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Regional Competitiveness in Latin America: A Comparative Study of the Key Elements for Regional Performance

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ABSTRACT:

Cross-country comparison is critical to understand the success of some regions and the stagnation of others in Latin America. This study measures regional competitiveness using a set of comparable regional indicators for Chile, Colombia, and Mexico in the 2008-2017 period and through a model that separates input competitiveness from results competitiveness (Aiginger and Firgo, 2017). The measurement allows comparison of regional competitiveness across countries. Results show that high regions with higher input competitiveness yield higher progress in competitiveness results for the studied period and that competitiveness capabilities play a major role in population well-being.

KEYWORDS: Regional competitiveness; Latin America; regional performance.

JEL CLASSIFICATION: R11.

Competitividad Regional en América Latina: Un Estudio Comparativo de los Elementos Clave para el Desempeño Regional

RESUMEN:

La comparación entre países es fundamental para comprender el éxito de algunas regiones y el estancamiento de otras en América Latina. Este estudio mide la competitividad regional utilizando un conjunto de indicadores regionales comparables para Chile, Colombia, y México en el período 2008-2017 y a través de un modelo que separa la capacidad competitividad del resultado competitivo (Aiginger y Firgo, 2017). La medición permite comparar la competitividad regional entre países. Los resultados muestran que las regiones con mayor competitividad de inputs presentan un mayor avance en la competitividad de resultados para el período estudiado y que las capacidades competitivas de una región juegan un rol clave en el bienestar de su población.

PALABRAS CLAVE: Competitividad regional; América Latina; desempeño regional.

CLASIFICACIÓN JEL: R11.

1. INTRODUCTION: LATIN AMERICA AND REGIONAL INEQUALITIES

Latin America has a wide variety and diversity of regions, some of them have been successful and have shown advancements in their regional performance indicators, while others are still lagging (ECLAC, 2015; ECLAC, 2017). In general, successful Latin-American regions are the ones that allocate an important city (usually capital city) or the ones that have based their economic development on the extraction of natural resources (ECLAC, 2015). The prevailing factors determining regional performance

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in Latin America are not as clear as in comparative studies for regions within the European Union (EU), which identify factors such as basic education and improving institutions for middle-developed regions and innovation factors for developed regions (Annoni & Dijkstra, 2017). Innovation has been widely discussed as a competitiveness factor for Latin American regions, but there is little evidence of its relative importance compared to other competitiveness factors. Similarly, Aiginger & Firgo (2017) identify education and innovation, and high institutional quality factors as solid drivers of regional competitiveness in the EU.

According to Figueroa (2013), in the 1950s, social scientists believed that the main reason for underdevelopment in Latin American countries was the economic dependency they had with developed economies, in what they called a center-periphery model. Since then, economic growth became the core of development policy in Latin America, setting the basis for development policies in the second half of the XX century. There is a consensus that Latin America has a productivity gap with developed economies and that this is the main reason behind slow economic growth and not the lack of investment (Cornick, 2016; Fernandez-Arias & Rodriguez, 2016; OECD, 2019). Consequently, there is a renewed interest in productivity growth policy and its role in promoting development in Latin American countries.

Social indicators in Latin America improved, poverty was reduced from 45,5% in 2002 to 27,8% in 2014 (ECLAC, 2019). However, poverty increased to 30,8% in 2018. Inequalities measured by the Gini index decreased from 0,538 in 2002 to 0,465 in 2018, but inequality reduction was much slower between 2014 and 2018.

Despite having reduced poverty and income inequality, economic growth in Latin America has not been enough to converge to well-being levels of developed economies (OECD, 2019).

Convergence implies closing productivity gaps between Latin American countries and the developed economies, but also closing structural inequalities within the countries (ECLAC, 2010). Regional inequalities determine the level of potential wellbeing in a certain location, that is why their reduction is crucial for development in Latin America (ILPES, 2009; ECLAC, 2010).

According to 2017 data from the United Nations Economic Commission for Latin America and the Caribbean demographic and economic concentration in are relatively high compared to OECD economies, with one region concentrating most of the population or GDP. The Metropolitan region in Chile concentrated 46% of the country's GDP and 42% of the population, the City and State of Mexico concentrated 26,2 % of Mexico's GDP and 21 % of the population, while Bogota and Cundinamarca concentrated 30,8 % of Colombia's GDP and 23% of the population (ECLAC, 2017). The high levels of demographic and economic concentration have been accompanied by high regional inequalities measured through regional GDP per capita differences. Regional inequalities are higher in Latin American countries such as Chile, Colombia, Mexico, Peru, Brazil, and Panama, compared to OECD economies such as the United States and Spain. However, despite having high regional inequalities, Chile, Colombia, Mexico, Peru, and Brazil had a convergence trend between 2000 and 2010. For a comprehensive review of regional inequalities in Latin America see Llungo (2018).

2. REGIONAL COMPETITIVENESS: CONCEPTS AND APPLICATIONS

2.1. COMPETITIVENESS: FROM THE NATIONAL LEVEL TO THE REGIONAL LEVEL

Competitiveness is a widely used term, several researchers agree that there is no clear definition and interpretation of competitiveness to this date (Borozan & Strossmayer, 2008; Aiginger & Firgo, 2017; Ketels, 2016; Huggins & Thompson, 2017; Annoni & Dijkstra, 2017).

Michael Porter formally addressed the definition of competitiveness in the 1980s, taking basis on the concepts of absolute and comparative advantages to explain the economic performance of companies and firms. Porter (1985, 1990), introduces the concept of "competitive advantage", which is the one created and sustained locally and that allows a country to have an advantage in certain industries where the environment, institutions and competition are favorable to them.

Krugman (1994) questions the very existence and use of the concept of country competitiveness. He argues that countries do not compete in the same way companies do, since their objectives and the very nature of competition are different. Krugman points to the fact that noncompetitive firms are not sustainable and eventually go out of business, but countries that have a poor economic performance do not go out of business. However, Porter (1990; 2003) and Krugman (1994) both agree that productivity ultimately defines the capacity of a nation to generate a high and rising standard of living for its citizens. Krugman establishes that, in general, it is productivity and domestic factors, and not international trade, what determines the level of wages and living standards of a country.

Modern definitions of competitiveness implicitly distinguish the competitiveness of firms from country competitiveness by recognizing a link between company performance and the capacity of a country to produce wellbeing for its population. The World Economic Forum (WEF) defines country competitiveness as the “*set of institutions, policies and factors that determine a country’s level of productivity*” and recognizes that the goal is to improve human wellbeing (Schwab, 2017). For the IMD World Competitiveness Center, country competitiveness is “*ability of a nation to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people*” (IMD, 2017).

Porter (2003) acknowledges that much research on competitiveness has focused on the national scale, without recognizing the internal differences between regions, which exist in all countries. He suggests that the major components that determine economic performance are regional components, such as specialized inputs, infrastructure, education of the labor force, institutions which will encourage agglomeration of firms in the form of clusters.

2.2. REGIONAL COMPETITIVENESS

Storper (1997) defines regional competitiveness as the capability of a region to attract and maintain firms with stable or rising market shares in an activity, while maintaining or increasing standards of living. Aiginger (2006) defines competitiveness as “the ability of a country or location to create welfare”.

