Measuring Competiveness: Latin-American Experience

Lourdes Gabriela Daza Aramayo and Marek Vokoun

Abstract—This paper presents and discusses the calculation of a new competitiveness index for 18 countries in Latin America. The position of each country in our index is based on the comparison of 8 indicators in four dimensions and the weight thereof throughout the years 1999-2010. The system of weights allows time and dimensional preference. The dimensions analyzed are economic, social, institutional and technological. The indicators used are: real GDP per capita, net foreign direct investment per capita, net migration rate, income per capita, the rate of property rights, the level of freedom, corruption, investment in research and development per GDP%, and labour force with tertiary education. The competitiveness index of selected Latin-American countries was calculated based on the sequence and value of these indicators, resulting in a ranking of these countries. Other factors such as security, infrastructure, the role of technology, education, liberalization of the economy, and factors associated with investments in human capital were also post examined. This rather simple and easily computable index yields very good results and is comparable with other indices. We hold the idea that other indices of competitiveness calculated in the world are too complicated and don t cover all the countries. In this paper we have tried to demonstrate that it is possible to find other, simple methods of how to explain and calculate a competitiveness index.

Index Terms—Latin america, competitiveness index, economic development, institutions.

I. INTRODUCTION

For years, Latin America and the Caribbean were characterized by low and unstable levels of economic growth. This region is currently seen as dynamic and macro-economically stable. In recent years these countries have experienced a significant, above average growth, despite the economic financial crisis. The region is growing strongly due to a significant increase in exports, which stimulates the accumulation of international reserves, in turn restoring the credibility of their economies. This, along with good management of public finances and fiscal and monetary policies that characterize their current independence and economic autonomy, helps stimulate growth.

Until late 2009 and early 2010, a large portion of Latin America and the Caribbean had successfully avoided the consequences of the economic crisis, mainly due to the increased demand for raw materials from China and the timely economic policy response from the government.

Despite the positive high economic growth news from Latin America, it cannot be forgotten that the region still faces major challenges, the primary being competition. Latin America and the Caribbean have not yet reached their potential level. This is a great challenge for Latin America in

the future.

The goal of this paper is to present a method that allows reasonable weighting of collected input data and yields better results for interpreting competitiveness than other such indices. The selected 8 indicators in 4 dimensions are rather arbitrary as there is a whole "science" behind creating indices; however, we followed our working definition that combines different approaches concerning extensive and often contradictory theoretical background that defines competitiveness and we are open to discussion and future adjustments to the index to more effectively measure competitiveness.

II. DEFINITION OF COMPETITIVENESS

The first definitions of the term 'competitiveness' dates from classical economists like Adam Smith [1] and David Ricardo [2], who link the factors of production with the use of comparative advantages. This term has been linked to trade liberalization from its origins. Competition has since been seen as the ability of a particular nation to be successful in the international market [3] with the use of their factors. Although this term has been used continuously for more than three centuries, there is no uniform definition to define the level of competitiveness.

The dynamics of the international market, with the multiplicity of new actors, the inclusion and importance of new production factors such as knowledge and the deployment of services like transferable activity, have contributed to the absence of a common definition. It has constantly adapted to changing dynamics, acquiring different scopes and nuances according to the context.

For some authors, the concept of competitiveness has no meaning when applied to national economies and the obsession with it is wrong and dangerous. Paul Krugman [4] is aware of the danger that can come from seeking competitiveness at any cost. The problem is that most people treat the competitiveness of a nation the same as the competitiveness of a private company. Krugman [4] correctly points out the importance of not confusing the terms productivity and competitiveness. This index was developed using as many clear cut indicators and interpretations of results as possible. In contrast to indices like Doing Business WB [5] or GCR WEF [6], micro-economic aspects aren't included because the inclusion of black market firms can lead to a difficult and variable interpretation.

