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Decentralization in Colombia: Searching for social equity in a bumpy economic geography*

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Abstract

Colombia's decentralization was conceived to improve population's access to social services, reduce poverty and equalize well-being across the territory. However, after more than 20 years of its implementation a big gap across municipalities still remains. This paper analyses the impact of the Colombia's fiscal decentralization process over the achievement of social minimums as depicted by the average multidimensional gap and the multidimensional deprivation headcount. We implement an instrumental variable spatial autoregressive model with spatial autoregressive disturbances to take into consideration the spatial interrelated behaviour of deprivation in the Colombian context. This, while accounting for the endogeneity that arises when evaluating the impact of fiscal decentralization. We find strong statistically significant results across all the proven specifications that confirm causal diminishing effect of the share of own resources over multidimensional deprivation. Counterfactual scenarios of spatially differentiated decentralization policies highlight their grater effectiveness over geographically mute designs.

Keywords: Decentralization, multidimensional poverty, social equity, economic geography, spatial interdependence, Colombia.

JEL Classification: H71, I31, I38, O23, R58.

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1. Introduction

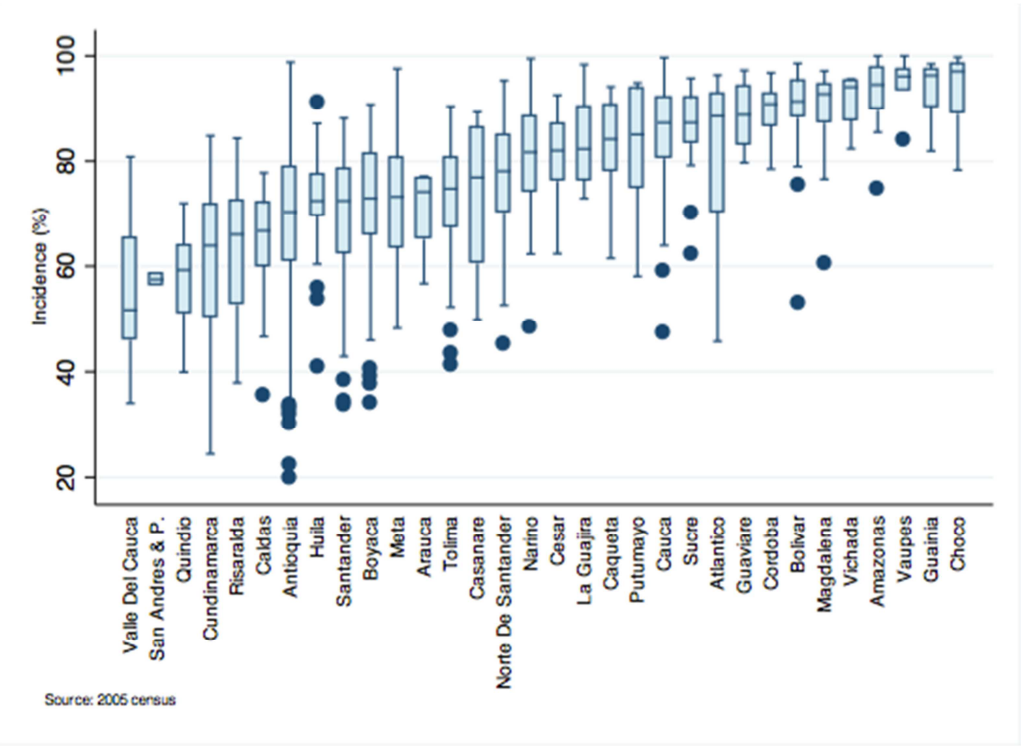
Colombia's decentralization was conceived to improve population's access to social services, reduce poverty and equalized well-being across the territory. However, after more than 20 years of its implementation a big gap in social achievements across municipalities remains. According to 2005 census calculations, 55.6% of the national population is under multidimensional poverty with astonishing differences across municipalities ranging from 19.8% to 99.8%.[1]

Several studies have tackled the divergent economic pattern of Colombian territories over time, such as Cardenas (1993), Bonet and Meisel (1999), Acevedo (2003) and, more recently, Cortés and Vargas (2012) among others; however, most of them focus their analysis on economic convergence and their unit of analysis is *´departmentos´* (Colombian counties). In this paper we focus on convergence to social minimums at the municipality level, the smallest political – administrative unit in Colombia.

This choice is not irrelevant: one of the key insights of this study is that poverty needs to be understood taking into account its spatial dimension, where economic geography features and institutional capabilities of local governments play a crucial role. Therefore, for the Colombian case addressing the geographical dimension of poverty at the county level hides the high heterogeneity that lies inside counties. For instance, when plotting the dispersion of multidimensional poverty incidence across Colombian municipalities and by county, as shown in Figure 1 below, most of the counties register a large dispersion. Antioquia, for example, shows municipalities ranging from 19.7% of multidimensional poverty (Envigado) up to municipalities with 98.8% of multidimensional poverty (Vigía del Fuerte).

[1] The Colombian Multidimensional Poverty Index (CMPI) is the national indicator of multidimensional poverty launched by the Colombian government in 2012. This indicator sets the socially acceptable minimums for the five most important Colombian social public policy dimensions (education of household members; childhood and youth conditions; health; employment; and access to household utilities and living conditions) (Angulo et al, 2013). Figures correspond to our census based calculations and version of the CMPI (See section 5.a for a broader description on this indicator).

Figure 1: Dispersion of multidimensional poverty headcount by county



We argue that rather than economic convergence, where differences across the territory are explained and even desirable because of agglomeration processes and external economies arising from urbanization, the claim is therefore for convergence to social minimum achievements that allow the population to fulfil their life with valued functionings[2], which is the ultimate goal of the "Social Rule of Law" (*Estado Social de Derecho*) specified by the 1991 Colombian Constitution.

In fact, the "decentralization model" conceived by the Constitution of 1991 can be understood as a rearrangement of the State and the relationships between levels of government to achieve social equity. The objectives of decentralization as stated in the Constitution are: a) to improve the access of the population to social and public services, with emphasis in education, health, water supply and sanitation; b) to target resources toward the poorest population in order to take them out of poverty; c) to diminish territorial inequalities; d) to promote productive processes to improve income and employment, and e) to improve and to deep representative and political democracy (Maldonado, 2011).

[2] According to Sen (1993) approach to well-being and advantage, the life that a person held can be seen as a finite set of doings and beings, some very basic and strongly valuated and other more complexes. Those various doings and beings are called by Sen as *functionings.*

In this context, there is a particular strand within the decentralization literature that explores the relationship between poverty and decentralization, trying to establish whether or not the fiscal decentralization process has served the poor. Studies within this strand at the international arena are still inconclusive or contradictory. While Von Braun and Grote (2000), based on a cross country sample of 173 developing countries, found a positive marginally decreasing relation of the share of subnational expenditures over poverty, Sepulveda and Martinez (2011), based on information for 34 developing countries from 1970 to 2000, find that the share of income of local governments has a negative and statistically significant effect.

Now, for the case of Colombia, two papers have approached the fiscal behavior of local governments under the Colombian specific decentralization design: Perry and Olivera (2009) and Sánchez and Pachón (2013). While Perry and Olivera (2009) explore the relationship between fiscal effort (tax income as a share of GDP) and royalties from coal and oil and found that increments in royalties has been accompanied by reductions of fiscal effort for some municipalities; Sánchez and Pachón (2013) assess the causal relationship between political competition and fiscal effort and found that indeed political competition variables are related with the Colombian municipalities' fiscal effort, and that the size of this effort affects the efficiency in the provision of water and education services.

As pointed out by Von Braun and Grote (2000) and indicative in Sánchez and Pachón (2013), fiscal decentralization cannot be studied as an isolated policy mechanism, it needs to be accompanied considering simultaneously political and administrative measures as well. As a result, we asses the causal effect of the Colombian municipalities' fiscal effort over multidimensional deprivation, controlling not only by the other sources of income of local governments (mainly governmental transfers), but also by the political and administrative components of the decentralization process in Colombia. We address multidimensional deprivation as an economic geography phenomenon, disentangling the effect of the decentralization process in the context of the economic geography issues that emerge from a very heterogeneous territory. These two constitute the empirical contributions of this paper in the Colombian decentralization literature.

We use 2005 census data and several administrative registers from Colombian agencies on household social conditions, social public expenditures and others. With this information, we implement a spatial autoregressive model with spatial autoregressive disturbance for the multidimensional deprivation headcount and poverty gap. We apply an instrumental variable approach to account for the

possible endogeneity that could arise when evaluating the impact of fiscal decentralization over multidimensional deprivation.

From our analysis we derive policy implications to improve social convergence to minimums. Results suggest a causal negative effect of fiscal decentralization (measured by the per capita rate of own generated resources) over the multidimensional deprivation headcount and gap. We find a strong statistically significant effect of spatial spillovers of deprivation across municipalities that should be taken into account when designing public policy interventions. Additionally, we test counterfactual scenarios of spatially differentiated decentralization policies that highlight the greater effectiveness of such type of policies over geographically mute designs. Territorially differentiated decentralization policies that take into account the heterogeneity of regions and municipalities are required to improve social convergence to minimums.

