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Go beyond income: a portrait of poverty in Latin America

Oltre il reddito: un'analisi della povertà in America Latina

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INTRODUCTION AND MOTIVATIONS

Poverty and extreme poverty is a deep concern in Latin America. All nations in this region are greatly affected by it. This is widely known and is often an issue in the international community. According to the UN's Economic Commission for Latin America and the Caribbean (ECLAC), 30.1%1 of the regional population is under the poverty line, whereas it was below the extreme poverty line. It means that approximately 185 million people in the region are poor, of which 66 million people are in extreme poverty (2019).

There are many reasons to acknowledge poverty in some countries, more than others. This happens because there are multiple factors than can explain poverty in Latin America. It is known that each country in the region has its domestic problems. In that sense, it is natural to understand that there are a variety of variables that influence poverty.

Not only one country's income index exposes the extent of poverty it has but also several variables which can only indicate the reality by an integrally developed analysis. Many elements have to be taken into account to understand poverty. This is not an easy task. Multidimensional analysis is needed to be done, and there is an urgency to comprehend the issue integrally. In contrast, the idea to measure poverty

in a short-sighted vision by understanding it as a one-factor phenomenon is incorrect.

The importance of this study is gigantic due to the plenty of consequences that poverty causes. Latin America is a region that has several problems. There is a large scale of violence, migration, humanitarian crisis, and lack of economic, cultural, and social development.

In this work, we will try to explain poverty from several variables to help to comprehend the variables that have more influence. A framework analysis of the previous literature is presented. Then, the selection of the variables will take place, and the statistics descriptions of each will be prepared. Consequently, a cluster analysis will be computed in order to group the countries for a better analysis. Finally, proceed with the construction of a composite indicator with the variables selected, that is the final delivery of the work.

Chapter 1

LITERATURE REVIEW

1.1 Theoretical Framework of Poverty

Poverty is an economic and social condition that affects the whole world. This happens in a more extended manner in some countries than in others. In this chapter, we are going to mention some previous studies which analyse this condition with different variables and different points of view.

When we talk about poverty, it is necessary to understand two terms and know the difference between them; unidimensional and multidimensional poverty.

Unidimensional poverty can be applied and calculated when we have a well defined single-dimensional resource variable, such as income. This one has been selected as the basis for poverty evaluation in every case. The unidimensional context proceeds typically by establishing a poverty line corresponding to a minimum level of income, and who is below this line is considered poor.

However, when we talk about Multidimensional poverty analysis, it is necessary to take into account more variables such as poor health, lack of education, inadequate living standards, disempowerment, poor quality of work, corruption, unemployment, and living in environmentally hazardous areas, among others. The analysis of several indicators gives, as a result, the creation of a complete scenario. It reveals who is poor, and the most crucial factor it reveals how they are poor, the

range of different disadvantages they experience. In addition to providing a headline measure of poverty, multidimensional measures can be disaggregated to reveal the level of poverty in different areas of a country and among different sub-groups of people. A person who is poor can suffer several disadvantages at the same time, not just lack of money, for example, they may have poor health or malnutrition, clean water or electricity, poor quality of work or little schooling. (Foster & Alkire,2015) . Just putting all the attention on one factor, such as income, is not enough to capture the actual reality of poverty.

In order to be able to understand fully, some definitions are proposed: Poverty can be defined, taking into account various areas. It can be conceptualized as the deprivation of wellbeing, the lack of access to basic capacities of human beings, the absence of an adequate income to meet the needs of education, health, security, empowerment, and basic rights (Haughton & Khandker, 2009).

According to the United Nations Declaration issued as a result of the World Summit for Social Development held in Copenhagen in 1995, poverty is "*the condition characterized by several deprivations of basic human needs, including food, drinking water, sanitary facilities, health, housing, education, and information. Poverty depends not only on monetary income but also on access to services*" (ONU, 1995).

As stated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), three perspectives should be considered when evaluating whether an individual is in a situation of poverty: 1) If their income is below a poverty line; 2) If the person has the necessary basic services; and 3) If he or she has enough basic capacities to function in society (UNESCO, 2015).

Poverty can be defined in absolute or relative terms. Absolute poverty is defined concerning a quantity of money necessary to satisfy basic needs (food, clothing, and more) without incorporating quality of life concepts (Galindo and Ríos, 2015). In this type of poverty, people living below the poverty line are not affected even if the country in which they live is economically prosperous. In other words, no matter how rich and prosperous the economy of the countries concerned is, people living in absolute poverty have no benefit from the economic prosperity of their country. In this measurement, poverty is defined by one-dimensional causes, for example, when the minimum consumption per day of calories, or the amount of $ 1.90 per day, is established as the poverty threshold.

On the other hand, relative poverty takes into account that human beings are social actors and that poverty must be measured compared to those who share the same social environment (Hulme,2010). It can be defined where household income is a certain percentage below the average incomes. Although people living in this type of poverty do not live in absolute poverty, they cannot afford the same standard of

living as others in that society. It can sometimes refer to a lack of TV, internet, clean clothes, decent and safe housing, and education. Although it seems to be less severe than absolute poverty, it is still a category that can be permanent, and this makes people unable to live in society. According to the Habitat for Humanity institute, the people that are living in this type of poverty is thus confined to low income and unable to break down social barriers.

Following the approach of the Inter-American Institute of Human Rights (IIHR) exposed in its work: "Poverty and Human Rights: Towards the definition of conceptual parameters from the doctrine and actions of the Inter-American System" (2010), the existing consensus on the character multidimensional approach to poverty, and the two approaches to the concept of poverty, conservative and progressive, are synthesized: The first defines poverty as an individual phenomenon and uses the indicators of needs and income for its measurement. From this point of view, an individual is poor because he does not want to work or due to the attitudes that show little interest in progressing. Based on the poorness indicators associated with this concept, he concludes that one is poor when the person "does not reach a certain threshold of income or when he or she presents any of five needs considered socially basic." The progressive conception of poorness, in contrast, considers that poverty is a social-structural phenomenon with collective effects that prevents both individuals and communities from leading a decent life (IIDH, 2010).

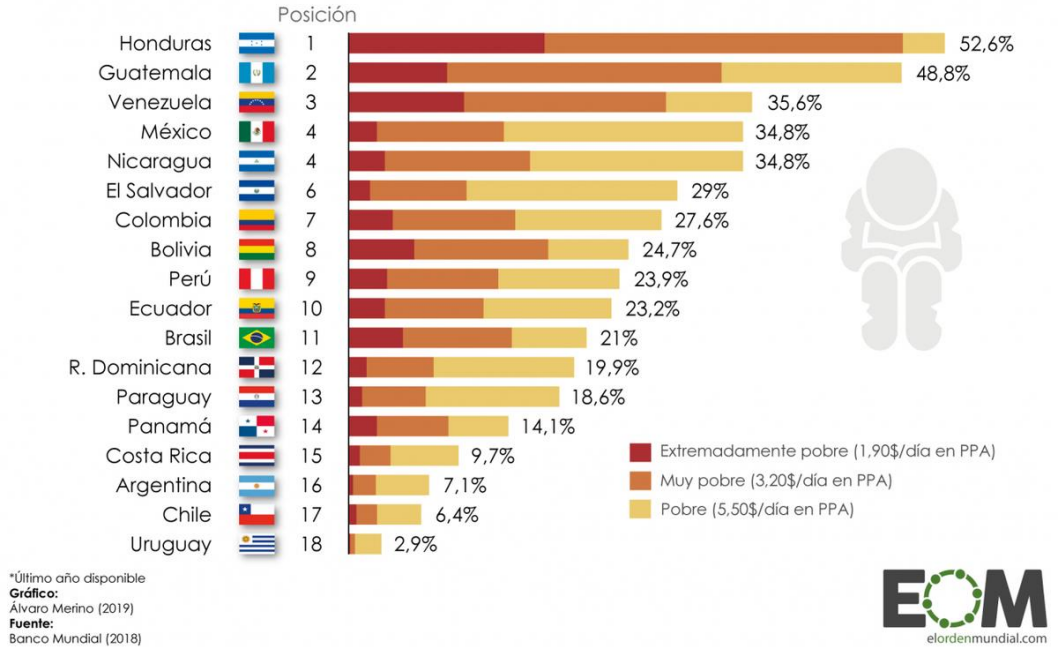
According to "The Social Panorama of Latin America," an annual inform prepared by The Economic Commission for Latin America and the Caribbean (ECLAC), in 2019, the poverty can be measured by the poverty lines that represent the level of income that allows each household to satisfy basic needs of all its members. Considering the level of physical activity, food availability, prices in the family basket in each geographic area. The international poverty line, IPL, also known as poverty threshold, or just as poorness line, "in line for a given individual can be defined as the money the individual needs to achieve the minimum level of 'welfare' to not be deemed 'poor,' given its circumstances." (Ravallion, 2006).

In October 2015, the World Bank updated the international poverty line (IPL), an absolute global minimum, to $1.90 per day. It is calculated by finding the total cost of all the essential resources that an average human adult consumes in one year. This imaginary line helps us to understand and to set the approximate number of people that live in this condition. However, the World Bank (2008) also considers that there are also other less severe levels of poverty than living on less than $ 1.90 a day: severe poverty, which means living on less than $ 3.20 a day and other poverty milder, covering less than $ 5.50.

The focus of the current work is the Latin American countries. Bellow, we show the distribution of poverty, taking account of the three types of poverty above mentioned.

Figure 1 Distribution of poverty in Latin America

% of population that is poor, very poor and extremely poor



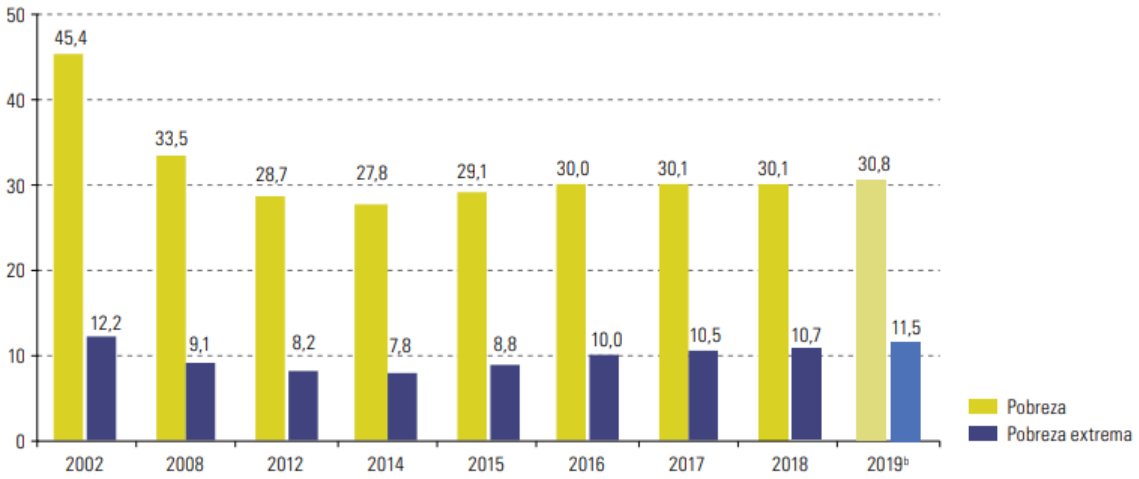
Source: World Bank (2018)

Figure 1 shows eighteen countries with their percentage of poverty taking account of the three types above mention. Being the highest Honduras with 52.6% and the lowest Uruguay with 2.9%, according to the World Bank (2018).

The poverty rate is the ratio of the number of people (in a given age group) whose income falls below the poverty line, taken as half the median household income of the total population. In Latin America, the poverty rate decrease since 2000, but in the years 2016, 2017, and 2018 did not have significant changes. It was around 30%

and 0.7% of the people that were in extreme poverty. Last year it had an increase of this rate to 30,8 and 11,5% respectively, as we can see in the following table.

Figure 2 Latin America poverty rates and extreme poverty, 2002-2019 (In percentages of people)



Source : ECLAC (2019) based in *Banco de Datos de Encuestas de Hogares* (BADEHOG)

According to the ECLAC (2019), poverty in Latin America is one of the most significant difficulties in achieving sustainable development. Nowadays, countries are trying to eradicate poverty in all its forms, and thus, achieve the first goal on The Sustainable Development Goals (SDGs).

1.2 Indicators utilized to measure the poverty

Poverty is not something that comes alone, and many indicators influence it. In this part, we will mention which literature has taken account of the previous research.

To start, in the "Social Panorama of Latin America" (2019) made annually, by UN and ECLAC, they took GDP per capita and the Gini index (an indicator of economic inequality in a population) to forecast how will the poverty be in 2030; supposing that the GDP per capita increase in 2% and the Gini index decrease in 1,4 %, South America would achieve the ODS goal number one to reduce poverty from 30,1% to 14,5%. This analysis shows us the importance of these two variables. However, to achieve these changes, we have to consider also other elements that are related. These could be, for example, social spending, that in 2018 registered an average of 13,2% and just Brazil, Argentine and Uruguay were above it, the rest registered a below percentage. This is an exciting fact because Argentine and Uruguay are the least emerging countries in this region. Moreover, it is essential to take into account the distribution of social spending as well, that has as a composition the following points: 1) Social protection; 2) Education; 3) Health; 4) Housing and community services; 5) Recreational activities, culture, and religion; 6) Protection of the environment.

In 2010, the United Nations Development Programme (UNDP) and the Oxford Poverty and Human Development Initiative (OPHI) published the Global Multidimensional Poverty Index (MPI). On the understanding that people living in poverty claim to be affected by more than just lack of income. The Multidimensional Poverty Index complements income poverty measures by assessing the deprivations that each poor person faces at one time, making an

analysis on an individual basis, taking into account that poor people suffer multiple deprivations and the magnitude of poverty is measured by the range, type, and level of these deprivations.

Another important feature of the MPI is that it can be disaggregated to show a vivid picture of people living in poverty, both across countries, regions, and the world and within countries, by ethnic group, urban/rural location, or other essential household characteristics. In this way, policymakers and planners can do so more effectively, because not only is it known who is poor, but also how they are poor.

This indicator also allows us to analyse which combinations of poverty are most common, to reflect the results of effective policy interventions quickly, to identify the poorest people, and also to show the shortcomings of the selected indicator that affect a person's life, so that it can inform a holistic response.

It measures three key targets – living standards, education, and healthcare in 109 developing countries. These three dimensions were divided into ten indicators that are interesting to mention and to compare with other variables taken into consideration by other researches. These are nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing, and assets.

Subsequently, in the article "Macroeconomics and poverty: lessons from Latin America," Lopez says that the vulnerability of the individuals for fall in the poverty

condition is linked to the variables related to the fiscal scheme, the economic growth: education, informality, and unemployment. (López,2004). He points out, as well, about the variable of social welfare that countries spend. These elements have to meet the basic needs of citizens to give a better condition of life. With this regard, we mentioned earlier that education, health, living place, social security and other social services are essential.

In this context, it is relevant to mention corruption, which is defined as: *Corruption is one of the most significant challenges of the contemporary world. It undermines good government, fundamentally distorts public policy, leads to the misallocation of resources, harms the private sector and private sector development and particularly hurts the poor"* (Transparency International,1998)

It is essential to consider because an efficient eradication of it can tackle down poverty. Corruption can influence income inequity and poverty from various channels, including overall growth, biased tax systems, inadequate social programs targeting, and human capital formation and education inequalities. As Gupta et al. (2002) point out, it is confirmed that high and rising corruption increases income inequality and poverty.

On the other hand, corruption by itself does not produce poverty, but it has direct consequences on economic and governance elements, which are intermediaries that produce poverty. Other problems also are that corruption reduces economic growth,

increases income inequality, and reduces governance capacity (Chetwynd E, Chetwynd F &Spector,2003).

Several researchers mention that policies of government differ the degree of poverty that the countries have, as well as the other variables. Thus, priority should be given to win-win policies, such as price and demand stability, land reform, agricultural productivity growth, and public education (Schmidt,2005). According to Schmidt, the policies made by the government are the ones that have the most significant impact on reducing poverty.

Furthermore, remittance that is usually understood as the money or goods that migrants send back to families and friends in origin countries are often the most direct and well-known link between migration and development (IMF, 2009)

It has been one variable studied in the analysis of poverty. Before 2011, researchers believed that remittance tends to worsen income inequality and eventually raise (Lipton 1980). However, the last study revealed that remittances contributed to reducing poverty as manifested by the negative relationship of remittances, countries in the highest poverty quantile, and the poorest among the developing countries that may need remittances to increase household consumption (Serino & Donghun, 2011). They measured poverty using: the headcount ratio, the poverty gap ratio, and the squared poverty gap. Moreover, the variables used for the analysis were: index of income inequality, GDP, the total amount of remittances that flow

through banks and foreign direct investment, and official aid. In this way, the countries government might replant their policies to help the attraction of a higher inflow in remittances and decrease poverty. Conversely, The Economic Commission for Latin America and the Caribbean (ECLAC), declared that the estimates of the analysis of poverty hinted that the remittance does not seem to contribute to a substantial decrease in poverty at the aggregate level, partly because a significant part of remittances is captured by the richest quintiles of the income distribution.

The United Nations Population Fund (UNFPA) mentions three commonly used methods to determine the degree of poverty understood as insufficient income:

the construction of a poverty line and the calculation of various measurements that consider the real expenses of the households in relation the poverty limit; the construction of a poverty index using a set of qualitative and quantitative indicators and the rapid evaluation and participatory diagnosis in which community members categorize households by their level of wealth. (Lopez, 2007)

Consequently, adequate active and passive policies of employment are needed to create stable and quality jobs that give. As a result, wages that satisfy the standards of life. Ensure jobs with optimal wages, adjusted to inflation rate, allow the access and permanence in the educational system followed by a professional and technological training that responds to the needs of a productive system. (Neffa,2005). The unemployment rate is relevant to mention, and there is strong

evidence that unemployment increases the risk of poverty and contributes to inequality. It gives rise to a series of debilitating social effects on unemployed people themselves, their families, and the communities in which they live. (Saunders,2002)

1.3 Methods used to analyse poverty

There are many works with different methods to analyse this topic, following we will mention some:

Layte, Maitre, Nolan & Whelan (2000) apply the regression with ordinary least squares (OLS) to explain deprivation in twelve countries of the European Union. They moved from general to specific showing the relative impact of hierarchy analysis in a comparative way.

