

Municipal Public Expenditure in Colombia and its Effect on Income Inequality: An Analysis through Propensity Score Matching

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Summary

The objective of this research was to identify the effects of public social expenditure on education, health and housing in the reduction of income inequality in Colombia, in the period between 1980 and 2018. from the World Development Indicators of the World Bank (2019) the GINI was obtained, and the data from the CEDE of the Universidad de los Andes for municipal spending. A linear regression model of municipal spending against inequality and *propensity score matching* was used. The results allow us to conclude that the municipalities in the highest quartile of expenditure effectively reduce income inequality in their territories, it was evident that the higher level of expenditure could have had an impact on poverty reduction and the NBI index; It is also highlighted that municipalities with better public management indices reduce inequality in their territory.

Keywords: Public Expenditure, Income Distribution, Education, Educational policy, Health, Public Investment

JEL Classification: H4; H5; O15

Introduction

Colombia has historically presented major problems of inequality and poverty, which continue to be national and subnational socioeconomic challenges. In contrast to the above, it is also one of the countries with the greatest natural wealth on the continent and with a significant working-age population, a situation that has allowed it to boast economic growth so far in the twenty-first century above the average for Latin America and the Caribbean according to the Economic Commission for Latin America and the Caribbean (ECLAC) (2020).

However, due to the abundant wealth of natural and cultural biodiversity of the country, the social indicators do not improve significantly, the economy grows above the Latin American average, but inequality does not decrease, on the contrary, it increases or in the best of cases is maintained, this behavior for Stiglitz (2008) is the fault of the State, both for what it does and for what it does not do, because it puts all its trust in the market as a solver of social problems. However, evidence shows that the market is not a good mechanism to fight inequality, poverty, social exclusion, on the contrary, it can increase it unless economic growth is accompanied by the generation of qualified and low-skilled jobs, which occupy the unemployed from the lowest strata and thus become a mechanism of wage equity.

In this sense, it is necessary to mention that, for Cárdenas, Moran, and Rosero (2019), inequality is understood as the level of concentration and polarization of the way in which income is distributed according to population groups. One way to measure inequality is through the GINI Index¹.

One measure to better distribute income and correct inequality according to Samuelson and Nordhaus (2010) is through tax and expenditure policies, for this reason in order to fight against inequality, it is first necessary to know the causes that generate it, then establish state policies from governments aimed at eliminating them.

Income distribution is fundamental, especially in countries where there are higher levels of poverty, because according to Deaton (2003) there is a concave relationship between income and health, therefore, it is essential for states to seek a better distribution of income and reduce inequality, to improve the well-being and general health of the population.

Reducing inequality is a basic principle that should guide public management and economic policy, since it can be a guarantee of stability in society. Inequality makes the quality of life of society at the bottom precarious, because it leaves them without bargaining power to fight for better working conditions and gives the ability to subjugate the strongest or those at the top of the social order, which undoubtedly transforms into class struggles that often result in social instability and even physical violence.

¹ Which is an indicator that measures the level of income concentration, in a range between 0 and 1, when the result is 0 there is complete income equality and when it is equal to 1 there is complete inequality, that is, a single person owns all the income.

Evidence shows that the management of public policy (public spending) is a relevant factor in improving income distribution, since the State can modify the structural effects generated by aggregate production or the market on the holding of wealth (Copeland, 1947); (Aaron & McGuire, 1970) and (Stiglitz, 2012). In this sense, the use of public policy and State intervention is desirable because growing income inequality generates harmful effects on political stability, creates violence, social and economic uncertainty, which reduces investment and thus the potential growth of an economy (Alesina and Perottiu, 1996). (UNDP, 2021) and (Mejía, Cardona, & Mejía, 2021).

For Mostajo (2020), social spending policies have short-term distributional impacts through the provision of health, education, subsidies, and cash transfers, and in the long term allows the formation of human capital that negatively affects income distribution. Another widely accepted line in the literature to explain the effectiveness of public spending in reducing income inequality is that which defends public investment in promoting the quality of education, on which it is proposed that a better quality of education acts indirectly in the redistribution of income. since it raises the labor productivity of all people, including those with low levels of education, this not only raises the wages of these people but also increases the elasticity of substitution between skilled and unskilled workers, causing relative increases in the demand for skilled workers to have a dampening effect on the wages of unskilled workers (Beyer, 2020).

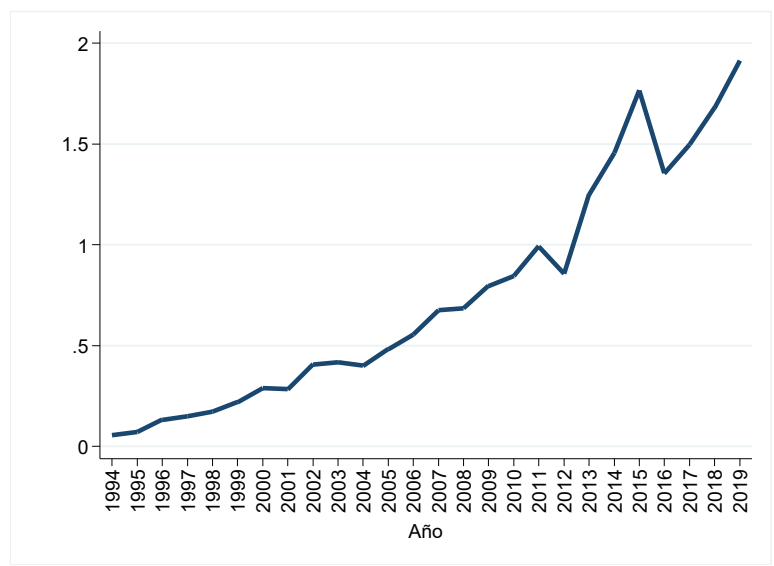
Along the same lines, there are theorists who establish that disparities in educational attainment increase inequality, while the increase in the average level of schooling has a negative effect on inequality (Tinbergen, 1957); (Aigner and Heins, 1967); (Marin and Psacharopoulos, 1976), (Winegarden, 1979) and (Vargas et al., 2019).

On the other hand, Pinzón et al. (2014) and Cid and Prieto (2012) establish that public spending on health has indirect and positive effects on income distribution, since higher public spending reduces the risk of incurring catastrophic out-of-pocket expenditure for lower-income households. Similarly, Vargas (2004) argues that public spending on health through subsidies focused on demand in the most vulnerable population generates a better redistributive effect and reduces the GINI, because less of the out-of-pocket income of the most vulnerable population goes to pay for the health service.

In addition to the above, Trilla (2014) states that the enjoyment of housing that guarantees households access to conditions of protection against the inclemency of nature, has also become one of the objectives of social policy in many states, because in people with low incomes, housing costs account for the largest proportion of their disposable income, which deepens income inequality; Consequently, the orientation of public policy in housing is a factor of social expenditure with a great impact on the reduction of income inequality.

In contrast to the above, in Colombia, for example, municipal public expenditure per inhabitant in the last decade of the twentieth century and so far in the twenty-first century has shown significant growth, as evidenced in Graph 1, which suggests that the Colombian State has directly or indirectly oriented public policy to fight inequality.

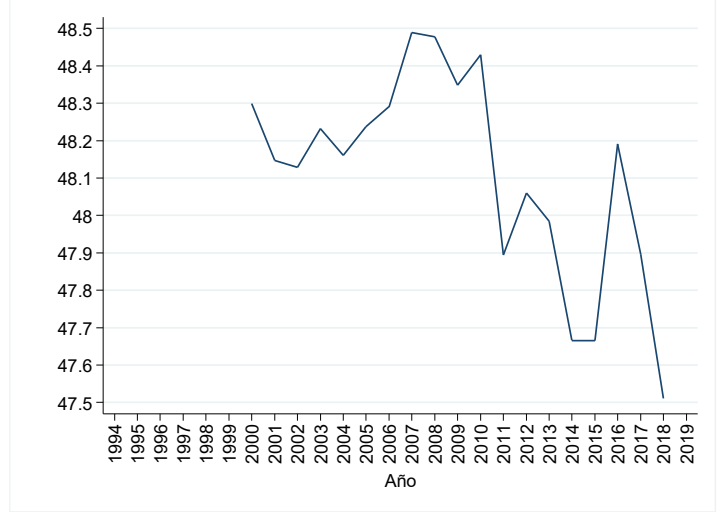
Graphic 1 Municipal public expenditure in Colombia per inhabitant



Source: Authors' elaboration based on information from CEDE Universidad de Los Andes, 2020. In original Spanish language

In divergence from the increase in public spending observed in Graph 1, the effects on educational attainment of students in Colombian municipalities measured in the results of the Saber 11 tests have been decreasing as shown in Graph 2, which may be an indication of the ineffectiveness of spending, in substantial improvements in quality in the education sector and consequently in inequality in Colombia. In this case, a negative externality in labor matters can be generated as a possibility, since quality results can affect the quality of employment and productivity, as well as constitute a mechanism of greater probability for unemployment that socially has a greater incidence in young people and women.