According to other authors, success is, in the case of developed economies, mainly determined by the capacity for innovation (Porter [7]). Amiti [8] affirms that regional competitiveness is closely linked to technological advances, maintenance of industrial connections, and the vertical dependence compatibility of old technologies with new. Regional competitiveness is closely linked with the region's ability to adapt to current trends in the use of powerful technology and market their vertical connections. Malmberg, Sölvell and Zander [9] also argue that competitiveness is

associated with maintaining their positions at a regional and international level, particularly in the context of economic globalization. Madies and Prager [10] argue that regional competitiveness is determined by the ability to attract international resources, e.g., investment, skilled labor, etc. Reference [11] mentions transport as a crucial factor for the development of a competitive economic environment,.

From this arises a big question: what causes a nation to be more or less competitive than another? This is where the greatest discrepancy arises because, according to the perspective and scope, or the definition used for competitiveness, it can give a different value to specified variables which encompass the concept.

It is difficult to analyze the competitiveness of a country or a region without reference to other parts of the world. In this regard, international comparisons based on competitiveness indicators are used to provide comparative practices which could highlight measurements. Moreover, the achievements of other countries or regions can be used as benchmarks for assessing past performance and future economic potential of those whose competitiveness is under investigation.

Our definition of competitiveness is the ability of a region, in the long term, to promote themselves economically against other regions, through the implementation or improvement of technology, infrastructure, education, and maintaining social cohesion and environmental sustainability. This definition corresponds to the construction of this index which has four dimensions. This index has been developed based on distinctive empirical research using the relationships between economic growth and trade openness, foreign direct investment, quality of infrastructure, technological development, labor efficiency and the quality of its institutions, and the level of corruption, etc.
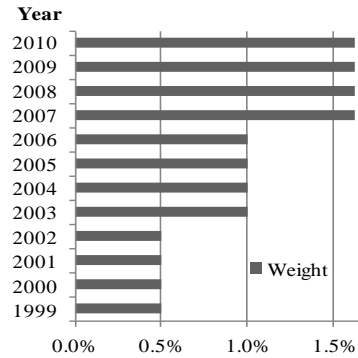
III. INDEX SPECIFICATION

This competitiveness index (CI) compares indicators (I_i) for a given state (j) and year (t) with the most favorable value among other countries (max [I_{ijt}]). According to our working definition of competitiveness there are 4 dimensions and each has two indicators. Each of the country's 8 indicators is therefore weighted by a uniform share (12.5 %). To account for some dynamics (Fig. 1) this 12.5 % uniform share is divided into three 4-year periods 1999-2002, 2003-2006, and 2007-2010. These are weighted (P_k) 2, 4 and 6.5 % for practical reasons and ease of interpretation. This allowed priority to be given to the recent development rather than past values. The choice of the distribution can be linear or exponential as is suggested in Cameron [12] for prediction techniques in time series analysis. We were inspired by M. Damborsky, R. Wokoun and J. Kourilová[13], Drezner [14] and methods that deals with portfolio analysis.

The final weight adjustment for every indicator ratio is done over its standard deviation, i.e. recomputed back to 100 % (sum of total standard deviation). To evaluate the regional competitiveness of Latin America with the 18 countries chosen, we have used the following formula:

$$CI_j = \sum_{i=1}^{8} \left(\sum_{t=1}^{12} \frac{I_{it}}{max[I_{ijt}]} \times \frac{\frac{0.25 \times P_k}{SD_{it}}}{\Sigma \left(\frac{0.25 \times P_k}{SD_{it}} \right)} \right)$$

$$CI_j = \sum_{i=1}^{8} \left(\sum_{t=1}^{12} \frac{I_{it}}{max[I_{ijt}]} \times \frac{\frac{0.25 \times P_k}{SDit}}{\Sigma \left(\frac{0.25 \times P_k}{SD_{it}} \right)} \right) \tag{1}$$

Source: Own calculations
Fig. 1. Distribution of weights in time

In order to get the ratio between I_{it} and max [I_{ijt}] correct (see the first fraction in Fig. 1) it has to be adjusted in the cases where we have negative observations. We have negative values in FDI and Migration (see Table I). The process of adjustment (see Fig. 2) for this indicator rests on the extra use of the difference between the largest and smallest values (Range) instead of simple ratio $I_{it}/max[I_{ijt}]$. This adjustment ensures that there is a large enough shift to always get a positive ratio.