Cardona, Gonzalez, Rivera & Cardenas (2013) analysed the poverty with the regression model with the variables: percentage of poverty, extreme poverty, and the coefficient of Gini. In the same way, Poza & Fernandez (2011), in the article "What factors explain multidimensional poverty in Spain? An approximation through the structural equation models." elaborate a structural equation model, linear and logistic regression, sustaining that the level of education and employment seem to be the most determining constructs. Specifically, the level of formation and healthy state, crucially influence on multidimensional poverty.

Asselin (2002) made a composite indicator of multidimensional poverty for Vietnam with data of Living Standard Survey of the same country considering as indicators economy, infrastructure, education, health, and agriculture.

Zahoor A, Zainab. (2011) made classification of households concerning poverty by using cluster analysis. The variables they used were: household income, family size, sex ratio, household education, dependency ratio. The analysis was made with data obtained from the Pakistan Social and Living Standard Measurement Survey.

Moreover, Luzzi (2008) applied the cluster analysis to analyze poverty in Switzerland, choosing different variables like access to public goods, health, and education. His work is interested in a more descriptive approach to multidimensional poverty.

Siddhisena (2006) made the study of poverty of Sri Lanka, applying it into sixteen regions of the country and utilizing the factor analysis for the calculations and six indicators in which the Gini index had more weight than the others. The objectives of the study were: identification of the poor by using a broader definition of poverty; measurement of regional differences on poverty using the poverty indices and constructed poverty lines; and development of a Composite Indicator of Multidimensional Poverty to identify poverty by severity and also to examine regional disparities of poverty.

To conclude, it has been done much research on the analysis and measurement of poverty, which has taken into account different variables of methods. All of them help us to make a more accurate analysis by comparing them and selecting the best of each.

Chapter 2

MULTIDIMENSIONAL PHENOMENON OF POVERTY: DATA DESCRIPTION

Latin America is a group of countries that includes all the Spanish and Portuguese speaking nations, located in the South of the United States. The countries share significant similarities because they were colonized either by Spain or Portugal. Latin America consists of 20 countries with a total population of 642,216,682. (World Bank, 2018). The states are Argentina, Bolivia, Brasil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua, Panamá, Paraguay, Perú, Puerto Rico, Uruguay y Venezuela. In this work, Cuba is not considered due to the lack of data, and the available information is not sufficient for developing a complete analysis like with the other countries.

The region comprises more than twenty million square kilometers of surface, which correspond to approximately 13.5% of the planet's emerged surface. Due to its extension, Latin America presents a vast geographic and biological diversity. The largest cities in Latin America are Mexico City, in Mexico. Sao Paulo in Brazil and Buenos Aires in Argentina.

The study was made for three years, 2000, 2010, 2018, to see the evolution of the economy and development of each country. In this way, we have a big picture of

the poverty and all the variables that influence it. The year 2018 was taken because it is the most recent year that we can find accurate information.

The variable selected in this work are seven and are the following: Poverty, GDP per capita, social spending, literacy, Gini Index, unemployment, and corruption perception.[1]

2.1 Poverty:

Poverty, as the previous chapter mentioned, is well defined by the Organization for Economic Co-operation and Development (OECD) as "the deprivation of common necessities that determine the quality of life." Therefore, we can say that poverty is a multidimensional concept. It is not just measured by the income of the country; more indicators affect it, including economic, social, and political elements.

According to the most recent estimates of the World Bank analysis, in 2015, 10 percent of the world's population or 734 million people lived on less than $1.90 a day.

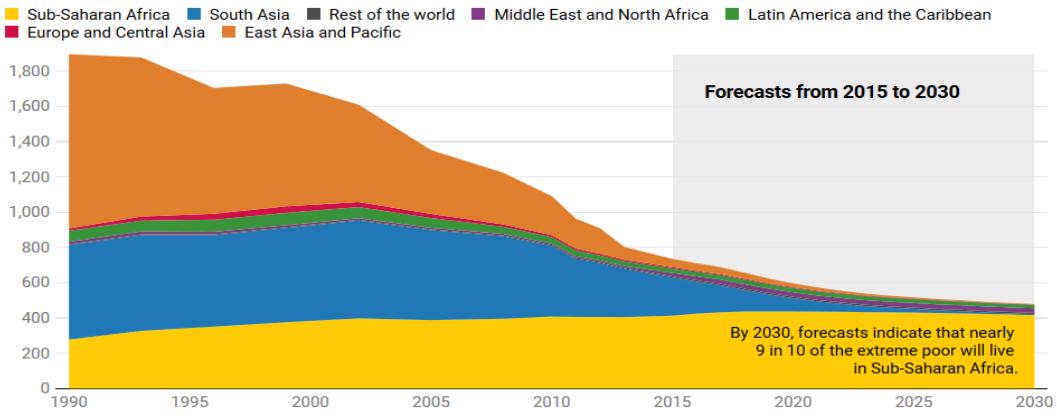
This analysis reveals that access to education, health, electricity, clean water, and other critical services remains elusive for many people, often determined by socioeconomic status, gender, ethnicity, and geography. The multidimensional

[1] Table A2, A3 and A4 in the appendix collect the information about the data of all the variables presented

vision - which includes other aspects such as education, access to essential services, health care, and security - places us in a world where poverty is a much broader and more entrenched problem.

Before poverty was measure only based on the income, but like as we mentioned, now the World Bank measures poverty in multiple and simultaneous ways with the MPI. Most of the people living below the poverty line live in South Asia and sub-Saharan Africa. According to Poverty and Shared Prosperity of the World Bank in 2015, Sub-Saharan Africa was home to 27 of the world's 28 poorest countries and had more extremely poor people than in the rest of the world combined, the factors behind the higher levels of poverty in Africa include the region's slower growth rates, problems caused by conflict and weak institutions, and a lack of success in channeling growth into poverty reduction.

Figure 3 People in extreme poverty by continents (by millions)



Source: World Bank Povcal Net and Poverty & Equity Data Portal

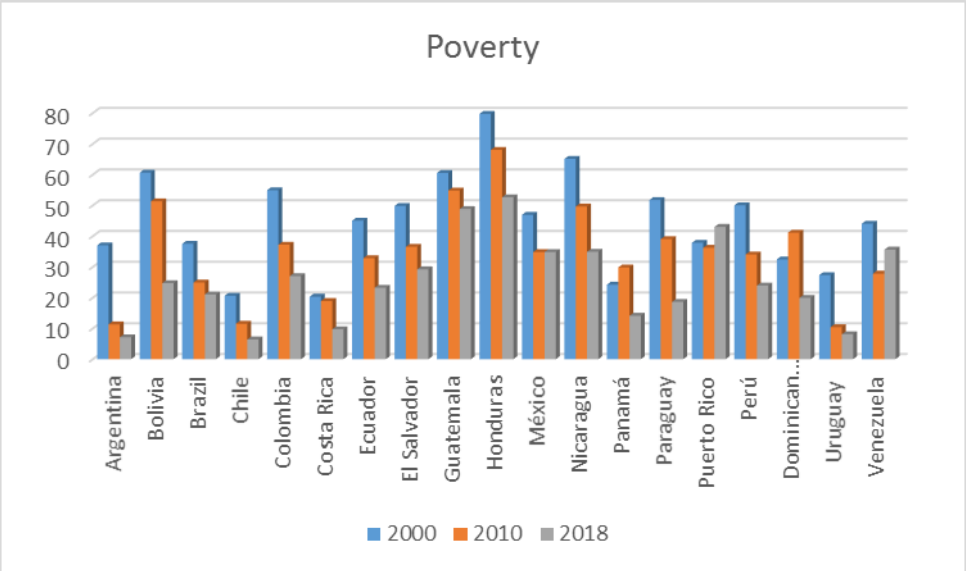
However, poverty in Latin America is also measured in very high numbers. According to the ECLAC 30, 2% of the Latin Americans are poor, and 10,2% are extremely poor.

This fact has significant consequences for the region, among which the following stand out:

- Violence
- Low life expectancy
- Malnutrition
- Illiteracy
- Underemployment
- Marginalization

Likewise, poverty and underdevelopment directly affects children, promoting child labor, and then the school dropout. For sure, there are many consequences, but in this chapter, we are going to see the real data that poverty and the other variables have. Consecutively, we will show the influence of the different variables have on poverty and how these can affect positively or negatively to the dependent variable. All the data of poverty was collected from the World Bank. The poverty rate taken in this analysis considers the people poor and extreme poor.

Figure 4 Poverty rate in 2000, 2010 and 2018



Own elaboration - Source: World Bank (200,2010, 2018)

Figure 4 shows the poverty rate that display the number of people that live below the poverty line. It is measured in percentages. It shows how poverty decreases from 2000 to 2018, in almost all the cases. In Mexico, it stays constant in 2010 and 2018 with 34.8%, Panama had an increase in 2010 but a decrease in 2018. Then, in Puerto Rico and Venezuela, the poverty decrease in 2010, but increased in 2018. It is important to remark that all the data was taken from the World Bank. However, Venezuela, like Cuba, has hidden data. Some informal channels said that the last three years Venezuela arrive until 60% of poverty or more, however in this work, we took the 35,6% published by the World Bank.

The tree poorest country in 2018 are: Honduras with 52.6%, Guatemala with 48.8% and Puerto Rico with 43%. The less poor countries are Chile with 6.4%, Argentina with 7.1%, and Uruguay with 8.1%. Then, the highest percentage of poverty registered was 79.7 % in Honduras in 2000. Bolivia is the country that had the highest decrease from 2000 until 2018, reducing 35.9 %, from 60.6 to 24.7 %.

Table 1 Descriptive statistics of poverty rate in Latin America

Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	44.49	45	20.3	79.7	15.92
2010	34.2	34.8	10.4	68	15.23
2018	25.4	23.9	6.4	52.6	13.68

Own elaboration. Source World Bank (200,2010, 2018)

The descriptive statistics for each variable were made by the program Gretel, with the function "summary statistics." It shows that the mean of 2000 was 44.48%. In 2010 it was 34.2% and, in 2018, was 25.4 %. That means that the poverty decrease in averages in 19.08 percentage points.

The minimum poverty rate registered was in Chile in 2000 with 20.3% and in 2018 with 6.4%. Then, Uruguay had the lowest percentage in 2010 with 10.4%. On the other hand, the maximum poverty rates were in Honduras the three years, with 79.7%, 68%, and 52.6%, respectively.

2.2 GDP per capita

Gross domestic product (GDP) is an indicator of the economy of a country or region that reflects the monetary value of all final goods and services produced in a period, usually one year.

The World Bank defined the GDP as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.

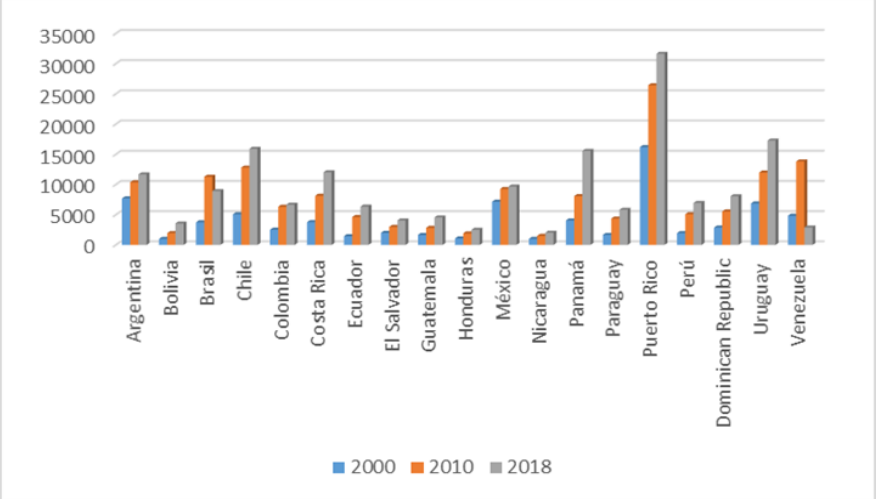
Therefore, GDP per capita is an economic indicator. It measures the relationship between the level of income of a country and its number of people. It is calculated by: GDP per capita = GDP / number of the population. It is an indicator of economic performance and a useful unit to make cross-country comparisons of average living standards and economic wellbeing. For the World Bank and the International Monetary Fund (IMF), this indicator is essential for determining interest rates on loans.

It is necessary to mention that although GDP per capita shows the level of annual wealth per inhabitant within a country, it is an average and, as such, is not a specific indicator to measure wellbeing. A high number of GDP per capita does not necessarily imply an equitable distribution of wealth or coverage of basic needs. Nevertheless, it is a good indicator to measure the growth of the income of a population.

The GDP per capita can be expressed in current US dollars or can be adjusted with a conversion factor, which is known as the Purchasing Parity Power (PPP). In this case is used the GDP per capita expressed in current US dollars.

According to the IMF, the growth of GDP per capita in Latin America is slow. In 2018 it registered a 1.2% growth. The slow growth can be due to many explanations, for example: The lack of investment, the slow increase in productivity, unfavorable business climate, the low quality of infrastructure and education, substantial uncertainty of economic policies, social tension, and many more. Following, we can see how is the trend of GDP per capita in the 19 countries studied and how they increase or decrease during the years.

Figure 5 GDP per capita in 2000, 2010 and 2018 (US dollars)



Own elaboration Source: World Bank (200,2010, 2018)

In Figure 5, we can see that Puerto Rico, a particular case, has the highest GDP per capita that achieves until 31651.34 US dollars in 2018. However, it is not considered one of the wealthiest countries of the region for its living conditions. Puerto Rico is a clear example of what we were mentioning above that GDP is not directly connected with wellbeing.

After Puerto Rico, the countries with the highest GDP per capita in this region, are; Uruguay with 17277.97 US dollars, Chile with 15923.35 US dollars, Panama with 15575.07 US dollars. Consecutively, the poorest are; Nicaragua, with 2028.89 US dollars, Honduras with 2500.1 US dollars, and Bolivia with 3548.5 US dollars (World Bank,2018).

Table 2 Descriptive statistics of GDP per capita in Latin America

Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	4033.1	2869.1	997.58	16192	3637.9
2010	7860.8	6326.5	1503.9	26436	5964.6
2018	10638	8050.6	2028.9	31651	8255.0

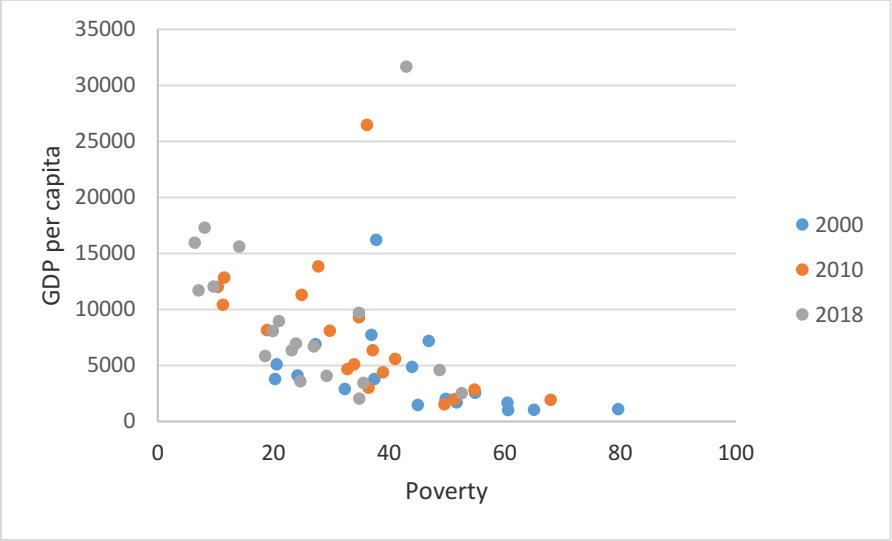
Own elaboration Source: World Bank (200,2010, 2018)

The main descriptive statistics of each variable have been elaborated in the program, Gretel with the function "summary statistics" In America Latina, the levels of GDP per capita reached a mean of 10638 US dollars in 2018, and it had

an increase of 2777.2 US dollars from 2010. From 2000 to 2010, it had an increase of 3827.7 US dollars. We cannot conclude that in the first decade, it had higher growth because we are taking into consideration just until 2018, which is the most recent year with data available. However, this comparison makes us to have a big idea of the evolution of the GDP per capita.

The country that registered the highest number in the three years is Puerto Rico. The case of Puerto Rico is a particular case because it has the highest GDP per capita with 31651.34 $ but is not considered one of the wealthiest countries of the region for the living conditions of the people that live there. The standard deviation is really high, and this means that the data is widely spread, this can be for the value of Puerto Rico.

Figure 6 GDP per capita and poverty in 2000, 2010 and 2018



Own elaboration. Source: World Bank (2000, 2010, 2018)

Figure 6 shows a high dispersion of data for the years 2000, 2010 and 2018, but not a significant difference between each year. GDP per capita does not have a direct relationship with poverty. The only fact that we can say is that the most impoverished country also has the lowest GDP per capita, and it is the case of Honduras. Then we can see that the country with more GDP has high poverty, and the less poor has an average GDP per capita.

2.3 Social Spending

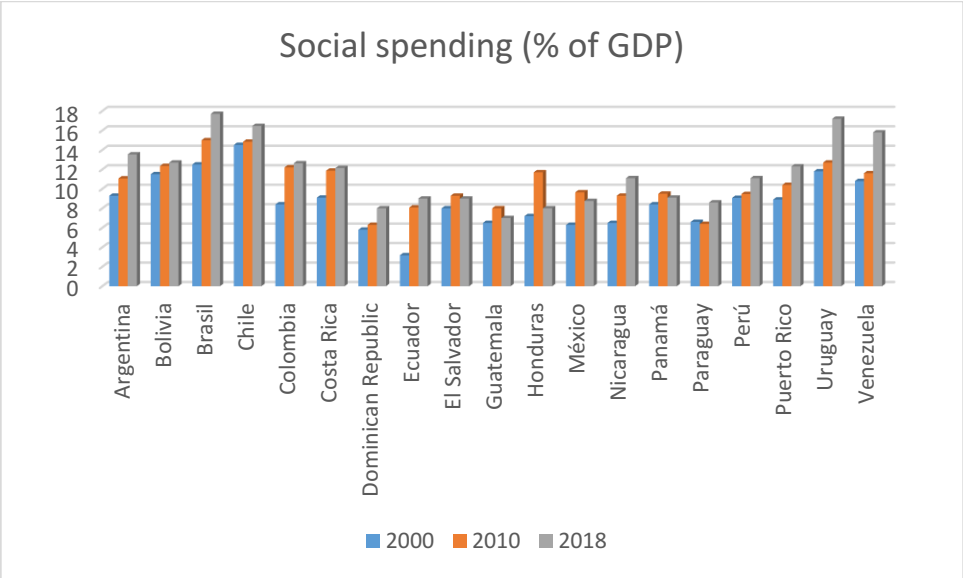
According to the OCDE, social spending is defined as "the provision of benefits and financial contributions to individuals, by public and private institutions." It should be noted that the OECD emphasizes that the financing of social spending is not exclusively public, but that the private sector can participate. However, in this analysis, we will take into account only the public sector.