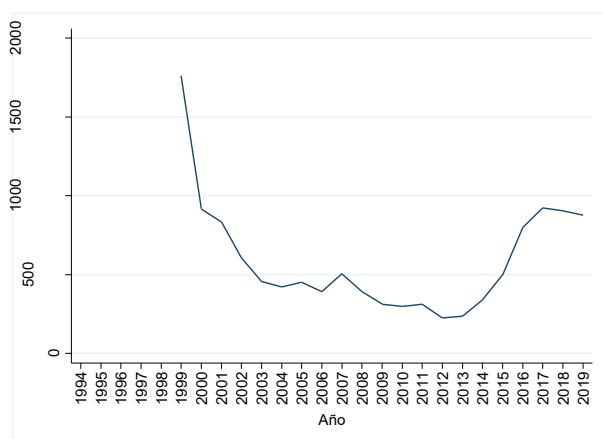
Graphic 2. Average of Saber 11 Tests by municipalities in Colombia



Source: Authors' elaboration based on information from CEDE UNI ANDES, 2022. In original Spanish language

In addition to the above social performance indicators, paradoxically in Colombia in recent years the illicit cultivation of coca considered is U-shaped, that is, since the end of the last decade of the twentieth century it decreased significantly, but then in the first decade of the twenty-first century it maintained a gentle decline until it increased significantly again in the last 5 years as evidenced in Graph 3. which can have direct effects with the persistence of historical inequalities in territories with a prevalence of illicit crops.

Graphic 3 Hectares cultivated with coca in Colombian municipalities



Source: Authors' elaboration based on information from CEDE UNI ANDES, 2020. In original Spanish language

Describing the behavior of coca crops in Colombia is important because it can give indications of the failures in the targeting of public spending and the behavior of inequality in the country.

Given the efforts to increase public spending in Colombia and the persistence of inequality, this research work had as its central problem to measure : What has been the effect of municipal public spending on the income inequality that Colombia faces in the period 1980 -2018?

To this end, it was proposed as a null hypothesis that: municipal public expenditure in the period from 1980 to 2018 has a direct effect on income inequality and as an alternative hypothesis that municipal public expenditure in the period from 1980 to 2018, has a significant indirect effect on income inequality in Colombia.

To test the hypotheses raised, data from the National Planning Department (DNP), the National Administrative Department of Statistics (DANE), the Statistical Yearbook of the Economic Commission for Latin America (ECLAC) for public social expenditure, the World Development Indicators of the World Bank (2019) for the GINI and data from the CEDE of the Universidad de los Andes for municipal public expenditure were used

This article is structured in four sections, the first part contains this introduction that also includes the review of the literature, the second addresses a descriptive analysis of income inequality GINI and public spending in Colombia in the governments between 1980 and 2018, the third part presents the methodological specifications of the PSC model and the last part presents the results of the model in a stylized way, the testing of the hypotheses, the conclusions, final recommendations are presented.

Literature review

As for the fight against inequality, through the use of public social spending, there is abundant literature at the international level and few at the national level, but this is growing and is becoming relevant 30 years after the implementation of a process of decentralization of powers and resources to territorial entities that has provided them with mechanisms for applying public spending at the territorial level

In this sense, Cárdenas, Morán, and Rosero (2019), through a panel data regression model for Latin American countries, determined that there is an indirect relationship between the variables of public expenditure (education and health) with the GINI coefficient. They establish that the more spending a government makes, the lower the value of the GINI coefficient, the latter means that a country that manages spending properly can reduce the income inequality gap.

Along the same lines, Garrochamba (2017) analyzed the relationship between public spending and inequality in Ecuador through an econometric model with a time series, from which he concluded that in Ecuador public spending and inequality have a negative and statistically significant relationship, therefore, he considers that the intervention of the State is essential to improve the well-being of citizens. mainly through providing and guaranteeing free and quality access to services such as education at all levels, health, housing, environmental sanitation, drinking water and sewerage.

On the other hand, Molina, Guarnido and Amate (2013) establish that in Europe, social spending allowed the 2008 crisis not to worsen inequality indices, therefore, targeted public social spending is an effective way to fight inequality if it is focused on issues that affect the population in a greater proportion. In Mexico, according to Ángeles, Salazar, and Contreras (2017), social spending is focused on meeting needs in the areas of education, health, social infrastructure, public safety, welfare, as well as the strengthening of municipalities and states, however, these measures have given positive results in the economic growth of the states, but have not shown a significant impact on the reduction of inequality. therefore, public social expenditure shows opposite results to those present in Europe.

In line with the above, Vliet and Wang (2015) establish that social investment policies have not had significant effects on the reduction of inequality and poverty in European countries, although so far in the first and second decades of 2000 the level of employment has increased as well as poverty and inequality or, at best, have stagnated.

Báez (2017) on the other hand analyzed the possibilities that the State has to reduce the level of economic inequality through fiscal policy, for which he estimated a panel of data from most OECD countries in the period 2007-2013, from which he concluded that the tax system seems to have a greater capacity to increase poverty and inequality than to reduce it. while social spending has a greater capacity to reduce poverty and inequality, especially through housing assistance, because

low-income people who manage to own their own homes free up part of their income to improve their consumption and expectations of a better life.

In line with the findings of Báez (2017) Sánchez (2015) after analyzing the redistributive effects of fiscal policy, public spending and taxes on disposable income and the well-being of the population of the Dominican Republic, through the study of inequality indicators such as the GINI, Kakwani and Reybolds-Smolensky concentration index, concluded that social spending has become a fundamental tool to improve the distribution of income in the Dominican Republic, through direct transfers to the population with lower incomes, which has improved their living conditions, while taxes that have a very limited effect on the distribution of income as a result of the very low levels of resources collected as a result of evasion and avoidance in the Dominican Republic. the payment of natural and legal persons.

Following the previous line, Bravo, Castro and Gutiérrez (2011) evaluate the effects of a fiscal policy, which taxes the consumption of the different sectors of the economy that are financed with resources obtained from investment in the drinking water and sewerage sector in Mexico. For this evaluation, they used a computable general equilibrium model, from which they concluded that it is possible to achieve an optimal level of investment in the drinking water sector with public spending, which improves the social welfare of the population if care is taken not to finance the investment with a higher consumption tax, because this will end up eroding the consumption capacity of the population and reducing its social welfare.

In this sense, Fernández (2003) analyzes fiscal policy in the European Union (EU) and its prospects in the coming years, and establishes that the EU seeks to establish a policy of direct taxation to achieve progress in taxation and thus channel social spending to the protection of the environment and the use of clean energy. that improves the quality of life of its population. Evidently, the perspective of public spending in the EU has a different perspective from that of Latin American countries, because they have overcome some basic problems of living conditions for their population, therefore, the focus of attention is on the environment and the use of clean energies.

For Sánchez (2017), the high level of inequality in Colombia is partly explained by economic, social, and labor reasons in each region of the country. This same author states that there is no defined relationship between income levels and inequality by departments in the country. However, for Sandoval and Liliana (2011), in Colombia, interdepartmental gaps in income levels are linked to territorial heterogeneities and the precarious educational conditions of the population, high economic inequality motivates internal migrations and strengthens groups that use violent actions for illicit purposes.

For his part, Rodríguez (2019) analyzes the effects on income distribution and tax collection generated from policy changes, for which he used a micro-simulation model of taxes and monetary transfers through which public social spending is instrumentalized, from which he concluded that public social spending materialized through the cash transfers of Familias en Acción and the Colombia Mayor program, They have a positive effect on the redistribution of monetary wealth and the fight against poverty, greater than that generated by tax-based fiscal policy.

To broaden the spectrum of public social expenditure in Colombia, Eslava, M (2006), analyzes the effects of fiscal policy on the decision of Colombian voters, for which he used a data panel for the municipalities of Colombia between 1987 and 2000 with estimates for a dynamic

panel, from which he concludes that public spending in the country is more focused on infrastructure and increases by approximately 10% in the period of time. elections, while transfers are reduced by 30%. Therefore, it is inferred that the management of public expenditure and especially public social expenditure, is a variable that voters take into account when electing their rulers, therefore, from this author public social expenditure is considered as a political variable that does not have a defined focus to reduce inequality but to win votes.

Another of the lines of analysis to reduce inequality on which there is literature is through the management of taxes, in this line Ávila (2013) through a model of overlapping generations with heterogeneous households, analyzed the determinants of fiscal policy and its effectiveness in reducing inequality and increasing GDP expansion, from which he concluded that if long-term growth is to be maximized, taxes should be higher in those economies that use labor intensive in the production of final goods and different for each dynasties, especially the tax rate should be lower in those that use intensive private resources. in such a way that private spending is stimulated in education and higher in those that use public resources more intensively.