Borožan and Strossmayer (2008) place the concept of regional competitiveness between microeconomic and macroeconomic competitiveness. Micro-economic competitiveness refers to the ability of a firm to compete in a market successfully. Macro-economic competitiveness refers to country competitiveness and is linked to the idea that the environment that enables firms and companies to compete successfully.

The concept of regional competitiveness is complex because it is not the aggregation of microeconomic competitiveness nor of the productivity of the firms within the region (Borožan & Strossmayer, 2008). This vision neglects to consider the factors outside the region, which are not controllable, as well as spillovers and network effect. Additionally, companies and regions have different goals, companies seek profitability or productivity, while regions seek for higher living standards, better jobs, or minimization of corruption. Regional competitiveness is also not a derivative of national competitiveness, because of the differences between macro-economic factors and regional economic factors. National competitiveness is also much more heterogeneous than regional competitiveness. National governments have a wider range of macroeconomic adjustment mechanisms and much more influence over public, private, and non-profit sectors than regional governments have.

Competitiveness of companies and regional competitiveness are different concepts and relate to each other in a non-linear manner. Company success does not always translate into regional or national success. For instance, firms that search outside knowledge sources by externalizing services, as part of their strategy, may facilitate knowledge-based investment or capabilities within their region, which will translate into higher productivity for both the firm and the region (Huggins *et al*, 2014). This will increase competitiveness for the firm and for the region, but it is not always the case. Through a case study in Sweden, Osarenkhoe, A. & Fjellström, D. (2017) state that clusters and networks of SMEs are vital to gain a competitive advantage and promote regional growth. However, the way that cluster interactions occur is complex and the degree of cooperation within the cluster influences the overall competitiveness (Jankowska *et al*, 2017).

Boschma (2004) points out similarities between competitiveness of firms and regions. First, despite that regions do not compete for market share as firms do, regions that economically grow faster will gain a higher share of the national economic at the expense of slower growing regions. Secondly, regions that specialize in similar sectors will compete in the attraction of work talent and investments. On the other hand, one basic distinction is that companies enter or exit the market as they succeed or go bankrupt, while regions do not go out of business or disappear. Companies also compete to attract work talent, but the nature of regional goals is much more complex than the goals that companies have.

Borozan, D. & Strossmayer (2008) and Aiginger & Vogel (2015) distinguish between input competitiveness (costs, productivity, economic structure, and capabilities) and outcome competitiveness (wellbeing). Malecki (2004), Aiginger & Vogel (2015), and Aiginger and Firgo (2017) consider a narrow and an enlightened version of cost competitiveness. The narrow version of cost competitiveness is based only on reduction of cost components such as taxes, wages, and energy, labor or raw materials costs. The enlightened version of cost competitiveness incorporates productivity in addition to cost; if the costs are higher, an economy can still be competitive by increasing productivity.

Ketels (2016) distinguishes competitiveness definitions by those that are centered in costs and those that are centered in productivity. Cost competitiveness depends on unit production costs in a specific place; low unit production costs allow companies to be competitive in global markets. By contrast, productivity competitiveness relies in the capacity of a place to add value based on production factors, in other words how productive that place is. Productive factors, such as labor and capital, move between regions and there are spillovers and synergies between regions, thus, the subnational economic structure differs from the national economic structure. In other words, regions do not correspond to smaller versions of national economies, because they are structurally different.

According to Ibarra-Armenta & Trejo-Nieto (2014), competitive regions have high and sustained levels of economic growth, along with high standards of wellbeing. In addition, competitive regions can attract productive investment in a context of economic openness and globalization, allowing them to achieve high levels of productivity.

Contemporary views of regional competitiveness highlight the importance of increasing productivity, but not at the expense of the population's quality of life. For example, an increase in productivity through the means of wage reduction will not increase people's quality of life. Even though it may generate a positive trade balance, it would not be sustainable in the long term (Huggins & Thompson, 2017). Michael Peneder (2017) defines competitiveness as the "ability of an economic system to develop" according to the goals of society, in a sustainable manner and allowing for long-term increase in living standards. Malecki (2017) points out that the concept of regional competitiveness has value when it focuses on the bases and dynamics of long-term wellbeing and not on restrictive views that only focus on market share or resource competition.

In summary, modern definitions of regional competitiveness have advanced from economic-centered ideologies that prevailed in the 1980 and 1990s, towards a holistic concept that recognizes that the goal of regional competitiveness is to increase wellbeing through productivity. This feature is what separates regional competitiveness from other purely economic definitions and from development concepts that only focus on wellbeing, making it a comprehensive framework to address regional performance differences.

From a practical perspective, the regional competitiveness conceptual framework allows a broad understanding of the differences in regional performance. Differences in regional performance have been addressed by endogenous growth models (Romer, 1994), which place investments on human capital, innovation and knowledge as key drivers of growth, in addition to the traditional factors of capital and labor (Huggins, *et al* 2014; Huggins & Thompson, 2017b). According to Huggins & Thompson (2017a), a major difference between endogenous growth models and competitiveness models is that endogenous growth models seek to explain past growth. By contrast, competitiveness models are also seeking to measure the potential for future growth, incorporating the explanatory factors adopted by growth theorists such as labor, capital, technology or investment in human capital, as well as current rates

of output and productivity. In other words, competitiveness models are implicitly based on endogenous growth models.

2.3. THE IMPORTANCE OF REGIONAL COMPETITIVENESS

The advancement of free trade, globalization, and having a quick and efficient transport and communication services would lead us to believe that location is less important. On the contrary, the place of establishment of companies remains a very relevant variable. Competitive advantages develop from local factors, such as knowledge, cooperation, competition, and concentration (Porter, 1998).

Both Porter (1998) and Camagni (2003; 2005) recognize the local environment or *milieu* as a key determinant of competitive advantages. The place of settlement or location will be an important factor in determining a company's performance at all geographical levels. The regional context will influence the behavior and performance of companies and, consequently, will be relevant in determining their competitiveness (Bochma, 2010). Regions compete, therefore, in providing the best platform to reach high levels of productivity (Huggins & Thompson, 2017).

Esser *et al* (1996) point out to the creation of a favorable environment in achieving competitiveness, together with a collective effort from firms, associations, State and other stakeholders. The absence of a favorable environment reduces the capacity of a company to sustainably achieve competitiveness.

Local environment is determined by factors that arise from different scales or levels, for instance, macroeconomic policy from the federal government as well as local institutions, public infrastructure, or networks will influence the local environment. The systemic competitiveness model (Esser *et al*, 1996) systematizes these factors in four different levels: Micro, Macro, Meso and Meta. The Micro level includes factors linked to companies or firm networks such as human capital, business management, and business strategies. The Meso level consists of environmental factors such as geography, location, security, proximity to urban centers, and public infrastructure. The Macro level includes elements of the macroeconomic context that influence the efficiency of markets and growth. The Meta level consists of structural elements such as the political, economic, and legal organization, values, and cultural elements.

Social capital, defined as norms and values that determine the relationships between people, will favor competitiveness (Camagni, 2003). Malecki (2017) states that knowledge and innovation are the core of regional competitiveness, as creativity and innovation occur only in some places. Global innovation networks, which are the fundamental pillar of competitiveness, settle in places that are attractive to them. Therefore, regional competitiveness is a dynamic process, constantly changing and adapting through the learning process. Innovation capacity is dynamic, in the sense that it requires constant renewal, and provides a relevant advantage for competitiveness compared to static aspects of production such as costs or natural resource advantages (Fratesi, 2017).

