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Fiscal Decentralization and Multidimensional Poverty Reduction in Colombia: A Spatial Approach

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ABSTRACT

Fiscal decentralization as an instrument to reduce poverty is an open debate that still takes place with little and contradictory empirical evidence on whether or not it has served the poor. This paper analyses the effect of fiscal decentralization on multidimensional poverty in Colombia. We estimate the impact of municipalities' own resources over the multidimensional poverty headcount ratio and the multidimensional poverty gap. An instrumental variable spatial autoregressive model with spatial autoregressive disturbances is implemented as empirical strategy to disentangle the causal effect of fiscal decentralization, while taking into account that multidimensional poverty exhibits strong spatial correlation among Colombian municipalities. We find statistically significant results, across several proven specifications, which demonstrate a causal diminishing effect of fiscal decentralization over both, the multidimensional poverty headcount ratio and gap. The findings of the paper highlight the need to strengthen subnational revenue systems through policy designs that increase municipalities' own generated resources. We, hence, evaluate the potential effect of some possible alternative fiscal decentralization designs, by simulating different counterfactual policy scenarios. The results of these policy scenarios demonstrate that spatially differentiated fiscal decentralization policies have greater effectiveness in reducing multidimensional poverty than geographically mute designs.

Keywords: Fiscal decentralization, multidimensional poverty, spatial interdependence, Colombia.
JEL codes: H71, I31, I38, O23, R58

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1. INTRODUCTION

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 (Maldonado, 2011). For these reasons, decentralization is also meant to improve participation, efficiency and targeting at the local level. In this view, decentralization serves the poor (Bardhan, 2002; Dethier, 2000; Von-Braun and Grote, 2000).

There are also, nonetheless, arguments against decentralization policies as an effective way of reducing poverty. Poor and less developed countries can be arguably more prone to corruption and political capture by local interest groups that distort and divert resources to their own interests (Bardhan, 2002, Bardhan and Mookherje, 2005). Also, decentralization can be viewed as a design that increases the provision's cost of social services in a context in which the institutional capacity is very low, which in turn might increase territorial inequalities (Bird and Rodriguez, 1999). In addition, decentralization would increase political tensions across unequal territories, and in some cases it might jeopardize political and economic progress in greater detriment of the most disadvantaged population (Von-Braun and Grote, 2000).

As a result, fiscal decentralization as an instrument to reduce poverty is a debate far from closed. This debate takes place, nonetheless, with little and contradictory empirical evidence on whether or not fiscal decentralization has served the poor. On one hand, cross country studies such as Von-Braun and Grote (2000), based on a sample of 50 developing countries, and Sepulveda and Martinez (2011), based on information for 34 developing countries from 1970 to 2000, report opposite results. While Von-Braun and Grote (2000) analysis suggest a positive association between the share of subnational expenditures poverty reduction, Sepulveda and Martinez (2011) find a significantly negative effect of the share of income of local governments over poverty reduction.

Country-specific analyses, on the other hand, are not much more conclusive. In particular, Jutting et al. (2004) review different studies on the relationship between decentralization and poverty reduction among 19 different developing countries. Their results suggest an ambiguous link between decentralization and poverty reduction, where the degree of success of fiscal decentralization to reduce poverty depends on the institutional capacity and political conditions of each country.

Rigorous empirical work on the causal effect of decentralization on poverty reduction is a delicate task that has still a broad scope in literature (Bardhan, 2002). In particular, while a double causality between municipalities' fiscal effort and poverty might take place, also non-observable political forces and elites dynamics at the regional level can be related to both, fiscal decentralization and deprivation. As such, an endogeneity problem can bias econometric results on the relationship between decentralization and poverty at the local level. In this vein, this paper contributes to the decentralization literature providing rigorous causal empirical evidence to disentangle the causal effect of fiscal decentralization on multidimensional poverty incidence and gap for the particular case of Colombia.

Why our outcome of interest is multidimensional poverty? If we conceive as decentralization's key goal the improvement of the population's access to social and public services and the reduction of the territorial inequalities in this regard, the relative degree of success or failure of the decentralization shall be assess over the joint distribution of deprivation in the multiple social outcomes that the decentralization process aims to improve. We opt to assess the effect of decentralization on multidimensional poverty rather than on monetary poverty, also because expenditure or income poverty depends on dynamics that are beyond the decentralization process and involve the existence of agglomeration economies and endogenous growth mechanisms at a regional level. Besides, there is no monetary poverty figure at municipal level available for Colombia. As a result, we evaluate the causal effect that fiscal decentralization has over the Colombian Multidimensional Poverty Index (CMPI). The CMPI is a national index launched by the government in 2012 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 housing conditions (Angulo et al., 2015).