2. Data

Our decentralization analysis was grounded on municipality data derived from the 2005 Colombian population and housing census and administrative registers. The 2005 population and housing Colombian census interviewed 10.4 million households for a total of 41.5 million persons. The Census was intended to cover all the national territory and according to a post-censal assessment, it had an overall estimated coverage of 96.3% of the total population. The population and housing Census was made mainly of two questionnaires, the first one applied over each of the respondent households including dwelling conditions and household composition questions. The second questionnaire, an extended version of the first one, was applied over a probabilistic subsample of conglomerates with a household Bernoulli selection procedure. The extended questionnaire included information regarding education and labor conditions for each of the household members and allows for municipality figures estimations.

On the other hand, regarding Colombian administrative registers we use: i) the local budgetary execution register from the National Planning Department[3]; ii) the 2003 national registers on voting

[3] Information system for capturing the local budget execution (*Sistema de Información para la Captura de la Ejecución Presupuestal,* SICEP)

from the National Registry Department; iii) primary and secondary road network information from the System of Cities and from the National Geographical Institute (IGAC); iv) the administrative register regarding social protection affiliation for formal employees from the Social Protection Ministry; and v) demographic indices from the Colombian UNDP 2011 report (Machado, 2011).

3. Decentralization in Colombia: A Model of Delegation financed by Governmental Transfers

The fundamental core of decentralization from a fiscal federalism model rests in the definition of competences to different levels of government, and in the allocation of resources that enable local governments to exert those competences. According to Martinez-Vazquez and Timofeev (2009) decentralization could be defined as the process of transferring decision power to the lower levels of government. Then, decentralization, in general, can be understood across three main areas were local governments are empowered: fiscal, administrative and political dimensions.

The ideal model of fiscal decentralization, embedded in the so called "fiscal federalism" (Litvack et al., 1998) proposes fiscal independence of each jurisdiction over the basis of a distribution of incomes and responsibilities. In practice however, the degrees of decentralization vary. The usual models of decentralization can be put into three schemes: a) deconcentration of national agencies that imply some autonomy with control and regulation from the central government; b) delegation, for which the subnational government is able to supply some social services, under the regulation of the central government; c) devolution, which implies full autonomy in terms of competences and with the ability to generate the resources needed to exert those competences. While devolution implies that municipalities take over the provision, financing and regulation of public services; delegation and deconcentration do not imply self-regulation of the public services provision at the municipality level. Moreover, deconcentration only takes part in the public services provision but neither in their financing nor in their regulation.

The current state of decentralization in Colombia is the result of 25 years of accumulation of major reforms that began with the Legislative Act (AL) No. 1 of 1986 and extend through the reforms of royalty and territorial planning in 2011-2012. Since the beginning, it was recognized that fiscal federalism was

not a possibility for the large group of municipalities that lacked sources to generate their own income and that the model of fiscal federalism only could be applied, if any, to cities (Bird, 1981). The recognition of vertical and horizontal imbalances led to the design of a transfer system that would allow subnational governments to achieve the main objectives of decentralization.

Therefore, the Colombian decentralization is, in practice, an eclectic model of decentralization, deconcentration and delegation strongly funded by subnational transfers from the Central Government. As Bird (2012) states, "it may now be argued that Colombia's real model of decentralization is perhaps best characterized as one of delegation rather than devolution". In the discussion between "devolution" and "delegation" model there are, however, important sectorial differences. For example, in water supply and sewerage the system is decentralized (all the investment decisions are responsibility of subnational governments), while resources come from transfers and own resources (price charges and royalties)[4]. On the other hand, health services are also fully decentralized: departments and municipalities have full autonomy for budgeting and managing their own resources but this is constrained to previous certification to enable the territorial administrations for that regard. In education, however, the scheme is more of delegation than devolution.

This model has been consistently nuanced with elements of coordination and concurrency which are becoming stronger. Since the Constitution of 1991 and the Law 60 of 1993, the resources of the General System of Transfers, (*Sistema General de Participaciones*, SGP by the Spanish acronym), were earmarked to certain sectors, mainly education, health services and water supply and sewerage. The use of resources usually has been guided and monitored by the national government, in some cases with a certification from the central government of sub national governments' skills to provide these services.

According to 2010 governmental figures, in education, health services and water supply and sewerage around 90% of public investment is responsibility of sub national governments. Between them, municipalities have played a lead role in the decentralization process, while departments have played a secondary role. Out of the total public investment budget, 47% was executed by the municipalities, 22% by the counties and 31% by the national or central level. The share of sub national

[4] The scheme of Departmental Water Plans can be considered as a change in competences between municipalities and departments. The new scheme gives more responsibilities to departments mainly due to economies-of-scale arguments.

governments is even more important in the case of social investment[5] (Table 1 within the Annexes report the 2010 Colombian governmental investment structure by levels of government).

a. Measuring Colombia's decentralization

As stated before, decentralization is understood across three complementary levels: fiscal, administrative and political. We explain below our measurement approach to each of those levels.

Fiscal decentralization: according to the Colombian decentralization design, we measure the two most important features of fiscal decentralization: first, the taxation ability of each municipality; and second, the dependency of each municipality from the central government. The limited fiscal decentralization in Colombia is reflected in the fact that in 2005, on average, the share of own resources over the total was only 12% across municipalities, although there were some municipalities with a share around 80%. These figures reflect the importance of governmental transfers to subnational governments. However, the diversity of different taxes collected by the municipality is very narrow and their fiscal effort is mostly based on property tax collection; only few municipalities collect other taxes different from the property tax, mainly industry and commerce taxes. Therefore, we operationalize taxation ability as the per capita property tax collection. Regarding dependency from the central government, we use the per capita central government transfers to each municipality.

On the other hand, we also include royalties as an important source of financing for some municipalities. In 2005, for more than 70 municipalities in which the production of minerals and hydrocarbons was important, royalties represented more than 20% of their revenues. Although, on average, royalties are not as important as transfers, for some municipalities they represented up to 15 times the size of the transfers coming from the central government, as is the case of Aguazul, Casanare, where 87.8% of their revenues come from royalties and 5.6% from central government transfers[6].

[5] Social investment in this case includes education, health, attention to vulnerable groups, social promotion, dwelling, drinking water and basic sanitation, and public services different from water and sanitation.

[6] With the constitutional reform to royalties in 2011, the distribution of these resources among subnational governments changed drastically. With the former regime 20% of municipalities and counties received 80% of royalties; with the new regime their share will decrease to 20% after a transition period.

As shown in Table 2 below, we approached these three fiscal indicators as the municipality per capita amount of investment financed from each source.

Administrative decentralization: it is approached with an indicator of administrative capacity, which ranges between 0 and 100. This indicator was calculated by the National Planning Department and takes into account the stability of top (non-elected) officials, educational attainment of local administration employees, relative use of information technologies, degree of process standardization, auditing capacity and internal control system performance.

Political decentralization: this is one of the main objectives of the Constitution of 1991, and it is measured by the share of total votes for departmental candidates ("*Asamblea*") from the electoral potential. Those are taken from the elections hold in 2003. The reason not to use directly the votes for municipal candidates was the large number of missing values for that year due to violence and the presence of illegal armed groups that prevented elections to take place[7].

Table 2. Descriptive statistics: decentralization variables

Decentralization		N	Mean	Std. Dev	Min	Max	Units	Source
Fiscal	Taxation capability: 2003 per capita property tax revenue	1075	15.35	19.68	0.00	295.09	2003 per capita thousand Colombian pesos	SICEP, National Planning Department (NPD)
	Per capita investment financed by SGP, 2003	1094	214.70	132.57	0.00	1063.45		
	Per capita investment financed by royalties, 2003	1094	29.58	166.91	0.00	3838.00		
Administrative	Administrative ability	1098	51.66	18.84	0.00	85.48	Index that ranges from 0 to 100	NPD (Overall performance index)
Political	Share of total votes over electoral potential, 2003	1111	58.00	14.40	0.20	96.4	Percentage share (0-100)	National Registry Department

[7] In 2002, almost one third of the municipalities elected majors could not perform from their offices because of risks arising from the presence of these illegal armed groups that had control, at that time, over important parts of the territory.

4. Operationalizing social equity

To evaluate the relative degree of success of decentralization in Colombia to achieve its ultimate goal, which is the improvement to the population's access to social and public services and the reduction of territorial social inequalities in Colombia, we use the Multidimensional Poverty Index (CMPI) at municipal level.

The CMPI is a national indicator that sets the socially acceptable minimums for the five most important Colombian social public policy dimensions (household's educational condition; childhood and youth conditions; health; labor characteristics; and access to household utilities and living conditions) and is able to capture how far is each household from each minimum (Angulo et al., 2013). The CMPI was launched by the National Planning Department in 2012, based on the Alkire and Foster (2010) method for multidimensional poverty indices; it uses as unit of analysis the household and aggregates 15 indicators among those five most important social dimensions. One interesting feature of the CMPI is that all the indicators that compose the index could be potentially affected by public policies and social investment.

The original CMPI was conceived using the Colombian Living Conditions Survey; however, since such survey do not allow for estimations at the municipality level we opt for implementing the CMPI using 2005 census individual data. Table 3 below describes the dimensions, variables, cut-off points and weights per variable of the CMPI indicator that we calculated based upon 2005 census data. [8]

[8] The official methodology to calculate the CMPI uses the 2003, 2007 and 2010 Colombian Living Conditions Survey (CLCS); for a complete description of such official CMPI see Angulo et. al. (2013). The CMPI that we implemented have two minor differences with respect to the official CMPI: the first source of difference is given by slightly differences in the wording of some of the 2005 census questions and CLCS questions and also the absence of some particular questions that the CLCS uses. The second source of differences is given by the expression of some of the indicators of the household education conditions and access to public utilities and housing conditions to be able to depict the full set of indicators in a cardinal scale – that is, it requires each of the indicators to be measured on a scale with meaningful value of the difference between two points, rather than just indicating the presence or absence of a certain attainment. For a complete description of the methodology to construct the 2005 census based CMPI that we use and the transformations done over the official CMPI see Ramirez et. al (2013).