2.4. MEASURING REGIONAL COMPETITIVENESS

There are many approaches to measure regional competitiveness due to the diversity in interpretation of current regional competitiveness conceptual frameworks (Annoni & Dijkstra, 2017).

Although the functional form of regional competitiveness is unknown and its concepts are abstract by nature, the competitiveness of two regions can be compared by measuring a set of competitiveness-related indicators (CGE, 2018).

A comprehensive definition of regional competitiveness is "*the ability of a region to deliver beyond GDP goals for its citizens today and tomorrow*" (Aiginger *et al*, 2013; Aiginger and Vogel, 2015; Aiginger & Firgo, 2017). Similarly, Annoni & Dijkstra (2017) define regional competitiveness as the "*ability to offer an attractive and sustainable environment for firms and residents to live and work*". These definitions address wellbeing and economic objectives and incorporate the idea of a regional environment that enables the achievement of those objectives. Under these definitions, competitive regions have certain requirements and characteristics, which listed below. For the purposes of this research, regional competitiveness is defined as the ability of a region to sustainably deliver economic, social and environmental goals to its

citizens and workers (Aiginger *et al*, 2013; Aiginger & Vogel, 2015; Aiginger & Firgo, 2017, Annoni & Dijkstra, 2017).

The first characteristic is the idea that the region offers an environment for companies to achieve a certain level of performance. In other words, competitive regions offer an environment that boosts company productivity.

Secondly, sustainability is a requirement for competitiveness, in the sense that it allows sustained high performance for the companies. This implies that the setting cannot be composed of short-term factors or time-specific conditions.

Third, a competitive region needs to offer attractive conditions for both companies and residents; the region needs to be attractive so that workers will live in that region. Regions in Latin America specialized in the mining sector, are often considered competitive only because of company performance and without considering any aspects of the resident's wellbeing. Some of these regions offer a good environment for mining companies to have a high performance, but many workers travel from other regions and have no interest in residing within the region, because they get better services in other regions. These types of regions are not competitive under the definition stated before.

Forth, this definition implies that competitive regions need to offer certain conditions that attract companies and people, which can allow a high productivity for companies and a high level of wellbeing for people, but also that they need to show positive results in both of these factors. This last characteristic implies that competitiveness features both certain conditions (environment) that will allow a potential outcome, as well as the actual outcome (productivity and wellbeing). Wellbeing involves economic, social, and environmental results.

Finally, the goal of regional competitiveness is to increase wellbeing, which can be achieved by increasing productivity (Porter, 1990; Krugman, 1994; Peneder, 2017). The concept of regional competitiveness is strictly related to productive capacity acquired from being on those regions and how this increased production allows or a higher regional performance. This feature is what separates regional competitiveness from other purely economic definitions and from development concepts that only focus on wellbeing.

2.5. REGIONAL COMPETITIVENESS MEASUREMENT IN LATIN AMERICA AND CROSS-COUNTRY COMPARISON

There are several measurements of regional competitiveness in Latin America. Table 1 summarizes available regional competitiveness measurements for Argentina, Colombia, Chile, Mexico, and Peru. One of the characteristics of competitiveness measurements in Latin America is the fact that most countries have more than one institution measuring it simultaneously. These measurements rank regions within the country. However, no research compares regional competitiveness between countries in Latin America. A comparative analysis of regional competitiveness measurements would allow establishing common factors that arise from different research and competitiveness indexes.

A major problem of comparing regions in Latin America is the availability of comparable indicators, as few of them are constructed using similar sources and methodology. Additionally, the variability in the size of administrative regions is enormous; there are regions in Latin America, such as Sao Paulo, Rio de Janeiro or Mexico's Federal District that have larger populations than entire countries (ECLAC, 2015). Furthermore, when comparing different countries there are a number of factors such as institutional setups, patterns of trade and innovation, industrial specialization, cultural factors, that differ between countries and regions, and that may be a distorting factor when comparing performance (Smith, 2001). To reduce this problem, best practice would be to use different performance measures, instead of a single indicator or measure.

Considering source and methodology consistency in Latin America, only few indicators are comparable, these include indicators that come from population census, household surveys, employment surveys, and national accounts. These indicators are usually constructed by National Statistics Institutes

or Central Banks in each country, which use the same standards and methodologies. All these institutions follow international standardization methods and rely on similar sources (Buitelaar *et al.*, 2015).

Cross-country comparison is critical to understand the success of some regions and the stagnation of others. Regions compete for foreign investment and companies within regions compete for product placement in international markets. In example, regions compete to attract foreign investments from high-tech companies. Several tech companies have announced recently the installation of data centers in Latin America. However, companies do not evaluate random locations, they look at regions such as the Metropolitan region in Chile, the Province of Buenos Aires in Argentina, Sao Paulo and Rio de Janeiro in Brazil, or the Federal District in Mexico, all of which provide the necessary telecommunication infrastructure, connectivity, and skilled workers.

Likewise, regions and their clusters compete in international markets, with others country's regions and clusters. For example, table grapes produced in the *Copiapó* valley from *Atacama* region, Chile compete with table grapes produced in the Ica valley (Peru) in the United States markets. This type of regional competition takes place between countries, it is not limited to in-country competition. As a result, understanding regional competitiveness requires an international approach that compares regions between countries.

3. METHODOLOGY AND DATA

Figure 1 shows the regional competitiveness model which distinguishes competitiveness inputs from competitiveness results (Aiginger & Firgo, 2017; Huggins & Thompson, 2017).

Inputs are those elements that allow for an attractive and sustainable environment for firms and residents and that constitute a potential capacity of yielding a result. Inputs are factors that allow the region to provide attractiveness for both people and companies to settle in. There are two types of inputs. The first type of inputs are those that lead to low road competitiveness: cost and efficiency (Aiginger *et al.*, 2013; Aiginger & Vogel, 2015; Malecki, 2017). The second type of inputs are complex factors that lead to high road competitiveness (Aiginger & Vogel, 2015; Malecki, 2017). These types of elements are related to the economic structure of the region and its capacities, including physical characteristics of the region as well as the social grid, institutions, networks, innovation and clusters (Aiginger & Firgo, 2017; Huggins & Thompson, 2017).

The result components are actual levels of performance and wellbeing that the region achieves. Following a comprehensive definition, the result is the economic, social, and environmental performance of the region.

Competitiveness is measured for 3 countries: Chile, Colombia and Mexico. These countries show similar levels of competitiveness scores in the World Economic Forum's Global Competitiveness Report (Schwab, 2018), and they have enough data to measure regional competitiveness. Mexico and Chile are the only two OECD countries in Latin America and Colombia is likely to be soon incorporated into the OECD economies.

The data sources and variables are presented in table 2. Dataset includes 32 variables for 15 regions in Chile, 32 regions in Mexico and 33 regions in Colombia for year 2008 and year 2017. Variables are normalized using the "min-max" scaling method using historical minimum and maximum for all regions and years to consider the evolution in the indicators across time (OECD, 2008).

Following OECD (2008) recommendations for composite indicators, variables used to measure regional competitiveness are weighed using Principal Components Analysis (PCA) for each factor. Principal Components Analysis (PCA) is used to give higher weight to those variables that explain most of the variance of the dataset. Additionally, PCA allows to identify hidden patterns in the dataset and which variables are correlated (Kassambara, 2017).