To account for the endogeneity that arises when evaluating the impact of fiscal decentralization over multidimensional poverty, we assess the causal effect of the Colombian municipalities' fiscal effort over multidimensional poverty applying an instrumental variable approach. At the same time, we take into account the fact that poverty is, also, a spatial phenomenon, which means that it is not distributed randomly in the territory. Specifically, we implement a spatial autoregressive strategy with spatial autoregressive disturbances to model the multidimensional poverty headcount and gap. The results of this analysis demonstrate a causal negative effect of fiscal decentralization (measured by the per capita ratio of own generated resources) over the multidimensional poverty headcount and poverty gap. We also find a strong statistically significant effect of spatial spillovers of deprivation across municipalities that should be taken into account when designing public policy interventions.

From our analysis we derive policy implications to reduce multidimensional poverty. Specifically, to provide policy lessons to improve the effect of fiscal decentralization over multidimensional poverty reduction we test counterfactual scenarios of alternative policies. The results of these scenarios indicate that spatially differentiated decentralization policies have greater effectiveness than geographically mute designs. Differentiated fiscal decentralization policies that take into account the heterogeneity of regions and municipalities are urged to improve social convergence to minimums.

This paper continues as follows. Section 2 describes the decentralization design and process that has taken place in Colombia. Then, Section 3 analyzes the empirical descriptive relationship observed among Colombia's municipalities between fiscal decentralization and multidimensional poverty. Section 4 presents the econometric strategy that we pursue to disentangle the causal effect that the per capita municipalities own resources has over multidimensional poverty incidence and gap. Section 5 analyses the obtained results of this empirical strategy. The paper finalizes with Section 6, which presents the concluding remarks.

2. DECENTRALIZATION IN COLOMBIA: A MODEL OF DELEGATION FINANCED BY GOVERNMENTAL TRANSFERS

This section first presents a brief conceptual background on decentralization as a policy design and then, in light of these concepts, describes the fiscal decentralization process that has taken place in Colombia.

Decentralization can be defined as the process of transferring decision power to the lower levels of government (Martinez-Vazquez and Timofeev, 2009). 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. The ideal model of fiscal decentralization, embedded in the so called "fiscal federalism" proposes fiscal independence of each jurisdiction over the basis of a distribution of incomes and responsibilities (Litvack, 1998).

In practice then, the degrees of decentralization vary. According to Litvack et al (1998), 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 territorial 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 30 years of accumulation of major reforms that began with the Legislative Act (AL) No. 1 of 1986 and extends through the reforms of royalty

and territorial planning in 2011-2012. Since the beginning of this decentralization process, 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 across the territory led to the design of a transfer system that would allow subnational governments to achieve the main objectives of decentralization. Then, the Colombian decentralization is, in practice, an eclectic model of 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" there can be observed, however, important sectorial differences in the country. 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). 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' ability to provide these services.

As a result, Colombian municipalities are financed mainly through central government transfers, royalties and own fiscal effort. Table 1 presents the descriptive statistics of the share of these three sources into the total income of 1,087 out of the 1,111 Colombian municipalities. The data shows that in average 61.5% of the municipal income comes from central government transfers (SGP) and only 13.0% comes from tax revenues. Although there are some municipalities, for which almost 80% of their income comes from tax revenues, there are also municipalities that do not reach a share of fiscal effort larger than 1% of their total income.

In terms of royalties, on the other hand, out of the 1,087 municipalities, only 385 received royalties from the production of minerals and hydrocarbons and only in 58 of them royalties represented more than 20% of their total revenue. 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[1].

As suggested by Blume and Voight (2011) fiscal effort is the most important descriptor of the degree of decentralization. In Colombia, the municipalities' 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. Although this source of income is the most important tax that municipalities collect, it only represents more than 15% of the income in 10% of the municipalities. As such, despite Colombia's decentralization began about 30 years ago, the tight municipal fiscal effort and large dependency from the central government transfers of some municipalities reflect the still limited and heterogeneous fiscal decentralization in the country.