Table 3. Dimensions, variables, weights and cut off points of the implemented CMPI

Dimension	Variable	Indicator	Cutoff point
Household education conditions (0.2)	Educational achievement (0.1)	Percentage of people living 15 and older who holds at least 9 years of education	100%
	Literacy (0.1)	Percentage of people living in a household 15 and older who know how to read and write	100%
Childhood and youth conditions (0.2)	School attendance (0.05)	Percentage of children between the ages of 6 and 16 in the household that attend school	100%
	No school lag (0.05)	Percentage of children and youths (7–17 years old) within the household that are not suffering from school lag (according to the national norm)	100%
	Access to childcare services (0.05)	Percentage of children between the ages of 0 and 5 in the household who simultaneously have access to health, nutrition and education	100%
	Children not working (0.05)	Percentage of children between 12 and 17 years old in the household that are not working	100%
Employment (0.2)	Absence of long-term unemployment (0.1)	Percentage of household members from the economic active population that are not facing long-term unemployment (more than 12 months)	100%
	Formal employment (0.1)	Percentage of employed household members that are affiliated to a pension fund (formality proxy)	100%
Health (0.2)	Health insurance (0.1)	Percentage of household members over the age of 5 that are insured by the Social Security Health System	100%
	Access to health services (0.1)	Percentage of household members that had access to a health institution in case of need	100%
Access to public utilities and housing conditions (0.2)	Access to dwelling services (0.1)	Percentage of dwelling services that the household has access to; this out of (i) water source, (ii) elimination of sewer waste, (iii) adequate external walls* (iv) adequate floor++.	100%
	No critical overcrowding (0.1)	Percentage of absence of critical overcrowding**	100%

Source: Angulo et al (2013) and Ramirez et al (2013). **Notes:** The weight assigned to each dimension and variable is shown in parenthesis. *Urban households are considered deprived in water source if they are lacking of public water system. In elimination of sewer waste if they lack a public sewer system. In adequate external walls if the exterior walls are built of untreated wood, boards, planks, guadua or other vegetation, zinc, cloth, cardboard, waste material or when no exterior walls exist. Rural household are considered deprived in water source if the water used for the preparation of food is obtained from wells, rainwater, spring source, water tank, water carrier or other sources. In adequate elimination of sewer waste if they use a toilet without a sewer connection, a latrine or simply do not have a sewage system. In external walls if the exterior walls are built of guadua or other vegetation, zinc, cloth, cardboard, waste materials or if no exterior walls exist. ++Households (both urban and rural) with dirt floors are considered deprived in adequate floor. ** Deprivation is considered for: urban households with three or more persons per room or rural households with more than three persons per room.

The identification of the poor and aggregation method of dimensions and persons that the CMPI follows produce, first a multidimensional deprivation headcount (H), and second an average poverty gap ($M1$), both of them as the average across households within municipalities. The multidimensional deprivation headcount (H) depicts the share of the population that is considered as multidimensionally deprived, within each municipality. A household is considered as multidimensionally deprived under this indicator by having more than 33% of the weighted sum of the considered variables in situation of deprivation. On the other hand, the average poverty gap ($M1$) informs the average gap to reach the achievement levels set as minimums. In particular, we use $M1$ as an opposite measure of convergence to social minimums because it expresses how distant each household is from each of the dimensional poverty lines.

Worth highlighting that both, H as our measure of deprivation, and $M1$ as our measure of social equity, are meant to focus on the assessment of the lag to achieve social minimums within the municipality level. But, differences across municipalities are actually attempted to be explained when modelling the determinants of our outcomes of interest.

5. The relationship between decentralization and social equity

Conventional wisdom on decentralization asserts that in a fiscal federal system low income regions would be under disadvantage to provide public goods that could be necessary for promoting growth. Therefore, unless there are equalizing transfers, inter-regional gaps in per capita income will be wider. A different approach, however, as analyzed by Sorens (2014), comes from the market-preserving federalism framework (Weingast 1995 and Qian and Weingast, 1997). In this approach, fiscal decentralization, works as a commitment device that reduces “growth killing” incentives and because of that, it has positive effects on the growth prospects of poorer regions. To do so, the decentralization needs to be ‘market preserving’ in the sense that: 1) subnational governments have primary regulatory responsibility on the economy; 2) a common market is ensured in such a way that no local government can erect barriers against the flows of goods and services from other political units; and 3) the lower

governments face a hard-budget constraint. In this setting, equalizing transfers might have deleterious effects on growth because they provide wrong incentives to poorer regions.

The study of Sorens (2014) for 25 OECD countries with data from 1191 to 2005 at a county level supports the hypothesis derived from the market-preserving federalism framework, i.e., that fiscal federalism promotes regional per-capita income convergence, when lower-income regions enjoy substantial economic powers.

However, decentralization in developing countries, and certainly in the case of Colombia, is much more limited, with restrictions on the revenue raising ability of local governments, and with a strong emphasis on delegation of service delivery from the central government to local governments.

In this context, the main argument that justifies decentralization as a tool for the achievement of social goals lies in the premise that decentralization allows the revelation of local preferences, makes possible a more adequate supply of social services and basic goods to the conditions and necessities of local populations and put citizens in direct relationship with the level of government in whose election they participate, and over whom they can exert a closer accountability. Moreover, decentralization also is meant to improve participation, efficiency and targeting at the local level.

On the other hand, while the level of accountability, the accuracy of the targeting and the efficiency of the subnational administrations can improve with decentralization and therefore the delivery of goods and services for the poor can be more effective than with a centralized system, it is also true that local governments are prone to be politically captured by local interest groups that distort and divert resources to their own interests. For instance, Bardhan and Mookherje (2005), develop a model that addresses the relationship between decentralization and the provision of social services and accountability in government service delivery. In their model the potential political capture at local government, is crucial to determine the effect of centralization or decentralization on the welfare of the poor population. According to their model, when there is no capture at any level, the decentralized model behaves better and allows achieving a second best outcome characterized by cost effectiveness and targeting on the poor. But, with a sufficiently large extent of local capture, the decentralization model fails and the centralized solution is more appropriate.

Although it could be argued that political capture by interest groups is more likely to be higher in municipalities with higher poverty rate and higher inequality, bureaucrats at the Central Government can also be captured by local interest groups and corruption might arise as a consequence of lack of

monitoring and supervision. Indeed, Sanchez and Pachón (2013), when empirically addressing the Colombian case, found a positive effect of electoral competition, both national and subnational, on fiscal capacity.

Beside political inefficiencies of the decentralization system, the relationship between decentralization and social outcomes is yet not univocally determined. We argue that at least two elements drive this complex relationship. First, since most of the transfers from the central government to the municipalities are defined based on municipality poverty criteria, the most deprived municipalities are therefore more dependent on governmental transfers and have less incentive to increase their share of own generated resources. Second, since the most deprived municipalities have actually a smaller base of population and business that contribute to the municipality revenues, they actually have less ability to pay taxes. As a result, the per capita own resources and multidimensional deprivation at the municipality level might hold a double causality relationship.

Moreover, we hypothesized that the relationship between decentralization and deprivation at the municipality level is endogenous, not only because this double causality, but also because there are factors such as non-observable political forces and elites dynamics at the regional level, which are related to decentralization but that indeed we are not able to observe when trying to explain deprivation.

6. The economic geography's role when explaining social equity in Colombia

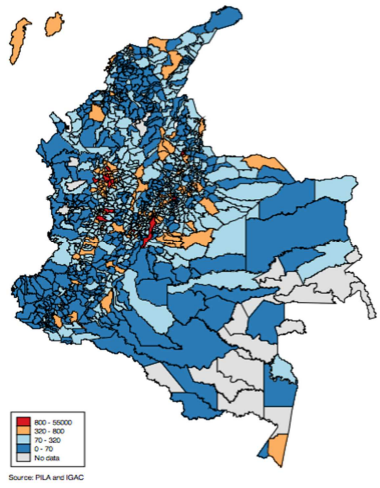
In this section we attempt to conceptualize how, for the Colombian case, economic geography plays a very important role when understanding the channels that drive deprivation at the local level.

According to Harvey (Harvey, 2009) findings, we can state that spatial distribution of economic activities tends to be unequal and concentrated in some geographical areas as a result of market forces of agglomeration, labour migration and specialization. Economic density is, therefore, a common characteristic of economic growth. Densification of economic activities goes at hand with densification of population (although the opposite not necessarily takes place, or not necessarily at the same pace). These endogenous dynamics imply a more efficient spatial structure of production with gains in terms of

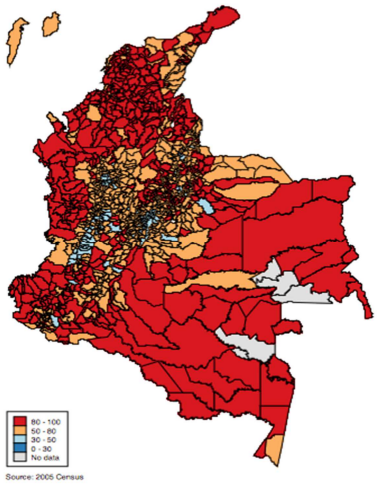
economic growth, productivity and income generation. Colombia is not an exception. As Figure 2.a below shows, the largest number of formal businesses per inhabitants is concentrated in Medellin and Bogota and their metropolitan areas, with a 2009, 2010 and 2011 average number of business of 1187 and 963 per 100 thousand inhabitants, respectively. As could be expected from an economic geography perspective, areas with higher economic density might become the ones with lower income poverty, since they concentrate the main economic activities, have a larger proportion of formal labor, and therefore higher wages and per capita labor incomes. In this sense, cities, as the geographical space with higher economic and population densities play a potential key role in the reduction of deprivation. The comparison of Figure 2.a against Figure 2.b suggests that agglomerations that concentrate the highest number of businesses per inhabitants register, at the same time, the lowest rates of multidimensional deprivation headcount, as is the case of Bogota and Medellin.

