Why does poverty persist in Latin America emerging economies? A spatial econometrics application for the Colombian case

ABSTRACT

This paper seeks to prove that despite the efforts made by governments in terms of reducing poverty have not been strong enough to achieve levels of convergence within the countries. In this sense, two hypotheses are tested: (i) the poverty has persisted in the last two decades in most countries of Latin America and (ii) there is spatial dependence among the political administrative units (departments) that explain this phenomenon. The testing strategy consists of providing evidence for an emerging economy like the Colombian and for that, the monetary poverty data between 1997-2019 are analyzed for the 23 main departments and its capital Bogotá DC. Subsequently, a General Nesting Spatial Model by panel data is estimated, which examines the degree of association of two components based on theory as poverty reduction: economic growth and income distribution and control variables such as unemployment and murders rates, percentage of women and two measures of conflict in order to know if they are consistent when spatiality is involved. The results confirm the hypothesis of persistence of poverty, since the analysis of beta and sigma convergence suggest that it takes 16.4 years for the poverty gaps to be reduced by half in Latin America and 17.3 years for Colombia. Besides, the hypothesis of spatial dependence is sustained and, therefore, the estimates made to analyze it that did not consider this assumption have been biased and inefficient. Finally, its verified that there are positive effects of economic growth and the mechanisms of income distribution to reduce monetary poverty. Likewise, the murder and unemployment rates, percentage of women and the conflict variables explain the persistence of poverty.

JEL Classification: I32, C33, O47, O15

Keywords: poverty, spatial econometric, convergence, economic growth, income distribution

Introduction

The proclamation of the Millennium Development Goals by the United Nations Development Program (UNDP) in 2000 led social policymakers in 189 countries to seek alternatives that would improve the quality of life of the vulnerable population, being the reduction of poverty levels one of the objectives under the precept of finding mechanisms that promote equality and individual freedom for all actors in society. Almost two decades later it is observed that the effort made until then has not been entirely successful. Latin America is among the regions with the highest rates of poverty and inequality in the world, which has been attributed to the dynamic economic insufficiency, and it is understood as lower rates of economic growth and high levels of population. Therefore, the strategy of reduction was directed to promote the increase of the first factor (growth) and tend towards the reduction of the second (population), leading to an eventual demographic transition (Filgueira, 2004, p. 5).

The Economic Commission for Latin America and the Caribbean -ECLAC- has conducted numerous studies that allowed the countries of Latin America to be grouped according to their poverty situation and the effort they should make to reduce it. Indeed, the literature has presented Argentina, Colombia and Venezuela have the most critical situations, followed by Paraguay. While Bolivia, Peru and Honduras are just beginning to accomplish the millennium goals, with lower percentage advances than expected. Other countries, including Costa Rica, El Salvador and Nicaragua were in a slightly more favorable situation. The most satisfactory result was for Chile, which was able to reduce by almost half the number of people living in poverty (Agostini, Brown, & Góngora, 2008) while Brazil was close to meeting the same goal without having high economic growth (Ravallion, 2011). Meanwhile, Mexico has presented cycles where poverty rates have been markedly reduced,

but since 2002 it has entered a path of low income growth and higher rates of inequality (Iniguez-Montiel, 2014).

Meanwhile, Colombia has been consistent with the inverse dynamic of higher economic growth and lower poverty rate. In the years 1999 and 2000, Colombia presented high poverty rates, 56.38% and 62.37% respectively, attributed to the deceleration of the Gross Domestic Product (GDP) as response to the increase in the fiscal deficit of the public and private sector (36% in the year 1992 to 58% in 2000). This reduction affected the labor dynamics and increased the number of unemployed (Caballero, 2000). On the other hand, the poverty in 2010 was close to 45.37%, mainly explained by the performance of the economy in the first decade of the 21st century. The described context suggests a close relationship between economic performance, the labor market and poverty. Nevertheless, it's possible to conclude that the economic growth benefits all the actors of society in an impartial manner, including the poor (Dollar & Kraay, 2002). It makes it praiseworthy to believe that the persistence of poverty can be intrinsically associated with problems of the economies low growth, low-income distribution and therefore, it is necessary to deepen the issues different from economic development to look for factors that contribute in the explanation of this phenomenon: what about the space? for instance.

The literature review generates doubts about the performance of Latin American governments in terms of poverty reduction, since apparently the results have not been consistent, and it would not be possible to conclude that Latin American region has significantly reduced poverty at least in recent years. It is clear that the deprivation of opportunities and the lack of public services faced by the population in these emerging economies is high and ends up creating poverty traps. On the other hand, a large part of the research carried out so far has not considered that this social phenomenon can be variant among the administrative units within each country (spatial heterogeneity) and has recognized the possible existence of a functional relationship between what happens at a certain point in space and what happens elsewhere (autocorrelation spatial). Both explain the dynamics of poverty: there are neighborhoods with high poverty that would lead to the resident population having low levels of education and job aspirations that are transmitted to children (Bowles, Durlauf, & Hoff, 2006, p. 157). The lack of the last assumption leads to biased and inefficient results that could be overestimating or underestimating the relationships found (Anselin, 2001; Driscoll & Kraay, 1998; LeSage, 2008; Plümper & Neumayer, 2010).

Therefore, this research studies the poverty with the methodological and theoretical tools of development economics such as beta unconditional convergence (Barro, Sala-i-Martin, Blanchard, & Hall, 1991) and sigma convergence (Bernard & Durlauf, 1996; Quah, 1993). Besides, an Exploratory Spatial Data Analysis (ESDA) and a General Nesting Spatial Model (GNSM) is estimated after following the identification method forward stepwise by Florax, Folmer and Rey (2003). The testing strategy follows three levels. The first provides empirical evidence to support the persistence of poverty in most Latin American countries. Subsequently, the analysis of poverty in Colombia begins in order to demonstrate that the persistence is explained due to the dependence that administrative units have with the geographic space in which they are located. In the last place, this research advances in the specification of a spatial econometrics model that analyzes the degree of association between poverty and variables of recognized trajectories in the explanation of the phenomenon: economic growth and income distribution. Also, this paper introduced the Intensity and Pressure Indexes of the conflict to know if there is any relationship with the poverty. Colombia has been immersed in along internal conflict for decades and this could have an impact on the prevalence of poverty in at least the departments with the greatest institutional weakness. The variables unemployment rate, the percentage of women and murder rate per 10 thousand inhabitants as controls are included.

The two hypotheses formulated in this paper are evaluated using three clearly identified strategies. The first seeks to provide empirical evidence to support the persistence of poverty in most Latin American countries. The beta unconditional convergence proposed by Barro, Sala-i-Martin, Blanchard, & Hall (1991) and sigma converge with kernel stochastic documented in Bernard & Durlauf (1996) and Quah (1993) is calculated for Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, México, Panamá, Paraguay, Perú and Uruguay. There is no mentioning of other countries because there is insufficient information available to other countries in at least 19 years. After studying the persistence hypothesis, the second strategy consists in the analysis of the 24 main administrative units in Colombia with the aim of testing that poverty

persisted in Latin America and that the result can be explained because within the countries there were no convergence processes during at least two decades (Colombian case) and the poverty gaps are high between those units. The ESDA sustains the appropriateness of carrying out a spatial examination of poverty, since the univariate global and local analysis of Moran's Index, C-Geary and Getis & Ord demonstrated the conformation of cluster but not of conglomerates. Thus, a General Nesting Spatial Model (GNSM) by panel data is defined from identification method by Florax, Folmer and Rey (2003).

The dataset used comes from institutional sources. The poverty data by Latin America comes from the statistical repository of the Economic Commission for Latin America and the Caribbean for the years 1999 and 2017, years in which most countries had information. For Colombia, the poverty and income distribution data are taken from the National Administrative Department of Statistics (DANE acronym in Spanish) and the bulletin 26 of the Economic and Social Situation of the National Planning Department (DNP acronym in Spanish), with which it was possible to consolidate the 1997-2019 period. The variables of economic growth and control are taken from DANE. The indexes of conflicts are taken from Registry Unique of Victims. In the section on empirical strategy, each one is presented in detail.

The paper is structured as followed. The first section presents the literature review. In the second section, a note on poverty measurement that justifies the use of the poverty lines method is exposed. The third section is the empirical strategy, presenting the source of the data, the corrections and imputation method to them, their main summary statistics and the specification model. The fourth section shows the convergence and ESDA analysis of Latin America and Colombia. The fifth section presents the results of spatial econometric estimation and the conclusions, limitations and policy recommendations are part of this chapter too.

1. Literature Review

Most literature on poverty focuses on the discussion about access to a basic food basket and the lack of essential conditions to develop and participate in society. Indeed, economic growth is associated with poverty reduction. In particular, growth in labor-intensive economic activities has important distributional effects and it is fundamental for fighting poverty. Thus, this literature review presents the seminal literature on poverty and combines it with the recognition of neighbor effects. This combination allows us to think about whether the magnitude of the effects found may or may not be intensified by the fact of being surrounded by poor neighbors. Several papers using spatial econometrics have shown the importance of neighbor effects to better understand poverty dynamics (Zezza, Carletto, & Davis, 2005; Grengs, 2007; Treviño -Cantú, 2015; Fleming, Abler & Goetz, 2010)

1.1 The effects of economic growth on poverty

Squire (1993) analyzed 31 countries that represented 80% of the world's population and found that if the economic growth rate was increased by 1%, it was possible to reduce poverty by 0.24 percentage points. However, the most relevant conclusion of this research lies in the assumption that promoting productivity in the use of labor unskilled, there would be a greater reduction of poverty since this factor constitutes the main property asset of the poor. Ravallion (1995) and Roemer & Gugerty (1997) found that growth effectively reduces poverty. The second authors suggest that if there's growth of 10% GDP per year, the average income of 40% of the poorest population would increase in the same proportion, while for 20% of this population, the increase in income would be 9.21%. On the other hand, the first author proposes that an increase of 1% of the average income reduces in 2.42% in the number of people who receive $1 USD/day.