Out of the 32 regions from Colombia, 9 lack the information to be processed through PCA (Amazonas, Arauca, Casanare, Guainía, Guaviare, Putumayo, San Andres y Providencia, Vaupes, and Vichada). Results are presented for 71 regions.

Inputs (or capabilities) competitiveness is measured through the following factors: cost and efficiency, regional structure, economic structure, innovation and education, health and social system, and institutions. Inputs (or capabilities) competitiveness is measured through the average of the six factors (equation 1). No regional variables that were comparable between countries were identified for sustainability and environment factors.

Results competitiveness is measured through the geometric mean of social, economic, and environmental results factors presented in equation 2. Since environmental, social, and economic factors are necessary and equally important to achieve a competitiveness results, the geometric mean is used to account and give the same importance to all factors. Additionally, it allows to overcome the possibility of compensation of one factor for the other. If one of the factors drifts to 0 then the overall index will drift to 0. This differs from the arithmetic mean, which allows to compensate the average value when one of the components leans to 0 by increasing the values of the other components. Variables that compose each factor are presented in table 2.

$$Input\ Index_i = \frac{1}{6}Eff_i + \frac{1}{6}Infras_i + \frac{1}{6}Ec\ Struct_i + \frac{1}{6}Educ_i + \frac{1}{6}Health_i + \frac{1}{6}Instit_i \quad (1)$$

Where:

Input Index = Inputs/capabilities competitiveness index for region i.

Eff = Efficiency and cost factor.

Infras = Regional infrastructure factor.

Ec Struct = Economic structure factor.

Educ = Innovation and education factor.

Health = Health and social system factor.

Instit = Institutions factor.

$$Results\ Index_i = \sqrt[3]{Economic_i * Social_i * Environmental_i} \quad (2)$$

Where:

Results Index = Results Competitiveness Index for region i.

Economic = Economic results component.

Social = Social results component.

Environmental = Environmental results component.

To test for consistency in the rankings and results, the Input Competitiveness Index was contrasted with calculations giving each variable within each factor the same weight. Similarly, Results Competitiveness Index was calculated using arithmetic means. Convergence trends for Results Competitiveness are observed following Royuela, & García (2015), who test convergence not only for economic variables but also for social variables in Colombian regions.

TABLE 1.
Competitiveness indexes in Latin America: supporting theories and scope

Country	Index Name	Author/Institution	Supporting Theory	Time frame	Scale/number of regions
Argentina	Índice de Competitividad Provincial	Bolsa de Comercio de Córdoba (2012)	Regional competitiveness is the "Capacity or potential of the economic system of a certain region to achieve higher levels of per capita income in a sustained manner".	2007-2012	24 regions (23 Provincias and Ciudad Autónoma de Buenos Aires)
Colombia	Escalafón de competitividad	CEPAL (Ramírez & De Aguas, 2017)	The index is based on an implicit definition of competitiveness that gathers structures, dynamics and achievements of a region that link economic growth, innovation, connectivity, the welfare of its population and the governance of the territory. This definition is part of a multidimensional vision, beyond GDP (Krugman, 1994), and provides a panoramic and comprehensive view of the relative development of each department.	2000-2017	32 departments
Colombia	Índice de Competitividad departamental (IDC)	Consejo privado de Competitividad & Universidad del Rosario (2018)	Based on the competitiveness definition from the World Economic Forum: " <i>set of institutions, policies and factors that determine a country's level of productivity</i> " (Schwab, 2017).	2013-2018 (6 versions)	Complete index for Bogota and 26 departamentos. Summarized index for 32 departamentos.
Chile	Índice de Desarrollo Regional - IDERE	El Instituto Chileno de Estudios Municipales de la Universidad Autónoma de Chile (2017)	Measures regional development using a multidimensional perspective, similar to the Human Development Index (HDI) from the United Nations Development Program (UNDP).	2016-2017 (2 versions)	15 regions
Chile	Índice de Competitividad Regional- ICORE	Centro de Estudios en Economía y Negocios de la Universidad del Desarrollo (Echeverría & Arce, 2015)	It is a measure of the competitive capacity of regions and accounts for the factors that enable systematically higher levels of productivity compared to other regions.	1999-2015 (12 versions)	15 regions

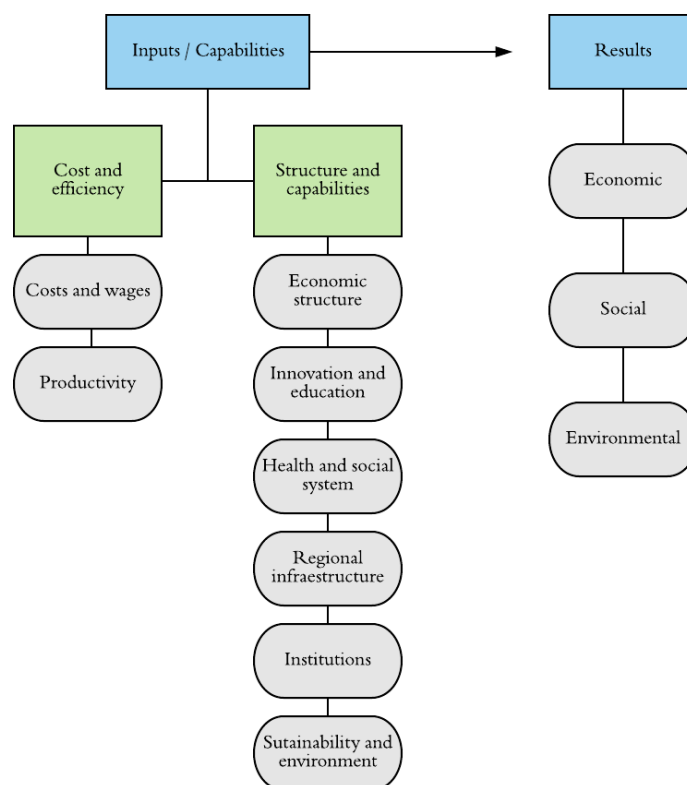
Source: Own elaboration.

TABLE 1. CONT.
Competitiveness indexes in Latin America: supporting theories and scope

Country	Index Name	Author/Institution	Supporting Theory	Time frame	Scale/number of regions
Mexico	Índice de Competitividad Estatal	Instituto Mexicano para la Competitividad – IMCO (2018)	Competitiveness is defined as the capacity of cities, states, or countries to generate, attract, and retain talent and investments. Both talent and investment tend to allocate in places that offer higher economic and social returns (IMCO, 2018).	2006 - 2018 (7 versions)	32 regions (Estados)
Perú	Índice de Competitividad Regional	Consejo Nacional de Competitividad (2013)	Based on the competitiveness definition from the World Economic Forum: “set of institutions, policies and factors that determine a country’s level of productivity” (Schwab, 2017).	2007/2008 - 2013/14 (7 versions)	24 regions
Perú	Índice de Competitividad Regional INCORE	Instituto Peruano de Economía (2018)	Based on the competitiveness definition from the World Economic Forum: “set of institutions, policies and factors that determine a country’s level of productivity” (Schwab, 2017).	2018 (6 versions)	25 regions (Includes Lima and Lima Provinces. Callao province is included in Lima)
Perú	Índice de Competitividad Regional	Universidad Católica del Perú (Centrum, 2017)	Regional competitiveness is defined as the management of resources and capacities to sustainably increase business productivity and wellbeing of the region's population.	2010-2016 (5 versions)	26 regions (Include Lima Metropolitana and Lima regions)

Source: Own elaboration.