On the other hand, areas with more disperse population tend to have higher deprivation headcount, not only in income terms, but also in multidimensional terms. Population dispersion implies higher transportation costs and it makes more difficult the provision of infrastructure and public services, and the access to technology, education and health services, lowering the quality of these services as well. Figure 2.c shows differences in population density across the Colombian territory. It suggests that less dense areas show indeed greater multidimensional deprivation headcount (Figure 2.b).

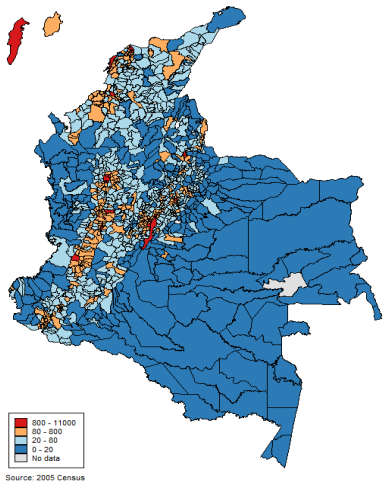
Figure 2. Spatial distribution of economic activity, deprivation and density



a) 2008, 2010 and 2011 Average number of business per 100 thousand inhabitants



b) Multidimensional deprivation headcount (H), 2005



c) Density (Inhabitants per squared kilometre), 2005

Actually, for the Colombian case, as Samad et al (Samad et al., 2012) argue, urbanization has generated higher social inclusion across municipalities: in 1964 there were huge gaps in access to public services between population living in large cities and urban population in small municipalities; those gaps have almost disappeared after five decades. While in 1964 only Bogota registered an average share of population with access to electricity, water and sanitation greater than 75%, in municipalities with less than 20 thousand inhabitants less than 30% of them had access to those services; in 2005 the average share of urban population with access to those services for any group of municipalities was greater than 80% (Figure 3 within the Annexes displays, in detail, the evolution in dwelling services coverage between 1964 and 2005 by size of municipality, for the population living in the urban areas).

Urbanization can also have a significant effect reducing rural poverty. Studies such as Cali and Menon (2009) found causal effect of urbanization over poverty reduction in the surrounding rural areas of Indian districts; the authors find positive and significant spillover effects of urbanization across rural territories, rather than significant movements from rural poor population to urban areas. They argue that this poverty reduction effect of urbanization could be explained mostly by greater demand for local agricultural products, and also in a fewer extent by the increase of remittances and rural nonfarm employment. Although, there is still no study with causal evidence for the Colombian case, there is a negative relationship between urbanization ratio and poverty; in fact, the Spearman pair wise correlation between urbanization ratio and the multidimensional deprivation headcount reaches -0.46 points for 2005 census data and -0.167 points between urbanization and rural multidimensional deprivation headcount.

However, despite urbanization and multidimensional deprivation are in average negatively related, there is still a high dispersion at municipal level as shown in Figure 4.a below. There are some cases with very high level of urbanization and high levels of multidimensional poverty incidence; in fact, out of 1106 municipalities 27.9% exhibit an urbanization rate greater than 0.5 but also multidimensional deprivation headcount greater than 50%. All this suggests that the urbanization degree, i.e., the differences in the proportion of the population living in urban areas, is not sufficient to explain poverty variation across municipalities.

On the other hand, as the report of the World Bank (2009) emphasizes, as important as density, is distance to densities. Two municipalities can have the same density and the same urbanization rate, but if one of them is close to an important urban center and the other is far from any, the first municipality can, potentially, take advantage of the agglomeration economies associated with the nearby city. It

means, to take advantage of scale and specialization economies (for example manufacturing firms located around urban centers), network economies, pooling or clustering of economic resources, learning economies, etc.

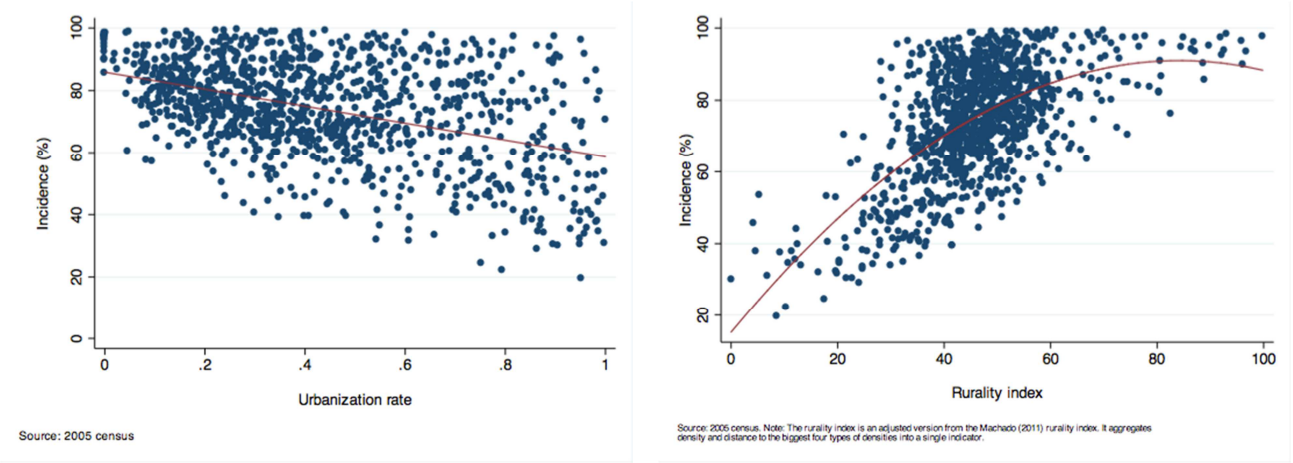
Indeed, (i) density and (ii) distance to density could be analyzed, as suggested by Machado (2011), as a joint phenomena by aggregating them into one indicator, a rurality index. In fact and following Machado (2011) we combine population density and four variables of distances to densities in a measure called "Rurality Index" (RI)[9].

As can be seen in Figure 4b, we found a strong positive relationship between incidence of multidimensional deprivation and the rurality degree of a municipality: less rural municipalities tend to have a lower incidence. More rural municipalities tend to have a higher incidence. However, in the middle range there can be observed a high dispersion of poverty incidence between municipalities with similar rurality degree[10].

[9] To obtain the proposed RI for each n-municipality, we first aggregate into one indicator ($Average\ Dist_n$), the following four meaningful distances: (i) distance to the closest municipality of at least a million inhabitants; (ii) distance to the closest municipality between 400 and 1000 thousand inhabitants; (iii) mean distance to municipalities between 200 and 399 thousand inhabitants and (iv) mean distance to the 50% closest municipalities between 100 and 199 thousand inhabitants. Second, we express $Density_n$ as the number of inhabitants per squared kilometer in each k-municipality. Third, we obtain a first stage rurality index for each municipality as $RI_n = ln(Average\ Dist_n / Density_n^2)$ and finally we expressed the RI_n^* definite rurality index for each municipality n as a relative function of the first stage RI_n for each municipality and the distribution of it across all N municipalities as follows: $RI_n^* = 100\left[\frac{RI_n - min(RI_n)}{max(RI_n) - min(RI_n)}\right]$.

[10] Municipalities with the same RI could differ substantially in poverty terms due to differences in their endowment of natural resources, soil quality or the presence of non-renewable natural resources that act, in fact, as an economic density pole that attract capital and other productive resources. De Janvry and Sadoulet (2007) differentiates between "marginal rural areas" (MRA) and "favored rural areas" (FRA). MRA are those characterized by poor agricultural endowments, and isolated from markets and employment sources. Geographical isolation and the poor endowments convert these areas in true poverty traps. In contrast, FRA can be transformed in dynamic regions based on their comparative advantages, if they are effectively and efficiently connected with their relevant markets.

Figure 4. Dispersion of incidence of multidimensional deprivation across urbanization rate and rurality index



a) Urbanization and multidimensional poverty

b) Rurality index and multidimensional poverty

It is worth noting that most of the municipalities with lower rurality degree are part of what is called the Colombia's "System of Cities"; this system was defined and identified by the Mission for the Consolidation of the System of Cities (DNP, 2012) based on the assessment of the functional relationships between centers of agglomerations and their surroundings; this by using indicators such as commuting, daily traffic flows, and travel times. The Colombia's "System of Cities" comprises the main cities of the country larger than 100.000 habitants and their agglomerations; they consist of 151 municipalities in total, 56 of which are larger than 100,000 habitants[11]. In 2010 the municipalities within the System of Cities represented 66% of total population, 80% of urban population and 81% of total formal employment[12].