Ravallion & Chen (1997) highlighted that the average income is a positive mechanism to reduce poverty, since it allows a reduction of 3% of incidence in poverty, measured as an indicator built under the poverty line of $1 USD/day. A similar study was carried out by Bruno, Ravallion, & Squire (1998) in 20 developing countries, where they returned the growth rate of the population living with less than $1 USD/day per person (as a measure of poverty) compared with the growth rate of an average income of the economies under study. It said that if average incomes increase by 1% there will be a reduction in the population that lives with less than $1 USD/day of 2.12%. Additionally, they studied the effects of inequality growth in poor countries, concluding that there

isn't a clear implication, and that the interpretation that must be made is that if inequality is not invariant over time, economic growth significantly reduces poverty.

The most cited paper in this field was written by Dollar & Kraay (2002) who found that growth is good for poverty reduction. After studying 92 countries, over four decades, they concluded that the average income of the poorest 20 percent of the population grew, on average, at the same rate as the average income of the total population. However, they point out that although the poor tend to benefit from economic growth in some way, there are differences between the average benefits they receive and the rest of the population, a premise that argues the need to explore these differences more rigorously. Hence, the importance of using the economic growth as a mechanism to reduce poverty. Nevertheless, it leaves us to glimpse the existence of alternative specifications that prevent the impacts of economic growth from having the same effect for everyone. Possibly, some of these specifications derive from the way in which economic growth is oriented (concentrated in sectors with low intensity of labor) or in the way in which the gains of growth are distributed.

Ravallion & Datt (1996) found that both growth in the agricultural sector and the service sector in India had a positive impact on poverty, while growth in the manufacturing sector had an equally positive effect but of a smaller magnitude. In a similar research for Southeast Asia, Warr (2002) concludes that growth in the agriculture was more important for the reduction of poverty than growth in the manufacturing or in the service sector. In Brazilian case, Ferreira, Leite, & Ravallion (2010) find that growth in the services sector had a greater impact on poverty reduction than growth in the agricultural and manufacturing sectors. However, in this research they suggest that the mechanism that played an important role in reducing poverty was the control of hyperinflation in 1994. Besides, the authors emphasize that despite concentrating all efforts on maximizing per capita income growth, it may be an unsuccessful strategy in terms of poverty reduction if this growth does not include the sectors with high participation of the poor population, in especial unskilled labor force.

Two more recent studies suggest positive effects that education has on reduction of poverty, complementing economic growth. Cherng & Hannum (2013) proved that the industrialization and impoverishment of communities in China were explanations for the educational gaps between genders in China. The authors review the characteristics of poor people based on a longitudinal study done on households for a single province. The main results are in the high correlations between impoverishment and industrialization with the gaps, these are also associated with the isolation generated by rurality, but these gaps are different as the educational levels of the people are analyzed. As income increases, women perform better than men in school, even though they are more involved in the industrialization of the country. Thus, educational environments are also important in the analysis of poverty gaps.

The paper written by Klasen & Reimers (2017) analyzes the Quality of Life Surveys for Rwanda in the periods 1999-2001, 2005-2006 and 2010-2011 where the investment in technical improvements in agriculture was considered an effective policy to reduce poverty. Thus, the authors find that the reduction of poverty during the period analyzed in Rwanda is attributable not only to changes in income resulting from higher productivity in agriculture but also to improvements in access to a better education system and to an increase in health coverage. The new tools provided by the authors indicate that the productivity growth of the poorest was faster than the one of the richest. The gaps in productivity between the richest and the poorest within the country are associated with the endowments in education, so it is recommended to make a greater investment in education in the future to reduce these gaps even more. Indeed, Fresneda, González, Cárdenas, & Sarmiento (1997) suggest that the resources of specific allocation of the budget, particularly those dedicated to education and health reduced poverty in Colombia in the eighties, meanwhile Nuñez, Ramirez & Cuesta (2005) found that changes in income distribution and changes in household endowments are the explanation for the increase in poverty between 1996 and 2000.

1.2 Income Distribution

An alternative field oriented to establishing the growth in favor of the poor is developed by Kakwani & Pernia (2000) where they introduce the concept of pro-poor growth as: "*the one that grants them a greater benefit*

compared to the non-poor", arguing that economic growth is accompanied by distributional changes prioritizing this population. Consequently, they propose a new indicator that measures "*pro-poor growth rate*"which was used to analyze the nature of economic growth in the Korea Republic, the Democratic Republic of Laos and Thailand. The result of this research expresses that in these economies growth was oriented in favor of the poor, characterized by adequate income distributions. In this order of ideas, understanding the impact that some sectors of the economy have on poverty deserves greater attention. For this, the best interpretation that can be made about growth in the sectors that make use of the greatest productive factor that this population has, is articulated in the theoretical definition presented by Ravallion (2005). Indeed, it can be that in an economy, growth is pro-poor when the income of the poor population increases more than the income of the rest.

Deininger & Squire (1996), Ravallion & Chen (1997) and Dollar & Kraay (2002) determined that the income of the poor increases in greater proportion than the income of the rest of the population, once economic growth is presented. However, in this context the results obtained were not consistent since they didn't reach consensus regarding the distributive effect of economic growth. Subsequently, a second definition on pro-poor growth is development. Poverty will be reduced independently if the income of the poor rises equal to or even less than the income of the rest of the population. Some of the most outstanding papers that compile this theoretical definition were written by Lopez & Serven (2004) and Kraay (2006). Kraay concluded that the economic growth is important in relation to the distributive changes to explain the reduction of poverty. Differently, a research oriented to analyze the distributional effects on poverty is carried out by Nuñez & Sanchez (2000) in Colombia. In this case, subsidies destined to education reduced poverty by 6.6%, health programs by 4.78%, and finally, subsidies destined to the protection of children, decreased the incidence of poverty in 0.58%.

Ravallion (2009) focused on analyzing why despite the progress experienced in welfare states in developing countries, there is still no convergence in the poor in these countries. The lack of convergence, even though the convergence in income and economic growth are responsible for the reduction of poverty, it must be that the distribution of income in developing countries has favored the advance of the backwardness but the time the growth progress. In other words, despite economic growth, it can be shown that the poorest have not benefited from this growth, despite the efforts of the States to reduce poverty. Thus, the author found that poor countries face a very particular situation: lower rates of growth, which prevent them from achieving convergence in both economic growth and the reduction of poverty. The higher the poverty, the lower the growth rate due to the low productivity of the labor force, plus the growth of each country, which only benefits the richest due to the productivity of capital. These two effects make the poorest developing countries increasingly distant from convergence in growth and poverty reduction. The consequences of this type of disadvantage are the low capital endowments that countries have, so one of the effects of this is the lack of employment policies effectiveness, and the low indicators of human development in these countries.

Indeed, according to the contributions made by the authors cited above, it is possible to recognize the strong link that exists between economic growth and income distribution as mechanisms to reduce poverty. However, the effectiveness of these mechanisms lies in the way in which it presents the growth and the characteristics of the sectors that drive it. In congruence, the adequate combination of economic policies that allow increasing levels of economic growth, complemented by social policies aimed at efficient gains distribution of growth, will allow a higher and consistent reduction of poverty.

1.3 Spatial econometrics and neighborhood effects

The spatial econometrics allows to recognize that social phenomena depend on space to the extent that the variation of a government policy not only affects a department, but can also affect its neighbors, for example. In that sense, Voss, Long, Hammer, & Friedman (2006) review the variations between counties through an exploratory analysis of spatial data to analyze the variations in the risk of children growing up in conditions of poverty, with data available for the United States in 1990. In a preliminary review, the authors seek to replicate documents with similar data to contrast the results by applying more sophisticated regression models. In this way, when finding spatial autocorrelation, they suggest that the risk of being in a situation of poverty is distributed through patterns and highlight the importance of introducing spatial analysis under the pretense of

finding more robust errors and a considerable reduction in the spatial correlation between waste of the model. The authors identify that a much more rigorous analysis of spatially generated externalities is required to achieve a better explanation of the patterns that explain the distribution of poverty in different areas, and therefore, explain the spatial patterns (low-low and high-high) that explain the risk of a child living in conditions of poverty, especially the effects of residence and family effects on the probability of being in poverty.

In this same line, in a later work, Chetty, Hendren, & Katz (2016) present the results of the experiment "The moving to opportunity (MTO)" that offered subsidies to families living in very poor neighborhoods of 5 large cities in the United States (Baltimore , Boston, Chicago, Los Angeles and New York) during 1994 and 1998 and was monitored for 12 years in three control groups (those who received subsidies and could only choose neighborhoods with very low poverty, a group that received subsidies and could choose where live, and a group that was not a beneficiary of the subsidies) to choose to move to neighborhoods with less poverty rates. The authors analyze the effect of this measure on children from variables such as school attendance, and children's housing choices when they have grown up. The authors found that the incomes of the young people who moved are 31% higher than the average of those who did not move, when the displacement happens before turning13 years old. There are negative effects associated with the adaptation of children to the environment, when this displacement happens after 13 years, and the potential gains are falling as the displacement happens at older ages. The policy implications show that the reduction of urban segregation through a better endowment of public goods, or a subsidy policy that allows certain families to choose better neighborhoods, could have a great impact on reducing the persistence of poverty, which would be reflected in higher tax revenues, so the social return on investment is high.