$$Adjustment = \frac{I_{it} + Range\ (I_{it})}{max\ [I_{ijt}] + Range\ (I_{it})} \tag{2}$$

IV. DATA

Eighteen Latin American countries were chosen, ten from South America, 7 from Central America and Mexico. The data comes from international data sources such as the World Bank (WB WDI), the Economic Commission for Latin America and the Caribbean (ECLAC), U.S. Census Bureau, RYCIT and the Heritage Foundation. Where possible, indicators came from the same source, using a single method of measurement. Due to an insufficiency of data in the area of expenditures for research and development, some data was estimated. The basic method of estimation was OLS, a linear prediction with a time and space variable.

TABLE I: SUMMARY STATISTICS FOR 18 L-A COUNTRIES

Indicator	Average	Std. Dev.	Min	Max
GDP	7171.52	3378.05	2075.00	14273.00
FDI	128.57	143.89	-153.03	783.30
Migration	-1.84	2.73	-11.43	2.80
GNI	3748.29	2513.60	700.00	11590.00
Property	43.52	17.46	5.00	90.00
Corruption	34.77	13.55	10.00	75.00
R&D	0.28	0.24	0.00	1.19
Labour	24.72	9.21	10.00	49.00
Population	28.45	45.00	0.73	195.15

Source: Own calculations according to data WB, ECLAC, RYCIT, U.S. Census Bureau, RYCIT and the Heritage Foundation

Note: Overview of 8 indicators for period 1999-2010 Number of observation for each indicator = 216

The indicators used for the Economic Dimension are the GDP (per capita) based on purchasing power parity (PPP, in the constant 2005 international dollar prices) obtained from the World Bank and Net Foreign Direct Investment per capita (FDI). The GDP indicator represents a country's economic power and a market value of final goods and services. We have a wide range of countries with a low GDP as is in Nicaragua and Guyana. On the other hand we observe a high GDP in Mexico, Argentina and Chile. The Net FDI per capita (million dollars/per 1 million inhabitants, new investment inflows less disinvestment) data was obtained from the Economic Commission for Latin America (ECLA). It might look like it has a negative impact on large i.e. above average countries with a population (Table I, Population) of more than 28.45mil inhabitants, but we chose a relative per capita indicator which allows us to compare FDI attractiveness regardless of the size of the country. The most successful countries are Panama, Uruguay and Chile. Argentina and Mexico lose their front positions (1999-2002) and are under average at 128.57 dollars per capita. There are in fact also negative values that are observed in Venezuela, Brazil (2006) and Bolivia (2005) which indicate waves of disinvestment.

For the Social Dimension, we chose Gross national income per capita (GNI) and the net migration rate (NMR, Migration). NMR is the difference of immigrants and emigrants in an area in a period of time, divided per 1,000 inhabitants. This indicator was obtained from U.S. Bureau of Census. A positive or stable (around average) value of NMR shows stable social conditions, in comparison to a high negative value which shows unstable social conditions. Chile and Costa Rica have the highest net surplus, while Guatemala and Guyana have negative values of NMR. The GNI (measured by World Bank Atlas method in current US dollars) reflects the average income of a country's inhabitant. It includes price level but according to the WB Atlas method some of the fluctuations in prices and exchange rates are smoothed. Chile and Mexico enjoy the highest per capita values in our sample; Nicaragua and Bolivia have the lowest per capita income.

For the institutional dimension the Property Right Index (Property) and Freedom from Corruption Index (Corruption) from Heritage Foundation have been used. The property rights index is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the State. This index measures the degree to which the country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption in the judiciary, and the ability of individuals and businesses to enforce contracts [15]. The freedom-corruption index is mainly derived from the Corruption Perception Index of Transparency International (CPI) which measures the level of corruption in 178 countries. The CPI is based on a 10-point scale in which a score of 10 indicates very little corruption and a score of 0 indicates a very corrupt government. In scoring freedom from corruption, the Index converts the raw data of the CPI on a scale of 0-100. This indicator introduces a measure of insecurity and uncertainty in economic relationships. High levels of corruption are considered to be indicator of weak rule of law and overall institutional setting. According to this data, Chile offers the highest level of security for private property, with one of the most efficient judicial systems in Latin America with a relatively high corruption-free level, with 67 %, the highest in region, followed by Uruguay and Costa Rica.