FIGURE 1.
Regional Competitiveness Model



Source: Based in Aiginger & Firgo, 2017.

TABLE 2.
Variables and Sources

Variable Number	Variable Name	Unit of measure	Source		
			Chile	Mexico	Colombia
Inputs					
Inputs - Cost and Efficiency					
1	GDP per worker dollars current prices	Dollars PPP	Estimation based in World Bank data (1)		
2	Real minimum wages	In 2018 constant prices at 2018 USD PPPs (country level)	OECD		
3	Median minimum relative to average wages of full-time workers	Ratio (country level)	OECD		

1: Regional GDP was estimated using Country GDP in current dollars in PPP from World Bank and assigning values of regional distribution of Gross Value Added within countries using official country data.

Source: Own elaboration.

TABLE 2. CONT.
Variables and Sources

Inputs - Regional Structure					
4	Internet broadband access	% of households	OECD	OECD	DANE
5	Density	Number of People per square kilometer	Based in Population and Area		
Inputs - Economic Structure					
6	GDP per area (dollars world bank)	dollars PPP	Estimation based in World Bank data		
7	Specialization index	Index 0-1	Based in GDP data		
8	Manufacturing industry	% of the sector in Regional GDP	Banco Central de Chile	INEGI	DANE
9	Financial services	% of the sector in Regional GDP	Banco Central de Chile	INEGI	DANE
10	Real state and household services	% of the sector in Regional GDP	Banco Central de Chile	INEGI	DANE
11	Personal services (Education and health) and professional services	% of the sector in Regional GDP	Banco Central de Chile	INEGI	DANE
12	Public administration	% of the sector in Regional GDP	Banco Central de Chile	INEGI	DANE
Inputs- Capabilities: innovation and education					
13	Illiteracy rate	%	CASEN	INEGI	DANE
14	Years of education	years	CASEN	INEGI	DANE
15	Tertiary education assistance rate	%	CASEN	INEGI	DANE
16	Secondary education assistance rate	%	CASEN	INEGI	DANE
17	Primary education assistance rate	%	CASEN	INEGI	DANE
18	PCT patent applications per million inhabitants	Fractional count; by inventor and priority year	OECD	OECD	World bank
Inputs- Capabilities: Health and Social System					
19	Life Expectancy at Birth	Years	OECD		
20	Infant Mortality Rate	Number of less than 1-year deaths for 1,000 live births	OECD		
21	Dependency Ratio, Elderly	% 65+ over population 15-64	OECD		

1: Regional GDP was estimated using Country GDP in current dollars in PPP from World Bank and assigning values of regional distribution of Gross Value Added within countries using official country data.

Source: Own elaboration.

TABLE 2. CONT.
Variables and Sources

Inputs- Capabilities: Institutions					
22	Intentional Homicide Rate	Number of homicides per 100,000 inhabitants	OECD		
23	Social Capital Index	Index 0-1 (country level)	Prosperity index - Legatum Institute		
24	Corruption perception index	Index 0-1 (country level)	Transparency international		
Results - Economic					
25	GDP per capita dollars current prices (world bank)	dollars PPP	Estimation based in World Bank data		
26	GDP Growth rate 5 years	%	Banco Central de Chile	INEGI	DANE
Results - Environmental					
27	Air Pollution in PM2.5	Average level in $\mu\text{g}/\text{m}^3$ experienced by the population	OECD		
28	Renewable energy consumption	% of total final energy consumption (country level)	World Bank		
Results- Social					
29	Poverty	%	CASEN	CONEVAL	DANE
30	Employment Gap (difference male-female)	%	CASEN	INEGI	DANE
31	Labor participation rate	%	CASEN	INEGI	DANE
32	Unemployment rate	%	CASEN	OECD	DANE

1: Regional GDP was estimated using Country GDP in current dollars in PPP from World Bank and assigning values of regional distribution of Gross Value Added within countries using official country data.

Source: Own elaboration.

4. RESULTS

4.1. REGIONAL INPUT COMPETITIVENESS AND RESULTS COMPETITIVENESS INDEX

Figures 2 to 4 show Inputs Competitiveness Index and Results Competitiveness Index rankings for Chile, Colombia, and Mexico in the year 2017. Detailed variables and ranking results are presented in Appendix I, Table 1 - 3.

The Input Competitiveness Index shows consistent results when compared with an index with no PCA weighting system. Similarly, Results Competitiveness Index show similar rankings using arithmetic means instead of geometric means. Results of each alternative index are presented in Appendix 1, graphs 1 and 2.

FIGURE 2.
Map of Chile. 2017 Input Competitiveness Index and Competitiveness Results Index by Region

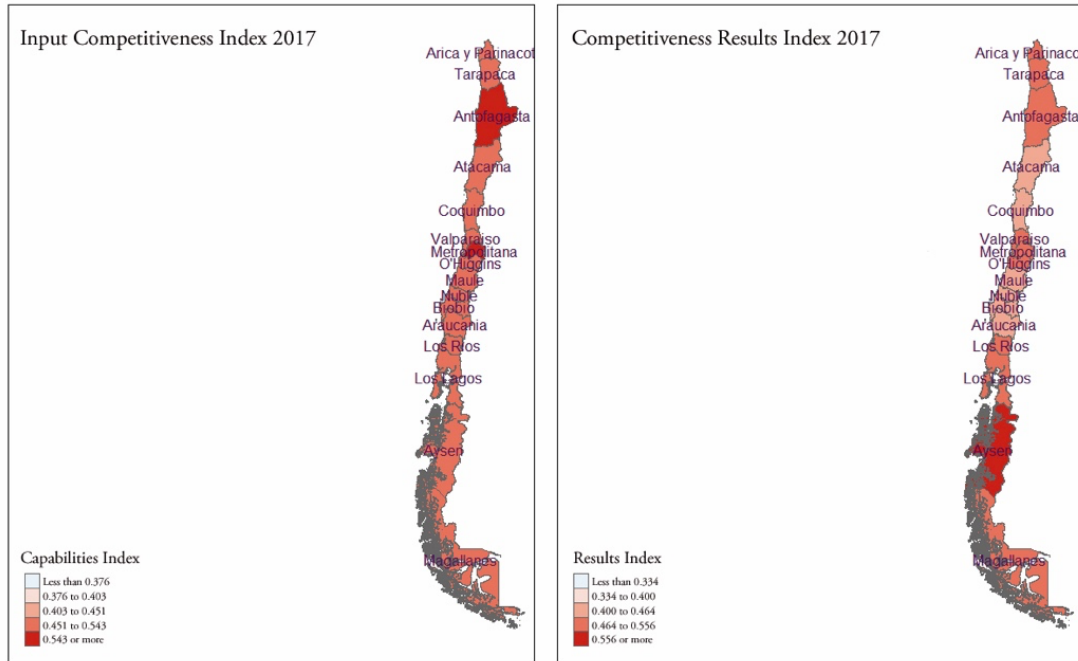


FIGURE 3.
Map of Colombia. 2017 Input Competitiveness Index and Competitiveness Results Index by Department