Jiménez & Alvarado (2018) with data from the integrated system of social indicators of Ecuador (SIISE), the INEC and the Central Bank (ECB) analyze at the canton (county) level, the effects of labor productivity and human capital on poverty for 221 observations that cover the map of the whole country in the year 2010. For this reason, georeferenced indicators of the economic and social conditions of the country are used. Using spatial regression methods, the authors analyze the causal relationships between poverty and human capital. Instrumental variables were used to correct the endogeneity in the model, and an exploratory analysis was made using spatial correlation coefficients such as the Moran index and maps of local spatial association indicators (LISA). There is a negative correlation between human capital and poverty, and high-high and low-low spatial patterns are also identified, which show that both human capital and poverty are spatially concentrated, which generates regional disparities that require interventions by policy to promote education and job training in the most vulnerable areas, accompanied by an employment strategy.

The literature presented synthesizes the broad discussion around the determinants that affect poverty, recognizing that this research is far from providing a solution in favor of economic growth or income distribution. However, there is lag in research that incorporates the spatial effects in their explanation. There is a theoretical conceptualization called poverty traps that explains, for example, why children with parents in poverty are more likely to remain in such condition. In that sense, it has not been considered that if people living in poverty are surrounded by a neighborhood that presents the same situation, the persistence of poverty can be explained by an effect of spillovers and this should be introduced in the econometric specifications previously made (Durlauf, 1994). Thus, this research is pioneer in the unification of the concepts of development economics and the methodologies of spatial econometrics to explain this social phenomenon. Indeed, this brief review suggests that strategies aimed at promoting the provision of public goods, access to markets and training in human capital in the most vulnerable areas, generate positive externalities in nearby environments and also guarantee the elimination of the generational persistence of the poverty, which is why these policies present fairly high social returns that would allow them to invest in overcoming poverty with a focus on access to opportunities, over and above subsidies or other types of policies.

2. A note on poverty measurement

In the studies on poverty there is no evidence of a predominant consensus between a technical or theoretical approach that defines and quantifies poverty. It is clear that poverty is a multidimensional phenomenon that

encompasses both aspects of income restriction (technical approach of poverty lines) and capacity development (technical approach of multidimensional poverty), the qualities of the treatment discern the statistics available for its study. For this reason, it is necessary to use an interpretation of the term poverty that is related to the methodology used for its construction.

The poverty lines approximation allows us to measure, in monetary terms, the income required by individuals to guarantee the minimum consumption of a basic food set and, in this way, guarantee their survival. In Ravallion (1998) there is a broad description of the objective and subjective approaches of the poverty lines, which allows to understand that the determination of a food set can be articulated in a broader way and even when considering other theoretical aspects, this being the most used approach in the construction of indicators that allows to quantify poverty. But then, the measurement of poverty from multidimensionality approach complements the indexes based on monetary measures. Additionally, it considers the limitations and deprivations experienced by this population. One of the most referenced investigations in treating poverty from this approach was written by Sen (1997) who introduced the term of deprivation of basic capacities, which does not allow the less favored populations to take part of society. These deprivations do not only allow people to achieve certain levels of food, but also prevent them from dressing properly, living in a house with suitable public health conditions, participating in collective decisions, among other aspects.

The United Nations Development Programme -UNDP- defines poverty as the inability of people to live a tolerable life, which allows them to live healthily, access education, enjoy political freedom, get a job, among other factors. Similarly, Spicker (2013) identifies, even in a more multidimensional way, eleven possible ways of interpreting poverty: need, standard of living, insufficient resources, lack of basic security, lack of entitlements, multiple deprivation, exclusion, inequality, class, dependency and unacceptable suffering. Another research that defines poverty as a multidimensional process was the one that was carried out by Boltvinik (2003) in which the well-being of households and people depends on six sources: current income, non-basic assets and capacity of household debt, family assets, access to free goods and services, free time and availability for domestic activities, education and rest and, the knowledge of the people. Indeed, the brief presentation of this approach aimed at exposing the first limitations of this paper. The lack of multidimensional poverty data for Colombia, since it is not available for the period here under review, addresses the 24 main administrative units of the country. This being the main input to explore why poverty persists within the countries once the hypothesis for Latin America is verified.

3. Data and descriptive statistics

The dataset used comes from one international institution and three Colombian national institutions. The poverty statistics for Latin America come from the statistical repository of the Economic Commission for Latin America and the Caribbean (ECLAC) for the years 1999 and 2017, years in which most countries have information of lines poverty. For Colombia, the poverty and income distribution data are taken from the National Administrative Department of Statistics (DANE acronym in Spanish) and the bulletin 26 of the Economic and Social Situation of the National Planning Department (DNP acronym in Spanish), with which it was possible to consolidate the 1997-2019 period, the poverty database most extended available in Colombia. The incorporated variables of economic growth and control come from DANE, meanwhile, the indexes of conflicts are taken from Registry Unique of Victims. The result of this analysis led to a balanced data panel with 552 observations. Besides, the monetary poverty data are reported for by ECLAC from 1981-2018 and the money line has been defined at 5.5 dollars per day. However, Cuba, the Dominican Republic, Guatemala, Nicaragua and Puerto Rico did not present data in 1999 and 2017, either in years before or after these to be imputated through a simple mean, as was done with Chile, El Salvador and Mexico in 1997 and Mexico 2017. For this reason, it was not possible to analyze them in beta unconditional convergence and sigma convergence for these countries.

Table 1. Statistics analysis poverty Latin America

Country	1999	2017	Mean	Better/Worst
Uruguay	9.10	2.80	5.95	-26.15
Argentina	24.20	7.70	15.95	-16.15
Chile	30.10	3.70	16.90	-15.20
Costa Rica	30.00	9.70	19.85	-12.25
Panamá	36.90	14.10	25.50	-6.60
Paraguay	37.20	18.60	27.90	-4.20
Brazil	45.90	20.40	33.15	1.05
Perú	53.50	23.90	38.70	6.60
El Salvador	49.90	28.90	39.40	7.30
Bolivia	54.80	24.70	39.75	7.65
México	48.80	33.50	41.15	9.05
Colombia	58.30	27.60	42.95	10.85
Ecuador	63.50	23.20	43.35	11.25
Honduras	65.20	52.60	58.90	26.80
Mean	**43.39**	**20.81**	**32.10**	

Source: author's calculations using ECLAC data

Table 1 shows an analysis of the performance of the states in terms of poverty reduction. The mean of poverty in the countries group analyzed is 32.10% and examining their difference Uruguay, Argentina, Chile, Costa Rica, Panamá and Paraguay have made a considerable reduction on the measurement. Honduras had the worst performance, followed by Ecuador, Colombia, Mexico, Bolivia, El Salvador and Perú. Brazil has remained close to the regional mean. On the other hand, the measure of poverty in Colombia represents the number of the poor over the total of a single reference population, constructed by means of a spatial price deflator that allows the ordering of the entire population under the same criterion of expenditure per capita through poverty lines. In the period 1997-2000 poverty was measured with the Quality-of-Life Survey (ECV), while in the period 2002-2019 poverty was constructed with information from the Large Integrated Household Survey and Continuous Household Survey. The poverty and the Gini coefficient were elaborated by the Mission for the Connection of the Employment, Poverty and Inequality Series (MESEP acronym in Spanish). In that sense, there is no data for 2001, 2006 and 2007. Therefore, data imputation process was carried out from the estimation of a semilogarithmic model specified by temporal component and region, where after implementing a test of average values for unpaired samples, the hypothesis that the average values are equal is not rejected (see Annex 1 and Annex 2).

The economic growth was defined as GDP per capita (constant 2015 Colombian pesos) and disaggregated into five economic sectors, according to the strategy by Weller (2004), Bonet (2007) and Ferreira, Leite, & Ravallion (2010): primary, secondary extractive, non-extractive, genuine services and spurious services . In the meantime, to capture the distributional effects of poverty, a distribution index is constructed by subtracting one from the Gini coefficient. The unemployment rate, female share of the population and the murder rate per 10 thousand inhabitants as controls are included as controls. Finally, the intensity index is defined as the number of individuals in forced displacement (expelled) by a department over the total population of department per 1000 inhabitants. Meanwhile, pressure index shows the number of individuals arriving in a department on the population total of the receiving department, per 1000 inhabitants. Both indicators seek to examine the incidence of the armed conflict affecting poverty in Colombia.

Table 2. Descriptive statistics Colombia 1997-2019

Variable	1997					2019				
	N	Mean	Std. Dev	Min	Max	N	Mean	Std. Dev	Min	Max
Poverty	24	55.204	9.234	35.1	72.5	24	41.929	13.562	20.400	68.400
Index distribution	24	0.495	0.059	0.34	0.61	24	0.495	0.038	0.440	0.600
Primary sector	24	$1,672.5	$1,342.3	$32.2	$5,494.8	24	$2,131.8	$1,947.3	$13.1	$7,449.9
Extractive sector	24	$304.6	$366.4	$4.7	$1,495.2	24	$1,466.5	$3,189.7	$12.8	$14,864.1
Non-Extractive sector	24	$2,804.7	$4,471.4	$57.6	$17,550.7	24	$6,638.3	$8,754.0	$203.5	$30,725.3
Spurious sector	24	$2,312.2	$3,101.2	$202.9	$13,967.9	24	$7,069.3	$11,522.7	$549.6	$54,716.4
Genuine sector	24	$5,544.2	$8,848.4	$600.1	$39,459.5	24	$15,022.3	$25,618.8	$1,497.2	$121,066.9
Unemployment rate	24	0.122	0.024	0.090	0.190	24	0.105	0.027	0.050	0.150
Women percentage	24	0.507	0.011	0.480	0.532	24	0.508	0.008	0.494	0.525
Murder rate	24	4.904	3.406	1.200	16.000	24	2.367	1.085	0.600	4.700
Intensity index	24	11.587	33.090	0.030	163.880	24	1.863	2.871	0.010	11.710
Pressure index	24	6.215	10.326	0.270	47.360	24	1.247	1.176	0.080	4.000

Note: GDP variables by economic sectors are presented in billions of Colombian pesos.