7. Empirical Strategy

Given that multidimensional deprivation is not randomly allocated across the national territory (as was illustrated in Figure 2.b when describing our conceptual background), estimation procedures need to take explicitly into account the existence of spatial correlation. Therefore, we use a spatial

[12] Source of population figures, Dane; and PILA 2005 for employment figures.

econometric approach, as has been done in the literature for a wide variety of economic related topics as house pricing, violence and crime, social movements, and political science issues, among others; examples of these are studies such as Ioannides (2002), Mears and Bhati (2006), Swaroop and Morenoff (2006) and Franzese and Hays (2008), respectively.

As some econometric and statistical textbooks state, ignoring the spatial dependence across observations of the dependent variable by estimating an Ordinary Least Squares (OLS), or even when using a fixed effect model, produces inefficient and inconsistent estimators of the coefficients and the sampling variance, on top of that, is also bias and underestimated. As a result, R^2, t and F statistics are overestimated. If the spatial dependence only affects the model's errors, the estimators will be unbiased but inefficient (Arbia, 2006; p.90, Wooldridge, 2002; p.134).

Traditionally, two kinds of specifications have been used to consider spatial interdependence. One is the spatial autoregressive model (SAR), introduced by Cliff and Ord (1981). This specification accounts for the existence of spatial spillovers in the dependent variable. This specification considers this interaction among data via the introduction of a spatial lag in the right-hand-side of the model representing the relation of each observation with the neighboring outcomes. Excluding this spatial lag in the presence of spatial autocorrelation in the dependent variable, implies an omitted variable problem. The second most well-known specification for spatial econometrics is the spatial autoregressive error model, SARE; this model accounts for spatial dependence on the disturbances. However, even though the SARE model accounts for spatial correlation, the expected value of the dependent variable is the same than in a traditional OLS; it means that this model excludes by construction any possibility of spillover effect, and for sufficiently large samples the estimators for this kind of model are equal to the OLS estimators.

A generalized version of the aforesaid two specifications is the spatial autoregressive model with spatial autoregressive disturbances (SARAR), proposed by Anselin and Florax (1995). The SARAR model accounts, at the same time, for spillover effects and for spatial autocorrelation of the errors (correlation among unobservables).

Due to the features of our data and our interest to understand multidimensional deprivation as an economic geography phenomenon with probable spillovers across geographical units, we focus our interest on a specification that allows us to test at the same time the spillover effect from neighbor

municipalities and to take properly into account the correlation across spatial units among unobservables, i.e., a SARAR specification. The SARAR model can be described as follows:

$$y_i = \lambda \sum_{j=1}^{n} W_{ij} y_j + \sum_{k=1}^{h} \beta_k x_{ik} + \varepsilon_i \quad [1]$$

$$\varepsilon_i = \rho \sum_{j=1}^{n} M_{ij} \varepsilon_j + u_i \quad [2]$$

Where y_i refers to our outcomes of interest for the ith-municipality: the H multidimensional headcount or the $M1$ average multidimensional gap; the spatial weighting matrices are denoted as W and M; and the λ and ρ spatial autoregressive parameters account for the intensity of the spatial correlation, the first one in terms of the lagged values of the dependent variable (y_j); *i.e* the value of the dependent variable but in the neighbor municipalities; and the second one in terms of the spatial autocorrelation given by unobservables (ε_j); finally, the u_i remaining error term is assumed independently and identically distributed. This specification also includes a set of h independent variables for each municipality (x_{ik}), and a set of parameters related to them (β_k). According to it, in case $\rho = 0$ we are in presence of a spatial autoregressive model; in turn, when $\lambda = 0$ the specification gets reduced to the SARE model; and whenever both parameters are equal to zero ($\lambda = 0, \rho = 0$), it reduces to the linear regression model.

Since the spatial lag term $\left(\sum_{j=1}^{n} W_{ij} y_j\right)$ is endogenous because the double causality between it and the dependent variable, the estimation procedure must account for this in order to obtain consistent estimators. Then, in terms of the estimators, there are two different options for the SARAR model; the maximum likelihood estimator (ML) and the generalized spatial two-stage least squares (GS2SLS). But, as Kelejian and Prucha (1999) pointed out, there is neither general statistical theory, nor large sample theory for the ML estimator. Therefore, we opt for implementing a GS2SLS estimator[13].

Besides the endogeneity that arises from the spatial lag term, we are concerned for the possible endogeneity coming from the decentralization variables that are indeed our main explicative variables of interest (see section IV for a full discussion on this regard). As a first measure to tackle this potential problem, we use the lagged values of such variables as a proxy of the contemporary ones; meaning that

[13] In particular, as proposed by Kelejian and Prucha (1999), Kelejian and Prucha (2004), and Arraiz et al (2010) for the SARAR model, we first use as valid instruments for the endogenous W_H, the spatial lags of the variables contained in X, then we estimate the instrumented specification by the generalized-method-of-moments and finally we perform a spatial Cochrane-Orcutt transformation to obtain more efficient estimates for β and λ.

instead of using the 2005 values of them we use the 2003 registers. However, this ad-hoc solution for our main parameter of interest could have not only problems of interpretability or precision; also does not allow us to test further whether the solution dealt properly with the problem or not. Then, beyond that, we found statistical evidence that indicated us that our main parameter of interest (taxation ability) is not exogenous yet; this, by performing a Durbin-Wu-Hausman test[14], which uses as null hypothesis exogeneity of tax ability and rejecting such hypothesis under a 1% of statistical significance.

For this specific case where there is evidence of endogeneity from one of the explicative covariates in the context of the SARAR model described previously, Drukker et al (2013) developed the IV-SARAR model, which for our case is specified as follows:

$$y_i = \lambda \sum_{j=1}^{n} W_{ij} y_j + \sum_{k=1}^{h} \beta_k x_{ik} + \theta z_i + \varepsilon_i \qquad [3]$$

$$\varepsilon_i = \rho \sum_{j=1}^{n} M_{ij} \varepsilon_j + u_i \qquad [4]$$

Where, in comparison with Equations [1] and [2], there is an additional term composed by θz_i, which refers to the endogenous explicative variables, taxation ability for the ith-municipality (z_i) and the parameter related to it (θ). The term x_k refers to the set of k control variables, which includes along to the other decentralization measures[15], the rurality index, the urbanization rate, a dummy of population size that distinguishes between municipalities under 30 thousand inhabitants and over 30 thousand inhabitants, a dummy variable that specifies whether a municipality belongs to the Colombian System of Cities mentioned before, a variable to account for the variability induced by the spread of violence in the territory, two dummy of demographic characteristics and per capita investments of the National Government done over the municipalities to alleviate poverty, such as the conditional cash transfer program '*Familias en Acción*'. We also control by the 32 possible country dummies and an initial state of deprivation using the 1993 rate of population under unmet basic needs. Table 4 within the Annexes reports the descriptive statistics for all these particular controls.

As instruments for the per capita property tax revenue we use a set of variables that we argue influence the tax ability but not multidimensional poverty: time spam since the last cadastral update in each municipality (measured as number of years) and a set of dummies to indicate the municipalities' year of foundation. According to 2003 registers, the number of years that a municipality in Colombia

[14] For a comprehensive explanation of the Durbin-Wu-Hausman test see Cameron (2005).
[15] The different decentralization measures are included individually within the regression analysis to avoid loss of information.

takes in average to update its cadastral register is 6.2; this variable ranges from zero years, because they did the last update actually during 2003, till 15 years at most. The cadastral update enables municipalities' administrations to have a more accurate register of each of the properties within the urban areas and constitute, therefore, an important tool when trying to increase property tax revenues. On the other hand, we argue that the launching year of each municipality indicates the taxation experience of the municipality administration and that therefore explains the taxation ability; in that regard we use three ranges of years of interest, first municipalities launched before the erection of the 48th law of 1887, law that rules the property tax in Colombia; then, municipalities launched after the 44th law of 1990 when was defined the property tax as a municipality revenue; and finally then municipalities launched after 1887 but before 1990.

Once we have explained the econometric model specifications that we test we move onto describe briefly the specification that we follow for the spatial weight matrix (W). Since the specification of W is in general arbitrary, we use two relevant specifications of the matrix to test the validity of our results.

Our first specification of the weighting matrix is the most common used within the spatial econometric literature, which is a contiguity-based matrix. In this case, two municipalities are considered neighbors when their two geographical polygons are adjacent, meaning that they share a common boundary. However, this definition typifies pairs of municipalities by whether or not they are neighbors and does not necessarily capture economic geography or the intensity of their relationship. Then, the second matrix that we use not only describes the relationship between municipalities as being neighbors or not; it also follows an economic-based criteria and intents to capture the intensity of such connection. This, by taking into account the four following indicators: (i) common boundary indicator, (ii) the inverse distance between municipalities that are not farther than 92 kilometers among each other, (iii) the per capita commutation process captured by the 2005 census and (iv) the per capita average daily traffic per kilometer, between 2002-2004 and reported within the national administrative registers of daily traffic. We aggregated those four components into a single indicator that ranges from 0 to 1 and that was constructed as an additively separable linear transformation from its components.

8. Econometric results

In this section we describe the main econometric results obtained from modeling the average multidimensional gap and the multidimensional deprivation headcount. The results presented below in Table 5, include the Ordinary Least Squares (OLS) and the SARAR estimations. For the latter we consider both specifications of the spatial-weighting-matrix, the contiguity based (S-Cont.) and the economic geography based (S-EG). Finally for each of these two latter specifications we estimate their instrumental variable version (S-IV-Cont and S-IV-EG). Table 5 below shows both, the estimation results of multidimensional average gap ($M1$) and the multidimensional headcount ratio (H). However, since the results reported by our models do not correspond strictly to elasticities, we follow only analyzing our results in terms of statically significance and sign. But, to produce more policy informative results, at the end of this section we present the estimated elasticity for our parameter of interest and some public policy counterfactual scenarios.