The United Nations Development Program (UNDP) defines social spending in two ways. "Social spending is a subset of public spending that groups together certain resources that the state directly allocates to attend to the development and wellbeing of its population." Then they defined as "social spending is a tool to reduce poverty, increase the standard of living, and generally improve human development." (UNDP,2003).

ECLAC uses the social spending motion of the ONU, which involves concepts associated with social sectors; education and culture, protection and social welfare, housing and urban development, work, health, and sanitation.

Social spending can be in dollars or measure as a percentage of the GDP. In this case, we took as a percentage of the GDP. All the data was collected from CEPALSTAT that is the databases of Economic Commission for Latin America and the Caribbean (ECLAC)

Figure 7 Social spending in 2000, 2010 and 2018



Own elaboration. Source: ECLAC (200,2010, 2018)

The data presented in figure 7 shows that in Latin America, the proportion of resources intended for the social remains lower in countries that have a lower level

of wealth and higher levels of poverty and vulnerability, as well as more outstanding deficiencies in various areas of social development.

Just five countries registered an increase in social spending from 2010 to 2018. These countries are: Honduras had the highest reduction from 11.7% to 8%, El Salvador reducing from 9.3% to 8%, Guatemala from 8% to 7%, Mexico from 9.64% to 8.75%, and finally, Panama 9.5% to 9.1%. The rest of the countries increased social spending. Uruguay was the country that increase more from 11.8% to 17.2%.

Table 3 Descriptive statistics of social spending in Latin America

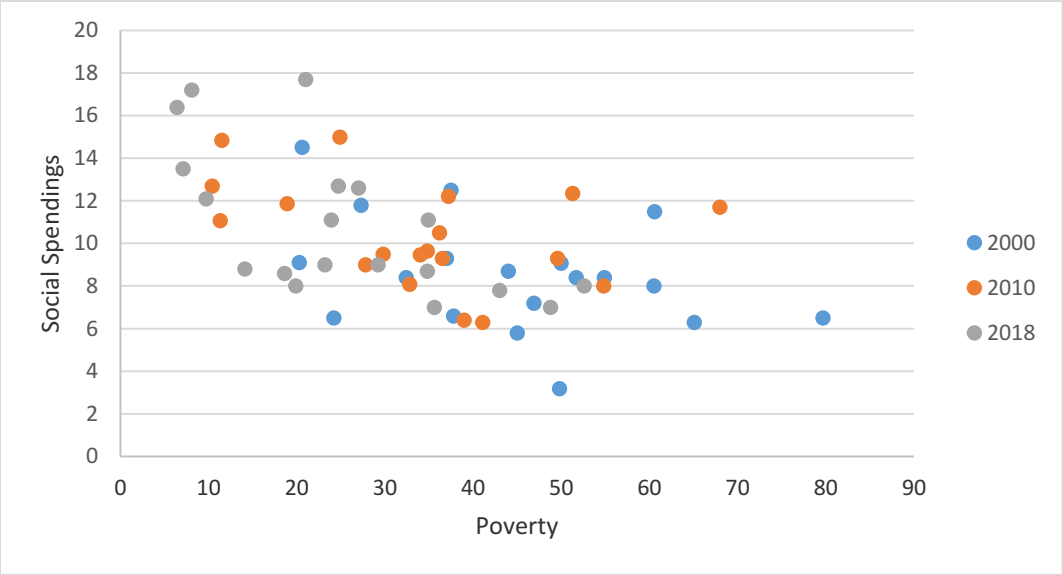
Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	8.51	8.40	3.18	14.51	2.66
2010	10.38	9.64	6.30	14.99	2.45
2018	10.86	9.00	7.00	17.71	3.41

Own elaboration. Source: ECLAC (200,2010, 2018)

The main descriptive statistics of social spending have been elaborated in the program, Gretel, with the function "summary statistics." It shows the average of the social spending, 8.5% in 200, 10.38% in 2010 and, 10.86% in 2018. We can see that from 2010 to 2018 were just a small increase. Ecuador registered the minimum percentage in 2000 with 3.38%. Ecuador in 2000 with 6.30% and, in 2018,

Guatemala with 7%. The maximum values of the three years are from Chile, 14.51%, 14.99% and, 17.71%, respectively. The standard deviation shows that the data is not widely spread. In the years 2000 and 2010, the distribution is approximately symmetric.

Figure 8 Social Spending and poverty in 2000,2010 and 2018



Own elaboration. Source: ECLAC and World bank (2000,2010,2018)

Figure 8 shows that there is a negative correlation. As social spending increases, poverty decreases. Chile and Uruguay have the lowest poverty and register the highest social spending (6.4,16.4) and (8.1,17.2), respectively. On the other hand, we have Honduras (52.6,8) not with the lowest social income but is one of the lowest.

2.4 Literacy

United Nations Educational, Scientific, and Cultural Organization define literacy as:

> Ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and broader society". (UNESCO, 2014)

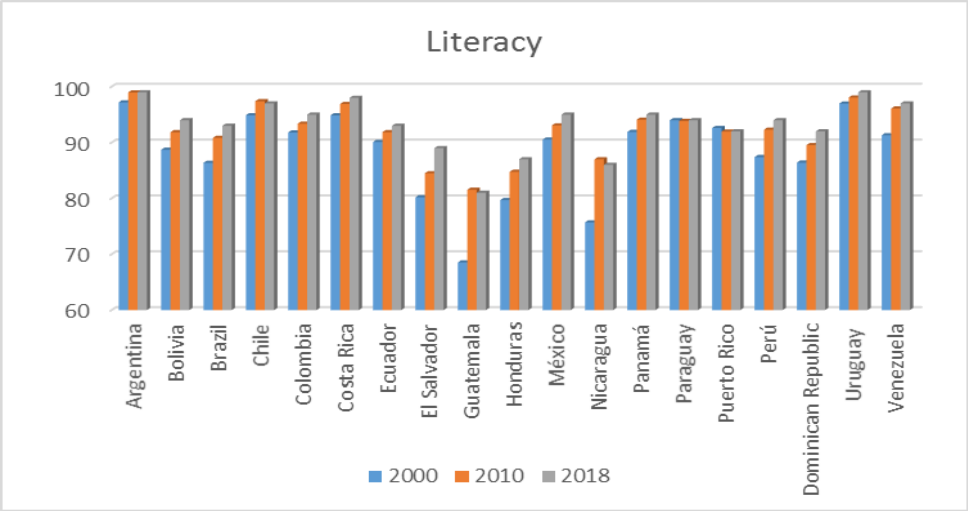
As a result of UNESCO's work, we can find a long list of international documents that have been generated to establish that education is a human right. It is related to children, adults, and women. It is necessary to ensure that everyone receives basic training that allows them to progress. Also, it is essential to mention, the most significant part of countries in Latin America have a democratic system of government. Consequently, democracy cannot be 100 percent effective if a large part of the population does not have access to the written language

Lack of reading ability is closely associated with poverty, both in the economic sense and in its broadest sense, which involves deprivation of possibilities. Reading strengthens the capacity of individuals, families, and communities to meet their needs for health, education, political participation, economy, culture, and services.

The current adult literacy rate worldwide stands at 86%, reaching 91% among young people, according to UNESCO data from 2016. In Latin America, the average is 93%, the share of people aged 15 or older who could read and write in this region around seven percentage points higher than the worldwide average. Literacy rates in Latin America and the Caribbean have been slightly improving in all three age groups since 2000. However, of the 630 million people living in Latin America and the Caribbean, 32 million are illiterate. It represents 4% of the illiterate in the world, according to the latest report from the UNESCO Institute for Statistics.

Literacy can be analyzed taking consideration the following groups: literacy rate adult total (% of people ages 15 and above), adult female/ male (% of female/ male ages 15 and above), youth female or youth male (% of female/male ages 15-24), youth total (% of people ages 15. 24). In this work, we chose the literacy rate adult total (% of people ages 15 and above) because, in this category, all the other are included.

Figure 9 Literacy rate in 2000, 2010 and 2018 (% of people ages 15 and above)



Own elaboration. Source: Work Bank (200,2010, 2018)

In almost all the countries, we can see an increase of literacy just Nicaragua had a small decrease from 87% to 86% and Guatemala from 81.76% to 81%. Then, it is interesting to mention that again, Argentina and Chile registered the highest percentages, 99%, and the lowest Guatemala in the three years with the highest value of 89% in 2018. Nonetheless, Guatemala registered the highest increase from 2000 to 2018 of 12.47 percentage points

Table 4 Descriptive statistics of Literacy

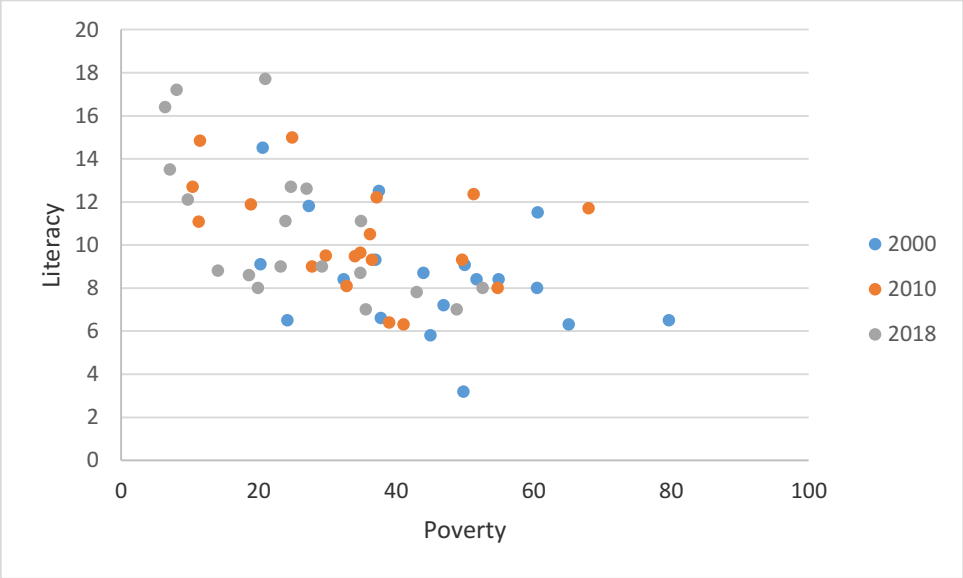
Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	88.38	90.54	68.53	97.19	7.5711
2010	91.99	92.3	81.54	98.96	4.8121
2018	93.16	94	81	99	4.6579

Own elaboration. Source: World Bank (200,2010, 2018)

The main descriptive statistics of literacy has been elaborated in the program, Gretel, with the function "summary statistics." It shows that the mean increase from 2000 (88.37%) to 2018 (93.15%). The minimum values registered in the three years are from Guatemala, having the lowest 81% in 2018. Then, the maximum values are of Argentina having the highest percentage of literacy with Uruguay 99% in 2018.

The standard deviation shows that it is not widely spread. In 2000 and 2010, the distribution has high skewed, and in 2010 the distribution is moderately skewed. Moreover, it seems to have a normal distribution.

Figure 10 Literacy and Poverty in 2000,2010 and 2018



Own elaboration. Source: World Bank (200,2010, 2018)

We can see that poverty and literacy have a small but clear negative correlation. If the literacy increases, the poverty is lower, on the other hand, if the literacy decreases, the poverty will increase. In 2018, Argentina had 99% of literacy and 7.1% of poverty, and in the other extreme Guatemala, 48.8% of poverty and 81% of literacy.

2.5 Gini Index

An inequality index is a measure that summarizes the way a variable is distributed among a set of people. Regarding economic inequality, said measurement is related to the income (or expense) of families or individuals (ECLAC, 2001)

The Gini index (or its graphical parallel the Lorentz curve) measures the degree of concentration that a variable presents. Then, what is meant by concentration must be defined. Gini clarifies this concept in the following way:

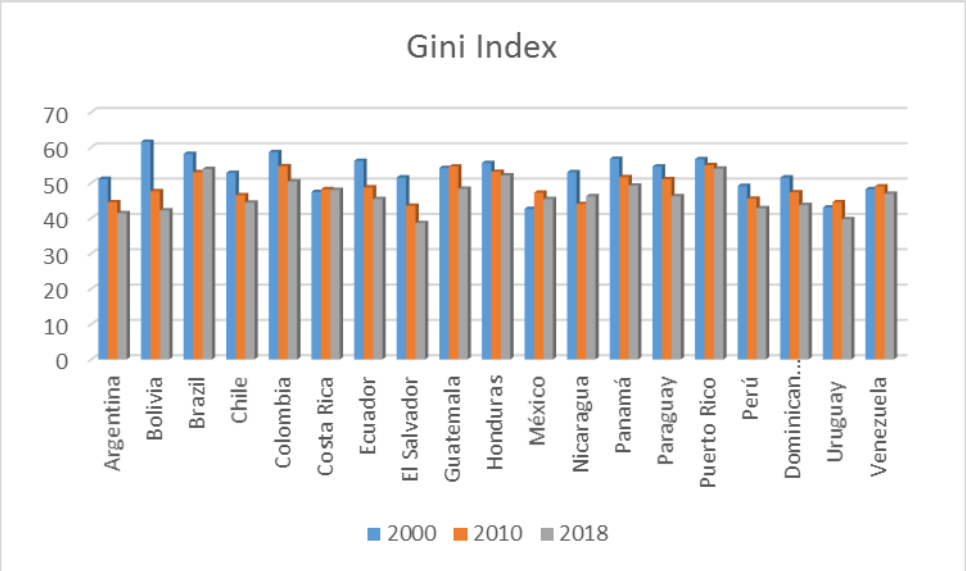
> "It is said that the wealth of a country is the more concentrated, the greater the part of the total wealth owned by the richest part of the population. We can also say that the concentration of wealth is the greater, the less the part of is owned by the poorest sector of that population" (Ruiz, 1978)

So, as Lusting affirms, the Gini coefficient is one of the most used inequality indicators and that the closer to zero (one), the more equal (unequal) is the distribution of the analyzed variable (Lustig, 2020)

According to Fernando Medina, the Gini coefficient is defined as the quotient of the differences between the equidistribution line and the values of the Lorenz curve. There are several ways to derive the Gini index algebraically, and one of them shows that it is precisely equal to half the relative mean difference (DMR), which is defined as the arithmetic mean of the absolute differences between all income pairs. (Medina, 2001).

The Gini index was developed by the Italian statistician Corrado Gini in 1912. The coefficient ranges from 0 to 100, 0 represents perfect equality, while an index of 100 implies perfect inequality.

Figure 11 Gini Index in 2000,2010 and 2018



Own elaboration. Source: World Bank (200,2010, 2018)

Just in Brazil, the Gini index increased, but in 0,9 percentage points. Then Costa Rica stays constant with 48 %. Even if Mexico and Guatemala increase in 2010, they decreased in 2018. One more time, Bolivia is the country that had the most significant decrease, from 61.6% to 42.2. It reduces 19 percentage points and also was the country that decrease more in poverty. We have to say that the Gini index in Latin America, even after the eighteen years, it continues high comparing to other regions of the world.

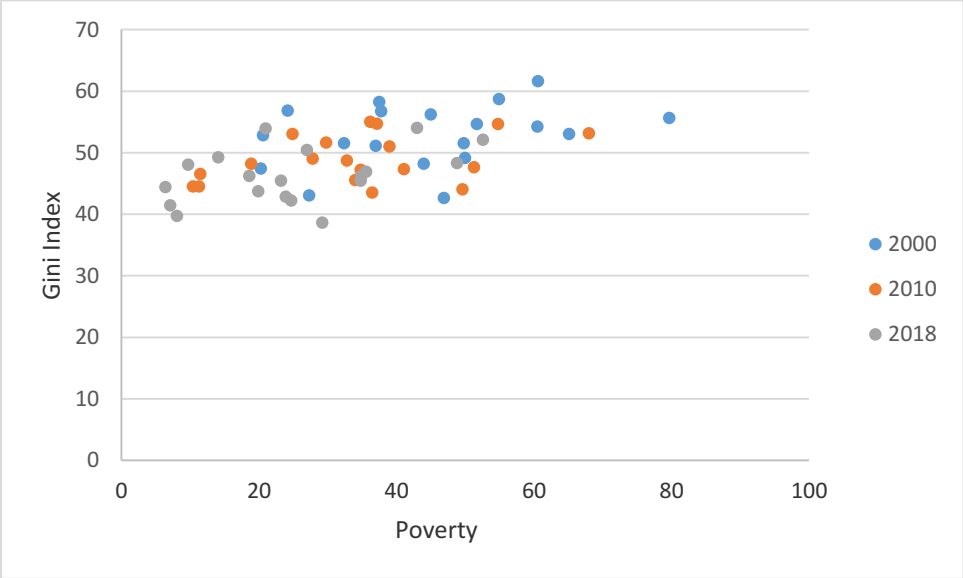
Table 5 Descriptive statistics of the Gini Index

Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	52.78	53	42.6	61.6	5.10
2010	48.92	48.2	43.5	55	3.85
2018	46.25	46.2	38.6	54	4.42

Own elaboration. Source: ECLAC(200,2010, 2018)

The main descriptive statistics of the Gini index has been elaborated in the program, Gretel, with the function "summary statistics." It shows that the mean reduces from 52.78% to 46.25%. It means that it had a reduction of 6.53 percentage points. El Salvador, in 2018, registered the minimum value of 38.6%. The maximum value was registered in 200 by Bolivia, with 61.6%. In 2018, Puerto Rico had a maximum value of 54%. Moreover, in 2000 the distribution is highly skewed. In 2010 and 2018, the distribution is moderately skewed; however, it has a normal distribution.