Table 2 presents the main descriptive statistics of the variables included in the model. The poverty is heterogeneous in Colombia, since observing the statistics in two different years, there is at least one department with poverty rates of 72.5% (max value in 1997) on average, while others are close to 20.40% (min value in 2019). Likewise, the distribution index suggests that although there are departments with a better income distribution, the standard deviation establishes that there is not much variation in the average values. Indeed, it seems not to vary in the last 20 years. Therefore, poor departments could face high poverty rates and low levels of income distribution, while others would have low poverty rates and similarly low levels of income distribution. On the other hand, the GDP per capita is in Colombian pesos and it is observed that, on average, the Colombian economy produces a greater quantity of goods and services in the secondary and tertiary sectors. There are not substantial differences in the percentage of women and men in the departments and the unemployment rate has been relatively high since it remained in two digits on average. Indeed, poverty, the homicide rate, and the levels of pressure and intensity of the conflict have decreased in the last 20 years.

4. Econometric Model

The econometric specification has a data panel structure with random effects of the log-log form. Thus, equation 1 reports eleven coefficients based on economic growth theory (1-5), on distributional effects (6), population characteristics controls and labor market outcomes (7-9) and two measures of internal conflict (10-11) with the interest of exploring if they explain poverty (10-11). The subindex i represents the 24 administrative units and t the number of years for a total of 552 observations. The random effect has an expected value of α and random of v_i.

Meanwhile, Ravallion & Datt (1996) found that these transitions in the productive structures of developing countries do not allow to conclude that growth of a specific sector has, proportionally, the same impact on poverty. In fact, the impacts on poverty depend on the size of the sector. Considering those precisions, it was decided to weigh the growth rates with the participations of each economic sector in GDP with $s^{J}_{it} = Y^{J}_{it} / Y_{it}$ where J represents the economic sector. So, the impacts generated by the sectors on the poverty are stabilized by their participation (Ferreira et al., 2010, p. 6).

$$\begin{aligned}\ln(\text{poverty}_{it}) = {} & \alpha + \beta_1 s_{it}^{\text{primary}} \ln(\text{Primary\_sector}_{it}) + \beta_2 s_{it}^{\text{extrac}} \ln(\text{Extractive\_sector}_{it}) + \beta_3 s_{it}^{\text{nonextrac}} \ln(\text{Non\_Extractive\_sector}_{it}) + \\ & \beta_4 s_{it}^{\text{spurious}} \ln(\text{Spurious\_sector}_{it}) + \beta_5 s_{it}^{\text{genuine}} \ln(\text{Genuine\_sector}_{it}) + \beta_6 \ln(\text{Distribution\_index}_{it}) + \\ & \beta_7 \ln(\text{Women\_rate}_{it}) + \beta_8 \ln(\text{Unemplyment\_rate}_{it}) + \beta_9 \ln(\text{Murder\_rate}_{it}) + \\ & \beta_{10} \ln(\text{Intensity\_index}_{it}) + \beta_{11} \ln(\text{Pressure\_index}_{it}) + \nu_i + \varepsilon_{it}\end{aligned} \quad [1]$$

This research used the method of identification *forward stepwise* by Florax, Folmer & Rey (2003). It concluded that the data generating process occurs through the estimation of General Nesting Spatial Model. The matrix presentation of the model is exposed in equation 2, where $W\ln(Y_{it})$ are the effects endogenous interaction of the dependent variable, $W\ln(X_{it})$ are the effects exogenous interaction between the independent variables, $W\upsilon$ are the effects of interaction between the terms of errors of the different administrative units, λ the autoregressive spatial coefficient, ρ the spatial coefficient of autocorrelation, θ and β are fixed and unknown parameters of order Kx1 . Besides, W is the spatial weights matrix standardized Queen type.

$$\ln(Y_{it}) = (I - \lambda W)^{-1}[W\ln(X_{it})\beta + \ln(X_{it})\theta + v_i + \rho u + e_{it}] \quad [2]$$

Finally, LeSage and Pace (2008), the proper marginal effects that need to be interpreted are not only the β parameters. This can be seen by:

$$\begin{bmatrix} \frac{\partial E(lnY)}{\partial X_{1k}} & \frac{\partial E(lnY)}{\partial X_{Nk}} \end{bmatrix} = \begin{bmatrix} \frac{\partial E(lnY_1)}{\partial X_{1k}} & \frac{\partial E(lnY_1)}{\partial X_{Nk}} \\ \frac{\partial E(lnY_N)}{\partial X_{1k}} & \frac{\partial E(lnY_N)}{\partial X_{Nk}} \end{bmatrix} = \begin{bmatrix} \beta_k & W_{12}\theta_k & W_{1N}\theta_k \\ W_{21}\theta_k & \beta_k & W_{2N}\theta_k \\ W_{N1}\theta_k & W_{N2}\theta_k & \beta_k \end{bmatrix} \quad [3]$$

In equation 3, the diagonal elements of this matrix represent the direct effects, which tell us how a change in an explanatory variable for individual i affects the dependent variable for department i. The off-diagonal elements of this matrix represent the indirect effects which indicate how a change in an explanatory variable for department i affects department j, where $i \neq j$ and the total effects are the sum of the direct and indirect effects. Error and fixed terms $(v_i + \rho u + e_{it})$ drop out due to taking expectations. So, table 4 presents these results.

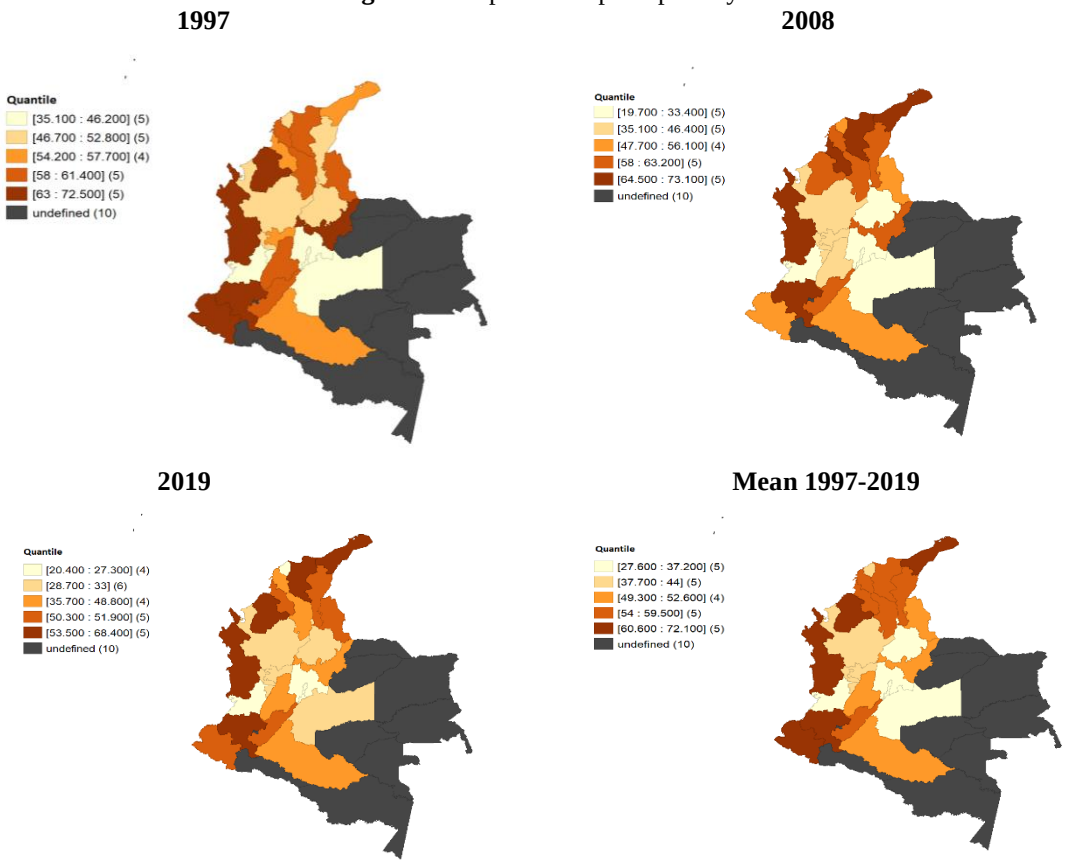
5. Convergence and Exploratory Spatial Data Analysis

5.1 Exploratory Spatial Data Analysis

The ESDA for the poverty in Colombia during the period 1997-2019 begins with the presentation of a traditional descriptive analysis (coroplast map) in order to detect a first pattern of agglomeration of poverty in the country. Subsequently, a univariate analysis is carried out on the variable of interest where the Moran's Index, C of Geary, G (d) of Getis and Ord and a scatter plot of Moran' Index are calculated to complement the analysis of local indicators of spatial association. These statistics show that the phenomenon of poverty has spatial dependence since the heterogeneity of the units of analysis. These being the 24 main departments of the Colombian geography that condense more than 80% of the population of the country.

Figure 3 shows the spatial distribution of the poverty rate by quantiles for the years 1997, 2008, 2019 and average of this indicator in the period defined for the study. In this sense, three great trends can be identified. The first of them focuses on recognizing that poverty in Colombia has presented a decline over a decade; for 1997, the lowest poverty rate ranged between 35.1% and 46.2%, while for 2019 the data shows that it was rounded off at 20.4% and 27.3%; it fell at its upper bound by almost 18.9 percentage points. The second trend is that the poverty rate decreases in the departments with the highest levels. For 1997, the indicator ranged between 63% and 72.5%, while for 2019, poverty rates were recorded between 53.5% and 68.4%; a reduction of 9.5 percentage points.