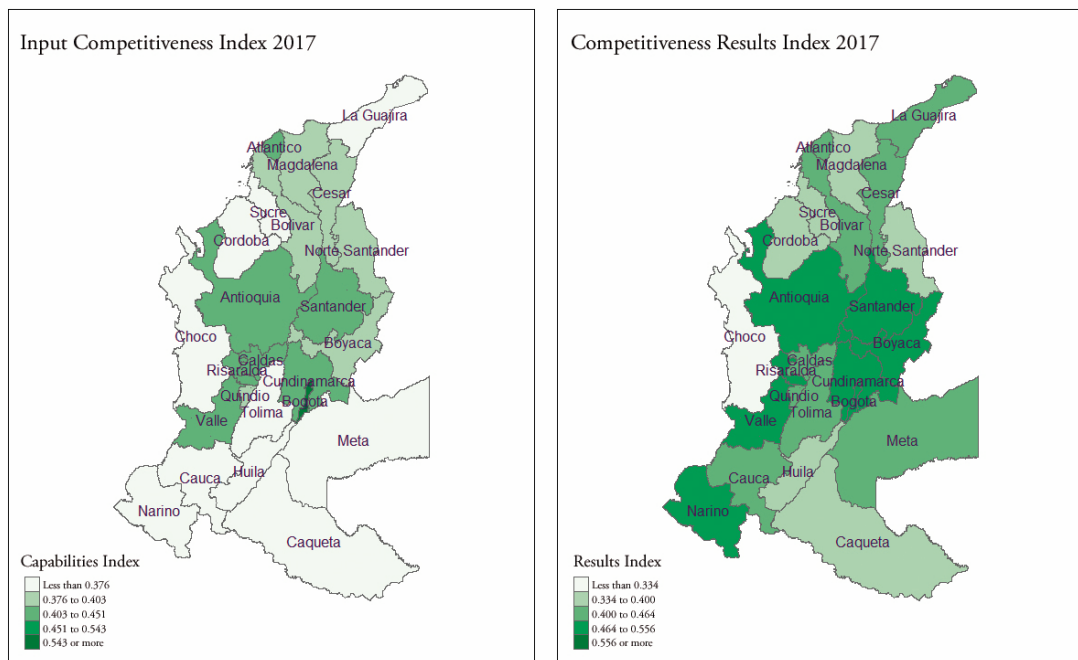
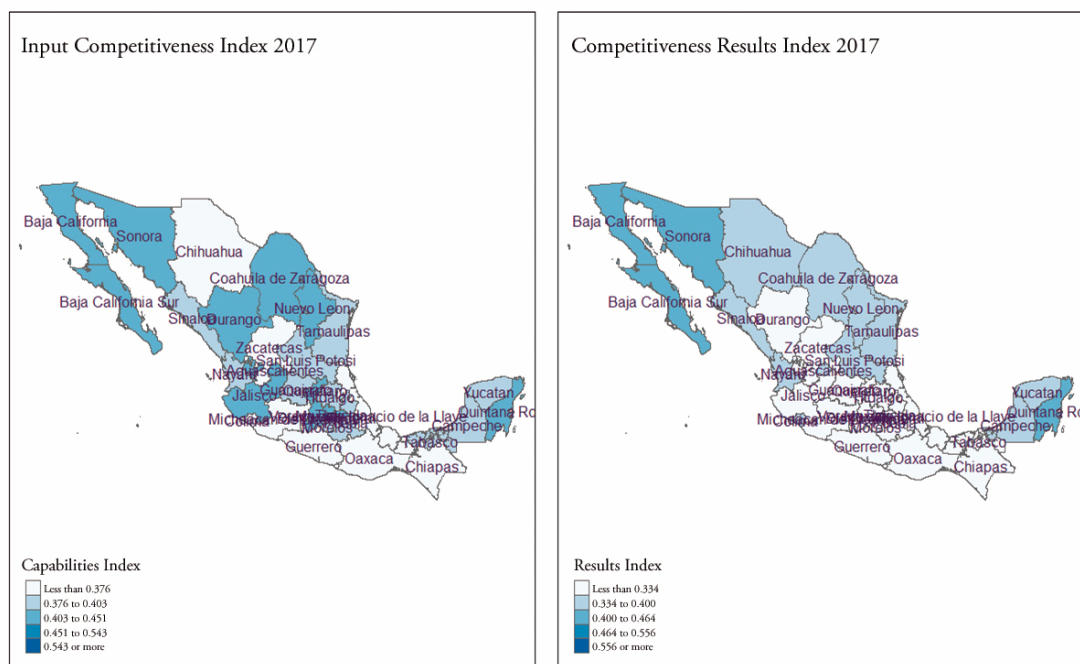


FIGURE 4.

Map of Mexico. 2017 Input Competitiveness Index and Competitiveness Results Index by Region



Graph 1 shows the Results Competitiveness Index for 2017 and the Inputs Competitiveness Index for 2017. Crossing red lines show the median score for the 2 indexes. Regions from Chile are clustered in high levels of competitiveness for both inputs and results, together with 7 regions from Colombia and 3 regions from Mexico. The clustering of regional competitiveness by countries indicate that there are strong country effects influencing overall scores.

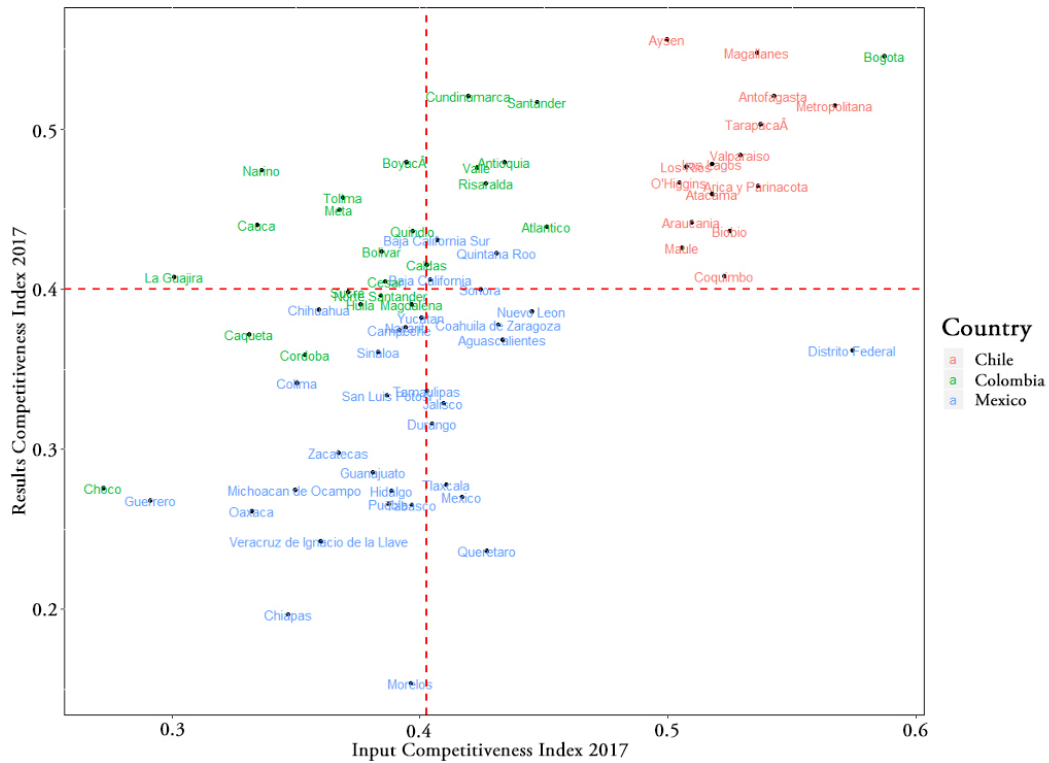
Most regions that present below median levels of Input and Results Competitiveness are from Mexico. *Chocó*, from Colombia, presents unusually low levels of Input and Results Competitiveness in 2017 along with the Mexican regions of *Guerrero*, *Chiapas*, *Oaxaca*, *Morelos*, and *Veracruz de Ignacio de la Llave*.