Figure 12 Gini index and poverty in 2000,2010 and 2018



Own elaboration. Source: World Bank (200,2010, 2018)

We can see that poverty and the Gini index have a negative correlation. Again, the two countries Argentina and Uruguay that have the lowest poverty rate have the lowest Gini index 7.1;41.4% and 8.1;39.7, respectively. Therefore, Honduras registered 52.6% of the poverty rate and 52.1% on the Gini Index.

2.6 Unemployment

Unemployment occurs when the supply of work by peoples that are economically active age is higher than the demand for work by companies.

In other words, when more people are willing to offer their work to companies than available jobs, an unemployment situation arises.

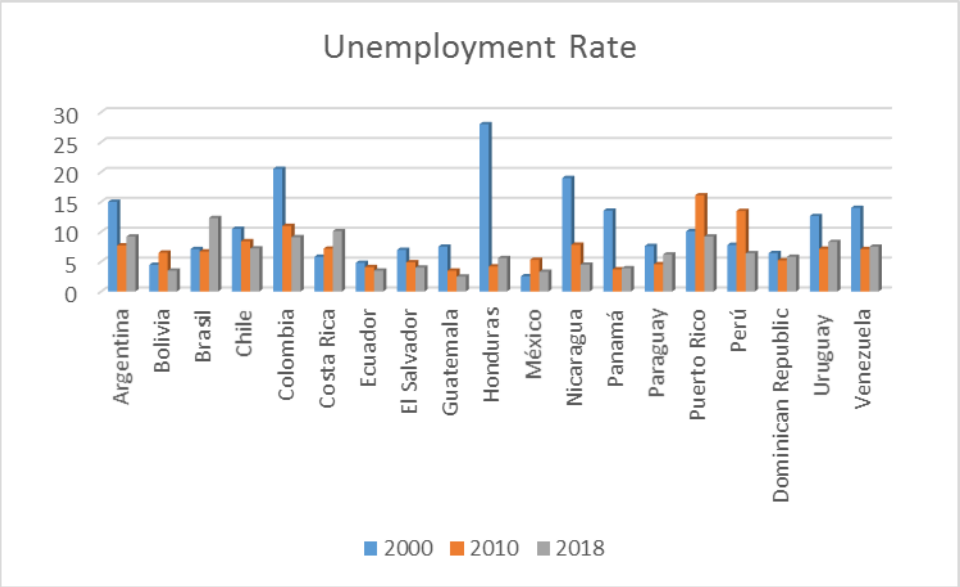
In order to calculate the unemployment rate of a place or region, it is necessary to consider those people who are in the working-age (between 16 and 65 years old) and are actively searching for work but cannot find employment, that is, what is known as the working population.

When a country has a high unemployment rate is a serious problem because it directly affects economic growth, in addition to the problem for unemployed people. Thus, the effects of unemployment can be economic, such as a decrease in real production, a decrease in demand and an increase in the public deficit.

The phenomenon of unemployment is increasing in the case of developing countries, such as in Latin America, where the labor markets are going through a moment of uncertainty reflected in a slight rise in the local unemployment rate and signs of precariousness that could worsen in 2020.

The opportunities to access decent and productive employment, with fair wages, social inclusion, social protection, and labor rights, are essential to respond to social demands to guarantee that the benefits of growth reach everyone and to guarantee governance.

Figure 13 Unemployment rate in 2000,2010 and 2018 (%)



Own elaboration. Source: ECLAC (200,2010, 2018)

Figure N°10 shows that the unemployment rate decrease in all Latin America. In some countries like Puerto Rico, Peru and Bolivia increased in 2010 but then decreased like all the rest countries. Honduras made the most noticeable change by reducing 22.4 percentage points from 28 to 5.6% in 2018. As well as, Colombia, that reduced 11.42 percentage points, from 20.52% to 9.1% and Nicaragua from 19% to 4.5% in 2018.

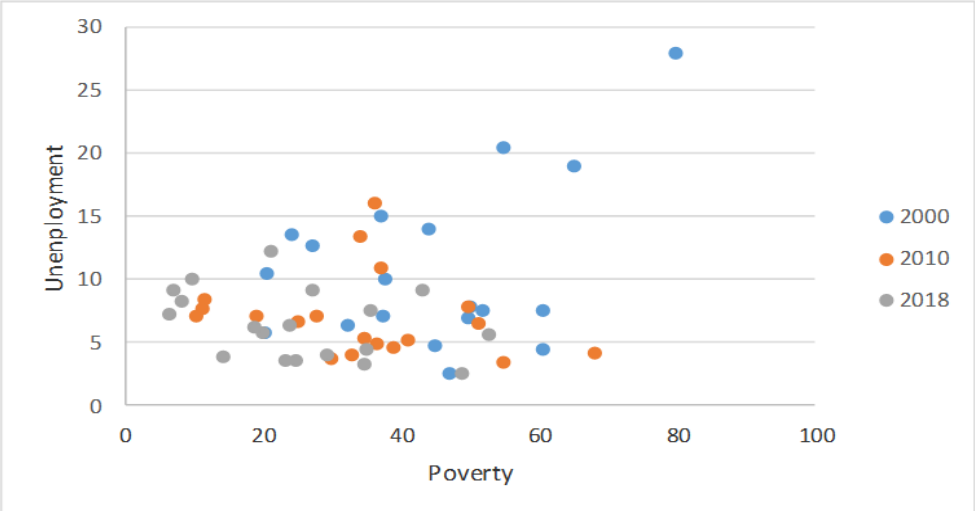
Table 6 Descriptive statistics of unemployment

Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	10.75	7.8	2.56	28	5.10
2010	7.084	6.7	3.49	16.1	3.33
2018	6.426	6.2	2.5	12.3	2.74

Own elaboration. Source: ECLAC (200,2010, 2018)

The mean of the employment reduced from 10.75% to 6.42%. The minimum percentage registered in 2000 was in Mexico, with 2.56%. Then, in 2010 was higher, with 3.49% in Mexico and 2.5 in 2018 in Guatemala again. The highest value registered was in 2010, with a 16% unemployment rate in Puerto Rico. The standard deviation shows that the data is spread but nor widely.

Figure 14 Unemployment and Poverty 2000, 2010, 2018



Source: World Bank (200,2010, 2018)

Figure 11 shows that there is not a high correlation between poverty and unemployment because the data is spread. Nevertheless, we can see a downhill from left to right that indicates a small negative relationship. If unemployment is higher, the poverty is going to be lower.

2.7 Corruption Perception

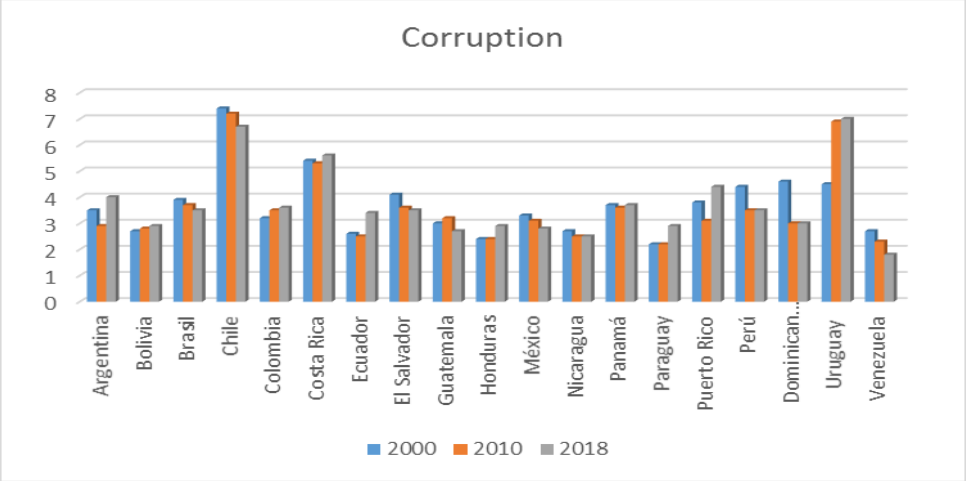
One of the biggest problems a country can have is the corruption. It distracts an enormous amount of public resources, notably worsens the country's services and impairs democratic legitimacy, if it exists. Corruption is a global phenomenon, regardless of whether a country is poor or rich, if it is located in the South or the North, if there is one dominant religion or another, in short, unfortunately, it is a universal phenomenon. Latin America is no exception. On the contrary, the perception of corruption that we measure from Transparency International every year through the Corruption Perception Index (CPI) shows us how the region, along with Africa, is one of the most affected.

According to the data collected by the Corruption Perceptions Index, prepared every year by Transparency International, the situation in the Latin American and Caribbean region is not optimistic. Except for a small group of countries, such as Uruguay, Chile or Costa Rica, the situation in the other countries does not invite us to think that their systems and those who participate in it do so cleanly and responsibly.

Besides, it also covers a multitude of issues: from the large-scale distraction of money or public resources to small non-payments of taxes, favoritism in the public sector, and a long etcetera. Furthermore, it often converges with other issues of enormous importance, such as crime or organized crime groups, the case of the "maras," or the Mexican cartels.

Only three Latin countries -Uruguay, Chile, and Costa Rica- exceed half the score, with 71, 67 and 56 respectively. The data was collected from Transparency International, the global coalition against corruption. The CPI scores countries and territories based on how corrupt a country's public sector is perceived. Until 2011 they used the scale 1 - 10, making one the highest corruption and ten the lowest. However, after 2012 they changed to scale from 1- 100, making one the highest corruption and 100 the lowest.

Figure 15 Corruption Perception Rate in 2000,2010 and 2018



Own elaboration. Source: Transparency International (200,2010, 2018)

In 10 countries, the corruption perception increase, but in this case, is a positive thing, Higher the corruption perception percentage, lower is the corruption in the country. Nevertheless, unfortunately, it is the variable that has less positive changes. We have the rest nine countries that registered an increase in this indicator. For example, Argentina and Puerto Rico had the most significant increase. On the other hand, the countries that have more corruption are: Honduras, Nicaragua, Venezuela, and Bolivia. Uruguay and Chile had the highest percentage of corruption perception that is positive for their countries.

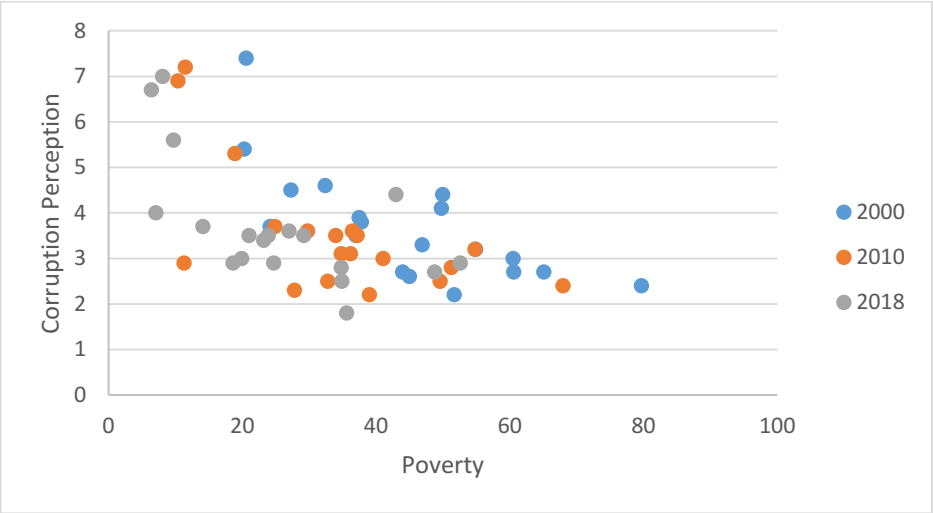
Table 7 Descriptive statistics of the corruption perception

Year	Mean	Median	Minimum	Maximum	Std. Dev
2000	3.69	3.5	2.2	7.4	1.24
2010	3.54	3.1	2.2	7.2	1.42
2018	37.05	35	18	70	13.65

Own elaboration. Source: Transparency International (200,2010, 2018)

The corruption perception increases on average, in a small proportion, from 36.9% to 37%. In 200 and 2010, the transparency International have just different nomenclature, but the meaning was the same. The minimum value was in 2018 is Venezuela, which means that it has more corruption than other countries. The higher value is 7.4 registered in Chile, the year 2000. The distribution for the three years is highly skewed and has a normal distribution.

Figure 16 Corruption and poverty



Own elaboration. Source: Transparency International (2000,2010,2018)

We can see a negative correlation relationship, when the corruption perception is increasing, (100 means no corruption and one corrupted country), the poverty will be lower. Diversely, when the poverty rate is higher, the corruption perception is lower.

Chapter 3

A CLUSTER ANALYSIS OF POVERTY

3.1 Cluster analysis Framework

Cluster analysis aims at grouping a set of objects in such a way that the members of the same group share similarities. It is a generic name for a variety of mathematical methods that can be used to find out which objects in a set have the same or similar characteristics. Observation is assigned to groups (clusters) so that observations within each group are similar to one another concerning variables or attributes of interest, and the groups themselves stand apart from one another. In other words, the objective is to divide the observations into homogeneous and distinct groups.

It is a classification scheme that represents a convenient method for organizing large data sets so that it can be understood more efficiently and be more useless and efficient (Everitt et al., 2011). Each group provides a concise description of patterns of differences or similarities. It helps to analyze the data in a more accurate and precise way.

"Cluster analysis is the name given to a set of techniques which ask whether data can be grouped into categories based on their similarities or differences. It began when biologists started to classify plants based on their various phyla and species

and wanted to derive a less subjective technique. It has been similarly applied to diagnostic classification." (McIntosh et al., 2010)

The clusters have to satisfy two main properties:

– Inner similarity: objects belonging to the same cluster should be as much homogenous as possible

– Outer divergence: objects from different cluster should be as much heterogeneous as possible

Cluster analysis involves selecting the data, formulating a problem, selecting a distance measure, choosing a procedure, deciding the optimal number of clusters, interpreting the results, and finally, assessing the validity of clustering.

The application of cluster analysis is wide, can be used in all the areas of study, for example, in market research, data mining, pattern recognition, medicine, biology, psychiatry, economics, and more.

The methods to carry out a cluster analysis can be classified in two:

- Hierarchical methods
    - Agglomerative methods, also known as ascenders, they begin the analysis with many groups as individuals are. Groups are formed from the first units in an ascending way, until the end that happened when all

the treated cases are included in the same conglomerate. In other words, at each step, the closest pair of clusters are merged, until the set has only one cluster.

- Divisive methods, also called descending, they constitute the inverse process to the agglomerative method. They begin with a conglomerate that includes all the treated cases, from this initial group, through successive divisions, smaller and smaller groups are formed. At the end of the process, there are as many groups as cases have been treated. In other words, at each step, the cluster is split until each cluster contains a point.

- Nonhierarchical methods

  The number of clusters is specified in advance or determinate as part of the clustering process. The more popular method is known as K-means clustering methods, in which the number of clusters is specified in advance. Nonhierarchical methods can be applied to more massive data sets than hierarchical techniques (Jhonson&Wichern,2007).

In the present work, the Hierarchical agglomerative method is applied because this chapter aims to discover the optimal number of cluster that is convenient to have for this analysis. In order to make a cluster analysis with a hierarchical method, we

need to compute the matrix distance (similarities), conversely in the nonhierarchical method is not necessary to compute it.

3.1.1 Distance Matrix

The cluster analysis can be made for different variables, with different data types (interval, categorical or ordinal), and this can complicate the analysis. That is the reason why it is essential to measure the distance between observations, it defines the similarity of two elements, and it will influence the shape of the clusters.

Different types of distance measures can be used to compute a cluster analysis: Euclidean, Manhattan, Minkowski, and more. The one applied in the current work is Euclidean distance.

3.1.1.1 Minkowski distance:

Minkowski distance is a generalized metric distance. The formula derived from Pythagoras metric. Lp norms or Minkowski distance is given by:

$$L_p(x,y) = (|x_1 - y_1|^p + |x_2 - y_2|^p + \cdots + |x_d - y_d|^p)^{\frac{1}{p}} = \left(\sum_{i=1}^{d} |x_i - y_i|^p\right)^{\frac{1}{p}}$$

Where p is a positive integer

When γ is one, the Minkowski distance is equal to the Manhattan distance. When it is two, it yields the Euclidian distance between two vectors.

3.1.1.1 Euclidean distance:

It is the square root of the sum of the squares of the differences between the values of the elements. If p = 2, L2 is the Euclidean distance given by:

$$d(x,y)=\sqrt{(|x_1-y_1|^2+|x_2-y_2|^2+...+|x_d-y_d|^2)}$$

It is the most used due to the simplicity and easy understanding but has some inconvenient, the scale of measurement of the variables could represent an issue, as changing scale will affect the distance between subjects, and if a variable has more range than the rest will dominate. Frequently to do not have this problem, the solution is to normalize or standardize the variables. However, it is necessary to mention that the standardized variables tend to reduce the distance between clusters; it is the responsibility of the researcher to decide after the analysis if it is convenient to continue with standardized variables or not.

3.1.2 Hierarchical agglomerative methods.

- **Single linkage method** (Nearest neighbor method) Groups are formed from the individual entities by merging nearest neighbors, where the term nearest neighbor connotes the smallest distance or most considerable similarity (Jhonson&Wichern,2007).

In simple words, when the groups are fused according to the distances of the nearest members.

- **Complete linkage method** (Furthest neighbor method) It proceeds in the same manner as the single linkage method. However, the difference is that instead of taking the nearest items, it takes the one that has the maximum distances or minimum similarity.

- **Average method** Treats the distances between two clusters as the average distances between all pairs of items where one member of a pair belongs to each cluster(Jhonson&Wichern,2007).

- **Centroid method**: the similarity between two clusters is given by the similarity between their centroids, where a cluster's centroid is its center of mass (Romersburg, 2004).

- **Ward's method**, known as the minimum variance method. Ward's is the only one among the agglomerative clustering methods that are based on a classical sum-of-squares criterion, producing groups that minimize within-group dispersion at each binary fusion (Murtagh et al., 2014).

3.1.3 The dendrogram

The main instrument for interpreting the output of cluster analysis is the dendrogram. It is a graph used in the hierarchical procedure that allows us to

observe the grouping process of the clusters in the different steps, forming a tree diagram. The dendrogram is a valuable visual tool that can help to decide the number of groups that could better represent the structure of the data. If, in the graph, there is a significant jump in the distances between clusters, the optimum number of clusters may be the number represent just before that broad jump.