Figure 3. Map of choropleth poverty

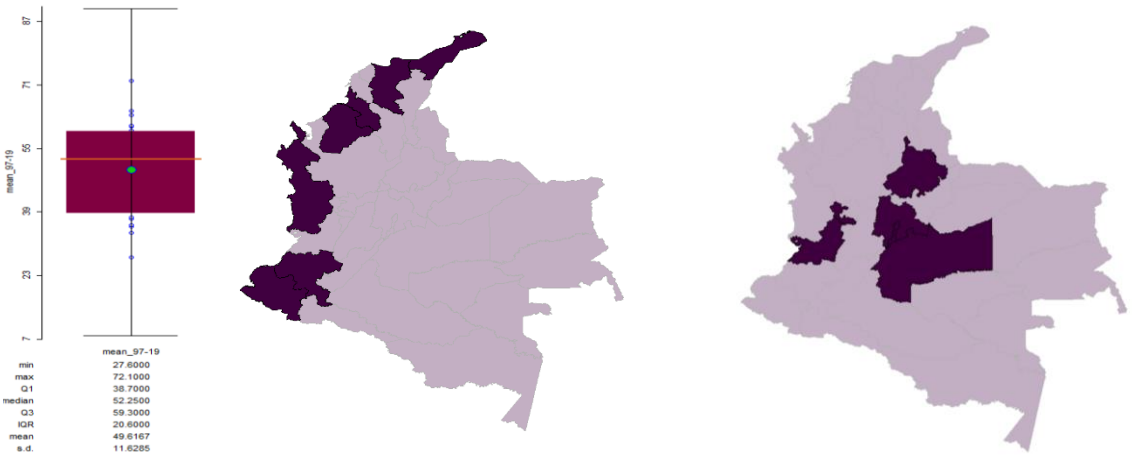


Source: author's calculations using GeoDa

The third main result suggests that the departments with the highest poverty rates in 1997 persist in this dynamic in the last 20 years; while for the group of departments with lower rates it turns out not to be consistent, since some departments are in the first quantile in 1997 but in 2019 it changes to the second, for example. Thus, figure 4 shows the main descriptive statistics of the mean poverty between 1997 and 2019, with the mean value equals 49.62% and where the group of departments with the highest levels of poverty are in the surrounding of the Pacific, Atlantic and Caribbean seas (seven departments), while those with the lowest poverty rates are close to the Eastern Mountain range (six departments). The previous results allow to elaborate the following research question: what are the dynamics of the departments that allow to explain these results for the last 20 years? In this sense, a set of indicators will be estimated, these will allow to know in the first instance if there are spatial patterns that form clusters between poor departments, for example, and conglomerates. All of them were calculated considering a spatial weights matrix standardized Queen type (see Annex 4). However, when testing the significance of the indicators with rook or k-nearest matrix, the results remain consistent.

Figure 4. Boxplot mean poverty 1997-2019

High poverty **Low poverty**



Source: author's calculations using GeoDa

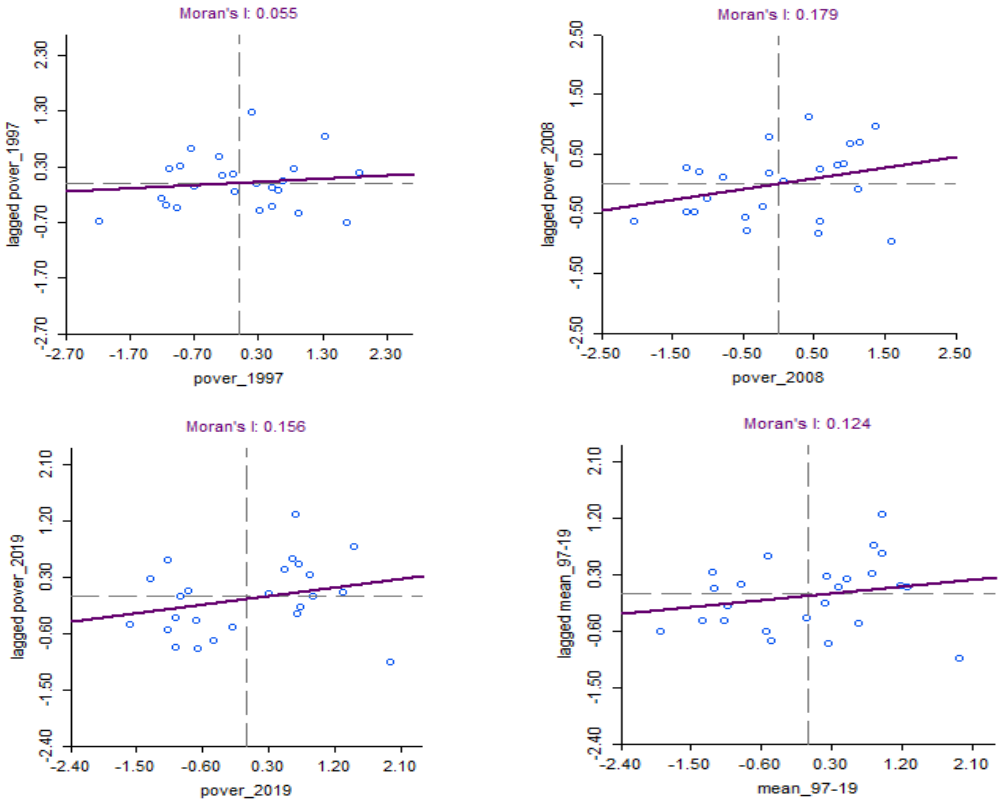
The global measures seek to examine whether there is a random distribution of the poverty rate in the 24 main administrative units of Colombia. These results are presented in table 3 and it shows that the means of every year analyzed the Moran's Index and in the Geary's C are statistically significant; sustaining that there is positive spatial dependence (see figure 5). On the other hand, the Getis-Ord G(d) seeks to analyze if there is evidence of concentration of high (low) values of the poverty rate in neighboring departments. Their results suggest that there is no such characteristic in the analyzed phenomena, being consistent with the evidenced in the choropleths presented in figure 3.

Table 3. Global measures of spatial dependence

Year	Moran Index Statistic	Geary's C Statistic	Getis- Ord G(d Statistic
1997	0.055	0.818	0.185
1998	0.152*	0.731**	0.183
1999	0.127	0.743**	0.183
2000	0.178**	0.705**	0.186
2001	0.127	0.784*	0.178
2002	0.099	0.834	0.183
2003	0.081	0.822	0.182
2004	0.008	0.903	0.180
2005	0.029	0.837	0.178
2006	0.127	0.796*	0.178
2007	0.127	0.796*	0.178
2008	0.179**	0.755**	0.179
2009	0.189**	0.751**	0.176
2010	0.201**	0.724**	0.175
2011	0.173*	0.767*	0.175
2012	0.135*	0.798*	0.175
2013	0.134*	0.811*	0.176
2014	0.069	0.865	0.176
2015	0.056	0.875	0.175
2016	0.102	0.842	0.175
2017	0.121	0.824	0.173
2018	0.144*	0.783*	0.174
2019	0.156*	0.769**	0.174
Mean	**0.124***	**0.794***	**0.174**

Note: Coefficients significative 0.001 '****' 0.01 '***' 0.05 '**' 0.10 '*'
Source: author's calculations using R

Figure 5. Scatterplot Moran's Index Univariate Global



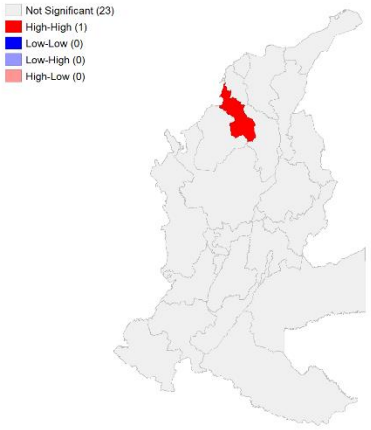
Source: author's calculations using GeoDa

The LISA analysis allows to know if poverty clusters are configured, considering their spatial distribution. In that sense, figure 6 shows the local moral index for three years and for the mean of the study period; with which two precisions are made with caution. The first one is that there is a cluster where the departments with low levels of poverty are surrounded by departments with this same characteristic (1998 and 2019); and the second is that there is a low concentration of poverty in certain departments that are surrounded by others with dissimilar characteristics (2008); which does not configure a High-High pattern as such.

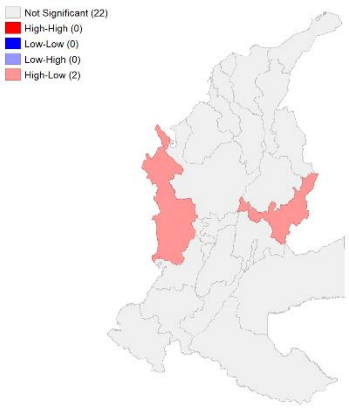
On the other hand, when implementing the measures of New-Gi and New-Gi* (see figure 7) a pattern of departments with high levels of poverty surrounded by neighbors with lower rates is observed, at least for the average of the poverty rate. With the above, it is possible to support the suitability of implementing a spatial analysis of poverty in Colombia, because although the most widely used measure at a global and local level such as the Moran's Index, they are statistically significant at a level of confidence of the 10% (mean of the variable), and should be remembered that if this is not present, the coefficients estimated by the traditional analysis would turn out to have bias and be inefficient; therefore, it is recommended to explore different models of spatial econometrics.