When regressing our two outcomes of interest, M1 and H, against the set of measures of fiscal, administrative and political decentralization -models (1) to (3) in Table 5 below-, we found a negative and statistical significant effect of those variables over both. However, such effect loses significance once we introduce our set of controls -models (4) to (6). Interestingly, taxation ability, our decentralization variable of interest, remains significant across all specifications for both outcomes.

Now, the classical OLS estimation for the case of M1 shows an R2 of 0.845 and for the case of H an R2 of 0.802 -both models (4) in Table 5 below-. When we test for spatial spillovers of deprivation across neighboring municipalities we found a statistically significant effect (lambda coefficient) in all the proven specifications. It is worth to note that the specifications that use the economic geography based matrix for the spatial interrelation among municipalities always register greater spillover effect than specifications that use a simple contiguity based relationship among municipalities. Additionally, despite we control for possible unobservables that vary at the departmental level through a set of 32 county dummies, we still find positive and statistical significant geographical effects in the error term (Rho coefficient); a coefficient that in magnitude always resulted smaller when using the economic geography based matrix than when using the contiguity based matrix.

The strong spatial positive transmission effect of deprivation across neighboring municipalities (lambda coefficient) along with the results concerning the Rho coefficient are consistent across different specifications of the spatial weighting matrix, these results, therefore, confirm that understanding deprivation as a geographical phenomenon is essential. Moreover, modeling the relationship among municipalities using only a contiguity relationship among municipalities could downwards bias the geographical effects. Then, operationalizing the municipalities' relationship in economic based terms rather than by a simple contiguity based relationship seems to capture in a better manner the deprivation geographical pattern.

Furthermore, when cleaning the endogeneity still embedded over taxation ability, its impact is revealed as statistically significant and becomes even stronger, i.e., more than three times its value from previous models -models (7) and (8)-. Those results demonstrate that in average Colombian municipalities improved its social equity and reduced its deprivation headcount as a result of their greater taxation ability. Notice that this result holds when controlling in particular for administrative ability, political decentralization, an initial level of poverty (measured by a variable of unmet basic needs in 1993) and all the other covariates.

On the other hand, when analyzing the correlation results shown from the other set of covariates included within the estimations, we find that policies oriented to transfer resources from the central government to the territories for CMPI related expenditures (education, health and drinkable water and sanitation) show statistical significance only in one of the incidence models. However, they show statistical negative effects over the average multidimensional gap; this result corroborate that despite that governmental transfers do not correlate with multidimensional deprivation, they are negatively associated with reductions of the intensity of poverty -Models (4) to (8)-.

In addition, governmental transfers for other uses as well as administrative ability, as expected, reduces statistically significantly the gap to achieve social minimums and the incidence of poverty, but the strength of this relationship diminishes after controlling for spatial correlation and it gets rolled out after controlling for our set of covariates. It is possible, in fact, that those municipalities with a higher local administrative capacity are the ones with a higher share of own resources.

On the contrary, the degree of political participation has a strong and robust negative effect on the average multidimensional gap but do not show statistically significant effect on incidence after controlling for our set of covariates. Municipalities with higher participation of citizens in the electoral

process tend to have lower multidimensional poverty incidence, and their population under poverty tend to be less poor than municipalities with lower political participation. Since for the case of multidimensional headcount this effect disappears when introducing our set of covariates, political decentralization seems to be playing a more important role on reducing the gap on the achievement of social minimums rather than preventing deprivation.

On the other hand, economic geography variables have a significant relationship on multidimensional deprivation with the expected sign: more rural municipalities (measured by the Rurality Index) tend to have a higher multidimensional headcount ratio and a higher multidimensional average gap. It means that municipalities with lower population density and/or more distant to cities are, in average, more deprived than other municipalities, and that their multidimensionally deprived population is, in average, farther to achieve those social minimums than the other municipalities.

At the same time, the urbanization ratio (i.e., the share of population living in the urban area of the municipality) has a negative effect on both, multidimensional headcount and gap. Additionally, municipalities with more population have lower multidimensional deprivation headcount and gap. There is, also, an *additional* negative effect on multidimensional poverty incidence for those municipalities that belong to the System of Cities as defined in previous sections. This means that to be part of the System of Cities in Colombia is a "bonus" to decrease poverty incidence, although this effect is not statistically significant for the case of the multidimensional gap.

Finally, the most important national program of conditional cash transfer to alleviate poverty (Familias en Acción) appears positively and significantly related with both multidimensional deprivation and gap but with less extent for the gap. This results probably reflects the targeting of the program in the poor population which, as we have seen, is not randomly distributed in the space but tend to concentrate in some regions more than in others.

Table 5. Determinants of multidimensional deprivation (Headcount ratio and Gap)

	Multidimensional average gap (M1)								Multidimentional deprivation headcount ratio (H)							
	OLS (1)	S-Cont (2)	S-EG (3)	OLS (4)	S-Cont (5)	S-EG (6)	S-IV-Cont (7)	S-IV-EG (8)	OLS (1)	S-Cont (2)	S-EG (3)	OLS (4)	S-Cont (5)	S-EG (6)	S-IV-Cont (7)	S-IV-EG (8)
Taxation ability	-0.007***	-0.003***	-0.004***	-0.003***	-0.002***	-0.002***	-0.007***	-0.005***	-0.161***	-0.084***	-0.106***	-0.081***	-0.053***	-0.054***	-0.209***	-0.117**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.018)	(0.026)	(0.028)	(0.012)	(0.014)	(0.014)	(0.066)	(0.047)
SGP CMPI	-0.000	-0.000	0.000	-0.000**	-0.000***	-0.000**	-0.000**	-0.000*	0.008	-0.002	0.007	-0.001	-0.006*	-0.002	-0.003	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.006)	(0.007)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
SGP NON CMPI	0.002***	0.002***	0.002***	-0.001*	-0.000	-0.000	-0.000	-0.000	0.047***	0.041***	0.050***	-0.008	0.001	0.000	0.006	0.003
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.010)	(0.013)	(0.015)	(0.006)	(0.006)	(0.005)	(0.008)	(0.006)
Royalities CMPI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	-0.001	-0.001	0.001	-0.001	-0.002	0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.007)	(0.007)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)
Royalities NO CMPI	-0.000	-0.000	-0.000	-0.000*	-0.000***	-0.000***	-0.000***	-0.000***	-0.004	-0.002	-0.002	-0.004	-0.003**	-0.003*	-0.004***	-0.003*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)	(0.002)
Administrative ability	-0.007***	-0.004***	-0.004***	-0.001*	-0.001	-0.001	-0.001	-0.000	-0.150***	-0.089***	-0.087***	-0.042**	-0.023	-0.013	-0.012	-0.009
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.027)	(0.028)	(0.024)	(0.017)	(0.015)	(0.014)	(0.015)	(0.014)
Political desc.	-0.010***	-0.006***	-0.006***	-0.002***	-0.002**	-0.002**	-0.002**	-0.002**	-0.128***	-0.064**	-0.072***	0.015	0.015	0.003	0.012	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.031)	(0.028)	(0.026)	(0.021)	(0.019)	(0.018)	(0.023)	(0.019)
Rural Index				0.006***	0.004**	0.004**	0.005***	0.004**				0.166***	0.142***	0.155***	0.153***	0.157***
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)				(0.039)	(0.036)	(0.037)	(0.040)	(0.038)
Urbanization				0.006***	0.004**	0.004**	0.005***	0.004**				-0.116***	-0.145***	-0.156***	-0.150***	-0.158***
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)				(0.013)	(0.014)	(0.013)	(0.014)	(0.013)
Dummy pop. 30 th. Inhab				-0.006***	-0.007***	-0.007***	-0.007***	-0.007***				-3.861***	-3.598***	-3.445***	-3.751***	-3.512***
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)				(0.803)	(0.792)	(0.764)	(0.795)	(0.757)
System of cities				-0.092***	-0.104***	-0.108***	-0.104***	-0.109***				-2.032**	-1.457	-3.264***	-0.721	-2.842***
				(0.035)	(0.038)	(0.037)	(0.038)	(0.037)				(0.869)	(0.979)	(0.937)	(1.144)	(1.002)
1993 Unmet basic needs share				0.016***	0.013***	0.013***	0.013***	0.012***				0.318***	0.263***	0.239***	0.236***	0.228***
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)				(0.022)	(0.024)	(0.023)	(0.026)	(0.025)
National program				0.000***	0.000***	0.000**	0.000**	0.000*				0.003***	0.002***	0.002***	0.002**	0.002**
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Roads per Km2				0.002	-0.016	-0.018	-0.017	-0.018				0.459	0.147	0.148	0.097	0.118
				(0.014)	(0.013)	(0.013)	(0.013)	(0.013)				(0.322)	(0.286)	(0.271)	(0.306)	(0.274)
Agro-concentration				-0.028	-0.001	-0.001	-0.011	-0.008				-0.138	0.651	0.703	0.282	0.571
				(0.026)	(0.024)	(0.024)	(0.024)	(0.024)				(0.590)	(0.562)	(0.566)	(0.598)	(0.583)
Attacks				-0.000	-0.000	0.000	-0.000	0.000				-0.000	0.010	0.028**	0.007	0.026
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)				(0.017)	(0.014)	(0.014)	(0.020)	(0.016)
Share of population between 5 and 15				0.546	0.879	0.929	0.820	0.848				22.393	32.330**	40.147***	29.164*	38.265***
				(0.631)	(0.781)	(0.714)	(0.791)	(0.723)				(14.331)	(14.004)	(13.176)	(15.115)	(13.475)
Share of population under				6.469***	6.002***	5.034***	5.908***	5.025***				84.668***	81.157***	60.042***	76.323***	58.907***
				(0.688)	(0.865)	(0.826)	(0.849)	(0.817)				(15.640)	(14.036)	(14.526)	(14.480)	(14.422)
Constant	3.060***	1.061***	0.706***	0.981***	0.749***	0.439**	0.933***	0.591***	84.115***	21.685***	11.316**	43.599***	30.323***	13.999***	38.064***	17.935***
	(0.107)	(0.210)	(0.171)	(0.159)	(0.173)	(0.170)	(0.209)	(0.189)	(2.317)	(7.664)	(5.414)	(3.604)	(5.036)	(5.230)	(6.449)	(5.449)
Controling by county dummies (32 counties)....																
Observations	1,060	1,060	1,060	1,060	1,060	1,060	1,060	1,060	1,060	*1,060*	1,060	1,060	1,060	1,060	1,060	1,060
R-squared	0.563			0.845					0.497			0.802				
Lambda		0.742***	0.897***		0.190***	0.399***	0.156***	0.373***		0.797***	0.939***		0.223***	0.482***	0.174**	0.453***
		(0.056)	(0.055)		(0.050)	(0.050)	(0.055)	(0.049)		(0.077)	(0.065)		(0.074)	(0.063)	(0.077)	(0.064)
Rho		-0.504***	-0.332**		0.274***	0.399***	0.236***	0.337***		-0.470***	0.013		0.381***	0.697***	0.297***	0.672***
		(0.094)	(0.130)		(0.065)	(0.095)	(0.062)	(0.110)		(0.107)	(0.155)		(0.069)	(0.054)	(0.061)	(0.059)