3.2 Carrying out Cluster analysis

First, according to Romersburg (2004), the following steps are the general ones to build a cluster analysis with hierarchical method:

> (1) Collect a data matrix whose columns stand for the objects to be cluster-analyzed and whose rows are the attributes that describe the objects; (2) optionally standardize the data matrix; (3) using the data matrix or the standardized data matrix, compute the values of a resemblance coefficient to measure the similarities among all pairs of objects; (4) use a clustering method to process the values of the resemblance coefficient, which results in methods to process the values of the resemblance coefficient, which results in a diagram called a tree, or dendrogram, that shows the hierarchy of similarities among all pairs of objects. (pg.3)

In this way, using the data collected from the 19 countries and the six variables mentioned in chapter two (GDP per capita, social spending, literacy, Gini index unemployment, and corruption perception), we performed the analysis in the

program R Studio. First, the data was standardized. Second, we compute the distance matrix, and the cluster analysis was made with each method and the respective dendrogram. Then, we chose the best method and decided the optimum number of clusters comparing silhouettes plots.

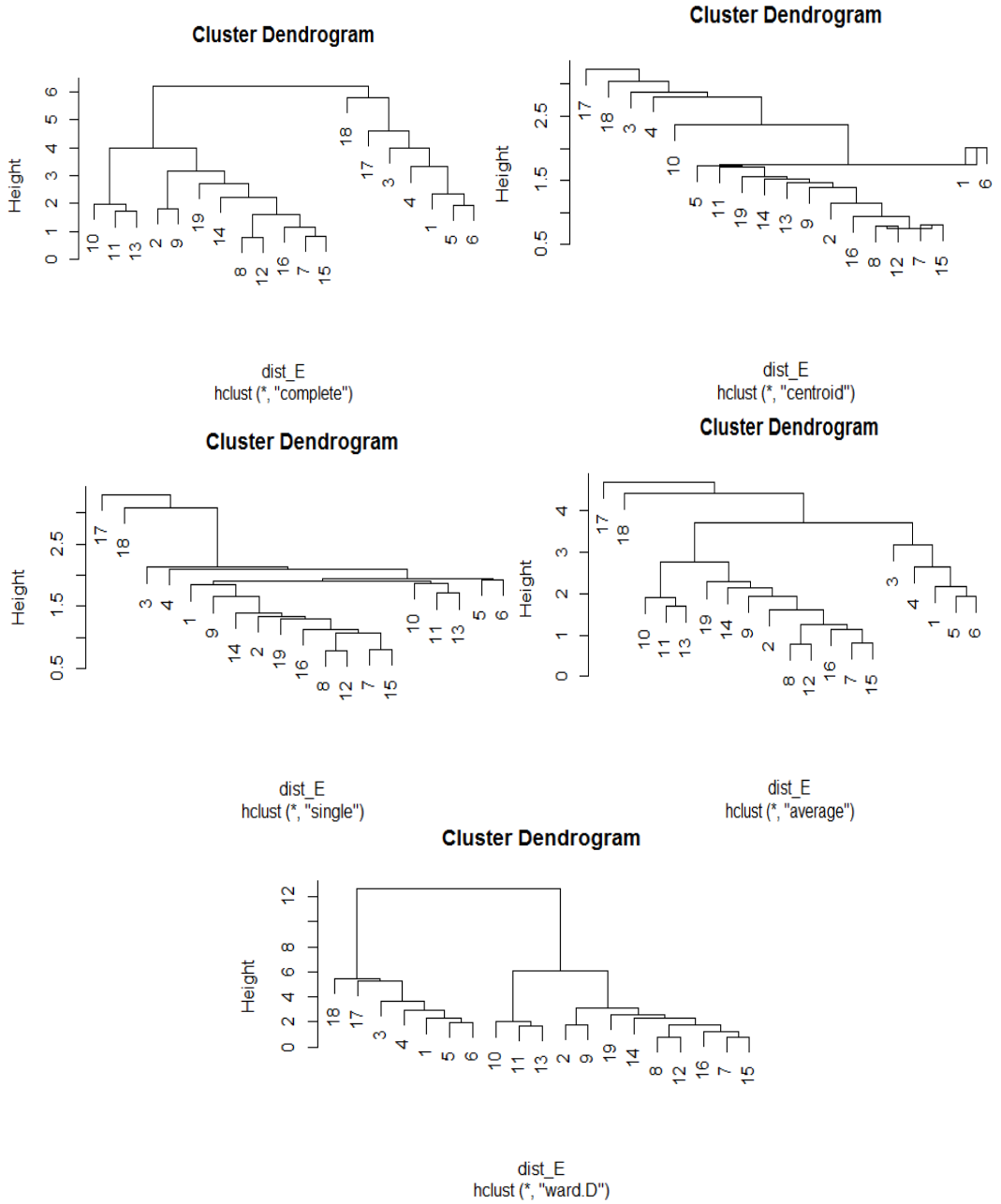
The following table represents the Euclidean distance:

Figure 17 Matrix Euclidean Distance

Country no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0.00																		
2	2.68																		
3	3.57	4.49																	
4	2.46	3.69	3.89																
5	2.33	2.84	2.11	3.18															
6	1.98	3.64	2.96	2.07	1.85														
7	2.72	1.79	4.39	3.97	2.49	3.22													
8	3.02	1.41	4.54	3.81	2.60	3.35	1.06												
9	3.37	1.80	5.36	4.28	3.67	4.16	1.62	1.80											
10	5.35	3.56	5.61	5.80	4.27	5.35	2.90	2.80	2.96										
11	4.33	3.13	4.09	4.95	2.66	3.98	2.29	2.23	3.19	1.96									
12	3.00	1.58	4.68	4.01	2.75	3.49	1.22	0.74	2.20	3.20	2.60								
13	3.87	2.06	4.29	4.63	2.94	4.20	1.92	1.87	2.10	1.86	1.71	2.31							
14	3.13	2.52	4.27	3.55	2.47	2.94	1.90	1.50	3.06	3.46	2.58	1.32	2.86						
15	2.60	1.82	3.94	3.90	1.93	2.91	0.80	1.10	2.24	3.18	2.07	1.19	2.04	1.72					
16	1.81	1.31	3.85	3.12	2.05	2.60	1.12	1.38	1.82	3.64	2.84	1.59	2.22	2.13	1.16				
17	4.37	5.15	4.22	4.39	3.55	3.41	4.03	4.27	5.28	5.06	4.09	4.17	4.85	3.08	3.94	4.24			
18	2.59	4.25	4.66	1.27	4.05	2.28	4.59	4.57	4.70	6.67	5.92	4.72	5.42	4.46	4.61	3.67	5.21		
19	3.56	4.07	4.86	4.83	3.58	3.89	3.05	3.49	4.37	4.94	4.18	2.98	4.37	2.65	3.06	3.39	2.81	5.33	0.00

Moreover, the respective dendrogram of the five methods mentioned above was made:

Figure 18 Cluster Dendrogram for Complete, Single, Average, Centroid and Ward's method



For making more understandable the dendrograms each number represent a country as the following table

Table 8 List of countries

Country	Number
Argentina	1
Bolivia	2
Brasil	3
Chile	4
Colombia	5
Costa Rica	6
Dominican Republic	7
Ecuador	8
El Salvador	9
Guatemala	10
Honduras	11
México	12
Nicaragua	13
Panamá	14
Paraguay	15
Perú	16
Puerto Rico	17
Uruguay	18
Venezuela	19

As we can see in the dendrograms, some countries are clustered together in all the methods, for example; Honduras, Guatemala and Nicaragua; Mexico and Ecuador; Dominican Republic and Ecuador; Colombia and Costa Rica. Then, Uruguay is alone and Puerto Rico as well. In the complete and Ward method are clustered Bolivia and El Salvador, then in a bigger cluster; Uruguay, Puerto Rico, Chile, Brazil, Colombia, and Costa Rica.

The following tables represent a comparison between methods. It shows the number of countries included in the clusters. Furthermore, it is interpreted by columns or rows, for example, "member.ce" refers to the centroid method, which has fifteen countries grouped in the first cluster and one in the second. On the other hand, we can see that "member. av" refers to the average method that has four countries in the first cluster and twelve in the second cluster.

Table 9 Comparison of the number of countries included in different methods

	member.ce				
member.av	1	2	3	4	5
1	3	0	1	0	0
2	12	0	0	0	0
3	0	1	0	0	0
4	0	0	0	1	0
5	0	0	0	0	1

	member.si				
member.co	1	2	3	4	5
1	3	0	1	0	0
2	12	0	0	0	0
3	0	1	0	0	0
4	0	0	0	1	0
5	0	0	0	0	1

	member.co				
member.w	1	2	3	4	5
1	4	0	1	0	0
2	0	9	0	0	0
3	0	3	0	0	0
4	0	0	0	1	0
5	0	0	0	0	1

In general, it is concluded that: The centroid method groups fifteen countries in the first cluster, one in the second cluster and one in the third cluster.

The average method groups four countries in the first cluster, twelve countries in the second cluster and one country in the third cluster

The single method groups fourteen countries in the first cluster, one country in the second and one country in the third one again.

The complete method groups four countries in the first cluster, twelve in the second cluster, and one country in the third cluster.

The ward method groups five countries in the first cluster, nine countries in the second cluster, and three countries in the third cluster. It is the only method that groups more than one country in the third cluster.

After comparing each dendrogram, we decided to use Ward's method because we can see the different clusters in a more defined and transparent way. It does not have several numbers of countries alone in a cluster, some of the clusters are repeated in other methods, and that means that it is more accurate than the others and because it groups more countries in each cluster.

The program gives us some information more of the cluster analysis, using Ward's method, and Euclidean distance we compute:

Table 10 Cluster formation

	[,1]	[,2]
[1,]	-8	-12
[2,]	-7	-15
[3,]	-16	2
[4,]	-11	-13
[5,]	1	3
[6,]	-2	-9
[7,]	-5	-6
[8,]	-10	4
[9,]	-14	5
[10,]	-1	7
[11,]	-19	9
[12,]	-4	10
[13,]	6	11
[14,]	-3	12
[15,]	-17	14
[16,]	-18	15
[17,]	8	13
[18,]	16	17

At each step of the Cluster Analysis, either individual cases are added to existing clusters, two individuals are combined, or two existing clusters are combined. Table

10 reposts how groups are constituted. ." If an element "j" is negative, then the observation "j" was merged at this stage. If "j" is positive, then the merge was with the cluster formed at an early stage.

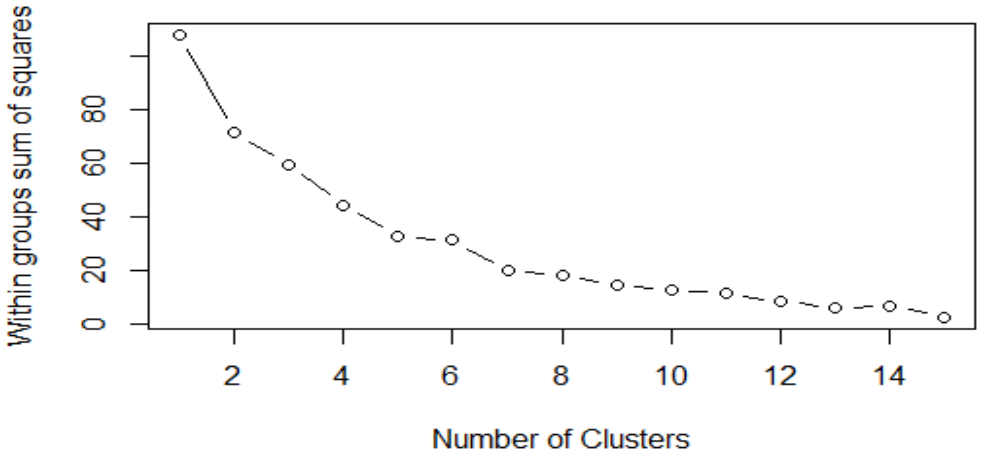
In other words, negative numbers in the columns indicate the country. Furthermore, the positive numbers indicate the clusters.

In the first step, we have merged 8 and 12 that indicates Ecuador and Mexico. In the second step, we have merged 7 with 15 that are Dominican Republic with Paraguay. At the step number tree, we can see that Peru merged with the second cluster and so on.

3.3 Optimal number of clusters

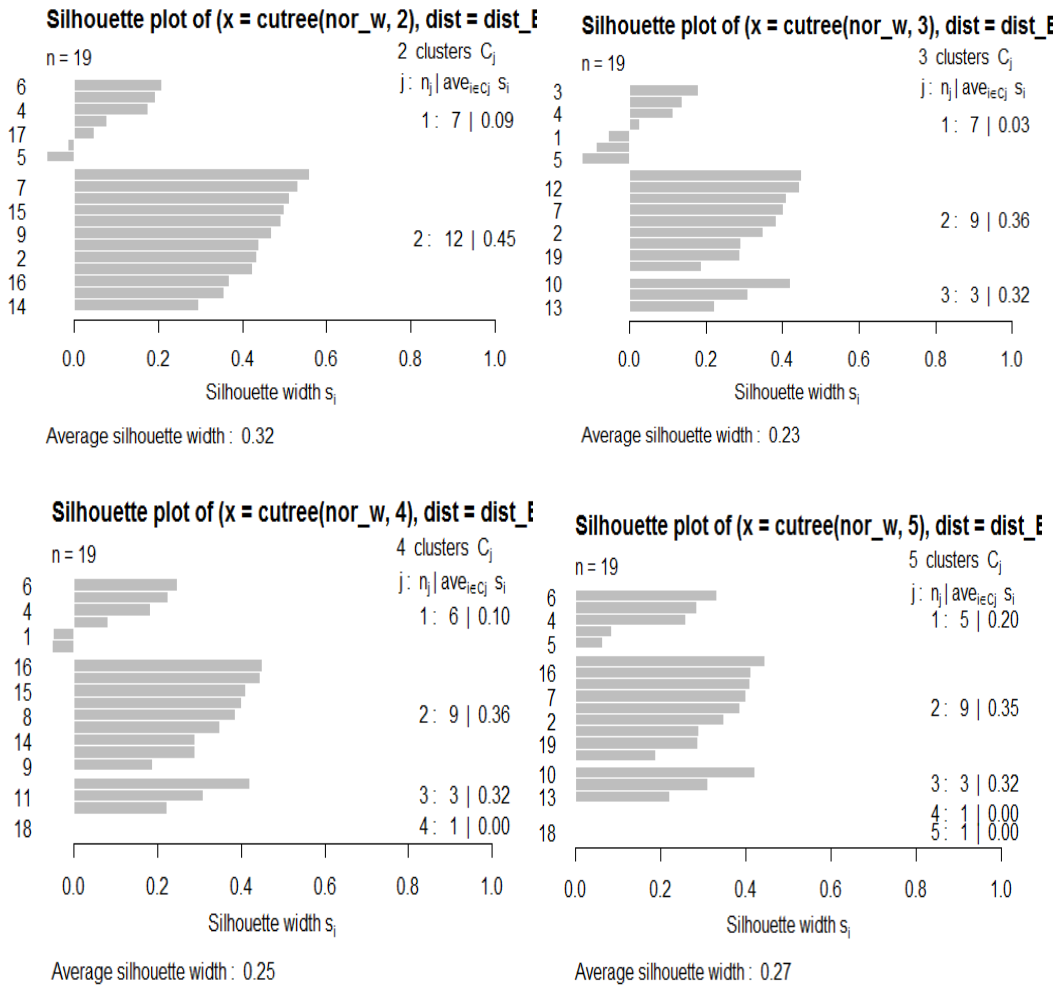
To be entirely sure of how many clusters are optimum to have, is performed within the sum of squares (WSS) and the graph of the silhouette.

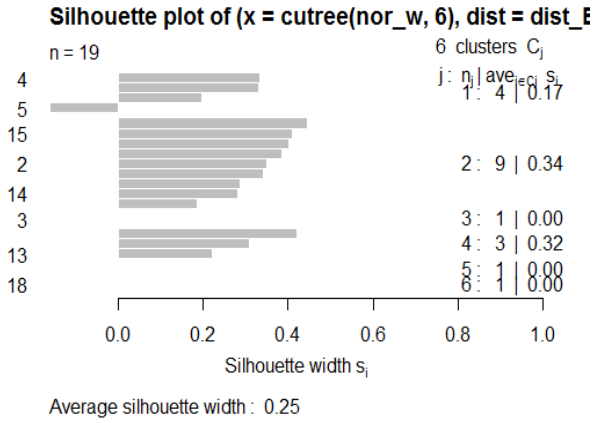
Figure 19 Within groups sum of squares



The scree plot for the cluster analysis of the nineteen countries and six variables shows: As the number of clusters increases, the variability (within-group sum of squares) decreases, we can observe that there is a significant drop in the variability. Around five, this drop is not so big, so it represents that the best number of clusters would be five because it indicates the most parsimonious balance between minimizing the number of clusters and minimizing the variance within each cluster.

Figure 20 Silhouette plot for 3,4,5 and 6 clusters with Euclidean distance

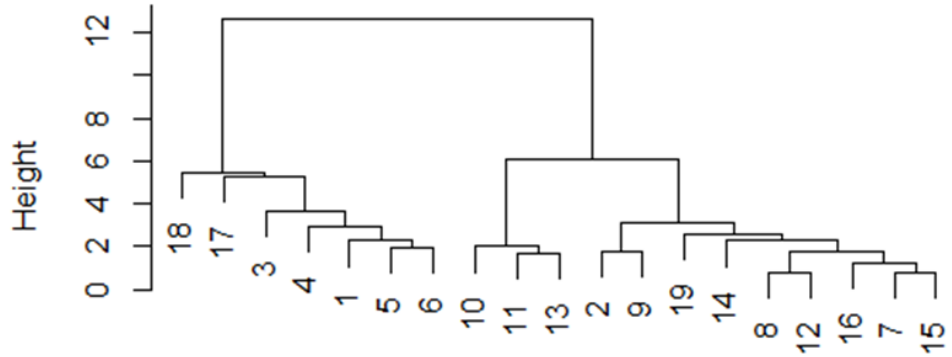




Silhouette plot is used to study the separation distance with the resulting cluster. So, the plot displays a measure of how close each point in one cluster is to a neighbor cluster. It provides a way to assess the parameter like the number of clusters in a visual way. The measuring range goes from 0 to 1; a coefficient near 1 indicates that the sample is far away from the neighbor cluster, is a good value. The values near zero means that it is close to the decision boundary between two neighbor cluster, not a good value. Negative value indicates that those samples were assigned in a wrong cluster. We can see in figure 20 that for just for the number of clusters five, we do not have negative values. Thus, the optimal number of clusters is five because the samples are farther from zero**.**

To conclude, Ward's method was the selected, and the following figure is the dendrogram with the Euclidean distance:

Figure 21 Dendrogram using Ward's method



Where we can see all the clusters generated and in Table 11 we can see the countries that are included in the Clusters.