On the other hand, authors such as Barreix, Roca and Villela (2015) in a study carried out on the progressivity and redistributive capacity of taxes and public social expenditure in the countries of the Andean Community conclude that the redistributive effect of fiscal policy in the Andean countries is positive although insufficient, but it can improve significantly if the total tax burden is increased, especially on personal income. because this tax has a redistributive potential, but this increase in revenue must be accompanied by greater effectiveness in focusing public spending on the poorest, given the high levels of poverty.

Along the same lines, Jiménez and López (2012) establish that "The main factors that have limited and limit the redistributive capacity of fiscal policy in the region are: (i) a low and volatile tax burden, (ii) a tax structure biased towards more regressive taxes and (iii) a narrow tax base characterized by high levels of evasion and extensive use of tax expenditures" (p.17) they also state that fiscal policy can affect distribution income through public spending, mainly through social spending, mediated by monetary transfers that reach directly or indirectly the population with the greatest monetary needs.

These same authors consider that in Latin America, the high volatility in tax revenues reduces the fiscal capacity of governments to face their functions, which has an impact on poverty and income inequality through the fluctuations that can occur in public social spending. Meanwhile, in Spain, according to Cantó (2014), income-conditioned benefits have led to an increase in the redistributive capacity of the tax and benefit system, which is most likely linked to the creation of a minimum benefit for the unemployed in households in a very poor economic situation.

Theoretical framework

To support the theoretical analysis of the effects of social spending on inequality, it is first necessary to define the role of the State in the economy. According to Smith (1776) the fundamental thing is that "the State does not intervene in the economy, only that it fulfills its essential tasks of defense, security, justice, and exceptionally the construction of large public works", the same position is stated by Ricardo (1819) in his book on the principles of Political Economy and Taxation, where he establishes that the market acts in a better way without interference from the State, in the same way for Mill (1848) the main role of the State is to protect people and society through an

efficient legal system or administration of justice, but he also states that government intervention is necessary in "official education, the regulation of working hours and the care of the poor" (p.805). under this premises, the doctrine, classic economic model or free market, was constituted, however, with the passage of time and with the appearance of the Nation State and later the Enlightenment as an ideological source that puts human dignity at the center, the acceptance of the market as the only force that generates well-being was losing strength, due to recurrent crises and the significant increase in social and income inequality in the world.

In this context, at the beginning of the twentieth century, Pigou (1920) in his text *Welfare Economics*, proposes a broader role of the State in the economy, through the correction of externalities, external costs and benefits not accounted for by the market with the use of public policies, for Reyes and Franklin (2014) Pigou's "Welfare Economics" had in mind not only the corrections of externalities, but also the corrections of externalities. but also the presence of a welfare state that provides social security and gives opportunities for more egalitarian consumption to all sectors in sensitive areas such as education, housing and health. This is why it led to the transfer of resources from the rich to the poor. According to his criteria, the marginal utility of money decreased as its quantity increased (Diminishing Marginal Utility), so a poor person enjoyed money more than the rich regretted losing those resources.

However, Keynes (1936) with the publication of the book "General Theory of Employment, Interest and Money" contradicts the postulates of the classical theory and gives the State an active role in the orientation of the economy, where aggregate demand must be encouraged from its intervention.

For Keynes, the State, through fiscal policy with an increase in public spending, can generate an increase in aggregate demand through the multiplier effect and improves the well-being of society, because there will be more money, greater quantities of goods and services can be enjoyed, therefore, as there is more money circulating, there will be greater redistribution and a reduction in inequality will be experienced.

Indeed, under this framework there is no clear consensus on the role of the State in the economy as an agent that solves social problems, but what is intended with this work is to analyze the role of the Colombian State in guaranteeing minimum living conditions to its inhabitants, which improves the high levels of income inequality. Consequently, this paper will understand public social expenditure along the same lines as defined by Vélez (1995), who establishes that "public expenditure is that which contributes to the production, expansion and renewal of the national human capital stock, that is, to the development of the productive capacities of citizens. Expenditures in the education, health, nutrition and basic sanitation sectors are strictly associated with this objective" (p.502).

Nevertheless in Colombia Article 41 of the Organic Statute of the Budget of 1996 defines Public Social Expenditure as "that whose objective is the solution of unsatisfied basic needs of health, education, environmental sanitation, drinking water, housing, and those tending to the general welfare and improvement of the quality of life of the population, programmed both in operation and in investment".

On the other hand, inequality is defined by Cárdenas, Morán, and Rosero (2019) as the level of concentration and polarization of the way in which income is distributed according to population groups.

Schema of income inequality in Colombia.

Colombia is a country of great social and economic inequality, evidence shows that since the 1980s it has been increasing, this perhaps in response to the strong difficulties that the country faced in economic matters, in coherence with the problems that the world faced from the first oil crisis in 1973 and the debt crisis of the 80s As can be seen in table 1.

Board 1 GINI in Colombia from 1980 to 2018

Years	GINI	Years	GINI	Years	GINI	Years	GINI
1980	0,51	1990	0,51	2000	0,53	2010	0,56
1981	0,51	1991	0,51	2001	0,53	2011	0,55
1982	0,51	1992	0,51	2002	0,57	2012	0,54
1983	0,51	1993	0,52	2003	0,55	2013	0,54
1984	0,51	1994	0,52	2004	0,55	2014	0,54
1985	0,51	1995	0,52	2005	0,55	2015	0,52
1986	0,51	1996	0,53	2006	0,52	2016	0,52
1987	0,51	1997	0,53	2007	0,52	2017	0,51
1988	0,51	1998	0,53	2008	0,57	2018	0,52
1989	0,51	1999	0,53	2009	0,56		

Source: ECLAC Statistical Yearbook, 2020

In the 1980s, income inequality measured through the GINI remained at 0.51, in the 1990s income inequality in Colombia experienced a significant increase, going from 0.51 in 1990 to 0.53 in 1999, in the decade from 2000 to 2010 inequality deepened, going from 0.53 to 0.56 in the last year and in the period 2011 to 2018 inequality It has shown some reduction, but remains above the limits of the 80s.

On the basis of the great challenges in terms of inequality experienced in the country, Article 350 of the Political Constitution of 1991 establishes that the appropriations law must have a component called public social expenditure that groups the items of this nature, as defined by the respective organic law. This same charter establishes that public social spending will have priority over any other allocation, Article 366 of the Political Constitution, establishes as a fundamental objective of public social spending, the solution of unsatisfied needs in health, education, environmental sanitation and drinking water.

Obviously, as shown in Table 2, Public Social Expenditure (GPS) in the 1980s was on average 8.0% of GDP, although there are important oscillations, the most important being that of 1989 when the GPS reached 9.9% of GDP in the last year of the government of Virgilio Barco Vargas.

Table 2 Public Social Expenditure as a Percentage of GDP from 1980 to 1990

Years	Public Social Expenditure	Social P Expenditure on Education	Social P Expenditure on Health	Social Spending on Housing	President	Development Plan
1980	7,6	3,2	1,2	0,5	Julio Cesar Turbay Ayala	National Integration Plan
1981	8,0	3,3	1,2	0,2		
1982	8,1	3,5	1,2	0,5		
1983	8,2	3,6	1,2	0,4	Belisario Betancur Cuartas	Change with Equity
1984	8,2	3,7	1,1	0,5		
1985	8,0	3,5	1,4	0,3		
1986	7,7	3,3	1,3	0,4		
1987	7,7	3,3	1,3	0,4	Virgilio Barco Vargas	Social Economy Plan
1988	7,9	3,2	1,4	0,3		
1989	9,9	3,3	1,2	0,4		
1990	8,2	3,2	1,2	0,3		

Source: ECLAC Statistical Yearbook, 2020

From the 1990s onwards, the GPS experienced a significant increase, going from 8.2% in 1991 at the beginning of the presidential term of César Gaviria Trujillo, to 15.2% in 1996, a year before the end of the government of Ernesto Samper Pisano, as can be seen in Table 3.

The increase in social spending in the Gaviria and Samper governments is explained by the influence of the new mandates established in the 1991 Constitution and the evident social component of the government of Ernesto Samper Pisano, materialized in the development plan called "The Social Leap" and the changes in terms of competencies and resources generated by the decentralization process that also expand the transfers to the territorial entities.