Figure 6. Local Moran's Index

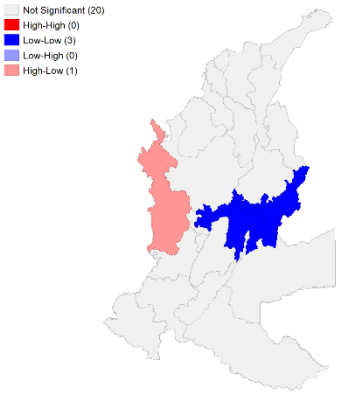
1997



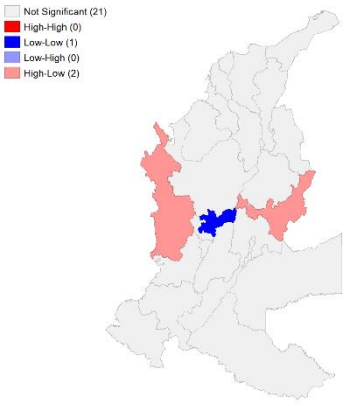
2008



2019

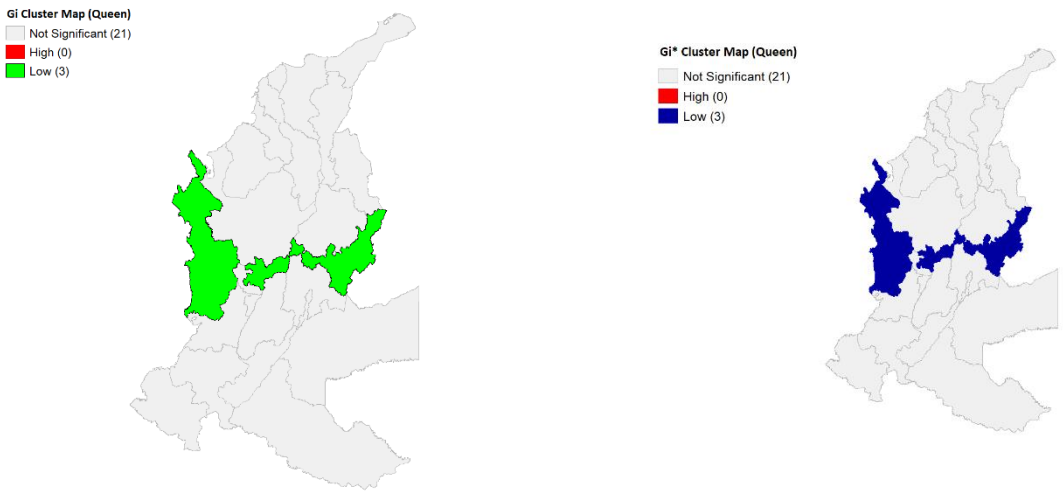


Mean 1997-2019



Source: author's calculations using GeoDa

Figure 7. New-Gi and New Gi*



Source: author's calculations using GeoDa

5.2 Beta and sigma convergence

The estimation of the growth rate of the poverty 1999-2017 by Latin American emerging economies showed that the coefficient of the regression model (annex 3) is equal to -0.066 with a standard error of 0.045 and a level of significance of 10%. Therefore, applying the formula of the speed of convergence (SC) from the calculation of the beta parameter and considering the 19 years of which information is available, it was found that this speed is 4.26% and that it would take approximately 16.29 years to close the gap between countries with the highest and lowest poverty rates, which leaves evidence that there is a high degree of heterogeneity between these countries in the fight against poverty (eq 3).

$$\mathrm{SC}_{Latin\_America} = \frac{\ln\left(1-T\widehat{b}\right)}{T} = \frac{\ln\left[1-19*(-0.066)\right]}{19} = 4.26\%$$

$$years = \frac{ln2}{\mathrm{SC}_{Latin\_America}} = 16.29 \qquad [3]$$

Meanwhile, the results for Colombia are not entirely encouraging. The estimated coefficient was equal to -0.031, a standard error of 0.017 and a level of significance of the 10%. The previous results suggest that the speed of convergence for this country is 2.34% and it would take 17.35 years to reduce the gap by half between the poorer departments (eq 4), which is the case of Chocó, and the least poor, the capital city Bogotá D.C.

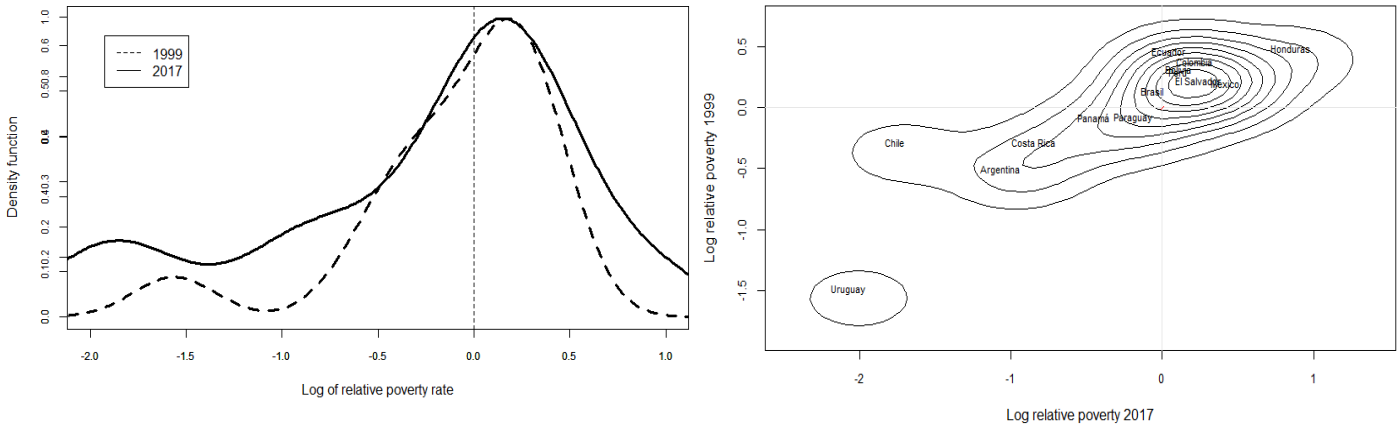
$$\mathrm{SC}_{Colombia} = \frac{\ln\left(1-T\widehat{b}\right)}{T} = \frac{\ln\left[1-23*(-0.031)\right]}{23} = \quad 2.34\%$$

$$years = \frac{ln2}{\mathrm{SC}_{Colombia}} = 17.35 \qquad [4]$$

The graphs presented in figures 8 and 9 complement in analysis of beta unconditional convergence presented before. Figure 8 shows that there are countries in Latin America with high levels of poverty for the period analyzed and the formation of a cluster of low poverty rates with Uruguay, Chile, Argentina and Costa Rica, while Honduras is the country with the highest poverty rate. Figure 9 presents the analysis for the 24 main administrative units of Colombia. Choco, Cordoba, Cauca, Nariño, La Guajira and Magdalena form the poorest departments cluster, while Bogotá, Cundinamarca and Valle del Cauca are the administrative unit with the lowest levels of this phenomenon.

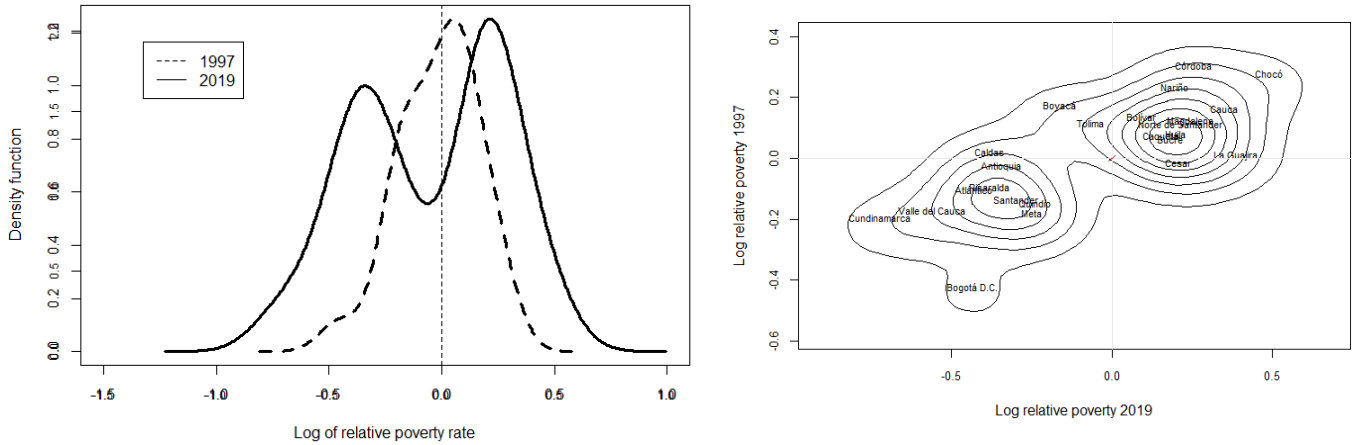
These results provide evidence on the hypothesis of persistence of poverty in most Latin American countries and Colombia. So, it opens the discussion on the unsuccessful efforts that countries have made to reduce poverty. In a period of 20 years there has not been strong convergence processes in most countries of Latin America, while in the last two decades the poverty gap detected for Colombia remains unchanged.