For the Technological Dimension the two indicators taken are R&D expenditures as a percentage of GDP and the Labor Force with tertiary education. The research and development expenditures (% of GDP) were obtained from RYCIT. This indicator is the current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including the knowledge of humanity, culture and society, and the use of knowledge for new applications. R & D covers basic research, applied research and experimental development.

TABLE II: COUNTRY SPECIFIC SUMMARY STATISTICS 1999-2010

Country	Population	GDP	FDI	Migration	GNI	Property	Corruption	R&D	Labor
Argentina	38.5	11164.3	155.0	-0.7	6008.3	38.3	29.3	0.47%	27.7%
Bolivia	9.1	3810.8	50.1	-1.3	1168.3	32.1	24.6	0.25%	34.8%
Brazil	184.5	8614.6	109.6	-0.1	5035.0	50.0	38.0	1.03%	15.6%
Colombia	42.9	7359.7	82.1	-0.3	3330.8	38.3	34.0	0.14%	24.3%
Costa Rica	4.3	9093.4	231.3	0.5	4802.5	50.4	49.5	0.40%	35.1%
Ecuador	13.3	6550.3	38.4	-5.7	2610.8	32.1	23.9	0.11%	29.7%
El Salvador	6.1	5662.3	69.0	-3.7	2726.7	52.5	39.3	0.08%	20.2%
Guatemala	12.6	4116.8	34.5	-5.3	2099.2	35.4	29.8	0.03%	13.9%
Guyana	0.7	2531.4	130.4	-7.3	1550.8	45.8	28.5	0.39%	14.3%
Honduras	6.8	3212.8	79.3	-1.5	1360.0	36.7	23.7	0.06%	14.2%
Chile	16.2	11891.1	284.3	2.4	6468.3	89.6	71.0	0.54%	33.8%
Mexico	105.3	12489.2	171.0	-4.7	7485.0	50.0	34.3	0.41%	26.4%
Nicaragua	5.4	2288.0	59.1	-1.2	870.0	28.3	25.6	0.05%	18.6%
Panama	3.2	9605.1	382.0	-0.5	4839.2	35.8	39.2	0.29%	37.4%
Paraguay	5.8	4008.9	21.0	-0.1	1575.0	30.4	19.1	0.08%	22.2%
Peru	27.5	6521.2	114.3	-1.0	2880.0	40.0	38.2	0.12%	41.4%
Uruguay	3.3	10152.6	279.4	-0.4	6566.7	70.0	54.0	0.32%	17.1%
Venezuela	26.5	10015.1	23.4	-2.3	6092.5	27.5	24.1	0.35%	18.4%

Source: WB, ECLAC, RYCIT, U.S. Census Bureau, RYCIT and the Heritage Foundation

A highly educated workforce is the last indicator need for this analysis. This indicator shares the most qualified employees for their different educational attainments and was very important for the technological dimension. The data was obtained from the Economic Commission for Latin America (ECLA). Brazil excels in R&D expenditures, but lacks a skilled labor force. In reverse order Peru excels in skilled labor but lacks R&D investment and innovation expenditures. Chile, Argentina and Costa Rica seem balanced but in comparison with the EU or Brazil they are under average and their R&D expenditures are still very low.

Table II shows the summary statistics of the analyzed countries in Latin America from 1999 to 2010. In this table it is possible to observe of the 8 analyzed indicators that make up the four dimensions of the index created. The number of observations per country is 9, including population.

V. RESULTS

In Table III below, we show the Competitiveness Index score for the 18 countries of Latin America. The four dimensions on which the index was developed are visible, each with a calculated weight of 25% in the index.