Table 3 Public Social Expenditure as a Percentage of GDP from 1990 to 1998

Years	Social Spending	Social Expenditure on Education	Social Expenditure on Health	Social Spending on Housing	President	Development Plan
1990	8,2	3,2	1,2	0,3	César Gaviria Trujillo	The Peaceful Revolution
1991	8,1	3,1	1,1	0,3		
1992	9,3	4	1,1	0,4		
1993	10,0	3,8	1,8	0,4		
1994	11,4	3,6	2,5	0,4		
1995	14,0	4,3	3,1	0,9	Ernesto Samper Pizano	The Social Leap
1996	15,2	4,3	3,7	1,1		
1997	15,2	4,5	3,7	0,9		
1998	6,7	3,9	3,5	0,8		

Source: ECLAC Statistical Yearbook, 2020

At the beginning of the twenty-first century, the focus of public social expenditure in Colombia in the government of Andrés Pastrana Arango continued on a path of growth after experiencing a reduction in the last year of the Samper government, the GPS went from 7.8 of GDP in 1999 to 9.9 points of GDP in 2002, with GPS experiencing greater prevalence in health. and a reduction in investment in housing.

In the two periods of Álvaro Uribe Vélez's government from 2003 to 2010, the GPS continued to grow until it reached double digits as can be seen in Table 4, going from a GPS of 9.5 of GDP in 2003 to 12.2 points of GDP in 2010, following the same spending parameters of the Pastrana government.

Table 4. Public Social Expenditure as a Percentage of GDP from 1999 to 2010

Years	Social Spending	Social Expenditure on Education	Social Expenditure on Health	Social Spending on Housing	President	Development Plan
1999	7,8	4,4	3,6	1,1	Andrés Pastrana Arango	Change to build peace
2000	8,4	3,5	5,7	0,1		
2001	9,2	3,7	6,0	0,2		
2002	9,9	4,3	5,8	0,1		
2003	9,5	4,3	5,8	0,2	Álvaro Uribe Vélez	Towards a community state
2004	10,3	4,1	5,8	0,2		
2005	10,8	4,0	6,1	0,2		
2006	10,7	3,9	6,4	0,2		
2007	11,4	4,1	6,5	0,3	Álvaro Uribe Vélez	Community State: Development for All
2008	11,3	3,9	6,9	0,4		
2009	13,3	4,8	7,3	0,5		
2010	12,2	4,8	7,1	0,5		

Source: ECLAC Statistical Yearbook, 2020

In the second decade of the 21st century in the governments of Juan Manuel Santos Calderón, GPS spending remained at 12 points of GDP, with low growth, but with the prevalence of spending on health, education and to a lesser extent housing, it went from a GPS of 12.3 points of GDP in 2011 to 12.6 points of GDP in 2018 as evidenced in Table 5.

Table 5 Public Social Expenditure as a Percentage of GDP from 2011 to 2018

Years	Social Spending	Social Expenditure on Education	Social Expenditure on Health	Social Spending on Housing	President	Development Plan
2011	12,3	4,5	6,8	0,5	Juan Manuel Santos Calderón	Prosperity for All
2012	12,4	4,4	6,8	0,6		
2013	12,8	4,9	7,3	0,7		
2014	12,9	4,6	7,1	0,6		
2015	13,0	4,5	7,3	0,5	Juan Manuel	All for a New Country
2016	12,5	4,5	7,2	0,5		

2017	13,4	4,5	7,2	0,6	Santos
2018	12,6	4,5	7,2	0,5	Calderón

Source: ECLAC Statistical Yearbook, 2020

Evidently, public spending as a proportion of GDP has shown significant growth, but income inequality measured through the GINI has also increased in the same period of time, which perhaps shows that public spending has not been sufficient to pressure a decrease in income inequality in Colombia.

However, there is currently little literature that explains the behavior of income inequality in the municipalities of Colombia or the effect of municipal spending on inequality, for this reason for this work the empirical evidence on national public expenditure on inequality will be taken as a proxy for the effects of municipal public expenditure on the GINI of the municipalities.

In this context, it must be said that income inequality, when studied by departments, cities and municipalities, is heterogeneous and represents great differences, which reflect the gap between municipalities, within the national territory. For Bonilla (2008) there is evidence that in Colombia the most equitable departments and cities are those with middle incomes, while the rich and poor are almost always part of the group of the most unequal. In this line, to solve the research problem posed, the methodology and econometric models to determine the relationship between municipal public expenditure and inequality in them are presented below.

Methodology

The research was designed with a quantitative approach of correlational and descriptive type; taking into account that a correlational study "aims to establish the causes of the events, occurrences or phenomena that are studied" (Hernández, Fernández & Baptista, 2011, p. 83) and "aims to answer for the causes of physical and social events and phenomena. It focuses on why a phenomenon occurs and under what conditions it manifests itself, or why two or more variables are related" (Hernández, et. al., 2011, p. 85). This means that, for the present study, the effects of municipal public expenditure on the reduction of inequality in Colombia are explained.

On the other hand, a descriptive study "seeks to specify properties, characteristics, and important features of any phenomenon that is analyzed and describes trends in a group or population" (Hernández, et. al., 2011, p. 80). For this research, and according to the literature, the factors that affect inequality, poverty and social exclusion in Colombia were selected, to contrast them with public policies, materialized through municipal public spending in Colombia.

The data used are from the Municipal Panel of the Center for the Study of Economic Development CEDE of the Universidad de los Andes, which consolidates information at the municipal level from different sources and entities in a single database. The panel presents information on general characteristics of municipalities, fiscal and good governance variables, conflict and violence, education, the agricultural sector, health and public services. The main sources are the National Administrative Department of Statistics DANE, the Agustín Codazzi IGAC Institute, the National Planning Department DNP, the Ministry of Agriculture, AGRONET, the Ministry of Health, the Ministry of Mines and Energy, among others.

The good governance panel gathers information related to income, expenditure, investment and performance of local administrations from 1,123 municipalities and 234 variables. The main sources of consolidated information are the National Planning Department (DNP) and the Attorney General's Office.

The dependent variables used in this research to respond to the research problem are: Municipal Expenditure per capita GPM, GINI index, Poverty Index, Unsatisfied Basic Needs Index (NBI) and the multidimensional poverty index (MPI) as shown in Table 6.

Table 6. Dependent variables

Code	Variable	Time
GPC	Municipal per capita expenditure	1993 and 2005
GINI	Municipal GINI Index	1993 and 2005
POVERTY	Incidence of municipal poverty	1994 and 2005
NBI	NBI - Unmet Basic Needs	1993, 1995, 2000, 2005 and 2018
IPM	Multidimensional Poverty Index	2005 and 2018

Source: The variables come from CEDE Universidad de Los Andes, 2020.

The structural or dependent variables used in the proposed econometric models as shown in Table 7 are: investment in health, investment in housing, investment in education, total investment in the period 2000 – 2010 and Total Expenditure of the municipalities from 1984 to 2019, these variables are used following the previous studies consulted in this regard and developed in the state of the art.

Table 7 Structural variable

Investment in health	2000 – 2010
Investment in housing	2000 – 2010
Investment in education	2000 – 2010
Inv_total	2000 – 2010
G_total	1984 – 2019

Note: variables are used to analyze the impact they have on the variables in Table 1. by CEDE Uni-Andes, 2020.

The main control variables used in the model are the height above sea level of the municipalities, linear distance to the capital of the department, GDP per capita of the municipality, total number of homicides by municipalities, hectares cultivated with coca, literacy rate, results of 11 of the students, Number of students in the traditional levels: preschool, primary, secondary and middle school, among others presented in Table 8, with the use of these variables we seek to reduce the bias of omitted variables and group municipalities with similar characteristics for the estimation of econometric models.

Table 8 Control variables.

Variable	Specification	Time
Height	Meters above sea level according to those in which the IGAC municipalities are located	1993-2019
Linear distance to the capital of the Department	Distance between the municipality and the capital of the department in kilometers according to IGAC	1993-2020
Municipal GDP per capita (Constant 2005)	Municipal per capita income	
Total number of homicides	It includes the total number of homicides by municipality	2003-2019
Hectares cultivated with coca	Number of hectares cultivated with coca per municipality	1999-2019
Coca	Dummy of presence of coca crops (0 = if there is no presence of cultivation in the municipality and 1 = if there is presence of cultivation in the municipality)	1999-2019
Indice_alfa	Percentage of population aged 15 years and over who can read and write (Literacy rate)	1993, 2005 and 2018
Learn 11_total		2000 -2018
Alumno_total	Number of students at traditional levels: preschool, primary, secondary and middle school	1996 – 2018
Docentes_total	It includes the number of teachers per day or in-service teacher	1996 – 2018

Coverage _subsidiado	Relates the percentage of population with coverage in the subsidized regime	1998-2016
Management Capacity: Management Score Gpph	Evaluates public management (in its programming, execution and monitoring stages)	MDM_g_puntaje

Source: The variables come from CEDE Universidad de LosAndes, 2020.