Table 11 Composition of clusters

Case	6 Clusters	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1:Argentina	1	1	1	1	1
2:Bolivia	2	2	2	2	2
3:Brasil	3	1	1	1	1
4:Chile	1	1	1	1	1
5:Colombia	1	1	1	1	1
6:Costa Rica	1	1	1	1	1
7:Dominican Republic	2	2	2	2	2
8:Ecuador	2	2	2	2	2
9:El Salvador	2	2	2	2	2
10:Guatemala	4	3	3	3	2
11:Honduras	4	3	3	3	2
12:México	2	2	2	2	2
13:Nicaragua	4	3	3	3	2
14:Panamá	2	2	2	2	2
15:Paraguay	2	2	2	2	2
16:Perú	2	2	2	2	2
17:Puerto Rico	5	4	1	1	1
18:Uruguay	6	5	4	1	1
19:Venezuela	2	2	2	2	2

Table 11 indicates the number of clusters and the countries that belong to each cluster. The optimal number of cluster are five; therefore, we can see that we have:

- In the first cluster: Argentina, Brazil, Chile, Colombia, Costa Rica.
- In the second cluster: Bolivia, Dominican Republic, Ecuador, El Salvador, Mexico, Panama, Paraguay, Peru, and Venezuela.
- In the third cluster: Honduras, Guatemala, and Nicaragua
- In the fourth cluster: Puerto Rico
- In the fifth cluster: Uruguay

In order to compare and understand the grouping of each cluster, the mean of the six variable was calculated:

Table 11 Variable's average of clusters

	GDP per capita	Social Spending	Literacy	Gini Index	Unemployment	Corruption Perception
Cluster 1	11044.6	14.5	96.4	47.6	9.6	46.8
Cluster 2	7047.2	9.2	93.7	44.5	4.9	30.6
Cluster 3	3026.0	8.7	84.7	48.9	4.2	27.0

Table 12 Variables values of Puerto Rico and Uruguay

	GDP per capita	Social Spending	Literacy	Gini Index	Unemployment	Corruption Perception
Cluster 4 Puerto Rico	31651.3	7.8	92.0	54.0	9.2	44.0
Cluster 5 Uruguay	17278.0	17.2	99.0	39.7	8.3	70

The mean was calculated with the real values, not the normalized to understand in a better way, and as is not possible to calculate the mean for a single observation, the data of Puerto Rico and Uruguay is shows without any mathematical intervention.

We want to start to comment in separate ways cluster four, cluster five, and then the rest of the clusters.

Uruguay has the highest values in almost everything except unemployment that is not the highest neither the lowest, and the GDP per capita is the second-highest of all the clusters. Then, in the rest variables has the highest values. That is why we think it is alone, because it is the best-performing country by far.

Moreover, Puerto Rico is alone in other clusters because it has the highest GDP per capita and is recognized as a high-income economy by the World Bank. The other variables do not have a relationship with the other countries.

Now we are going to compare the three first clusters. Cluster one is composed of Argentina, Brazil, Chile, Colombia, and Costa Rica. It registered an average of 11044 $ in GDP per capita being the highest, as well in social spending, literacy, and corruption perception. It has the highest unemployment and the second-highest Gini index.

Cluster two composed by Bolivia, Dominican Republic, Ecuador, El Salvador, Mexico, Panama, Paraguay, Peru, and Venezuela. It registered values smaller than the first cluster but greater than the third cluster. It has as average 7047.2 $ of GDP per capita, 9.2% of social spending, 93.7% of literacy, and 30.6% of corruption perception. The Gini index is the lowest of the three clusters.

Cluster three, composed by Honduras, Guatemala, and Nicaragua. It has the lowest values in all the variables, except tin unemployment, that is 4.2%.

To conclude, as we saw the values, the three first clusters are formed by the countries with the highest performance to the countries with the lowest performance, sharing some similarities in values. Furthermore, the Cluster analysis

concludes to put in different groups to Puerto Rico. After all, it does not share similitudes to the other countries and Uruguay because it has the best performing by far.

Chapter 4

ONE FOR ALL: SOME ATTEMPTS FOR THE CONSTRUCTION OF COMPOSITE INDICATOR

4.1 Framework for composite indicators

This chapter aims to build a composite indicator of poverty, suggest a new way to measure and understand poverty in Spanish and Portuguese language countries of America.

Composite indicators are constructed when several indicators are compiled into a single measure. They work under a multi-dimensional concept.

Nowadays, composite indicators are recognized as a useful tool for policy making and specific studies of countries' performance in fields like; biology, environment, economy, or technology. The interpretation of composite indicators is more straightforward than trying to explain a common trend in a several number of indicators.

The composite indicator will help us to compare nineteen countries performance and the different indicators that we already talk in chapter number two.

Moreover, it is necessary to mention that composite indicators have positive and negative aspects:

4.1.1 Pros of composite indicators

- It makes it easier to understand complex or multi-dimensional issues.

- Decrease the size of a set of indicators or add relevant information within the existing size limit.
- Simplify the communication with ordinary citizens and encourage accountability

4.1.2. Cons of composite indicators

- Due to mistakes in all the dimensions of the performance, the policies may result wrong
- The selection of variables and the measurement of them could be the target of political challenge
- May bring an inappropriate indicator, if the various stages (selection of indicators, standardizing, weighing) are not transparent and based on statistical math models or conceptual principles.

4.1.3 Steps towards composite indicators

In order to accomplish the aim, according to the Handbook on Constructing Composite Indicators of the OECD, the steps to make a composite indicator are the followings:

4.1.3.1 Theoretical framework for the construction of composite indicator

In order to construct a composite indicator, the theoretical framework has to be clearly defined. It is relevant to set what will be measured and its sub-components. This step can take some time due to the importance of defining the objective of the analysis. It provides the basis for the selection and combination of variables into a meaningful composite indicator. We should look at the indicators as an entity to investigate its structure.

4.1.3.2 Data selection

It has high importance, as the outcome of the composite indicators will rely on the quality of the input data. It should be based on the analytical soundness, measurability country coverage, and relevance of the indicators to the phenomenon being measured and related to each other. It is suggested to look for high-quality statistics as input data to use in this analysis.

4.1.3.3 Imputation of missing data

In order to realize a complete analysis, is needed a complete dataset, and if something is missing, with statistical methods, replace and assign a value (e.g., employing single or multiple imputation).

4.1.3.4 Multivariate analysis

It is an analysis of the suitability of the dataset, is performed to yield a better understanding of the data structure and, it helps in following methodological choices. (e.g., cluster analysis, principal components analysis).

4.1.3.5 Normalization

Different variables taking account have different ways to be measure; they should be carried out to render the variables comparable, because they can influence to subsequent steps in the process of building a composite indicator.

4.1.3.6 Weighting and aggregation

For the construction of the composite indicator, it is needed to assign a weight to each indicator because weights can have a significant effect on the overall composite indicator and the country rankings. Several weighting techniques exist, but regarding what method that is chosen, weights are mostly value judgments. (OECD,2008). It Should be done along the lines of the underlying theoretical framework.

4.1.3.7 Uncertainty and sensitivity analysis

This step should be undertaken to assess the robustness of the composite indicator in terms of, e.g., the mechanism for including or excluding an indicator, the normalization scheme, the imputation of missing data, the choice of weights, the aggregation method. It depends on the underlying assumptions and methods chosen. By using a combination of uncertainty and sensitivity analysis, the robustness of the composite indicator can be gauged, and transparency can be improved. (UNECE,2019)

4.1.3.8 Back to the data

It is necessary to reveal the main drivers for an overall good or bad performance. It can be used the spider diagram to demonstrate the stretch of the components in the composite indicator.

4.1.3.9 Links to other indicators

Composite indicators often measure concepts that are linked to other simple or composite indicators. These correlation links are used to test the explanatory power of the composite indicator. It can be used; cross plots or regressions.

4.1.3.10 Visualization of the results

It should receive proper attention because the presentation of the data gives the correct interpretation. The visualization can influence (or help to enhance) interpretability. In this step, we represent the result obtained in all the analysis of the construct of the composite indicator.

4.2 Process of construction composite

The first and second step, theoretical framework and data selection, was made in the first and second chapter. Then, the collection of data was complete, and the only country with missing data was excluded from the analysis. Hence, the step number three, imputation of missing data, was not necessary. Consequently, in chapter number three, we made the cluster analysis that corresponds to the multivariate analysis. Thus, the other five steps are going to be taken in this chapter. In order to

finish the construction of the indicator, we are going to respect the steps suggested by the OECD.

4.2.1 Normalization of the data

A data set often has different types of measurement units, that if we compare without doing any change, we may have a wrong result. That is the reason why normalization is required before any data aggregation. Several normalization methods exist, for example: Ranking, Standardization (or z-scores), Min-Max, Distance to a reference, and more.

The normalization method should take into account the data properties, as well as the objectives of the composite indicator.

In this case was used the formula with re-scaling approach used by M.Ciommi et al. (2017, p 283):

$$r_{ij}\begin{cases}\dfrac{(x_{ij}-Min_{xj})}{(Max_{xj}-Min_{xj})} & \text{If the indicator j has positive polarity}\\ \dfrac{(Max_{xj}-x_{ij})}{(Max_{xj}-Min_{xj})} & \text{If the indicator j has negative polarity}\end{cases}$$

In order to normalized the data, we used the first formula with the following indicators because we measure the ABSENCE of poverty:

- GDP per capita: It has a negative relationship with poverty, if GDP per capita increases, poverty will decrease

- Social spending: It has a negative relationship with poverty, if social spending increases, poverty will decrease
- Literacy rate: It has a negative relationship with poverty, if the literacy rate increases, poverty will decrease.
- Corruption perception: It has a negative relationship with poverty, if corruption perception increases, poverty will decrease. Note that corruption perception is measure with values near 100 have LESS corruption, and values near to 0 have MORE corruption. That is the reason corruption is considered a negative relationship with poverty.

On the other, the second formula was applied to the indicators with a positive relationship:

- Gini index: It has a positive relationship with poverty, if the Gini index increases, poverty will increase as well.
- Unemployment rate: It has a positive relationship with poverty, if unemployment increases, poverty will increase as well.

Table 14 Normalized matrix

	GDP per capita	Social Spending	Literacy	Gini Index	Unemployment	Corruption Perception
Argentina	0.3259	0.6075	1.0000	0.8182	0.3163	0.4231
Bolivia	0.0513	0.5327	0.7222	0.7662	0.8980	0.2115
Brasil	0.2326	1.0000	0.6667	0.0065	0.0000	0.3269
Chile	0.4690	0.8785	0.8889	0.6234	0.5204	0.9423
Colombia	0.1565	0.5234	0.7778	0.2338	0.3265	0.3462
Costa Rica	0.3374	0.4766	0.9444	0.3896	0.2245	0.7308
Dominican Republic	0.2031	0.0935	0.6111	0.6688	0.6633	0.2308
Ecuador	0.1455	0.1869	0.6667	0.5584	0.8980	0.3077
El Salvador	0.0682	0.1869	0.4444	1.0000	0.8469	0.3269
Guatemala	0.0848	0.0000	0.0000	0.3701	1.0000	0.1731
Honduras	0.0156	0.0935	0.3333	0.1234	0.6837	0.2115
México	0.2577	0.1589	0.7778	0.5584	0.9184	0.1923
Nicaragua	0.0000	0.3832	0.2778	0.5065	0.7959	0.1346
Panamá	0.4569	0.1682	0.7778	0.3117	0.8571	0.3654
Paraguay	0.1276	0.1495	0.7222	0.5065	0.6224	0.2115
Perú	0.1653	0.3832	0.7222	0.7273	0.6020	0.3269
Puerto Rico	0.9995	0.0748	0.6111	0.0000	0.3163	0.5000
Uruguay	0.5142	0.9533	1.0000	0.9286	0.4082	1.0000
Venezuela	0.0467	0.0000	0.8889	0.4610	0.4898	0.0000

Own elaboration

4.2.2 Weighting and aggregation

Weights can have relevant effects on the overall composite indicator and the country rankings, that is why the election of the method is essential. There are several types of methods; Principal component analysis (PCA)or factor analysis, participatory methods like budget allocation processes (BAP), analytic hierarchy processes (AHP), conjoint analysis (CA) and, the most common that is equal weighting (EW). For the last three methods, we need the opinion of experts, and in this work, it was not possible to accede to interview to experts in the area. The method of PCA and FA was tested using the extension Xstat in excel. However, one of the first rules to use this method is to have to be a high correlation between variables, and the matrix of correlation of Pearson's shows as that almost all values were below 0,5. It means that the correlation is weak

Table 15 Correlation Matrix Pearsons

Variables	GDP per capita	Literacy Rate	Social spending	Unemployment	Gini Index
GDP per capita	**1**	0.371	0.306	0.408	0.230
Literacy Rate	0.371	**1**	0.595	0.512	-0.252
Social spending	0.306	0.595	**1**	0.713	-0.007
Unemployment	0.408	0.512	0.713	**1**	0.342
Gini Index	0.230	-0.252	-0.007	0.342	**1**

Own elaboration

As we can see, just unemployment with social spending has a high correlation, then the rest no. Therefore, the method used in this part was the equal weighting; all variables are given the same weight. It essentially implies that all variables are "worth" the same in the composite, in this way, we can avoid the introduction of an element of double counting that usually happens when two or more indicators have a high correlation and is used the equal weighting. Nevertheless, our indicators do not have a high correlation, so it is a positive aspect to use this method.

Aggregation method:

The first and simplest additive aggregation method entails the calculation of the ranking of each country according to each indicator and summation of the resulting rankings. The method is based on the Borda's rule. It is simple and independent of outliers. The following formula is used for this aggregation method:

$$CI_c = \sum_{q=1}^{Q} Rank_{qc} \quad \text{for } c=1,\ldots,M.$$

Table 16 A frequency matrix for the application of Borda's rule

	GDP per capita	Social Spending	Literacy	Gini Index	Unemployment	Corruption Perception
Argentina	6	2	1	3	14	5
Bolivia	16	4	5	4	2	11
Brasil	8	1	6	17	16	8
Chile	3	3	3	7	10	2
Colombia	11	5	4	15	12	7
Costa Rica	5	6	2	12	15	3
Dominican R.	9	12	7	6	8	10
Ecuador	12	8	6	9	3	9
El Salvador	15	8	8	1	4	8
Guatemala	14	14	11	13	1	14
Honduras	17	12	9	16	6	12
México	7	10	4	8	1	13
Nicaragua	19	7	10	10	6	15
Panamá	4	9	4	14	4	6
Paraguay	13	11	5	10	8	12
Perú	10	7	5	5	10	8
Puerto Rico	1	13	7	18	12	4
Uruguay	2	1	1	2	14	1
Venezuela	18	14	3	11	12	16

Own elaboration

Table 16 shows the position of countries of each indicator. It is ordered in ascendant order. The first position is for the country that has more GDP per capita, literacy, social spending, and have less in the Gini index, unemployment and, corruption. For example, Uruguay has the highest percentage in social spending, literacy and

has the lowest corruption perception, that is why it is in the first place on all those indicators. On the other hand, Nicaragua has the lowest GDP per capita; that is why it is in the nineteen positions.

Table 17 Frequency matrix for the application of Borda's rule

Ranking	Indicators																		Points
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1st	1		1						1	1							1	3		18
2nd	1			1		1						1						2		17
3th	1	1		3		1		1											1	16
4th		2			1							1		3			1			15
5th	1	1			1	1			1						1	2				14
6th	1		1			1	1	1					1	1						13
7th				1	1		1				1	1	1			1	1			12
8th			2				1	1	3			1				1				11
9th							1	2			1			1	1					10
10							1					1	2		1	2				9
11		1		1	1					1					1				1	8
12						1	1	1			2				1				1	7
13	1									1		1			1		1	1		6
14					1	1				3				1					1	5
15					1				1				1				1			4
16		1	1								1								1	3
17			1								1									2
18																	1		1	1
19													1							0

Own elaboration

Table 17 shows that in the vertical axis are the positions and in the horizontal axis, the countries. We can find the different positions that each country got.

The points were set according to the place of the ranking, for the first place 18, that is n, points were given, and for the rest were (n-1), for example, if it is the second

place will be n-1=17 and in the third n-2=16. By applying Borda's scoring rule, the following results are obtained:

Table 18 Ranking of countries

Country	Ranking	Points
Uruguay	1	94
Chile	2	85
Argentina	3	84
Panama	4	73
Costa Rica	5	72
Bolivia	6	71
Mexico	7	70
El Salvador	8	69
Peru	8	69
Ecuador	9	67
Domenica R	10	62
Brazil	11	59
Colombia	12	58
Puerto Rico	13	56
Paraguay	14	54
Guatemala	15	47
Nicaragua	15	47
Honduras	16	41
Venezuela	17	40

In order to compare the obtained results, we built the Table 18 that is the ranking of the countries just taking into consideration the indicator poverty rate of 2018 data taken from OEDC to compare both rankings. It is based on the poverty rate in 2018, data of OEDC.

Table 19 Ranking of countries based in poverty rate

Country	Absence of Poverty	Position
Chile	6.4	1
Argentina	7.1	2
Uruguay	8.1	3
Costa Rica	9.7	4
Panama	14.1	5
Paraguay	18.6	6
Dominican Republic	19.9	7
Brazil	21	8
Ecuador	23.2	9
Peru	23.9	10
Bolivia	24.7	11
Colombia	27	12
El Salvador	29.2	13
Mexico	34.8	14
Nicaragua	34.9	15
Venezuela	35.6	16
Puerto Rico	43	17
Guatemala	48.8	18
Honduras	52.6	19

To compare the two rankings presented above, we are going to use the Spearman correlation, that calculate the relationship between two variables based on their ranks. It is optimal to use when data shows a non-linear relationship, and at least one variable is ordinal (like the case of the rankings).