TABLE III: THE RESULTS OF THE INDEX FOR LATIN AMERICA, 1999-2010

Country	Index	Economic	Social	Institutional	Tech.
Chile	87.31%	28.20%	19.06%	26.98%	13.06%
Uruguay	71.67%	27.02%	15.85%	21.36%	7.44%
Costa Rica	69.83%	25.19%	15.50%	16.51%	12.64%
Panama	68.03%	29.60%	14.51%	11.97%	11.95%
Brazil	63.87%	21.24%	15.03%	14.56%	13.04%
Mexico	62.61%	25.38%	12.96%	13.87%	10.40%
Argentina	60.37%	23.12%	15.26%	10.69%	11.30%
Peru	57.48%	20.30%	12.31%	12.89%	11.97%
Colombia	53.40%	19.80%	13.44%	12.47%	7.68%
Venezuela	49.90%	19.34%	14.52%	8.19%	7.85%
El Salvador	49.03%	18.55%	9.55%	15.02%	5.90%
Bolivia	47.86%	16.64%	10.63%	9.21%	11.38%
Ecuador	44.04%	18.14%	7.89%	9.03%	8.98%
Paraguay	42.96%	16.01%	12.13%	8.44%	6.39%
Honduras	42.17%	17.42%	10.65%	9.84%	4.26%
Guyana	41.91%	18.37%	4.47%	11.91%	7.16%
Nicaragua	41.15%	16.22%	10.43%	9.07%	5.44%
Guatemala	39.93%	16.52%	9.01%	10.40%	4.00%

Source: Own calculations according to data WB, ECLAC, RYCIT, U.S. Census Bureau, RYCIT and the Heritage Foundation

Among the South American countries, Chile has the highest competitiveness index according to these calculations, followed by Uruguay, Brazil and Argentina. The South American countries with the lowest index of competitiveness are Bolivia, Ecuador and Venezuela.

Among the countries that are at the head in Central America are Costa Rica with 69.83 % followed by Mexico and Panama. The last places in Central America are for Nicaragua and Guatemala.

To better illustrate the function of our index, we have included a short synopsis of a few countries.

Chile is internationally known as one of the strongest economies in Latin America, which, in addition to institutional security, respect for private property and a relatively low level of corruption, attracts foreign direct investment. This is an open economy with independent trade agreements with more than 58 countries. The level of technology is also an important factor in this country, as well as the quality of education which are both among the highest in South America. This could explain the factors that have put Chile ahead in this index.

Uruguay has a very high economic growth, third in South America, an average unemployment rate and the second highest percentage in regard to respect for private property. It is a small, open economy with a projected market growth outside the international market. It has the highest level of broadband in Latin America and internet after Chile. Uruguay is a member of Mercosur with Argentina, Brazil and Paraguay, a free trade area with a GDP of more than 2 billion dollars. This country has one of the highest levels of schooling. It is considered a safe country along with Chile and Costa Rica and has a high level of infrastructure, especially in technology and water.

The explanation of the position number 3 (in south America) for Brazil is that this region is one of the countries with the highest economic growth rates but to detract from this, they have one of the highest migration rates, the second highest in South America and the labor force with tertiary education is below average, the lowest among all these countries. Brazil has also been marked by the imposition of protectionist measures which were strongly criticized especially in recent years.

Brazil and Argentina maintain their positions and are some of the top economies in Latin America. Peru and Colombia are advancing thanks to the strong institutional changes that have been made in recent years. This year Ecuador approved a new legal code to attract investment and increase production. The reform gives way to institutional changes such as wage increases and tax cuts, which could improve their position in the future.

At the head in Central America is Costa Rica with 69.83 % followed by Panama with 68.03 %. Costa Rica has the third highest economic growth rate in Central America, high above the average, the unemployment rate is above average, but has the highest rate of labor force with tertiary education after Panama and have the higher percentage respect for private property.

Costa Rica is among the technological pioneers in Latin America and has one of the lowest internet access costs. They also have a highly skilled workforce. Costa Rica is considered one of the safest countries in Latin America, followed by Chile and Uruguay.