Note: alternative estimations were carried out using instead of 2003 per capita property tax revenue and 2003 national transfers, the total for 2002, 2003 and 2004 per capita variables and the results do not differ significantly from the ones reported above.

a. The measured taxation ability effect

An average increment of one thousand Colombian pesos in per capita terms from own resources across the 1060 municipalities under study, which represents approximately an increase of 40 billion Colombian pesos in higher own resources, produces 0.008 percentage points of average reduction in the multidimensional average gap and 0.214 points of reduction in the average poverty headcount. Out of those 0.214 points of reduction, 45% of the total effect is given by the spillover effect. Table 6 below reports the total impact of taxation ability over our two outcomes of interest, decomposed by direct and indirect effects. Our results suggest that public policies that seek to strength the municipality fiscal capacity have statistically significant and important effectiveness reducing multidimensional deprivation and achieve convergence to social minimums. More than two thirds of the total effect of increments in the taxation ability would redound on reductions of multidimensional deprivation in the spatially interrelated municipalities.

Table 6. Decomposition of the total impact of taxation ability across direct and indirect

	Direct effect	Indirect effect	Total effect
Multidimensional average gap	-0.005***	-0.003***	-0.008***
	(0.002)	(0.001)	(0.003)
Multidimensional headcount ratio	-0.117**	-0.097**	-0.214**
	(0.047)	(0.037)	(0.083)

b. Counterfactual policy scenarios

In comparison to a decentralization policy that does not take into account the geographical relationship among municipalities; we test three alternative geographically differentiated policies. The first scenario (Policy A) corresponds to a non-geographically designed policy, which produces an

increment of 1.5% of the per-capita own resources per each municipality in the country. The geographically sensitive policies, on the other hand, are expressed in three scenarios: one (Policy B), focused on main urban areas, concentrates the same fiscal effort of Policy A but now over the centroids of the national system of cities; this corresponds to an increment of 2.4% of per-capita own resources in each of the 18th cities in the country with an spatial agglomeration around them.

The second spatially differentiated policy, Policy C, concentrates the same fiscal effort of Policy A but now over the 300 most spatially correlated municipalities in terms of multidimensional deprivation; according to this policy those 300 municipalities increase their own resources per capita in 2.1%.

Finally, Policy D testes the same fiscal effort but now concentrated on the 300 municipalities that are the most spatially correlated but that do not belong to the System of Cities; this Policy D would mean a 20% direct increment of the per capita own resources in those municipalities.

Worth noting that, while Policy A applies over any municipality, Policy B only over the 18th most developed cities, Policy C applies over the 300 most correlated, which includes the biggest cities, Policy D is simulated over the 300 most correlated but excluding the 18th cities.

Table 7 below presents across rows the mean multidimensional headcount and gap before any policy and the simulated change effect from each tested policy. Columns (1) to (4) report the simple mean and the effect of the policies, calculated across different subgroups of municipalities. When comparing the effect produced across policies, we found that concentrating the fiscal effort in the 18 most important Colombian cities (Policy B) do not produce a greater mean reduction neither in multidimensional headcount ratio nor in the average gap. It means that efforts concentrated only in the most developed municipalities are not enough to produce significant reductions in deprivation across all the territory.

Now, the same fiscal effort but concentrated over the most spatially deprivation correlated municipalities (Policy C), registers an important effect not only in the shocked municipalities but also in the remaining 760 municipalities that come from the spill over effect. However, the aggregated effect of such policy do not over pass the one produced by Policy D neither the result obtained from a geographically mute policy (Policy A).

By all means and as expected the most effective policy is Policy D (Column 1); notice that such policy has an effect of 0.167 percentage points of incidence reduction in average over all 1076 municipalities,

0.283 percentage points of incidence reduction over the 300 shocked municipalities, and when calculating the spill over effect of such policy over the 760 other municipalities that were not subject of the policy, multidimensional incidence gets reduced in average 0.121 percentage points there. Notice that this policy is targeting the most geographically correlated in deprivation but excluding the big cities.

These policy simulations illustrate the direct and indirect effects of the introduction of the same fiscal effort on own resources, but its differentiated effect regarding the targeted municipalities. The results suggest that policies targeted using as criterion of selection levels of deprivation but also geographically correlations criteria might produce more effective results than policies that do not take into account these important features of multidimensional deprivation.

Table 7. Mean change effect of each simulated policy over multidimensional deprivation

			All municipalities	The 18th Centroids	The 300 most correlated municipalities	The 300 most correlated municipalities (NSC+)
			(1)	(2)	(3)	(4)
M1	Simple mean		0.239	0.112	0.244	0.273
			(0.076)	(0.024)	(0.119)	(0.101)
	Difference	Policy A	0.0019***	0.0029***	0.0018***	0.0014***
			(0.0000)	(0.0001)	(0.0000)	(0.0000)
		Policy B	0.0001***	0.0018***	0.0002***	-0.0000
			(0.0000)	(0.0001)	(0.0000)	(0.0000)
		Policy C	0.0008***	0.0027***	0.0016***	0.0009***
			(0.0000)	(0.0002)	(0.0001)	(0.0000)
		Policy D	0.0062***	-0.0000	0.0092***	0.0105***
			(0.0002)	(0.0018)	(0.0006)	(0.0005)
H	Simple mean		73.702	39.553	70.787	78.495
			(15.322)	(6.952)	(23.846)	(18.478)
	Difference	Policy A	0.0515***	0.0790***	0.0492***	0.0385***
			(0.0010)	(0.0047)	(0.0023)	(0.0020)
		Policy B	0.0031***	0.0484***	0.0055***	-0.0005
			(0.0003)	(0.0035)	(0.0009)	(0.0004)
		Policy C	0.0231***	0.0739***	0.0443***	0.0249***
			(0.0011)	(0.0070)	(0.0028)	(0.0021)
		Policy D	0.1668***	-0.0008	0.2477***	0.2833***
			(0.0074)	(0.0481)	(0.0165)	(0.0155)

Note: +NSC refers to municipalities not included within the system of cities

9. Concluding remarks

This paper attempted to disentangle the effect of decentralization on multidimensional poverty incidence and gaps at municipal level in Colombia and its success or failure to overcome economic geography issues that emerge from a very heterogeneous territory. We assessed the causal effect of taxation ability, measured as the per capita municipal own resources, over multidimensional deprivation.

Multidimensional poverty was found not randomly distributed in the Colombian territory, it tend to concentrate in some regions more than in others. Then, we model poverty as a phenomenon with spatial interactions. We use a spatial econometric approach that accounts for spillover effects and for spatial correlation of the errors, correcting also for potential endogeneity of the fiscal decentralization variable. Our results imply a strong spillover effect of deprivation across municipalities. Therefore, strategies to overcome poverty need to be designed under a territorial approach that takes into account deprivation as a phenomenon strongly defined by its geographical interactions.

The results of the econometric estimations show, consistently across all the specifications, that the municipalities per capita own resources have a strong negative causal effect over multidimensional deprivation. This effect is robust under all our set of control variables and also once accounting for the spatial spill over effect of the Colombia's deprivation phenomenon.

Additionally, governmental transfers for education, health, and water and sanitation are negatively associated with reductions of the intensity of poverty, although they are not significantly associated with a lower rate of incidence at municipal level. Political decentralization, measured by citizen participation in local elections, also shows a negative and significant effect on poverty gap, but not on poverty incidence.