The formula used is:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where:

- d_i is the difference between a pair of ranks
- n is the number of observations

The interpretation is given by:

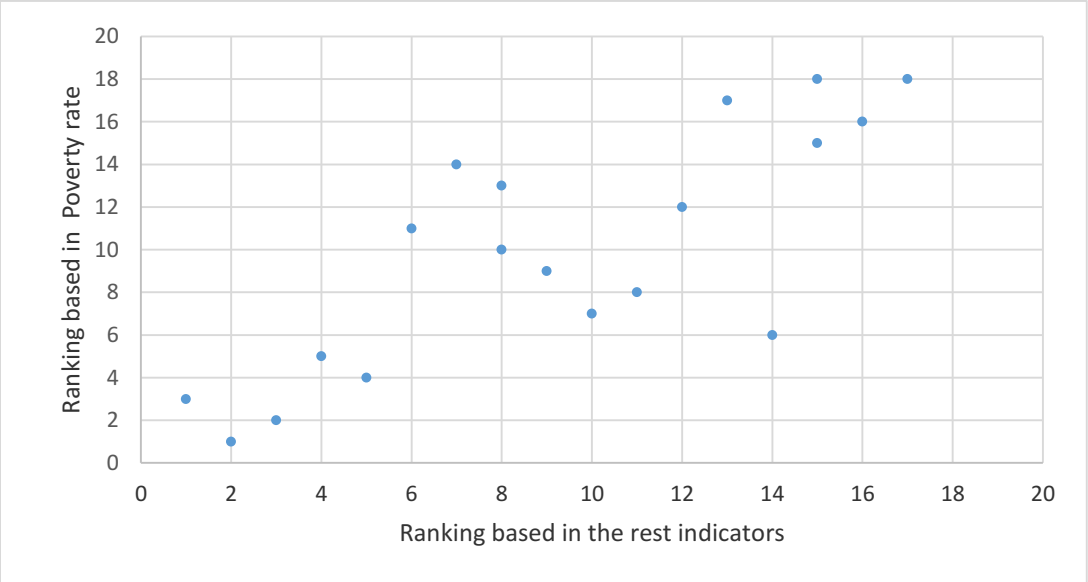
- 1 is a perfect positive correlation
- -1 is a perfect negative correlation
- 0 is no correlation

Table 20 Spearman Correlation matrix

Variables	Ranking based in the rest indicators	Ranking based in Poverty rate
Ranking based in the rest indicators	**1**	0.790
Ranking based in Poverty rate	0.790	**1**

Table 20 shows that between rankings, we have a positive correlation of 0.79, which is called a direct relationship.

Figure 22 Scatterplot of Spearman Correlation



Own elaboration

Figure 22 shows that in some countries, there was no difference. For example, in Ecuador in both rankings is in the nine position, Colombia in the twelve and Nicaragua in the position number fifteen. In other cases, it had a little change like in Chile that in the ranking of the absence of poverty was first but in the ranking base on the other indicators in second.

4.3 Construct of composite index with different methods

In order to finish the construction of an indicator, we are going to include in this subtitle the last steps; robustness and sensitivity, back to the data, links to other indicators, and visualization of the results.

Five methods are presented, as the step of robustness and sensitivity says, we need to make the analysis with different approaches to compare the results, in that sense, we applied the formula for the composite indicator for three different weights. Then, we propose to add the coefficient of variation to the original formula, and for method number five, we compute the absence of poverty using the formula of the Human Development Index.

The following formula is used to calculate a composite indicator; in this case, we are using it to calculate the absence of poverty:

$$Absence\ of\ povery = \sum_{j=1}^{k} w_j r_j$$

Where:

- w_j is the weight associated to the variable j
- r_j is the normalized value of the indicator j according to the modified version of the max-min method

4.3.1 First method:

With the aim to calculate the absence of poverty, the first method is presented. Applying the formula above explained and equal weights. The weight given to the indicators are showed in Table 21.

Table 21 Weights

GDP per capita	Literacy Rate	Social Spendings	Unemployment	Gini Index	Corruption Perception
0.167	0.167	0.167	0.167	0.167	0.167

As the overall weight has to sum 1, the individual weigh for the six variables observed is 0.167.

taking in consideration the 19 countries of Latin America and six indicators (GDP per capita, social spending, Literacy, Gini index, unemployment and, corruption perception) we calculate the coefficients of each country using the normalized data.

Table 22 Absence of poverty first method

Country	Composite Indicator Absence of poverty Method one	Position
Uruguay	0.8023	1
Chile	0.7218	2
Argentina	0.5830	3
Bolivia	0.5314	4
Costa Rica	0.5183	5
Panamá	0.4905	6
Perú	0.4888	7
El Salvador	0.4799	8
México	0.4782	9
Ecuador	0.4614	10
Puerto Rico	0.4178	11
Dominican Republic	0.4126	12
Colombia	0.3948	13
Paraguay	0.3907	14
Brasil	0.3729	15
Nicaragua	0.3503	16
Venezuela	0.3150	17
Guatemala	0.2719	18
Honduras	0.2440	19

Own elaboration

We can appreciate that Uruguay occupies the first place with a value of 0.8023, then, Chile and Argentina with 0.7218 and 0.5830, respectively. In table 19, when it was applied to Borda's rule for ranking, we had the same result for these three countries. Moreover, as the last countries, where exists more poverty, we have Guatemala and Honduras with values of 0.2719 and 0.2440, respectively.

It registered a big difference in the value of the Composite Indicator from the first position to the last, 0.5583 points of difference. It indicates that between countries of Latin America, there are relevant differences.

5.3.2 Second method:

In the second method, different weights were applied; more weight was given to GDP per capita and unemployment. Then, the rest of the indicators had an equal weight. This method was applied to see if there is a variation on the results because we saw that a big part of researchers gives relevance to GDP per capita in studies of poverty. Consequently, the indicator of unemployment was chosen because not all the best-ranked countries have a high position in unemployment, as we can see in table 16 and to see if there are some variation

Table 23 Weights – Second method

GDP per capita	Literacy Rate	Social Spendings	Unemployment	Gini Index	Corruption Perception
0.33	0.115	0.115	0.21	0.115	0.115

Continuing with the calculation using the formula applied in the first method, always working with the normalized data and in this second method with the new weights, we obtained the following composite indicators:

Table 24 Composite Indicator Absence of poverty - Method 2

Country	Composite Indicator Absence of poverty Method 2	Position
Uruguay	0.6597	1
Chile	0.5754	2
Puerto Rico	0.4662	3
Argentina	0.4649	4
Costa Rica	0.4137	5
Panamá	0.3681	6
Perú	0.3533	7
Bolivia	0.3528	8
El Salvador	0.3451	9
México	0.3381	10
Brasil	0.3068	11
Ecuador	0.3034	12
Dominican Republic	0.3025	13
Colombia	0.2767	14
Paraguay	0.2612	15
Venezuela	0.1966	16
Nicaragua	0.1960	17
Guatemala	0.1330	18
Honduras	0.1024	19

Own elaboration

Again as the first and second method, we obtain the country with more absence of poverty is Uruguay and after Chile. However, a change occurred, Puerto Rico went up in position from 11, in the first method to 3 in this second method. It happens due to the high GDP per capita that Puerto Rico has, it is the country of all Latin America with the highest GDP per capita, and in this method, we gave more weight to that indicator.

4.3.3 Third method

With the same formula, the third method is calculated, giving more weight to social spending and corruption perception because we saw that the best-performing countries have high values in these two variables.

Table 25 Weights- Third method

GDP per capita	Literacy Rate	Social Spendings	Unemployment	Gini Index	Corruption Perception
0.10	0.10	0.30	0.10	0.10	0.30

Table 26 Composite Indicator Absence of poverty Third Method

Country	Composite Indicator Absence of poverty Method two	Position
Uruguay	0.6822	1
Chile	0.6021	2
Costa Rica	0.4896	3
Argentina	0.4672	4
El Salvador	0.3785	5
Perú	0.3756	6
Puerto Rico	0.3722	7
Panamá	0.3687	8
Bolivia	0.3585	9
Ecuador	0.3462	10
México	0.3461	11
Dominican Republic	0.323	12
Colombia	0.3061	13
Paraguay	0.3028	14
Brasil	0.2553	15
Venezuela	0.2511	16
Nicaragua	0.1869	17
Honduras	0.1525	18
Guatemala	0.1344	19

Like the two first methods, Uruguay has the highest absence of poverty and Chile as well. Then, the third position is occupied by Costa Rica, which in the other two methods was position number five. It can be explained because Costa Rica is the third country with less corruption perception of the nineteen countries observed.

In the last position are Honduras and Guatemala again, with low value because the registered the lowest values in social spending and the highest values in corruption perception.

4.3.4 Fourth method

In this attempt, we add to the previous formula the coefficient of variation vj.

The coefficient of variation (CV) helps in the measurement of the dispersion of the data. It is the result of dividing the standard deviation by the mean. CV= (Standard Deviation / Mean). It is used for comparing the degree of variation from one data series to another.

The new formula is the following:

$$I = \sum_{j=1}^{k} v_j w_j r_j$$

Where:

w_j is equal weight

v'_j is a measure of variability computed within each dimension (CV)

In which the coefficient of variation is calculated by:

$$v_j = \frac{v'_j}{\sum_{j=1}^{k} v'_j}$$

Where first, we calculate the CV of the six indicators and the sum of all of them. Consequently, v_j is the result of the CV (of each indicator) divided by the sum of all the CV .

Appling equal weights to all the indicators with the new formula added CV. The following results are obtained:

Table 27 Composite Indicator Absence of poverty – Method 4

Country	Composite Indicator Absence of poverty Method 4	Position
Uruguay	0.1345	1
Chile	0.1213	2
Argentina	0.1050	3
Bolivia	0.1012	4
México	0.0943	5
Panamá	0.0925	6
Costa Rica	0.0917	7
Perú	0.0913	8
El Salvador	0.0906	9
Ecuador	0.0901	10
Dominican Republic	0.0800	11
Paraguay	0.0779	12
Colombia	0.0725	13
Venezuela	0.0701	14
Puerto Rico	0.0676	15
Nicaragua	0.0653	16
Brasil	0.0593	17
Guatemala	0.0517	18
Honduras	0.0492	19

The values obtained are smaller compared with the other methods due to the addition of the coefficient of variation. However, we can see that Mexico ranked up, from being in the ten or eleven positions to the fifth, Venezuela went from

position sixteen to fourteen and Puerto Rico from position seven, in the last method, to the position fifteen. Then, the other countries did not have significant changes.

4.3.5 Fifth method

For the last method, the formula of the Human Development Index was used, it was proposed for the first time in 1990 by the United Nations Development Programme (UNDP).

HDI is a measure of human development that combines three crucial human capabilities: health, education, and a decent standard of living. Health is represented by life expectancy, education by literacy and school enrolment, and standard of living by the gross national income GNI (PPP) per capita. (Stanton,2007).

The GNI is the sum of all the total domestic and the foreign output claimed by residents of a country, is the gross domestic product (GDP), plus factor incomes earned by foreign residents, minus income earned in the domestic economy by non-residents (Todaro & Smith, 2011)

The particularity of the method is that if a country has the lowest value in one indicator of all the countries observed, it will have zero as a coefficient in the composite indicator because each value is multiplied and zero times a number will always be zero.The following formula was applied, that is the same formula proposed by the Human Development Index (HDI):

$$I'' = \sqrt[k]{\prod_{j=1}^{k} r_j}$$

Where all the normalized indicators are multiplied between them, and re result is elevated to 1/n. In this case, n is equal to 19, for the nineteen countries analysed.

Thus, applying the formula, we have the following table:

Table 28 Composite Indicator Absence of poverty - Method 5

Country	Composite Indicator Absence of poverty Method 5	Position
Uruguay	0.755	1
Chile	0.694	2
Argentina	0.528	3
Costa Rica	0.462	4
Perú	0.433	5
Panamá	0.424	6
México	0.383	7
Bolivia	0.377	8
Ecuador	0.375	9
Colombia	0.345	10
El Salvador	0.341	11
Dominican Republic	0.325	12
Paraguay	0.312	13
Honduras	0.143	14
Puerto Rico	0	15
Nicaragua	0	15
Guatemala	0	15
Brasil	0	15
Venezuela	0	15

Source (UNDP,2019)

As we can observe, the results changed comparing to the other methods applied. Five countries have a coefficient of zero, including Brazil and Puerto Rico, that before were not in the last positions, that is why as we mentioned before, in some indicator, they have the lowest value, and the method computes as zero.

One more time, Uruguay and Chile are in the first positions, and some relevant changes can be observed, for example, Bolivia that was in the fourth position, in this method is in the eighth. Moreover, as says the step number nine "link to other indicators," in the following table, we compared the Human Development Index (HDI) of 2018 and the Composite Indicator of Absence of poverty (CIAP) with the same formula.

Table 29 Comparison of HDM CIAP

Country	HDI (2018)	Position	Composite Indicator Method 5	Position
Chile	0.847	1	0.694	2
Puerto Rico	0.845	2	0	15
Argentina	0.83	3	0.528	3
Uruguay	0.808	4	0.755	1
Panamá	0.795	5	0.424	6
Costa Rica	0.794	6	0.462	4
México	0.767	7	0.383	7
Colombia	0.761	8	0.345	10
Brasil	0.761	8	0	15
Perú	0.759	9	0.433	5
Ecuador	0.758	10	0.375	9
Dominican Republic	0.745	11	0.325	12
Paraguay	0.73	12	0.312	13
Venezuela	0.705	13	0	15
Bolivia	0.703	14	0.377	8
El Salvador	0.667	15	0.341	11
Guatemala	0.651	16	0	15
Honduras	0.623	17	0.143	14
Nicaragua	0.651	18	0	15

The first thing that calls the attention is the position of Puerto Rico in HDI, but is because the Gross National Income of this country is the highest of all the nineteen countries, the value is 20,100 in 2018 data taken from UNDP.

Then, just Argentina and Mexico maintain position, and Chile, Panama, Ecuador, Dominican Republic, Paraguay and, Guatemala increase or decrease one position. The other countries changed completed is because in the HDI, just tree variables were taken, and in the composite indicator that we are proposing, we took six different variables.

4.4 Comparison of the five methods:

To conclude, we present a summary table for the five methods used, in which we can see the positions that each country registered with the different methods. To sum up, the following five methods were presented:

Note that for all the methods, the data used were the normalized values calculated with the min-max modified formula.

Table 30 Summary five method applied

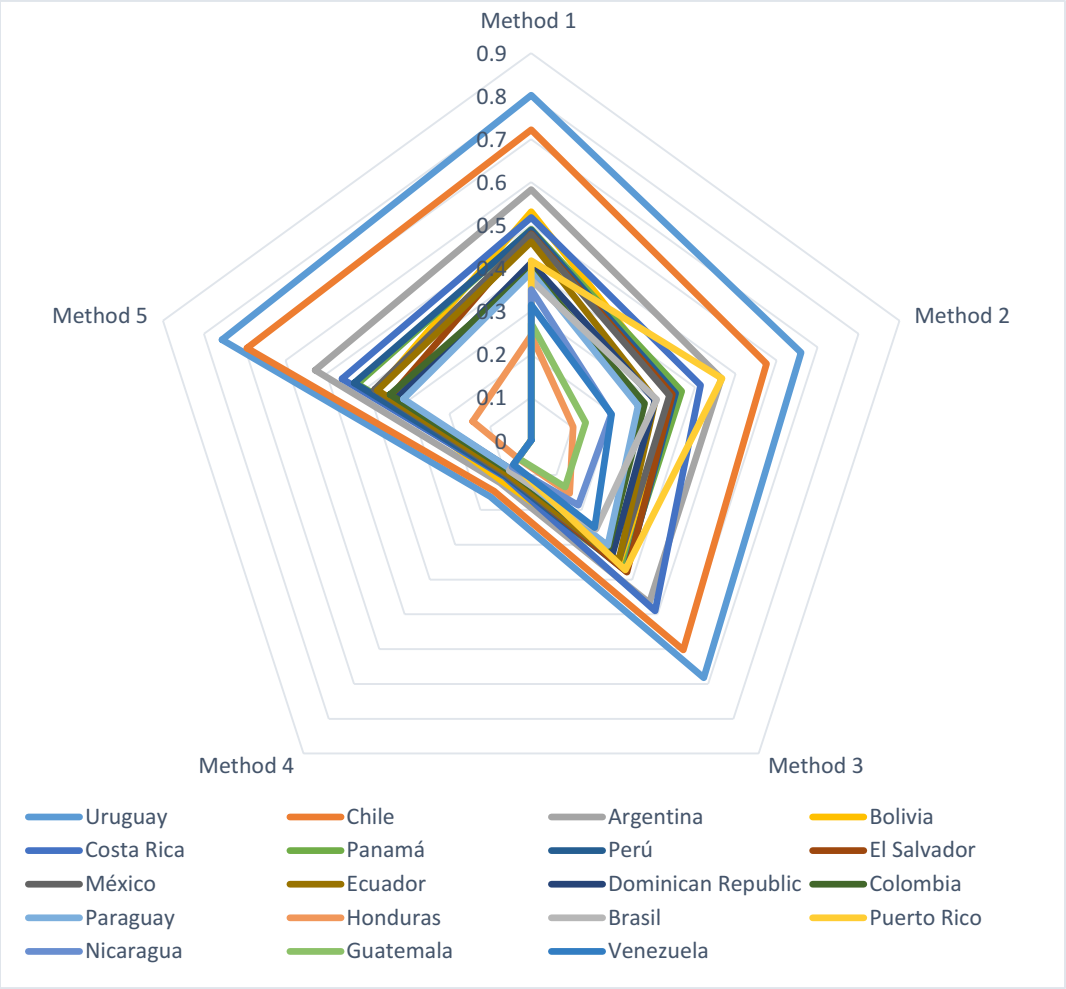
Method	Formulation	Characteristics
First method	$\sum_{j=1}^{k} w_j r_j$	EW w=0.167
Second method	$\sum_{j=1}^{k} w_j r_j$	GDP per capita= 0.33 Unemployment= 0.21 Other indicators w=0.115
Third method:	$\sum_{j=1}^{k} w_j r_j$	Social spending = 0.30 Corruption =0.30 Other indicators w=0.10.
Fourth method:	$\sum_{j=1}^{k} v_j w_j r_j$	EW w=0.167
Fifth method:	$I'' = \sqrt[k]{\prod_{j=1}^{k} r_j}$	EW w=0.167

In order to facilitate a visualization of the results, the spider is presented.

Spider chart, also called the radar chart is a graphical method of displaying multivariate data in the form of a two-dimensional graph of three or more variables represented on axes starting from the same point. In the following two graphs, we use different types of spider charts, and both were chosen just to facilitate the visualization and comprehension. In figure 23 is easier to see just the

color of the countries in lines, but on the other hand, in figure 24 is better to have the colored areas.