Econometric model

The present research used a multivariate econometric model to test the hypotheses raised, the estimation was made using the ordinary least squares (OLS) method, in all cases robust standard errors are included.

In particular, the following model is estimated:

$$Y_{it} = \beta_0 + \beta_1 G_{it} + \widehat{X}_{it} + \varepsilon_{it} \quad (1)$$

Where it represents the municipality and the year. *it*

Y_i It corresponds to the GINI, *G* represents the municipal expenditure per inhabitant and is transformed into a dummy that takes the value of one, if the municipality is in the last quartile and the value of 0 for the other quartiles, $\widehat{X}_{it}$ is a municipal control shown in Table 8. The econometric problems that may arise are those of heteroskedasticity, since there is great heterogeneity among the municipalities of the country, for this reason all estimates are made with robust standard errors. Now, for the multicollinearity problems, the correlation matrices of the variables and the Inflated Factor Variance test were performed.

For the demonstration of the working hypothesis, the following were taken as dependent variables: the GINI Index, the Index of Unsatisfied Basic Needs, Public Social Expenditure, and the Multidimensional Poverty Index, as shown in Table 6.

These estimates have problems of reverse causality, because the allocation of public spending depends on the behavior of variables such as: economic results, the collection capacity of the municipality and management capacity, among others, which generates problems of bias in the estimates. To correct the biases that are presented, the "Propensity Score Matching" matching methodology was used, which allows better comparisons and estimates of social spending on inequality.

Modelo Propensity Score Matching

To quantify the magnitude of the effect of public social expenditure on Municipal Income Inequality, two fundamental aspects were taken into account in the evaluation: the first of these aspects is related to the fact of comparing the value of the outcome variable (*Y*) of the municipalities that are among those that make the most public expenditure (*Y1*) and their respective value of the municipalities that are among those that make the least public expenditure (*Y0*), which is the counterfactual, must therefore be estimated in order to establish the effect of expenditure on income inequality. The second aspect has to do with the context or characteristics of the municipalities according to the level of spending. As has been indicated, most municipalities have

heterogeneous characteristics, which may bias the estimate of the effect of public expenditure on income inequality.

The importance of using the non-parametric Propensity Score Matching (PSM) approach in this work lies in the fact that this methodology allows estimating the average effect of a treatment on the treated (Average effect of Treatment on the Treated - ATT) by observing the outcome variable exposed to the treatment (Y_1) or factual state versus non-exposure (Y_0) or counterfactual state, this methodology began its use from the work of Rosenbaum and Rubin (1983) and has been widely used to evaluate the impact of public policies in different sectors.

In this case, when it is intended to estimate the effects of the Public Expenditure of the municipalities that spend the most and those that spend the least on the reduction of Income Inequality, the PSM estimates the counterfactual state, that is, the municipalities that spend the least public expenditure. The method makes it possible to find clone municipalities or similar that can provide sufficient information as a counterfactual. This estimate is based on the assumption that a municipality cannot be observed simultaneously in the two situations in the same period of time, therefore, the counterfactual state of the municipalities that do receive treatment is unobservable.

The PSM begins by establishing as a criterion for pairing between municipalities that make more public spending and the municipalities that make less public spending, their propensity to spend more. Because a large number of individual characteristics influence propensity, it is necessary to reduce them to a single scalar $p(X)$ or "Propensity Score (PS)" to make pairing more feasible. The propensity score is defined as the conditional probability of making more public spending given a set of individual characteristics (X) thus,

$$p(X) \equiv P\{D = 1 | X\} = E\{D|X\}$$

Where (X) is the vector of individual characteristics and $D = \{0,1\}$ is the indicator of being among the municipalities that make the most public spending. The latter takes the value of 1 when the municipality is located in the quartile of those that report the highest expenditure and 0 in the opposite case.

Matching occurs by selecting for each municipality that is located in the quartile of highest expenditure, a twin municipality among those that report the least expenditure, but which has the same propensity to do so (control group). In other words, the objective of the approach is to approach a situation where there are no differences between the two groups of municipalities with respect to a group of characteristics that influence the propensity to make more public spending. Because spending more is not random, the resulting variable among the municipalities with the lowest expenditure – counterfactual status – cannot be estimated as a simple average of its value among the municipalities that spend the least. It is necessary to control for the observable differences between the two groups of municipalities, to ensure that the resulting variable in the municipalities with the lowest expenditure Y_0 would be the same in both cases. This can be achieved if the following assumptions are met according to Rosenbaum and Rubin (1983) and Becker and Ichino (2002).

Hypothesis I. There is a balance in the set of individual characteristics (X).

$$D \perp X | p(X)$$

In this way, municipalities with the same propensity score value must have the same distribution of individual characteristics regardless of the state of the expenditure level. Thus, their belonging to the group of municipalities that spend the most is random and therefore the municipalities of the two groups must be on average observationally identical.

Hypothesis II. A Conditional Independence Assumption (CIA) is fulfilled, where it is assumed that the differences are captured in (X) and the outcome variables $\{Y_0, Y_1\}$ are independent of the state of being part of the group of municipalities that spend the most (Rubin, 1977).

$$Y_1, Y_0 \perp D | X$$

dado un propensity score,

$$Y_1, Y_0 \perp D | p(X)$$

Thus, the resulting variable of the Municipalities located among those that report the least expenditure Y_0 conditional on X has the same distribution function as the resulting variable Y_0 of the municipalities that are among the highest spenders and that would have been obtained if they were among those that spend the least. In other words, the estimated counterfactual state for the municipalities that are among the highest spenders is the closest to that experienced in the case of being among those that spend the least.

$$E[Y_0 | D = 1, p(X)] = E[Y_0 | D = 0, p(X)]$$

It should be noted that this hypothesis requires knowing all the variables that influence Y_0 or Y_1 , which allow a reasonable approximation to be reached (Almus et al. 1999, Arvanitis S. 2002 and Almus and Czarnitzki 2003)

Hypothesis III. A Stable Unit Treatment Value Assumption (SUTVA) is met. This assumption dictates that the impact of belonging to the group of municipalities that spends the most, on a municipality that is among those that spends the least does not depend on the participation status of other municipalities among those that spend the most. That is, under this assumption, the result observed for a municipality located among those that spend the most depends only on itself (Angrist, Imbens and Rubin 1996).

Once the above hypotheses have been met, the average effect of treatment on treated patients (ATT) can be estimated as follows:

$$\begin{aligned} \tau &\equiv E \{Y_1 i - Y_0 i | Di = 1\} \\ &= E\{E \{Y_1 i - Y_0 i | Di = 1, p(Xi)\}\} \\ &= E\{E \{Y_1 i | Di = 1, p(Xi)\} - E\{Y_0 i | Di = 0, p(Xi)\} | Di = 1\} \end{aligned}$$

To apply the PMS, several estimators can be used, however, for this work one of the best known and most used was used, the "Nearest Neighbor Matching" (NNM) estimator.

The matching process consists of taking for each treated unit a unit from the control group with the closest propensity score. A mathematical description of the process is presented below.

Defining T as the group of municipalities that makes the most public expenditure and C as the group of municipalities of control, then Y_i^T and Y_j^C are the outcome variables of both groups respectively. Defining $C_{(i)}$ as the set of control municipalities paired with a unit (i) of a municipality that is among those that spend the most given a propensity score (P_i) . The NNM method calculates:

$$C_{(i)} = \min_j \|P_i - P_j\|$$

The NNM estimator is:

$$\tau^{NNM} = \frac{1}{N^T} \sum_{i \in T} Y_i^T - \frac{1}{N^T} \sum_{j \in T} W_j Y_j^C$$

Where N_i^C indicates the number of controls paired with observations $i \in T$, weights are defined by $W_{ij} = \frac{1}{N_i^C}$ si $j \in C_i$ y $W_{ij} = 0$ otherwise, the variance that defines the error of the NNM estimator is given by

$$Var(\tau^{NNM}) = \frac{1}{N^T} Var(Y_i^T) + \frac{1}{(N^T)^2} \sum_{j \in C} (W_j)^2 Var(Y_j^C)$$

The mathematical specification of this method was developed based on Becker and Ichino (2022), who state that in relation to the quantity and quality of pairings, no method is superior to another.

In this sense, once the NNM has been applied and the matching of the differences between the treated municipalities (those with the highest expenditure) and the untreated municipalities or control group is obtained, the average effect of the treatments on the treated municipalities (ATT) is calculated and the average on these differences is obtained. Taking into account that it is possible that one of the municipalities that spends the most does not find its peer in the control group and this situation generates a support problem, this problem is solved by omitting participants with a poor match to obtain a better estimate of the ATT.