The findings of the paper also suggest some topics that should be part of an agenda for adjusting and reforming the decentralization model in Colombia. One of them is the need to strengthen the subnational revenue system to increase the share of own generated resources by municipalities. In practical terms, the focus of this policy should be municipalities with relative larger geographical interconnection with their neighbours. Cities should be given more autonomy and more capability to increase their own resources, and to set its own programs with the correspondent responsibility toward

their own citizens. In order to increase the share of own resources at subnational level a reform in the design of the transfer system is in order, as has been extensively discussed by Bird (2012). The purpose in this case is the design of a transfer system that takes into account the potential revenue-raising capacity of each municipality and does not disincentive its own fiscal effort.

Geography strongly correlates with multidimensional incidence and gap. Higher incidence and gap are associated with: a) a higher degree of rurality (lower densities and/or larger distances to densities); b) a lower urbanization rate; c) municipalities that are not part to the Colombian System of Cities. These results support the conclusion that the main difference in terms of poverty in Colombia is not between urban and rural areas, but between municipalities with higher densities or closer to cities, and municipalities with low densities and far from cities.

Spatially differentiated policies and decentralization designs that take into account the heterogeneity of regions and municipalities are definitely required in order to improve social convergence to minimums from the territories at the bottom of the distribution, and the role of economic geography variables should be taken into account in the design of such policies. In particular, Colombia has a pending agenda to decrease rural poverty (in the sense depicted by the Rurality Index). However, further research is still needed to address heterogeneous effects by sets of municipalities given their rurality levels.

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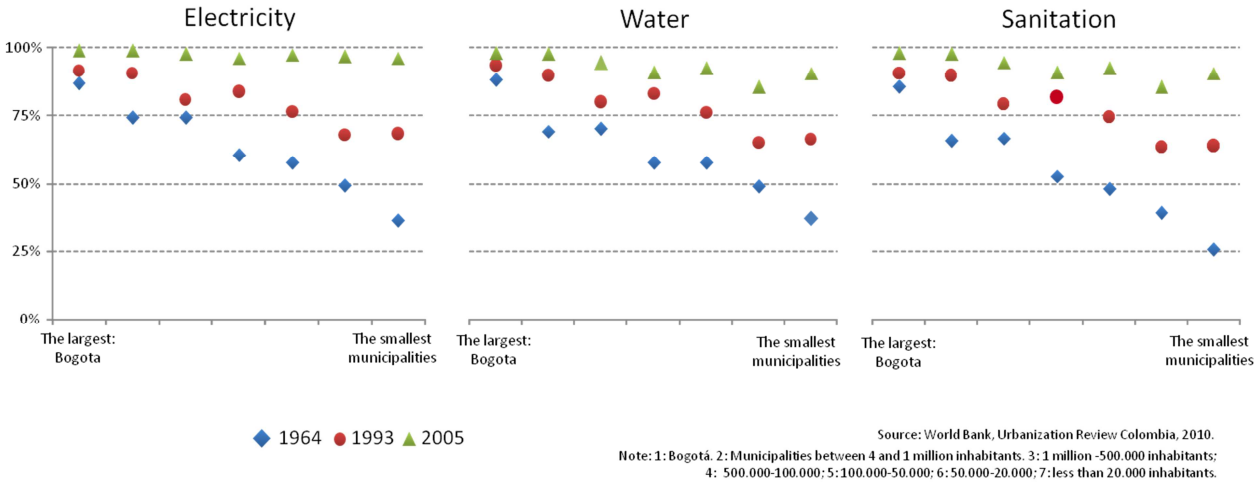
Annexes

Table 1. Governmental investment structure by levels of government, 2010

	Billions of 2010 Colombian pesos				(%)			
	Central government	Counties	Municipalities	Total	Central government	Counties	Municipalities	Total
Total Investment	**22.2**	**15.4**	**33.0**	**70.5**	**0.31**	**0.22**	**0.47**	**1.00**
CMPI related investment	**11.5**	**12.3**	**24.2**	**47.9**	**0.24**	**0.26**	**0.51**	**1.00**
Education	1.0	7.3	9.2	17.5	0.06	0.42	0.53	1.00
Health	1.6	3.3	9.1	14.0	0.12	0.24	0.65	1.00
Attention to vulnerable groups, social promotion	6.2	0.3	1.2	7.8	0.80	0.04	0.16	1.00
Dwelling	0.7	0.2	0.7	1.6	0.44	0.12	0.44	1.00
Drinking water and basic sanitation	0.3	1.0	3.5	4.8	0.06	0.21	0.73	1.00
Public services different from water and	1.7	0.1	0.4	2.2	0.74	0.06	0.20	1.00
Other non-CMPI related investment	**10.7**	**3.1**	**8.8**	**22.6**	**0.47**	**0.14**	**0.39**	**1.00**

Source: National Planning Department, 2010 administrative fiscal registers

Figure 3: Percentage of urban population with access to public services across type of municipalities



Source: World Bank, Urbanization Review Colombia, 2010.
Note: 1: Bogotá. 2: Municipalities between 4 and 1 million inhabitants. 3: 1 million -500.000 inhabitants; 4: 500.000-100.000; 5: 100.000-50.000; 6: 50.000-20.000; 7: less than 20.000 inhabitants.

Figure 4: The System of Cities in Colombia

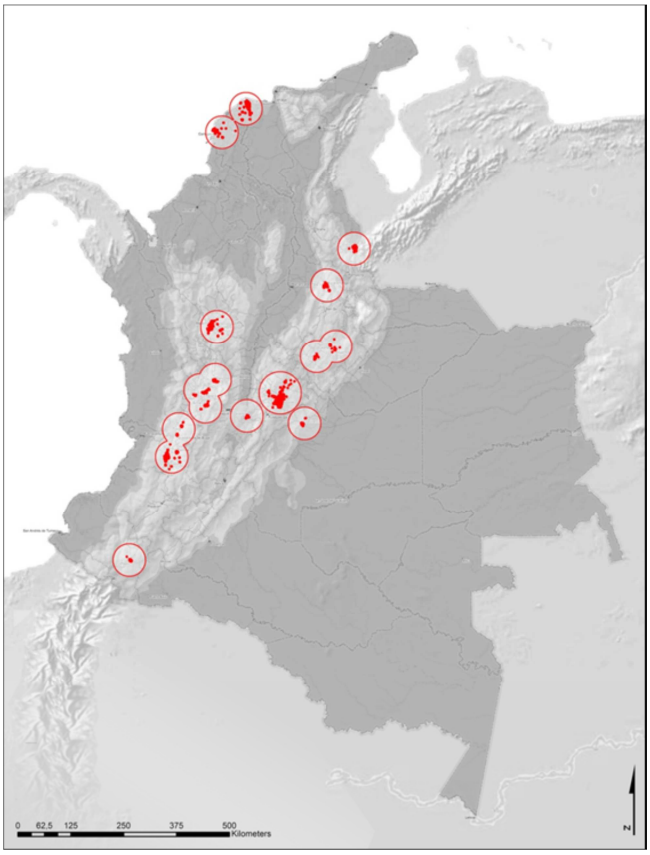


Table 4. Descriptive statistics: controls

Control variables		N	Mean	Std. dev	Min	Max	Units	Source
Location and size	Urbanization	1111	43.10	24.70	0.00	100.00	Percentage share (0-100)	2005 Census
	Dummy of population size	1111	0.06	0.23	0.00	1.00	Dummy, 1= Municipality with 30.000 or more inhabitants. 0= Municipalities with less than 30.000 inhabitants.	2005 Census
	System of cities	1111	0.14	0.34	0.00	1.00	Dummy, 1=belongs to the system of cities. 0= Do not belong	System of cities mission
	Rurality Index	1111	46.68	12.58	0.00	100.00	Index from 0 to 100	Based on UNDP, 2011
	a. Population density	1092	140.59	576.70	0.16	10682.55	Inhabitants per squared kilometre	2005 Census
	b. Distance to the closest municipality of at least a million inhabitants	1092	165.88	102.90	0.00	955.54	Kilometres	Euclidean distances based on map information
	c. Distance to the closest municipality between 400 - 1000 thousand inhabitants	1092	151.07	117.49	0.00	980.37	Kilometres	
	d. Mean distance to municipalities between 200 and 399 thousand inhabitants	1092	399.12	107.81	270.41	1147.87	Kilometres	
	e. Mean distance to the 50% closest municipalities between 100 and 199 thousand inhabitants	1092	244.72	84.94	155.61	1007.62	Kilometres	
Connectivity	Kilometres of primary and secondary roads per squared kilometres of the municipality	1096	1.23	0.88	0.00	13.33	Kilometres	IGAC and System of cities
Demography	Share of population 5-15 years old	1097	22.80	2.61	12.43	30.68	Percentage share (0-100)	2005 census
	Share of population under 5 years old	1097	11.11	2.74	5.51	26.70	Percentage share (0-100)	
Other controls	Population share with unmet basic needs, 1993	1103	53.85	19.44	9.20	100.00	Percentage share (0-100)	Dane
	Violence. Number of attacks from FARC, ELN and paramilitary groups from 1998-2002	1111	7.34	15.70	0.00	219.00	Number	National Police
	Central government investment. Number of beneficiary families to the national conditional cash transfer program: Familias en accion	1111	178.67	306.60	0.00	2609.27	Number	NPD, 2003
	Agro-concentration	1111	0.20	0.40	0.00	1.00	Dummy, 1=municipalities with greater concentration of agricultural activity. 0=municipalities without agricultural vocation	NPD