness, but also in the manner of ICT adoption (sig. 0.000).

The process of incorporating ICTs to become more competitive is not an easy task, especially for countries that are far behind in the process. Also, in some cases, technological change cause external effects. According to Cabaleiro & Gutiérrez (2019), Latin American countries are not doing well in adaptation of innovation. The effects of exogenous technological change and the informality on the process of innovation could be a limitation and emerging economies has to deal with that issue.

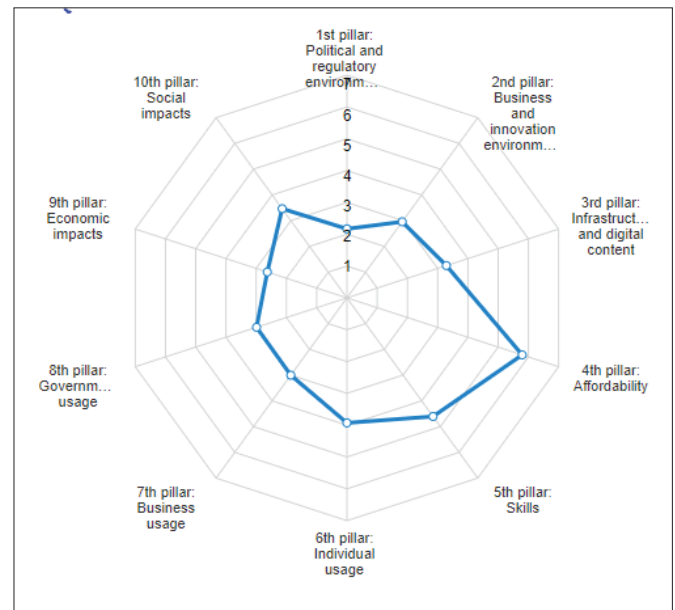
In Figures 2, 3 and 4 we try to show the particular differences in the way ICTs are implemented in different sectors, in each of three different countries. Each figure corresponds to a graphic example of a country in each of the clusters: 1) moderately competitive (Figure 2. Mexico), 2) less competitive (Figure 3. Venezuela) and 3) highly competitive (Figure 4. Chile) and their adoption of ICTs for innovation in the government, private and social sectors. This data is from the Networked Readiness Index (NRI) produced by the World Economic Forum.

Figure 2. México



Source: WEF (2016a)

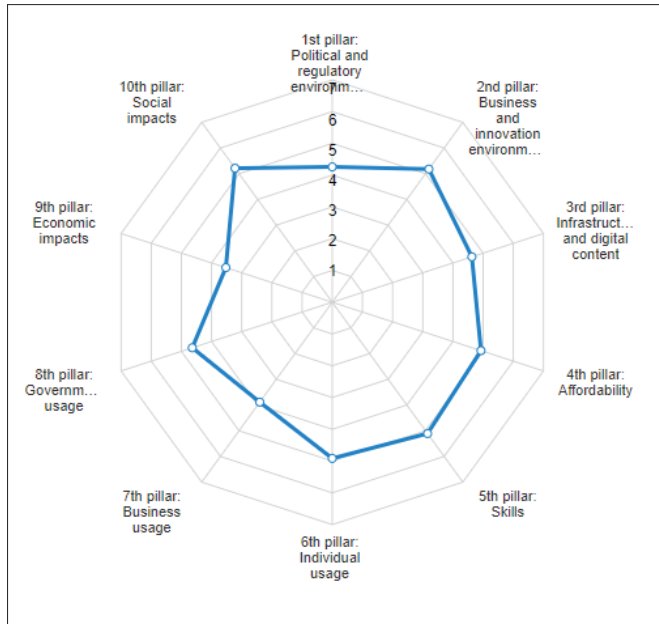
Figure 3. Venezuela



Source: WEF (2016b)

As can be seen in Figures 2 and 3, an important difference between a moderately-competitive cluster country (Mexico) and a less-competitive cluster country (Venezuela), concerns the way each nation has approached integrating the network for government use. Another (and more minor) difference is the focus each nation gives to business innovation, with Mexico showing a higher level of ICT integration in this area. In general, it is possible to say that group 1 is making more important efforts in these areas than group 2, although both Mexico and Venezuela have limited use of the network specifically for business.

Figure 4. Chile



Source: WEF (2016c)

As can be seen, in figure 4, Chile (a country that is part of the highly competitive cluster) shows wider ICT adoption in all areas when compared to the countries in groups 1 and 2. The graph may reflect how smart ICT adoption has underpinned development in the country, although this alone does not determine competitiveness.

Conclusions

The evidence shows variations in ICT implementation throughout Latin America, a variation which is even more marked if the reference includes developed countries. As indicated by the statistics, one group of countries is making significant advances in ICT implementation while another group is progressing more slowly. Although ICT adoption is not the only criterion that makes a difference in competitiveness at international level, it has been found that its impact is significant, which makes it an interesting finding. Chile deserves special attention in the Latin American region because of its level of competitiveness and adoption of ICTs. As a nation, Chile is emulating what is being done by highly competitive countries internationally, and thus can be seen as a good example for the rest of Latin America to follow.

The adoption of ICTs seems to be a specific strategy that the Chilean government has decided to pursue. The definition of an index that periodically measures the progress of ICT adoption in households, companies, and the public and education sectors, and makes comparisons with how this is being carried out in other nations, highlights the relevance of this pillar. It is important not only to have an index that measures ICT adoption, but also for nations to monitor it closely in order to become more competitive and to focus on innovation in business, government and education, as well as devising ways of integrating ICTs into society. The information compiled in this research is valuable because it demonstrates the relevance of the efforts that certain nations have been making to adopt ICTs in their economies. This adoption, as it has been seen, could trigger improvements in the digital communication environment and thus create more favorable environments for competitiveness.

Limitations

One limitation of this research is the selection of countries that form part of the study. The sample has been defined by taking evidence from various secondary sources without considering the particularities of each country in relation to its international trade relations. Additionally, although it is impossible to establish a unique and direct cause-effect relationship between ICT adoption and competitiveness, it is clear that differences exist. It is hoped that the article will provide a scientific basis for future research that will delve deeper into competitiveness and the role that ICT adoption plays in it.

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