Results

Descriptive statistics

In Colombia, the average total expenditure per inhabitant in the municipalities is \$21,451 pesos, the average investment in education per student is \$4,331,414 pesos, the average investment per inhabitant in health is \$8,596,883, the average investment per inhabitant in housing is \$445,710 pesos, the average score for the management of public resources is 50.37, the average municipal inequality measured through the Gini is 0.455, on average 53% of the population in the country's municipalities is in poverty as evidenced in Table 9. These data are important to identify the effect of these variables on income inequality in Colombia, taking into account that the literature establishes that higher public spending mainly on housing, education, and health has a significant effect on reducing inequality.

Table 9 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Code	4691 4	39113.439	26668.132	5001	99773
Year	4691 5	1995.388	20.83	1918	2019
G total	3954 0	21451.44 8	255268.1 8	0	19441086
MDM g score	4404	50.37	10.152	2.011	85.285
MDM	4404	50.372	10.17	2.033	86.817
Total Inv Educ	7293	4331414.4	42747556	0	1.493E+09
Inv in health	1174 9	8596883.7	1.099E+08	0	4.021e+09
Inv in housing	1174 9	445710.33	5536133.5	0	4.208E+08
Inv total	1174 9	25530410	2.594E+08	0	9.252E+09
Total Population	3029 3	38598.81	235211.3	0	8080734
Height	2917 2	1131.717	919.643	1	3350
Distance to the capital	3029 3	81.453	60.535	0	493.084
PIB Cons	5270	359164.86	3281679.2	207.965	1.063E+08
GDP Per Capita with GPC	5265 2086	7.154 158950.03	5.583 107767.53	.008 27246.201	80.1 585448.44
GINI	2086	.455	.036	.357	.568
Poverty	2086	.535	.128	.17	.874
NBI	5393	43.304	23.026	1.585	105.29
IPM	2235	55.569	21.817	4.5	100
Homicide	1909 1	14.066	75.329	0	2163
H coca	3942	550.096	1438.508	.07	23147.95
Coca	3942	1	0	1	1
Literacy Index	3366	86.049	8.122	.378	100
Total teacher	2559 4	389.765	2157.886	0	68838
Know 11 total	2084 3	48.11	2.676	35.191	65.797
Subsidized health coverage	2093 6	.889	.282	0	3.13

Source: The variables come from CEDE Universidad de Los Andes, 2020.

As can be seen, in Table 9 the average homicide rate is 14 people per 100,000 inhabitants, literacy is 86.04%, the average result in knowing 11 is 48.11 points.

When comparing the level of expenditure by quartiles, it is observed that the municipalities that spend the least (located in quartile 1) have a GINI of 0.463, while the municipalities that spend the most (located in quartile 4) have a GINI of 0.449; along the same lines, the poverty of the municipalities located in quartile 1 is 60.5%, while those located in quartile 4 is 46.9%; the same situation is evident in the NBI, in multidimensional poverty and in the public management index as evidenced in Table 10, which indicates that the higher level of public spending has positive effects on the reduction of inequality, poverty, and unsatisfied basic needs in the country's municipalities.

Table 10. Descriptive according to the quartiles of expenditure by municipality.

Quartile of expenditure by municipality	MDM_g_puntaje	MDM	Height	Distance to the capital	Gini	Poverty	NBI	IPM	Homicide
.	.	.	157.68	193.837	.	.	77.886	87.727	0.856
1	18.231	18.297	754.334	92.614	0.463	0.605	60.768	74.717	11.308
2	43.174	43.071	1390.651	77.402	0.452	0.53	48.866	70.331	2.347
3	48.127	48.12	1233.1	80.596	0.458	0.53	41.925	64.463	4.469
4	51.014	51.019	926.974	76.384	0.449	0.469	25.741	44.199	24.895

Source: The variables come from CEDE Universidad de Los Andes, 2020.

The data related in Table 10 show that the higher level of expenditure does not have positive effects on the reduction of homicides in the country's municipalities, this can be explained by the existence of organized criminal groups for which contract killings and illegality are the main source of income.

It is also important to highlight that the municipalities closest to the capitals are those with the highest level of public spending, lower rates of inequality, poverty and unsatisfied basic needs, and have better results in the management indicators of public resources, which can be understood by the influence generated by the capital in terms of management model. monitoring the use of resources, the irrigation of income and access to sources of financing and academic training of its inhabitants in the capital.

On the other hand, the municipalities of the country that have the highest volume of coca production per hectare, which are related in Table 11 with Number 1, are also the most unequal, the poorest and have the highest rate of unsatisfied basic needs and homicide as shown in Table 11. Evidently, the high prevalence of coca crops has deepened the social difficulties in these municipalities due to the fact that the GINI is 0.481, poverty is 5.83%, the NBI is 53.933, the homicide rate is 17.602 and public management is 46.03.

Board 2 Coca-growing municipality.

MDM_g_Puntaje	MDM	Height	Distance to the capital	GINI	Poverty	NBI	IPM	Homicide	
0	51.214	51.209	1208.2	75.449	0.453	0.532	42.21	53.197	13.316

1 46.003 46.039 615.722 121.59 0.481 0.583 52.933 67.37 17.602

Note: Calculations were made based on the ELCA. 1 corresponds to the coca municipalities and 0 are the non-coca-growing municipalities. Source: The variables come from CEDE Uni-Andes, 2020.

For the country's municipalities that do not have coca crops, public management of resources is better than in coca-producing municipalities, as well as inequality, poverty, unsatisfied basic needs, multidimensional poverty and the level of homicide as evidenced in Table 11, this is explained by the fact that in coca-producing municipalities, Public management has a focus more on combating production rather than on solving the social ills of poverty and inequality, but also like most crops, the processing is in the hands of illegal groups, which usually to solve their differences do so through the physical elimination of the adversary. which means that they have higher homicide rates and that the income generated remains in the hands of a few, thus deepening inequalities and poverty in all its forms, while in municipalities that do not have coca crops, the approach to public management of resources can be made with criteria of poverty and inequality.

On the other hand, when grouping the municipalities into quartiles by level of expenditure, it is evident that there is a significant linear relationship of the municipalities with the highest level of expenditure in reference to the municipalities with the lowest level of expenditure in the reduction of the GINI as evidenced in Table 12, the municipalities with the highest level of expenditure decrease the GINI by 1.47% compared to the municipalities that spend the least. results similar to those found by Mostajo (2020), Copeland (1947); Aaron and McGuire (1970), Stiglitz (2012). Cárdenas et al. (2019) and Garrochamba (2017); for the municipalities with average expenditure located in quartiles 2 and 3, the results are not significant in the decrease of the GINI as well as in the variable Height in meters of the municipality above sea level.

Board 3 Linear model: effects of municipal spending on inequality

VARIABLES	(1) Gini
Cuartiles of gpph = 2	-0.00245 (0.00458)
Cuartiles of gpph = 3	-0.00715 (0.00496)
Cuartiles of gpph = 4	-0.0147** (0.00678)
Reference(Quartile 1)	
Height of the municipality - MSL (Meters Above Sea Level)	-8.32e-07 (1.18e-06)
PIB per capita municipal (Constante 2005)	- 0.000669*** (0.000239)
Dummy of the presence of coca crops	0.0254*** (0.00279)
Total score	-0.00158*** (0.000477)
Coverage of people affiliated to the subsidized regime	0.00921* (0.00480)
Constant	0.527***

	(0.0229)
Observations	992
R-squared	0.139
Effect on municipalities	YES

Standard errors in parentheses

p<0.01, ** p<0.05, * p<0.1

Source: own elaboration

Now it is important to analyze the coefficients of the controls, it is highlighted that the municipal GDP per capita presents a significant linear relationship in the decrease of the GINI of 0.669%, in the same line the municipalities with the greatest presence of coca cultivation the GINI income inequality increases by 2.54%, which can be explained because the income from the crop remains in the hands of a few, especially criminal groups; municipalities with better indicators in the management of public resources significantly reduce income inequality by 0.00158%, which indicates that the focused management of resources has important effects on the reduction of the GINI; Similarly, the greater coverage of affiliation to the health system through the subsidized regime of the population significantly decreases income inequality by 0.921% (Vargas, 2004; Pinzón, Reveiz, Idrovo, & Reyes, 2014; Cid & Prieto, 2012).

On the other hand, when taking the MPI as a dependent variable and analyzing it by quartile of expenditure, in general a decrease in this is found in the municipalities that have the highest expenditure as evidenced in table 13.