On the other hand, all three regions that contain the national capitals from each country have the largest level of Input Competitiveness and are not clustered by country in the case of *Bogotá* (Colombia) and *Distrito Federal* (Mexico). High levels of both Results and Input Competitiveness are observed in *Bogotá*.

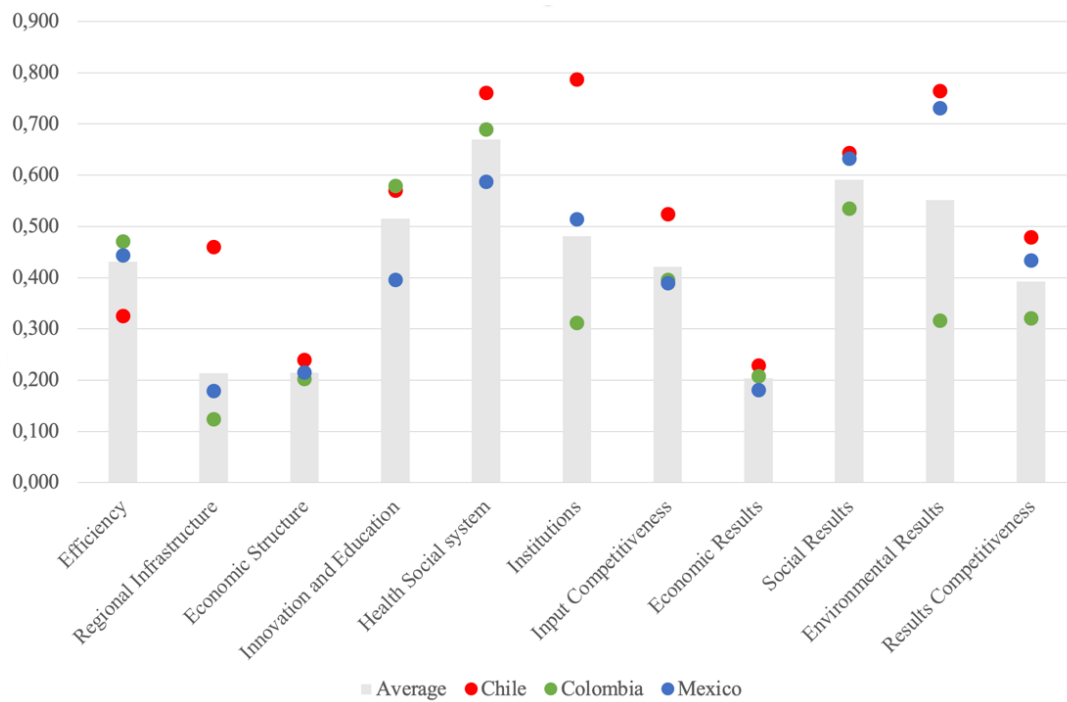
Graph 2 shows for each country average scores for each competitiveness pillar and for Results and Input Competitiveness Index. According to these results, the differences in Regional Input Competitiveness between countries are explained by Regional Infrastructure, Innovation and Education, and Institutions pillars. On the other hand, Results Competitiveness differences are explained by the Environmental and Social components.

In average, Chile shows a higher relative score of Input Competitiveness, and this is specifically due to higher results in Regional Infrastructure and Institutions pillars. Both Mexico and Colombia have similar Input Competitiveness average scores, and low relative values to Chile. In Mexico, the Innovation and Education pillar shows the lower relative score, while in Colombia the Institutions pillar shows the lower relative score. Results Competitiveness relative scores are similar between Mexico and Chile but are relative lower for Colombia. Colombia shows the lower relative score in the Environmental results pillar. Economic results scores are not relative different between the three countries.

GRAPH 1.
Results Competitiveness Index 2017 vs Input Competitiveness Index 2008



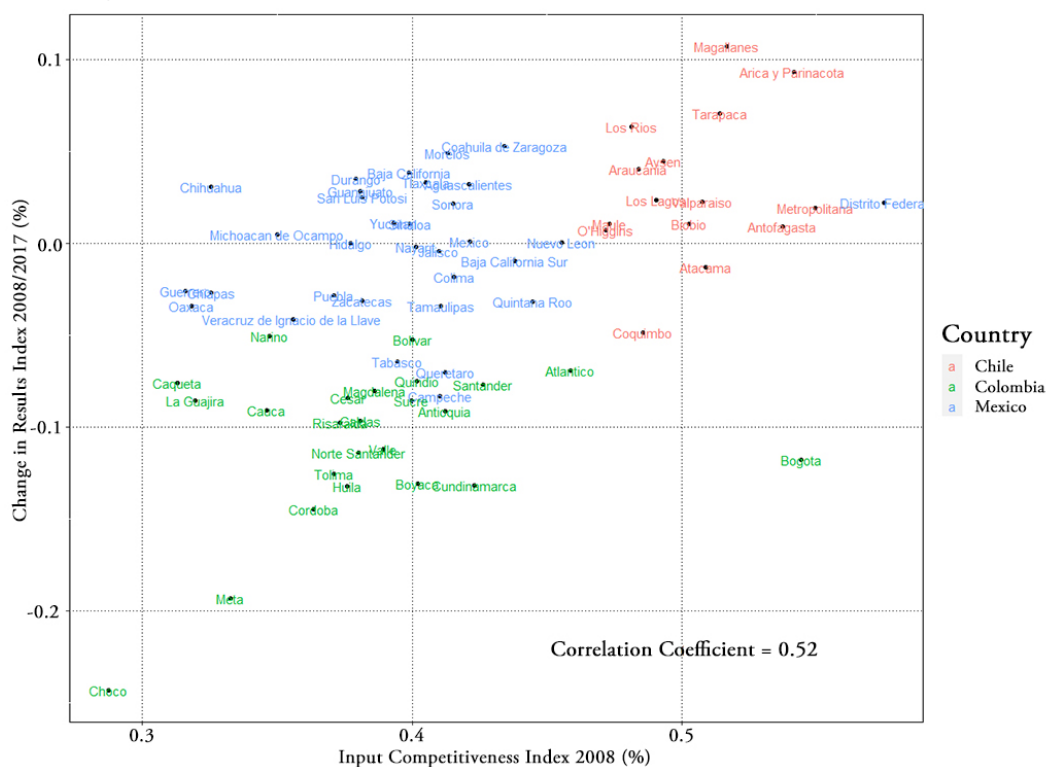
GRAPH 2.
Average Scores for Competitiveness Pillars and Competitiveness Index by Country



4.2. VARIATION OF REGIONAL INPUT COMPETITIVENESS AND RESULTS COMPETITIVENESS

Graph 3 shows the variation in the results competitiveness index between 2008-2017 and the initial levels of input competitiveness in 2008 for all regions. Regions with higher levels of input competitiveness in 2008 have a higher increase of their level of results competitiveness index between 2008-2017. The correlation coefficient between these two variables is 0.52. These results suggest that there is a positive relation between levels of input competitiveness and changes in results competitiveness, thus higher Regional Input Competitiveness levels would increase the growth of regional Results Competitiveness.