Figure 8. Univariate and Bivariate Kernel density of relative poverty 1999 and 2017 Latin America



Source: author's calculations using ECLAC data

Figure 2. Univariate and Bivariate Kernel density of relative poverty 1997 and 2019 Colombia



Source: author's calculations using panel data

6. Econometric Results

The results of econometric estimation for the model specified with the identification method Florax, Folmer, & Rey (2003) are reported in Annex 5 together a set of statistical tests proposed by Baltagi, Song, Jung, & Koh (2007) in order to validate if the model should include random and spatial autocorrelation effects. It is important to mention that the economic growth variables cannot be interpreted as elasticities given that these variables have been weighed. Therefore, I will only interpret their magnitude and find sign of them. On the other hand, the direct, indirect and total effects are presented (see table 4) with the purpose of knowing which are the possible determinants that originate the processes of persistence of poverty within the countries, being for this case Colombia. The direct and indirect effects allow to isolate the incidence of the control variables on poverty. So, if one of these variables in a spatial unit changes, not only changes the dependent variable in that spatial unit, but it would also change in other spatial units. Thus, the direct effect corresponds to the change in the dependent variable when the explanatory variable changes in the same department, while the indirect effect identifies the impact of changing an exogenous variable on the dependent variable of all other spatial units.

Table 4. Effects Direct, Indirect and Total GNSM

	Impact mesures		
Variables	**Direct**	**Indirect**	**Total**
Lnprimary	-0.121****	-0.099*	-0.221*
Lnextractive	-0.100***	-0.018***	-0.118***
Lnnonextractive	-0.157****	-0.346	0.189
Lnspurious	-0.105***	-0.372***	-0.478***
Lngenuine	-0.087**	0.205	0.117*
Lndistribution_index	-0.339****	-1.018***	-1.358****
Lnpercentage_women	-5.251****	-15.507***	-20.759***
Lnunenployment_rate	0.156****	0.501****	0.658****
Lnmurder_rate	0.025**	0.064	0.039*
Lnintensity_index	0.071****	0.083**	0.154**
Lnpressure_index	-0.049***	-0.123***	-0.172***
w_lnprimary	-0.247***	0.182**	-0.066***
w_lnextractive	-0.242****	-0.102**	-0.344****
w_lnnonextractive	-0.306****	-0.365***	-0.671****
w_lnspurious	-0.241****	0.572****	0.335****
w_lngenuine	-0.270****	0.553***	0.283****
w_lndistribution_index	0.135	1.396	1.53
w_lnporcentage_women	5.274**	5.064	10.338
w_lnunenployment_rate	0.298****	0.309***	0.607***
w_lnmurder_rate	0.039	0.123**	0.083*
w_lnintensity_index	0.179****	-0.006	0.174
w_lnpressure_index	-0.166****	0.138**	-0.029*

Note: Coefficients significative 0.001 '****' 0.01 '***' 0.05 '**' 0.10 '*'
Source: author's calculations using R

One of the most important results of the estimation lies in the positive and significant sign found for the lambda parameter reported in the annex 5 (0.749). This concludes that poverty is spatially correlated and that the administrative units in poverty situation are surrounded by neighbors with the same characteristics, which is consistent with the exploratory analysis presented in Moran's Index. Besides, the variables primary sector, extractive, non-extractive, spurious and genuine services, the distribution index, the percentage of women, the unemployment rate, murder rate and two indexes of conflict are statistically significant and therefore explain the poverty. The economic growth is a mechanism that explains and reduces poverty. All sectors have a negative sign. The primary, extractive and spurious sector concentrate activities that demand labor with low accumulation of human and physical capital. For instance, the hotel sector is constituted as a great employer of vulnerable population, because of demanding workers who do not require any academic training. At the same time, the activities of the field do not require specialized skills since they are mostly manual in developing economies. But the hiring process is also characterized by low job stability, and it condenses activities with low

productivity and few developments of infrastructure and technology, which does not permit the existence of continuous generation of jobs.

On the other hand, the non-extractive and genuine services concentrate the labor force with greater productivity and accumulation of human and physical capital as manufacturing industry, financial entities, immobile activities, e.g. But this result is consistent with economic theory, since it is likely that there is a person living in poverty working within any of these branches of activities. Nevertheless, these results do not seek to dictate that the poverty reduction strategy should be aimed at further promoting the activities of primary and spurious sectors because it would be assuming a linear process in terms of the demand for labor that may not happen.

These results must be considered as attributes that support the estimated model and that are related to pro-poor growth approaches. The complexity of the labor market must be recognized under the priori premises described in research like Urrutia & Ruiz (2010) who affirms that the growth is not implicitly guaranteeing sustained increases in the demand for unskilled labor. Conversely, it could increase poverty because there is a reverse dynamic between the markets of skilled and unskilled labor. The distribution index suggests that after increasing by 10% in this indicator a reduction of 3.39% in the poverty rate of the department would be expected, while if the effect occurred in a neighboring department the effect would reach 10.18%. Although this research does not allow us to outline a position in favor or against economic growth or the distribution of income as a mechanism to reduce poverty. The results once the assumption of spatial dependence has been incorporated, support the importance of encouraging distributive processes in developing economies being this position developed in Bourguignon (2003) and whose counterfactual is the research carried out by Roemer & Gugerty (1997).

Another interesting result lies in the composition of the population structures within the administrative units, since a negative elasticity was found. An increase of 1% in the percentage of women is associated with a reduction of poverty by 5.25%. These results are not entirely intuitive because the dynamic population of Colombia is not analyzed in a substantial way. Although Cawthorne (2008) explains why women experience more poverty compared to men, arguing that: i) women are paid less than men, even when they have the same qualifications and work the same hours, ii) women are segregated into low paying occupations, and occupations dominated by women are low paid and iii) women are more likely to care for children and elderly or disabled family members than men, the secular question that cannot be answered in this paper and that would become an extension of it is: are these population dynamics replicable in the Colombian economy?. This is based on recent literature on the benefits that the empowerment of women brings in economic development. Doepke & Tertilt (2014) mention that women play a better role in the management of resources so they are less compared to those obtained by men because they are intended for example, to contribute to the education of children, which suggests that in order to close the gap between men and women and to promote development, long-term political measures should be taken to improve the conditions of women at the expense of men such as Duflo (2012, p. 1076) proposes. This is not a finding of this research but a possible response to the result found in the modeling and that can well be supported by this literature.

Otherwise, the consistency of the results obtained in terms of the unemployment rate is quite interesting, as an increase in 10% translates into an increase in 1.56% in poverty rate (direct effect), whereas if the murder rate increases also in 10%, it is associated with a rise in 0.25% poverty rates. Unemployment has a direct impact on the well-being of people since it is a direct limitation of income, which deprives the economic agent of at least a basic consumption set. On the other hand, as the violence belts increase, it is unlikely that the demand for labor will increase, which leads to an increase in crime, being an inverse dynamics clearly supported in the study by Mehlum, Moene, & Torvik (2005). Finally, the index of intensity which exposes the number of individuals expelled from a department by internal violence is associated with an increase in poverty, while the index of pressure reflects the number of individuals who arrive at a department by forced displacement. Although the sign is negative, which justifies the reduction of poverty, the adequate interpretation of this indicator must be through an increase in available labor supply, which when migrating to another department is expected to be more favorable in comparison with the department expelled from, situation that has been common in Colombia in the last 50 years. Thus, it is concluded that an increase of 10% in the intensity index of the conflict is associated with a 0.71% increase in the poverty rate, while the associated indirect effect is

higher 0.83%. Otherwise with the pressure index, because the effect would be 0.49% in reducing poverty, but the indirect effect is 0.23%.

Conclusions, limitations and policy recommendations

This document presents a literature review suitable for the implementation of a theoretical definition of poverty according to the data used for its quantification. It would be of interest for researchers on the subject, to address the issues of poverty from multidimensional approaches and not just treat it from the income received. Besides, the fulfillment of the hypothesis of poverty persistence through the estimation of the parameters of beta and sigma unconditional convergence by the most of Latin American countries supports the importance of exploring the factors that influence this phenomenon. In contrast, the research proposes Colombia as a case study given the monetary poverty data reported by official institutions such as DANE. Colombia has multidimensional poverty data, but it is not possible to undertake spatial analysis because they are built for seven regions, a limited number. So, the estimation found that spatial dependence is a factor that contributes in explaining the phenomenon of poverty and not considering it would lead to biased and inefficient estimates. The positive lambda parameter implies that the administrative units in Colombia are surrounded by pairs with the same condition of poverty and in the exploratory analysis of spatial data, the poverty belt that covers the Pacific, Atlantic and Caribbean seas was found. Thus, the proposed panel data model with random effects, autocorrelation and spatial lag in the error is consistent according to the statistical tests reported in this research.

Economic growth breaking down by sectors explains the poverty. More attention should be given to the way in which development is presented within the sectors. Consequently, the Departments should not only tend to attract foreign direct investment, mainly focused on sectors like genuine services and non-extractive values. The most efficient mechanism to reduce poverty in Colombia is given by an improvement in the distribution of incomes. The distribution index created from the Gini Coefficient, has a strong impact on the analysis variable and allows us to recognize that the most serious problem in the country, which does not allow to overcome the poverty, is caused by a high concentration of income. Besides, this document makes it possible to understand the importance of keeping sustained economic growth, in the meantime generating an increase in the demand for labor (without specifying whether it is qualified or not qualified) and that leads the population in general to take part in the benefits derived from growth.

The main limitation of this study lies in not having poverty data constructed under the multidimensional method. So, the results are presumed to be more robust. However, this issue is faced by most of countries because only in 2010 the UNDP proposed the method of the multidimensional poverty index. The second limitation of the research is to recognize that it was not possible to incorporate a variable that captured the educational levels of the population, because in Colombia no aggregate measures were reported for the administrative units in the period addressed. By incorporating control variables such as the unemployment and murder rates, a positive effect on poverty was found, being consistent with the international literature that delves into this topic. At the same time, the variables of conflict proposed by this research provide an explanation of the behavior of poverty in Colombia. A limitation on the data is the lack of a higher level of disaggregation (municipality level for example); which would improve the identification of the “bastions of poverty” in Colombia. However, the territorial entities have not advanced in these processes. In the future it can be considered as a research item to be developed. Finally, this paper goes on to study the phenomenon of poverty using spatial econometrics, which complements the methodological tools provided by development economics such as beta and sigma convergence, verifying the two hypotheses raised at the beginning of the document.