Board 4. Linear Regression Multidimensional Poverty Index (MPI)

Dependent variable:	
	IPM
factor(quartile)2	-3.951** (1.904)
factor(quartile)3	-26.763*** (1.980)
factor(quartile)4	-29.029*** (1.758)
Height	-0.003*** (0.001)

distancia_mercado	0.055*** (0.009)
Constant	78.263*** (1.886)
Fixed effect of municipality	YES
Observations	361
R2	0.579
Adjusted R ²	0.573
Residual Std. Error	12.591 (df = 355)
F Statistic	97.559 (df = 5; 355)

*Note: *p**pp<0.01*

Table 13 shows the regression where the dependent variable is the MPI, and shows that, as per capita expenditure increases in terms of the expenditure quartile, the MPI decreases. In particular, the MPI is reduced by about 29 percentage points in the municipalities that spend the most per capita compared to those municipalities that spend the least (quartile 1). With regard to the controls that were considered, there is a direct relationship with the distance from the market and the MPI, that is, the greater the distance from the main market, the higher the poverty levels. On the other hand, those municipalities that are located at higher altitudes are related to reductions in poverty. While it is true that the results show a correlation, the problems of causality are evident.

The effects of public spending on indicators of inequality and well-being can be overestimated due to problems of omitted variable, due to the great heterogeneity of the municipalities, which is how the first regressions that are shown, their coefficients can present these biases. To account for this heterogeneity, the Oster test (2019) is included, which can be seen in Appendices 5. In particular, the estimates do not meet the robustness standards that set the boundaries between controlled beta and bias-adjusted beta includes zero. The above results indicate the problems that may arise with the linear regression model such as the one shown in table 12,13 and in annexes 6 and 7, to adjust these problems the present research addresses them by means of the matching methodology shown in the following below.

Appendix 1 and 2 show the behavior of municipal expenditure by quartile of municipality and the IMP.

Estimation Matchmaking methodology *propensity score matching*.

The above results were interpreted as relationships, since it is not performing **causality exercises**. Thus, problems of reverse causality may arise that may exist between public spending in its different dimensions and social indicators, these are evident, for example, municipalities that have good expenditure management at the same time are those that present the best indicators. To agree with this situation, the "*propensity score matching*" methodology is used, which allows comparing similar municipalities according to the characteristics observable in the database of municipalities provided by the CEDE of the Universidad de los Andes and that were used in the previous regressions.

The counterfactual used corresponds to the municipalities that are in the last quartile of the variable public expenditure per inhabitant, that is, those municipalities that have higher expenditure compared to those that do not, but are similar in terms of their observable characteristics. In other words, clone municipalities were sought in such a way as to reduce the problems of bias in the estimates.

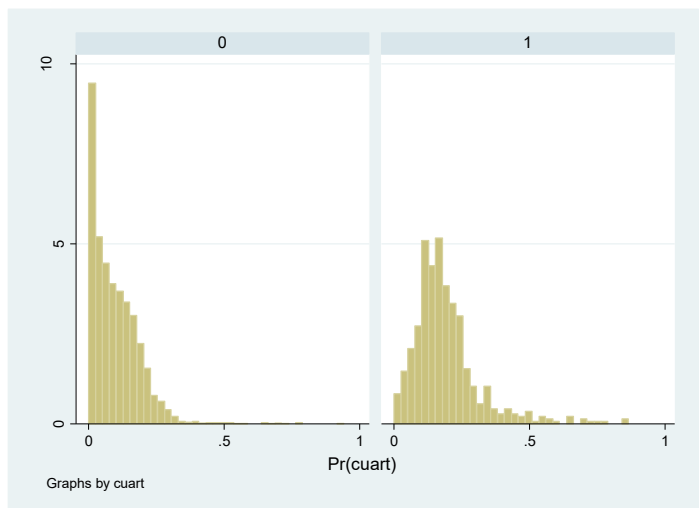
The steps to be followed are based on Bernal and Peña (2012) and in particular for the present research, they are as follows:

1. Estimate the probability that a municipality is among those with the highest public expenditure per inhabitant, expressed as those in the top quartile.
2. Restrict the sample to municipalities with similar propensities to be among those that make the most public expenditure per inhabitant.
3. Select the most similar municipalities, based on the kernel methodology and the closest neighbors.
4. Analyze that the controls between the municipalities that spend the most with respect to the others (control) are balanced in terms of their probabilities of executing the expenditure.
5. Estimate the average effects, treatment of the municipalities that spend the most Vs the others.

Given the above, the following section shows the steps to achieve the average treatment effect:

The probability distribution was estimated that a municipality is among those with the highest public expenditure per inhabitant, that is, that it is in the top quartile, compared to the control group, as evidenced in Graph 4.

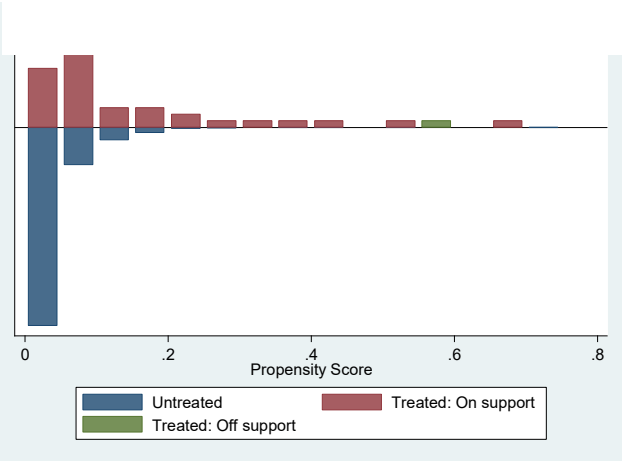
Graphic 4 Treatment Group Probability Distribution Vs Control



Note: It shows the probability distribution between those who spend the most (treatment) and the other municipalities that is the control. The figure was prepared in Stata 15, with data from the Municipal Panel of the CEDE of the Universidad de los Andes. 1 corresponds to the municipalities of the treatment and 0 are the municipalities of control, 2020.

Additionally, the sample was restricted to municipalities with similar propensities to be among those that make the most public expenditure per inhabitant, in Graph 5 the common support is shown, which indicates the similar probabilities of being in a treatment or control group, according to the variables used in this study.

Graph 5 Common support in municipality



Note: The green bar corresponds to the municipalities that did not manage to enter the common support zone, therefore, they are not considered in the mean comparison analysis, thus reducing the possible biases of a model that includes all municipalities, as was done in the linear regression. In particular, there were 7 municipalities that will be omitted to make the estimates of the average treatment effects.

Table 14 shows the differences in means between the treatment and control groups, as well as the percentage of bias between the treatment and control groups.

Board 5. Difference in means of the control variables between the treatment group and the control group.

Variable	UnmatchedMatched	Mean		% reduct		t- test		v(t)/v(c)
		Treated	Control	%bias	bias	t- test	p> t	
Height	In the	1130.6	1233.6	-11.8		-0.69	0.490	0.82
	M	1092.2	1083.9	0.9	91.9	0.04	0.966	0.80
PIB_ Per capita _Const	In the	5.4452	6.0279	-17.4		-0.88	0.381	0.33*
	M	5.5631	5.6178	1.6	90.6	-0.08	0.938	0.38*
Coca	In the	.07692	.14376	-21.3		-1.17	0.240	*
	M	.07895	.8558	-2.1	90.1	-0.10	0.918	*
S11_total	In the	48.742	48.3	15.6		1.21	0.225	2.41*
	M	48.762	48.498	9.3	40.4	0.37	0.711	1.58
Cobertura_ subsidized	In the	1.0292	.74055	121.3		8.39	0.000	1.61
	M	1.0121	.96341	20.5	83.1	0.82	0.418	0.80

Note: There are no statistically significant differences between the control variables and the treatment group.

Continuing with the estimates of the average treatment effects, a probit-type model is estimated where the dependent variable is belonging to the treatment group and the same control variables are contemplated, as can be seen in Table 15, the coefficients are mostly not statistically significant, which indicates a good balance between the variables used to determine the common support.

Board 6 Probit Model

Probit regression				Number of obs	=	992
Log likelihood = -132.04485				LR chi2 (5)		64.78
				Prob>chi2		0.0000
				Pseudo R2		0.1970
Quart	Coef.	Std.Err	with	P> z	[95% Conf.	Interval]
Height	-	.0001015	-2.21	0.027	-	-
	.0002245				.0004235	.0000255
PIB_ Per capita _Const	-	.2592	-0.85	0.393	-	.0286657
	.0221365				.0729387	
Coca	-	.2962048	-1.50	0.133	-	.135415
	.4451357				1.025686	
S11_total	.0384143	.0357094	1.08	0.282	-	.1084033
					.0315748	
Cobertura_ subsidized	2.615305	.3786236	6.91	0.000	1.873216	3.357393
	-	1.70207	-3.18	0.001	-8.75652	-
_cons	5.420525					2.084529

Source: Authors.

Now, when estimating the average effects of the municipalities that spend the most vs. the others on the GINI, through Kernel and Trimming, as can be seen in Tables 16 and 17, the municipalities that spend the most are on average those that reduce the GINI, this difference is statistically significant, as can be seen in the last column of the Propensity Score Matching Tables 16 and 17.