Figure 23 Spider Chart for the five method proposed



We can clearly observe that the two countries that have the best performance are Uruguay (blue line) and Chile (orange line), then, is Argentina (grew line). Puerto Rico (yellow line) shows that it has a high value in method two, as we said before is due to the high weight that we gave to the indicator GDP per capita. In method number four, we have small values that goes from 0.1345 the maximum and, the minimum 0.0492, because we worked with the coefficient of variation, that is the

reason why the graph result shrunken in the line of method 4. In order to see better the countries, the method four were removed from the analysis in the following graph

Figure 24 Spider Chart for method one, two, three and five.

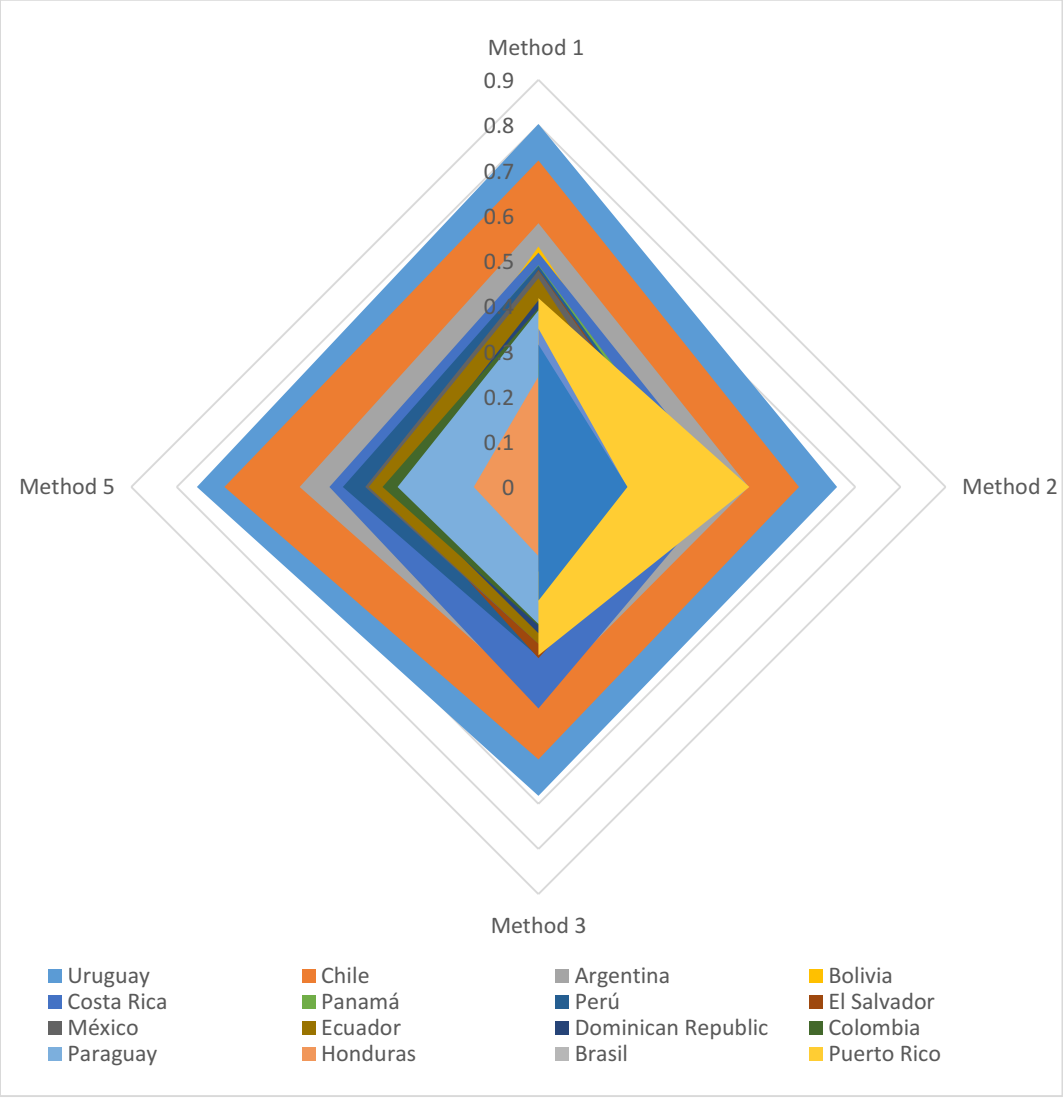


Figure 24 shows more clearly and confirmed what was commented above. Uruguay

(blue color) has the highest performance comparing all the other countries and in all the methods. In the second place, in the four methods observed, is located Chile (orange color). In the third position, we can see Argentina (grew color) in method one, two and, five. However, in method three, Costa Rica has the third position because we gave more weight to corruption and social spending, and Costa Rica has a low level of corruption. It can also be observed that Ecuador (light brown color) has better performance than Colombia (dark green color), Paraguay (light blue color) and, Honduras (light orange). Furthermore, we can say that Honduras is the worst-performing country because it is inside all the other countries.

Table 31 Positions of countries with the five methods

Country	Method 1	Method 2	Method 3	Method 4	Method 5
Uruguay	1	1	1	1	1
Chile	2	2	2	2	2
Argentina	3	4	4	3	3
Bolivia	4	8	9	4	8
Costa Rica	5	5	3	7	4
Panamá	6	6	8	6	7
Perú	7	7	6	8	5
El Salvador	8	9	5	9	11
México	9	10	11	5	7
Ecuador	10	12	10	10	9
Puerto Rico	11	3	7	15	15
Dominican Republic	12	13	12	11	12
Colombia	13	14	13	13	10
Paraguay	14	15	14	12	13
Brasil	15	11	15	17	15
Nicaragua	16	17	17	16	15
Venezuela	17	16	16	14	15
Guatemala	18	18	19	18	15
Honduras	19	19	18	19	14

Table 31 shows the positions that each country obtained with the computed methods.

Uruguay and Chile, as mention in the spider chart, obtained the first and second positions in the five methods.

Bolivia, in the first and fourth method, obtained the position four, in the second and fifth method, it obtained the position eight and, for the third method, it obtained the position nine. In this way, we can observe and compare for each country and method applied.

Table 32 Frequency in positions

Country	Num of 1	Num of 2	Num of 3	Num of 4	Num of 5	Num of 6	Num of 7	Num of 8	Num of 9	Num of 10	Num of 11	Num of 12	Num of 13	Num of14	Num of 15	Num of 16	Num of 17	Num of 18	Num of 19
Uruguay	5																		
Chile		5																	
Argentina			3	2															
Bolivia				2				2	1										
Costa Rica			1	1	2		1												
Panamá						3	1	1											
Perú					1	1	2	1											
El Salvador					1			1	2		1								
México					1		1		1	1	1								
Ecuador									1	3		1							
Puerto Rico			1				1				1				2				
Dominican Republic											1	3	1						
Colombia										1			3	1					
Paraguay												1	1	2	1				
Brasil											1				3		1		
Nicaragua															1	2	2		
Venezuela														1	1	2	1		
Guatemala															1			3	1
Honduras														1				2	2

Uruguay occupies the first position with the higher Frequency of numbers one. As well as Chile, in the five methods, it was in the second position. Argentina was in the third position tree time and two times in the positions four. An interesting fact Table 32gives us is that just Mexico did not repeat position in neither one method, then the rest of countries repeat position at least one time. Moreover, we are going to mention the positions of countries that obtained tree time that number like; Panama in tree methods she obtained the position six, Ecuador obtained the position ten, Dominica Republic obtained the position twelve, Colombia obtained the position thirteen, Brazil the fifteen and Guatemala the eighteen. In that way, we compare the nineteen countries analysed according to the composite indicator of the absence of poverty and the five methods computed.

FINAL CONCLUSIONS

Measuring poverty just based on income assumes that individuals in a society are distinguished only by that factor. Nevertheless, in most cases, people have insufficient levels of other attributes of well-being, like, for example, literacy, health care, unemployment and, more. Thus, an accurate measure of poverty should be based on monetary as well as nonmonetary attributes of well-being. That is why we can say that poverty cannot be measured with a single variable; it deserves a multi-dimensional analysis. In this work, we present six indicators. Which we saw were optimal for the analysis: GDP per capita, social spending, literacy, Gini index, unemployment and, corruption perception. In order to measure and analyse the poverty, a cluster analysis and a composite indicator were made.

All the countries that are considered Latin Americans were part of the analysis, except Cuba, because data was not found.

Even though all the variables work in an integrative way to provide a complete result, it was possible to see the behaviour of each concerning the poverty rate. These are the findings: unemployment has not a strong effect in poverty; it was evidenced because the most impoverished countries (according to the proposed composite index and the poverty rate) registered the lowest unemployment rate. On the other hand, the best-performing countries, as Uruguay, had not a good unemployment rate.

Then, a high corruption perception increases poverty; for example, Chile has the second-lowest corruption perception and is the second in the absence of poverty. In contrast, Nicaragua or Guatemala has the highest corruption perception and the lowest value of the absence of poverty. Moreover, literacy has a negative relationship; if the literacy increases the poverty will decrease and inverse., as well as GDP per capita and social spending that have a negative relationship as well, but to a lesser degree than literacy and corruption.

Gini index does not have a direct relationship with poverty; for example, El Salvador has the lowest Gini index but is not considered one of the countries with more absence of poverty.

Talking about the Cluster analysis, we conclude that the optimal number of groups for the study of poverty are five:

- In the first cluster: Argentina, Brazil, Chile, Colombia, Costa Rica.
- In the second cluster: Bolivia, Dominican Republic, Ecuador, El Salvador, Mexico, Panama, Paraguay, Peru, and Venezuela.
- In the third cluster: Honduras, Guatemala, and Nicaragua
- In the fourth cluster: Puerto Rico
- In the fifth cluster: Uruguay

These were grouped from the best-performing countries with more absence of poverty to the countries with a low absence of poverty. Furthermore, Puerto Rico is in a cluster alone because it has the highest GDP per capita and values that do not

share with the rest of the countries. For future research, we suggest to do not take Puerto Rico in to account as part of Latin America, because it has a different figure of government for being an associated country of the USA and has values that are not comparable to the other countries of this region.

And then, Uruguay is located in cluster five since it is the country that registered the best values in almost all the indicators, and it has been far from the other countries.

Therefore, for the construction of composite indicators, five methods were computed, which give us a positions of the degree of absence of poverty in each country. After the analysis and the comparison of the five methods applied, it is proposed a final ranking of the absence of poverty in Latin America. The ranking follows the Borda's rule that is based on the frequency matrix of all the methods computed.

Table 33 Final ranking - Absence of poverty in Latin America

Country	Position
Uruguay	1
Chile	2
Argentina	3
Bolivia	4
Costa Rica	5
Panamá	6
Perú	7
El Salvador	8
México	9
Ecuador	10
Puerto Rico	11
Dominican Republic	12
Colombia	13
Paraguay	14
Brasil	15
Nicaragua	16
Venezuela	17
Guatemala	18
Honduras	19

Table 33 shows that Uruguay is the country in Latin America with less poverty and Honduras the country with more poverty, thus, we can observe the position of each country. This calculation was proposed based on the construction of a composite indicator with five different methods.

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Appendix

Table A1 Variables

Variable	Definition	Unit	Source
Poverty rate	The poverty rate is the ratio of the number of people whose income falls below the poverty line; taken as half the median household income of the total population. It is measured in percentage .	Percentage	World Bank[2]
GDP per capita	Gross domestic product per capita is a measure of a country's economic output that accounts for its number of people. It divides the country's gross domestic product by its total population. That makes it a good measurement of a country's standard of living. It tells you how prosperous a country feels to each of its citizens.	US dollars	World Bank[3]
Social Spending	Public social spending is defined as the volume of resources allocated to finance policies related to the following six functions: 1) Social protection, 2) Education, 3) Health, 4) Housing and community services, 5) Recreational activities, culture and religion, 6) Protection of the environment.	Percentage of the GDP	ECLAC[4]
Literacy rate	Total number of literate persons in a given age group, expressed as a percentage of the total population in that age group. The adult literacy rate measures literacy among persons aged 15 years and above, and the youth literacy rate measures literacy among persons aged 15 to 24 years.	Percentage	World Bank[5]
Gini index	Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	Percentage	ECLAC[6]

[2] https://data.worldbank.org/topic/poverty

[3] https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

[4] https://www.cepal.org/es/publicaciones/44395-panorama-social-america-latina-2018

[5] https://data.worldbank.org/indicator/SE.ADT.LITR.ZS

[6] https://www.cepal.org/es/publicaciones/44395-panorama-social-america-latina-2018

Unemployment rate	Unemployment rate is the number of unemployed people as a percentage of the labour force, where the latter consists of the unemployed plus those in paid or self-employment. Unemployed people are those who report that they are without work, that they are available for work and that they have taken active steps to find work in the last four weeks. When unemployment is high, some people become discouraged and stop looking for work; they are then excluded from the labour force. This implies that the unemployment rate may fall, or stop rising, even though there has been no underlying improvement in the labour market.	Percentage	ECLAC[7]

[7] https://estadisticas.cepal.org/cepalstat/

Table A2 Data year 2018

	Poverty	GDP per capita	Social Spending	Literacy	Gini Index	Unemployment	Corruption Perception
Argentina	7.10	11683.95	13.50	99.00	41.40	9.20	40.00
Bolivia	24.70	3548.59	12.70	94.00	42.20	3.50	29.00
Brasil	21.00	8920.76	17.70	93.00	53.90	12.30	35.00
Chile	6.40	15923.36	16.40	97.00	44.40	7.20	67.00
Colombia	27.00	6667.79	12.60	95.00	50.40	9.10	36.00
Costa Rica	9.70	12027.37	12.10	98.00	48.00	10.10	56.00
Dominican Republic	19.90	8050.63	8.00	92.00	43.70	5.80	30.00
Ecuador	23.20	6344.87	9.00	93.00	45.40	3.50	34.00
El Salvador	29.20	4058.25	9.00	89.00	38.60	4.00	35.00
Guatemala	48.80	4549.01	7.00	81.00	48.30	2.50	27.00
Honduras	52.60	2500.11	8.00	87.00	52.10	5.60	29.00
México	34.80	9673.44	8.70	95.00	45.40	3.30	28.00
Nicaragua	34.90	2028.89	11.10	86.00	46.20	4.50	25.00
Panamá	14.10	15575.07	8.80	95.00	49.20	3.90	37.00
Paraguay	18.60	5821.81	8.60	94.00	46.20	6.20	29.00
Perú	23.90	6941.24	11.10	94.00	42.80	6.40	35.00
Puerto Rico	43.00	31651.35	7.80	92.00	54.00	9.20	44.00
Uruguay	8.10	17277.97	17.20	99.00	39.70	8.30	4.00
Venezuela	35.60	3410.80	7.00	97.00	46.90	7.50	18.00

Table A3 Data year 2010

	Poverty	GDP per capita	Social Spending	Literacy Rate	Gini Index	Unemployment	Corruption Perception
Argentina	11.30	10385.96	11.07	98.96	44.50	7.71	2.90
Bolivia	51.30	1955.46	12.35	91.85	47.60	6.50	2.80
Brazil	24.90	11286.24	14.99	90.83	53.00	6.70	3.70
Chile	11.50	12808.03	14.84	97.40	46.50	8.43	7.20
Colombia	37.20	6326.55	12.21	93.37	54.70	10.98	3.50
Costa Rica	18.90	8141.91	11.87	96.90	48.20	7.17	5.30
Dominican Republic	41.10	5555.39	6.30	89.54	47.30	5.21	3.00
Ecuador	32.80	4633.59	8.08	91.85	48.70	4.08	2.50
El Salvador	36.50	2983.24	9.30	84.49	43.50	4.89	3.60
Guatemala	54.80	2825.48	8.00	81.54	54.60	3.49	3.20
Honduras	68.00	1904.35	11.70	84.76	53.10	4.19	2.40
México	34.80	9271.40	9.64	93.07	47.20	5.30	3.10
Nicaragua	49.60	1503.87	9.30	87.00	44.00	7.83	2.50
Panamá	29.80	8082.03	9.50	94.09	51.60	3.71	3.60
Paraguay	39.00	4355.93	6.40	93.87	51.00	4.57	2.20
Perú	34.00	5082.35	9.47	92.30	45.50	13.48	3.50
Puerto Rico	36.20	26435.75	10.50	91.97	55.00	16.10	3.10
Uruguay	10.40	11992.02	12.70	98.06	44.50	7.16	6.90
Venezuela	27.80	13825.36	9.00	96.10	49.00	7.11	2.30

Table A4 Data year 2000

	Poverty	GDP per capita	Social Spending	Literacy Rate	Gini Index	Unemployment	Corruption Perception
Argentina	37.00	7708.10	9.30	97.19	51.10	15.00	3.50
Bolivia	60.60	997.58	11.50	88.70	61.60	4.47	2.70
Brasil	37.50	3749.75	12.50	86.37	58.20	7.10	3.90
Chile	20.60	5074.90	14.51	94.89	52.80	10.49	7.40
Colombia	54.90	2520.48	8.40	91.80	58.70	20.52	3.20
Costa Rica	20.30	3772.87	9.10	94.87	47.40	5.80	5.40
Dominican Republic	32.40	2869.11	8.40	86.40	51.50	6.43	4.60
Ecuador	45.00	1445.28	5.80	90.10	56.20	4.80	2.60
El Salvador	49.80	2001.54	3.18	80.20	51.50	6.96	4.10
Guatemala	60.50	1655.59	8.00	68.53	54.20	7.50	3.00
Honduras	79.70	1080.46	6.50	79.70	55.60	28.00	2.40
México	46.90	7157.81	7.20	90.54	42.60	2.56	3.30
Nicaragua	65.10	1007.50	6.30	75.70	53.00	19.00	2.70
Panamá	24.20	4060.32	6.50	91.90	56.80	13.53	3.70
Paraguay	51.70	1663.61	8.40	94.00	54.60	7.61	2.20
Puerto Rico	37.80	16192.13	6.60	92.60	56.70	10.08	3.80
Perú	50.00	1955.59	9.07	87.40	49.10	7.80	4.40
Uruguay	27.30	6875.02	11.80	96.98	43.00	12.63	4.50
Venezuela	44.00	4842.04	8.70	91.30	48.20	14.00	2.70