GRAPH 3.
Changes in Results Competitiveness Index 2017/2008 vs Input Competitiveness Index 2008



Graph 4 shows the variation in Results Competitiveness Index between 2008-2017 and the initial levels of results competitiveness for 2008 for all regions. The correlation coefficient between these two variables is -0.43. Regions with higher initial levels of Results Competitiveness Index had lower increases in the Results Competitiveness Index between 2008-2017, thus suggesting a convergence trend between 2008 and 2017.

Table 3 shows variation coefficients (CV) of Regional Results Competitiveness Index for year 2018 and 2017 by country and for all the regions. In 2017, lower levels of CV for Results Competitiveness are observed in Colombia, Mexico and all the regions, which supports the convergence trend observed in graph 4. The decrease in the CV is explained by the Economic and Environmental pillars which show lower levels of the CV in 2017. On the other hand, dispersion of the Results Competitiveness Index in Chile is higher in 2017 than in 2008, suggesting a divergence trend which is explained by the increase in the CV on the Economic Results Pillar.

GRAPH 4.
Changes in Results Competitiveness Index 2017/2008 vs Results Competitiveness Index 2008

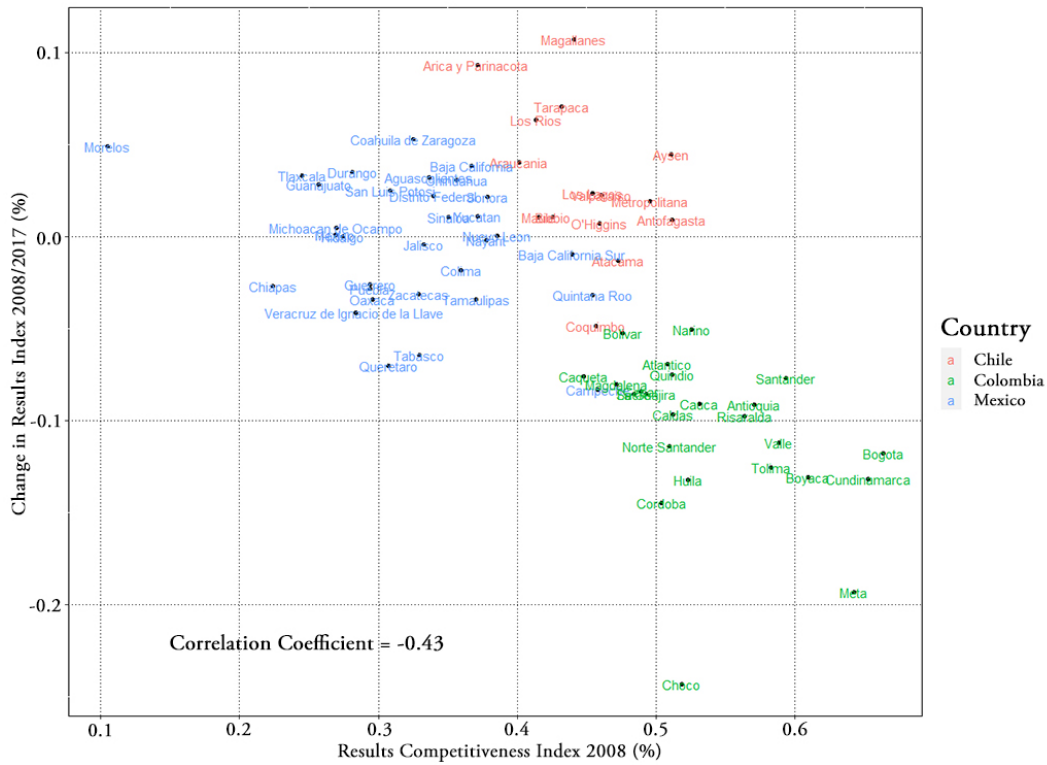


TABLE 3.
Variation Coefficients (CV) for Results Pillars and Results Competitiveness Index by Country

Pillar	Chile		Colombia		Mexico		All	
	2008	2017	2008	2017	2008	2017	2008	2017
Economic Results Pillar	0.052	0.055	0.074	0.051	0.047	0.037	0.101	0.050
Social Results Pillar	0.079	0.079	0.097	0.108	0.131	0.131	0.106	0.121
Environmental Results Pillar	0.147	0.083	0.085	0.101	0.059	0.059	0.284	0.231
Results Competitiveness Index	0.040	0.043	0.070	0.068	0.060	0.059	0.114	0.090

5. CONCLUSIONS

Comparable regional indicators are necessary to understand regional performance. Improving the standardization of regional data for Latin American regions and increasing the availability of indicators at the regional level is imperative, especially of those related to environmental and institutional factors, which are not widely available at the regional level.

The largest endowment of competitiveness capabilities in Latin America is found in regions that allocate major cities: *Bogotá* in Colombia, *DF* in Mexico and *Metropolitana* in Chile. Regions with higher

competitiveness results index are *Bogotá*, *Aysén* and *Magallanes*, these regions show higher levels of environmental, social, and economic indicators in 2107. Regions that are not capitals tend to cluster around within countries levels of competitiveness, which may be an indication of country factors, such as institutions having a major role in regional competitiveness.

The fact that *Bogotá* and *Distrito Federal* regions show unusually high levels for both input and results competitiveness may be an indication that they may be competing in a different way than other regions from those countries. In this sense, cross country comparison would make most sense when comparing highly competitive regions, which compete for capital, skilled workers and foreign investment, or regions that allocate exporting sectors, such as mining or agricultural industry. On the other hand, medium or low competitiveness regions cluster around national averages, is an indication that these regions may not be competing in the same way high competitiveness regions do.

Results show that regions with higher Input Competitiveness yield higher progress in competitiveness results for the 2008-2017 period. In consequence, the initial level of competitiveness capability of a region may be linked to an increase in the competitiveness result of a region and the welfare of its population. Specifically, pillars related to Regional Infrastructure, Innovation and Education, and Institutions present higher variability which would explain most of the differences in Input Competitiveness.

Policy implications regarding this issue are important, since promoting competitiveness capabilities, specifically of the identified Input Competitiveness pillars, in less advantaged regions would be crucial to achieve economic, social, and environmental gains in those regions, thus increasing population well-being.

Additionally, results suggest a convergence trend in Regional Results Competitiveness, since CV decreased between 2008 and 2017 for the whole sample. Within country dispersion of Regional Results Competitiveness decreased in Colombia and Mexico but increased in Chile. The economic and environmental pillars are the ones that explain most of the reduction in the dispersion.

Further research is needed to find econometric evidence to support the link between input and results competitiveness and of convergence patterns of not only economic, but also social and environmental variables.

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