Table 16 presents the estimated effect of the municipalities with the highest public expenditure per inhabitant through the pairing of Kernel and the predetermined common support, in particular this effect is -0.010 points in the GINI with 1% confidence.

Board 7 ATT Kernel Method

Variable Sample	Treated	Controls	Difference	S.E.	T-stat
<i>gini Unmatchad</i>	.44182821	.452104617	-.01027641	.005168439	-1.99
<i>THAT</i>	.44198421	.452955801	.010971595	.004831124	-2.27

Standard errors in parentheses

p<0.01, ** p<0.05, * p<0.1

Source: Authors.

On the other hand, table 17 shows the impact of the municipalities that spend the most with respect to those that allocate the least resources per inhabitant, by matching the nearest neighbor, trimming the extremes of the observations depending on the probability ranges, so the effect on the GINI is -0.016.

Board 8 Trimming Method

Probit regression				Number of obs	=	992
<i>Log likelihood = -132.04485</i>				LR chi2 (5)		64.78
				Prob>chi2		0.0000
				Pseudo R2		0.1970
Quart	Coef.	Std.Err	with	P> z	[95% Conf.	Interval]
<i>Height</i>	-	.0001015	-2.21	0.027	-	-
<i>PIB_ Per capita _Const</i>	.0002245				.0004235	.0000255
	-	.2592	-0.85	0.393	-	.0286657
	.0221365				.0729387	
<i>Coca</i>	-	.2962048	-1.50	0.133	-	.135415
	.4451357				1.025686	
<i>S11_total</i>	.0384143	.0357094	1.08	0.282	-	.1084033
					.0315748	
<i>Cobertura_ subsidized</i>	2.615305	.3786236	6.91	0.000	1.873216	3.357393
<i>_cons</i>	-	1.70207	-3.18	0.001	-8.75652	-
	5.420525					2.084529

Variable Sample	Treated	Controls	Difference	S.E.	T-stat
<i>gini Unmatchad</i>	.441828205	.452104617	-.010276412	.005168439	-1.99

THAT	.43906875	.455184375	-.016115624	.006371605	-2.53
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Note: S.E. does not take into account that the propensity score is estimated.

<i>psmatch2:</i>	<i>psmatch2: common</i>		
<i>Treatment assignment</i>	support off suppo	on suppor	Total
<i>Untreated</i>	0	953	953
<i>Treated</i>	7	32	39
<i>Total</i>	7	985	992

Note: In particular, there were 7 municipalities that will be omitted to make the estimates of the average treatment effects. Fountain. Own elaboration

Evidently, the matching methodology shows that there is a significant indirect relationship between the municipalities that spend the most and the GINI, that is, the higher public spending increases, the income inequality in those territories decreases.

The same procedure was carried out with the MPI (see annexes 3 and 4), where those municipalities that are among the 25% that spend the most per capita are taken as treatment, and the controls are those belonging to the other percentage distributions². In this case, the average treatment effect is negative, but not significant. The exercise was performed using different *matching algorithms such as: kernel, nearest neighbors*. In all cases, the ATTs were not significant. Given the above result, it is not possible to mention a causal relationship between public spending and poverty, although it exists.

Discussions.

When analyzing the results of the "*propensity score matching*" model by the Kernel and Trimming method, there is evidence of a decrease in income inequality by 0.010 and 0.016 points, respectively, in the municipalities with observable characteristics that spend the most; results similar to those identified in the descriptive statistics presented in Table 10 where, it is observed that the municipalities that spend the least (located in quartile 1) have a GINI of 0.463, while the municipalities that spend the most (located in quartile 4) have a GINI of 0.449; in the same line, the poverty of the municipalities located in quartile 1 is 60.5% while those located in quartile 4 is 46.9%; the same situation is evident in the NBI, In multidimensional poverty and in the public management index as shown in Table 10, the above indicates that the higher level of public spending has positive effects on the reduction of income inequality in the country's municipalities.

By contrasting the results of the model *propensity score matching (PSM)* by the Kernel method and Trimming, with the results of the Linear model of marginal effects of municipal expenditure on inequality presented in Table 12, similarities appeared; while in the PSM model by Kernel and Trimming, inequality in the municipalities that on average have the highest expenditure decreases by 0.10 and 0.016 points respectively, *in the results of the linear regression*, the municipalities with the highest level of expenditure decrease the GINI by 1.47% compared to the municipalities that spend the least, results similar to those found by Mostajo (2020), Copeland

² Exercises were also carried out comparing only with the lowest distributions as a comparison group and the results are similar in terms of the ATTs and their respective significance.

(1947); Aaron and McGuire (1970) and Stiglitz (2012). , and Mejía et al. (2020).(Cardenas, Morán, & Rosero, 2019)(Garrochamba, 2017)

The results of the Propensity Score Matching (PSM) are more robust and less biased, since the means of municipalities that have similar observable characteristics are compared. In this sense, the problems of endogeneity of the variables are corrected and allows us to accept more precisely the null hypothesis of the research and establish that public social spending in the municipalities of the country has a significant effect on the reduction of inequality measured through the GINI, however, it must be established that this effect is only significant in the municipalities with the highest level of expenditure. This evidence should serve to make a greater effort in spending in the municipalities that have the highest rates of inequality, in addition to this it must be clarified that this expenditure must be associated with efficient public management, where investment is prioritized in overcoming the basic needs established in Article 41 of the Organic Statute of the Budget, 1996.

Conclusions

The promotion of municipal public spending is an alternative to somehow solve the great problems of inequality faced by the municipalities of Colombia in the midst of the great heterogeneity that characterizes them, public spending policies cannot be ignored as a mechanism for social development and reduction of inequalities, on the contrary, they should be encouraged, but having a clear focus, effective control and high transparency in their management so that the results can be evident in the reduction of the GINI both at the local level and its effects at the national level.

According to the results of the linear model, it is evident that the municipalities with the highest level of public expenditure decrease the GINI by 1.47% compared to the municipalities that made less public expenditure in the study period, which allows us to accept the null hypothesis of the work, that is, public expenditure effectively has a significant effect on the reduction of inequality in the municipalities of Colombia. this same result is shown by the municipalities that have a higher GDP which decrease the GINI by 0.669% compared to those with a lower GDP, this can be explained because the higher level of production allows greater revenue collection to the municipalities and therefore a higher level of public spending, which ultimately puts pressure on a reduction in income inequality.

Not only does the increase in public spending have a direct effect on the decrease of the GINI in the municipalities that make the most public expenditures in Colombia, but it also decreases the Multidimensional Poverty Index, the results of the linear model show that the MPI decreases by about 29% in the municipalities that spend the most located in quartile 4, compared to those who spend the least located in quartile 1.

In addition, the results of the probabilistic model, when studying the average effects of the municipalities that report the most expenditure versus those that report the least expenditure on the GINI, it is found, as in the linear model, that there is a negative relationship between higher public expenditure and municipal income inequality, through the Kernel matching method it is found that the effect of the municipalities with higher expenditure compared to those who spend the least is that the GINI decreases by -0.010 points and with the Trimming method the decrease of the GINI is -0.016 in the municipalities that spend the most compared to those that spend the least,

therefore, the null hypothesis of this research work is accepted in coherence with those established by Mostajo (2020), Copeland (1947); Aaron and McGuire (1970), Stiglitz (2012). Cárdenas et al. (2019) and Garrochamba (2017).

In relation to the above, fighting inequality is an imperative that should focus the attention of public policymakers and public administrators, because, as Stiglitz (2012) states, inequality brings with it despair, deterioration of social stability, and a chain of problems that stop the development of territories.

Undoubtedly, the role of the State in all its instances must be aimed at overcoming the problems of inequality, multidimensional poverty and unsatisfied basic needs of the population, if we want to have a stable, prosperous country with human capital that contributes to development, as Cotte and Cotrino (2006) put it.

However, public spending should be focused on providing basic services such as: education at all levels, health, housing, environmental sanitation, drinking water and sewerage, as Garrochamba (2017) proposes. In Colombia, where most municipalities have major problems of job creation, poverty, inequality, guaranteeing access to health and education at all levels can make a difference in guaranteeing a prosperous future for territorial entities or in deepening the social ills they face, because, according to García et al. (2018), if these problems are not solved, it is impossible for the country's municipalities to be competitive and achieve improve their development.

In addition, it is important to say that public spending must change its character, it is necessary to move from electoral public spending as proposed by Eslava, M. (2006) to systematic public spending focused on solving basic problems of the living condition of the population that inhabits the municipalities of Colombia, this is imperative and should be the line of road of public administrators in all instances. If the vision of spending is not changed, it will be difficult to improve inequality and the other problems associated with it.

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