Panama is also highlighted due to its second position in Central America. Panama stands out due to its economic growth and great strides in infrastructure; it has 7 ports, a mega airport as well as a railway and canal connecting the Pacific with the Atlantic. They have actively worked on their competitiveness in the region. Unlike other regions, they are very focused on services rather than commodities. They took over the Panama Canal operations in 1999, which could explain their focus on services rather than goods, influenced as well by large amounts of international trade over the last

century. This international exposure could also explain a bit of their outward show of competitiveness.

VI. Comparasion of Results

The IMD World Competitiveness Yearbook (WCY) is the world's most renowned and comprehensive annual report [16] on the competitiveness of nations, ranking and analyzing how a nation's environment creates and sustains the competitiveness of enterprises. The IMD World Competitiveness Yearbook measures 59 countries on the basis of 329 criteria.

It is difficult to compare the results of this index with the results of the World Competitiveness Yearbook because they analyzed only seven Latin American countries as you can see in table number IV.

TABLE IV: THE IMD WORLD COMPETITIVENESS FOR LATIN AMERICAN COUNTRIES

Overall Competitiveness	2010	2011	Change
Chile	28	25	3
México	47	38	9
Peru	41	43	-2
Brazil	38	44	-6
Colombia	45	46	-1
Argentina	55	54	1
Venezuela	58	59	-1

Source: World Competitiveness Yearbook

Another ranking system, The World Economic Forum [17], has similar results to our index, with a few differences. The position of the country ranking is quite similar. In South America, the leading countries in the index would be Chile, Uruguay, Peru, Argentina, and Chile. In the lower positions are Venezuela, Paraguay, and Bolivia.

In Central America, the top position goes to Panama, followed by Costa Rica with the last countries being Belize, Nicaragua, and El Salvador.

TABLE V: COMPARISON OF THE RESULTS OF THE GLOBAL COMPETITIVENESS INDEX 2010-2011 FOR LATIN AMERICAN COUNTRIES AND THE NEW INDEX

Country	GCI 2010-2011 Ranking	New Index Ranking
South America		
Chile	30	Chile
Brazil	58	Uruguay
Uruguay	64	Brazil
Colombia	68	Argentina
Peru	73	Peru
Argentina	87	Colombia
Ecuador	105	Venezuela
Bolivia	108	Bolivia
Paraguay	120	Ecuador
Venezuela	122	Paraguay
Central America and Mexico		
Panama	53	Costa Rica
Costa Rica	56	Panama
Mexico	66	Mexico
Guatemala	78	El Salvador
El Salvador	82	Honduras
Honduras	91	Nicaragua
Nicaragua	112	Guatemala

Source: World Economic Forum and own calculations

In comparison with the results of the World Economic Forum, this international index includes some Caribbean countries while the new our index calculated includes only countries from South America, Central America and Mexico. For comparison reasons the table V included only data from the same Latin American countries.

VII. Conclusion

This index represents achieved values in Economic, Social, Technological and Institutional dimensions. The process of achieving prosperity itself is more complicated than simple numbers can represent and this papers attempts to shed some light on this issue by comparing common characteristics (index indicators, country facts) of countries with low and high levels of competitiveness. This paper and index can serve as a basis for further institutional change analysis to uncover possible casual effects of factors to competitiveness and country prosperity.

Among the common characteristics found in countries with low levels of competitiveness are the institutional and technological factors, low foreign direct investment in connection with the level of corruption and the largest common factor- the relatively high rate of migration from these countries before the global economic crisis. These countries have a large concentration in a few exports and still have one the greatest gaps between rich and poor. One issue of concern is the misuse of raw materials, and many countries are retreating to a singular focus on the export of raw materials.

Countries with a low rate of competitiveness, despite astonishing economic growth, have key structural problems; savings and investments are very low in comparison to other structures in the world. These countries have inadequate legal security for private property and fairly high rates of corruption. These factors lead to uncertainty, which results in low foreign direct investment, directly impacting the level of technology, industrialization and infrastructure development. These are the main barriers limiting economic development and competitiveness improvement.

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