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Appendix to chapter 1: Econometrics and Statistics

Annex 1. Mean test on poverty with unpaired sample

Variable	Observations	Mean	Standard Error	Standard Deviation	[95% Confidence. Interval]	
Poverty imputation	552	49.556	0.583	13.698	48.411	50.702
Poverty non-imputation	480	48.502	0.613	13.421	47.299	49.706
Combined	1032	49.066	0.422	13.574	48.237	49.895
diff		**1.054**	**0.847**		**-0.608**	**2.716**

diff = mean (Poverty imputation) - mean(Poverty non-imputation) t = 1.2446

Ho: diff = 0 **Degrees of freedom = 1030**

Ha: diff < 0 **Ha:** diff != 0 **Ha:** diff > 0

Pr(T < t) = 0.8932 Pr(T > t) = 0.2135 Pr(T > t) = 0.1068

Source: author's calculations using Stata 16.0

Annex 2. Mean test on gini with unpaired sample

Variable	Observations	Mean	Standard Error	Standard Deviation	[95% Confidence. Interval]	
Gini imputation	552	0.505	0.002	0.043	0.501	0.508
Gini non-imputation	480	0.507	0.002	0.044	0.503	0.511
Combined	1032	0.506	0.001	0.043	0.503	0.508
diff		**-0.002**	**0.001**		**-0.007**	**0.004**

diff = mean (Gini imputation) - mean (Gini non-imputation) t = -0.6377

Ho: diff = 0 **Degrees of freedom = 1130**

Ha: diff < 0 **Ha:** diff! = 0 **Ha:** diff > 0

Pr(T < t) = 0.2619 Pr(T > t) = 0.5238 Pr(T > t) = 0.7381

Source: author's calculations using Stata 16.0

Annex 3. Convergence poverty model

Residuals:	**Latin America**				**Colombia**		
	Median	**Min**	**Max**		**Median**	**Min**	**Max**
	-0.003031	-0.023151	0.025972		-0.005391	-0.040932	0.26688
Coefficients:							
	Estimate	**Std.**	**Significance**		**Estimate**	**Std.**	**Significance**
(Intercept)	0.18618	0.06674	**	(Intercept)	0.38434	0.16723	*
Ln poverty1997	-0.03128	0.01668	*	Ln poverty1999	-0.06552	0.04511	*

Note: The regression models have the poverty growth rate as the dependent variable in logarithms. Coefficients significative 0 '****' 0.001 '***' 0.01 '**' 0.05 '*'

Annex 4. Spatial weights matrix standardized Queen type

ID	Department	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Bogotá D.C.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.33	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Bolívar	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.14	0.14
3	Boyacá	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.17	0.00	0.17	0.00	0.00	0.17	0.00	0.00	0.00	0.17	0.00
4	Caldas	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.20	0.00	0.20	0.00
5	Caquetá	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Cauca	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00
7	Cesar	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.20	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
8	Córdoba	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
9	Cundinamarca	0.17	0.00	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00
10	Chocó	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.33	0.00
11	Huila	0.17	0.00	0.00	0.00	0.17	0.17	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00
12	La Guajira	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Magdalena	0.00	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
14	Meta	0.20	0.00	0.20	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Nariño	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Norte Santander	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
17	Quindío	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.33	0.00	0.00
18	Risaralda	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.17	0.17	0.17	0.00
19	Santander	0.00	0.20	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
20	Sucre	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Tolima	0.00	0.00	0.00	0.14	0.00	0.14	0.00	0.00	0.14	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.00	0.14	0.00	0.00
22	Valle del Cauca	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.20	0.00	0.00	0.00
23	Antioquia	0.00	0.14	0.14	0.14	0.00	0.00	0.00	0.14	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00
24	Atlántico	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: author's calculations using R

Annex 5. Estimation Panel Data and Spatial model

Variables	Pool (1)	Fixed (2)	Random (3)	SAR (4)	SEM (5)	SARAR (6)	SDEM (7)	SDM (8)	GNSM (9)
Constant	11.733****		11.033****	17.195****	18.851****	17.195****	-0.943	-6.085	10.985
	(1.91)		(2.51)	(2.73)	(3.23)	(2.73)	(9.60)	(8.90)	(10.04)
Ln(Primary)	-0.506****	-0.194****	-0.378****	-0.071**	-0.209****	-0.071**	-0.09**	-0.089**	-0.121****
	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
Ln(Extractive)	-0.459****	-0.182****	-0.343****	-0.055**	-0.185****	-0.055**	-0.069*	-0.067*	-0.100***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
Ln(Non-Extractive)	-0.502****	-0.207****	-0.384****	-0.094****	-0.219****	-0.094****	-0.113***	-0.109***	-0.157****
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
Ln(Spurious)	-0.467****	-0.184****	-0.351****	-0.055**	-0.182****	-0.055**	-0.072*	-0.071*	-0.105***
	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)
Ln(Genuine)	-0.477****	-0.192****	-0.358****	-0.054**	-0.193****	-0.054**	-0.048	-0.045	-0.087**
	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
Ln(Distribution_index)	-0.458****	-0.138	-0.275***	-0.143**	-0.293****	-0.143**	-0.296****	-0.314****	-0.339****
	(0.08)	(0.09)	(0.09)	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)
Ln(Porcentage_women)	-0.315	-2.891***	-0.618	-3.851****	-3.261****	-3.851****	-5.969****	-5.976****	-5.251****
	(0.49)	(0.94)	(0.66)	(0.73)	(0.86)	(0.73)	(0.90)	(0.91)	(0.83)
Ln(Unenployment_rate)	0.086****	0.242****	0.170****	0.135****	0.196****	0.135****	0.115****	0.111****	0.156****
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Ln(Murder_rate)	-0.071****	0.006	-0.029**	0.005	0.000	0.005	0.020	0.020	0.025**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(lntensity_index)	0.048****	0.076****	0.073****	0.068****	0.064****	0.068****	0.046****	0.039***	0.071****
	-	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Pressure_index)	-0.027**	-0.042**	-0.046****	-0.057****	-0.037**	-0.057****	-0.02	-0.016	-0.049***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
w_lnprimary							-0.119	-0.088	-0.247***
							(0.08)	(0.08)	(0.08)
w_lnextractive							-0.142**	-0.118*	-0.242****
							(0.07)	(0.07)	(0.07)
w_lnnonextractive							-0.133*	-0.082	-0.306****
							(0.07)	(0.07)	(0.07)
w_lnspurious							-0.137**	-0.114*	-0.241****
							(0.07)	(0.07)	(0.07)
w_lngenuine							-0.166**	-0.142**	-0.270****
							(0.07)	(0.07)	(0.07)
w_lndistribution_index							0.591****	0.649****	0.135
							(0.15)	(0.14)	(0.18)
w_lnporcentage_women							7.917****	8.956****	5.274**
							(2.28)	(2.20)	(2.22)
w_lnunenployment_rate							0.125***	0.079**	0.298****
							(0.04)	(0.04)	(0.06)
w_lnmurder_rate							-0.008	0.003	0.039
							(0.02)	(0.02)	(0.03)
w_lnintensity_index							0.08***	0.047**	0.179****
							(0.02)	(0.02)	(0.03)
							-0.06**	-0.029	-0.166****
w_lnpressure_index							(0.03)	(0.03)	(0.04)
							-0.943	-6.085	10.985
Spatial autoregressive (λ)				0.597****		0.597*****		0.197****	0.749****
Random regions effects (υ)				3.281***	1.606***	3.281***	2.668***	2.889***	2.722***
Spatial error (ρ)					0.316****	-0.507****	0.240****		-0.736****
N	552	552	552	552	552	552	552	552	552

Test Panel Data

F-statistic (pool-fe)	F= 15.355 df1= 23 df2=517 p-value=0.0000	**Ho:** The dichotomic variables of differential intersection are equal to zero
Test-Wooldridge(pool-re)	Z=3.246, p-value=0.0012	**Ho: T**he variance of the residuals of the random regions are equal to zero
Test-Hausman (fe-re)	Chisq=154.78 df=11 p-value=0.0000	**Ho:** The estimators of random and fixed effects do not differ substantially

Test Panel Data Spatial

LM1	LM1 = 7.683	p-value < 0.0000	**Ho:** There aren't random effects assuming not spatial correlation
SLM1	SLM1 = 12.951	p-value < 0.0000	**Ho:** Standardized version LM1
LM2	LM2 = 0.739	p-value = 0.4600	**Ho:** There aren't spatial correlation assuming not random effects

Annex 5. Estimation Panel Data and Spatial model

Variables	Pool (1)	Fixed (2)	Random (3)	SAR (4)	SEM (5)	SARAR (6)	SDEM (7)	SDM (8)	GNSM (9)
SLM2	SLM2 1.143		p-value = 0.2530	**Ho:** Standardized version LM2					
LM-H	LM-H = 59.574		p-value < 0.0000	**Ho:** There aren't spatial effects or random effects					
CLMlambda	LM*-lambda = 3.920		p-value = 0.0000	**Ho:** No spatial correlation assuming the possible existence of random effects					
CLMmu	LM*-mu = 7.995		p-value < 0.0000	**Ho:** No random effects assuming the possible existence of spatial correlation					

Source: author's calculations using R

Note: The columns 1, 2 and 3 are estimated by equation 1. The columns 4-9 are estimated by equation 2 consi dering if the spatial autoregressive, random region effects and spatial error are significant. Coefficients signif icative 0 '****' 0.001 '***' 0.01 '**' 0.05 '*'