Being fiscal decentralization in Colombia still limited, the debate on whether or not decentralization serves the poor by improving population's access to social and public services underscores its relevance in this context. Shall we deep decentralization policies, or, in contrast, come into a more centralized design

[1] 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 has decreased to 20%.

as a main strategy to reduce poverty? This is the relevance of the question that we want to address and our contribution to the literature.

To analyse the empirical evidence of the effect of the Colombian's decentralization on multidimensional poverty reduction, the next section analyses the relationship that can be observed between fiscal decentralization and municipal multidimensional poverty in the Colombian context.

Table 1. Main municipal financing sources, 2005

	N	Mean	Std. Dev.	Min	Max
a. Central government transfers (SGP) as a share of the total income	1,087	61.5	15.9	4.718	91.4
b. Royalties as a share of the total income	385	9.9	17.0	0.002	82.6
c. Tax revenues as a share of the total income	1,086	13.0	12.0	0.040	78.9
d. Property tax as a share of the total income	1,080	5.0	5.2	0.016	39.0
e. SGP, royalties and tax revenues (a + b. + c.) as a share of the total income	1,087	78.0	10.6	18.973	98.8

Source: Capture System of the Municipal Budget Execution administrated by the Colombian National Planning Department (SICEP because its acronym in Spanish).

3. MUNICIPAL OWN FISCAL RESOURCES AND MULTIDIMENSIONAL POVERTY: STYLIZED FACTS

This section first describes the data that we use for our empirical analysis and then the obtained multidimensional poverty estimates at municipal level. We also explore the stylized facts than describe the relationship between this variable and fiscal decentralization, as measured by the municipal per capita own resources.

3.1 Data

Several studies have analysed the 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 departmental level (Colombian counties) analysis. Still, for the Colombian case, addressing decentralization and poverty at the county level hides the high heterogeneity that lies inside counties. We therefore grounded our decentralization analysis on municipality data. As such, the analyses of this paper use 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.[2] On the other

[2] 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

hand, regarding Colombian administrative registers we use: i) the Capture System of the Municipal Budget Execution administrated by the Colombian National Planning Department (SICEP because its acronym in Spanish); ii) the 2003 national registers on voting from the National Registry Department; iii) primary and secondary road network information from the System of Cities and from the National Geographical Institute (IGAC); and iv) the administrative register regarding social protection affiliation for formal employees from the Social Protection Ministry.

3.2 The Colombian Multidimensional Poverty Index

This paper assesses the relative degree of success or failure of decentralization to achieve convergence to basic social minimums. Deprivation in those basic social minimums has been operationalized for the Colombian context, through the Colombian Multidimensional Poverty Index (CMPI). The CMPI was launched by the National Planning Department in 2012, based on the Alkire and Foster (2010) method for multidimensional poverty indices. It is an index that uses as unit of analysis the household and aggregates 15 indicators among 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). It sets the socially acceptable minimums for these five dimensions and is able to capture how far is each household from each minimum (Angulo et al., 2015).

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 A1 in the Annex describes the dimensions, variables, cut-off points and weights per variable of the CMPI indicator that we calculated based upon 2005 census data. [3]

For the purposes of this paper we focus our analyses on two municipal multidimensional poverty measures: the multidimensional poverty headcount (H), and the average multidimensional poverty gap ($M1$). Both of these two measures are calculated as the average across households within municipalities. On one hand, the multidimensional poverty headcount (H) depicts the share of the population that is considered as multidimensionally poor, within each municipality. A household is considered as multidimensionally poor under this indicator if it has 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. As such, $M1$ can be seen as an opposite measure of convergence to social minimums because it expresses how distant each household is from each of the dimensional poverty lines.

Figures 1.a and 1.b plot the average *H*-headcount ratio and *M1*-multidimensional poverty gap, across 1,113 observed municipalities in the 2005 census. Darker areas in the figures represent higher multidimensional poverty and lighter areas lower multidimensional poverty. It is observed in both, Figures 1.a and 1.b, that higher multidimensional poverty is concentrated in the country's peripheral areas and lower multidimensional poverty concur in the more central areas of the country. While peripheral areas are more disperse, central areas correspond to more dense and populated municipalities. We, therefore, observe less dense and disperse areas registering greater multidimensional poverty headcount and gap. This spatial distribution of multidimensional poverty could be attributed to the fact that 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. Multidimensional poverty, therefore, is not randomly distributed in geographic terms.

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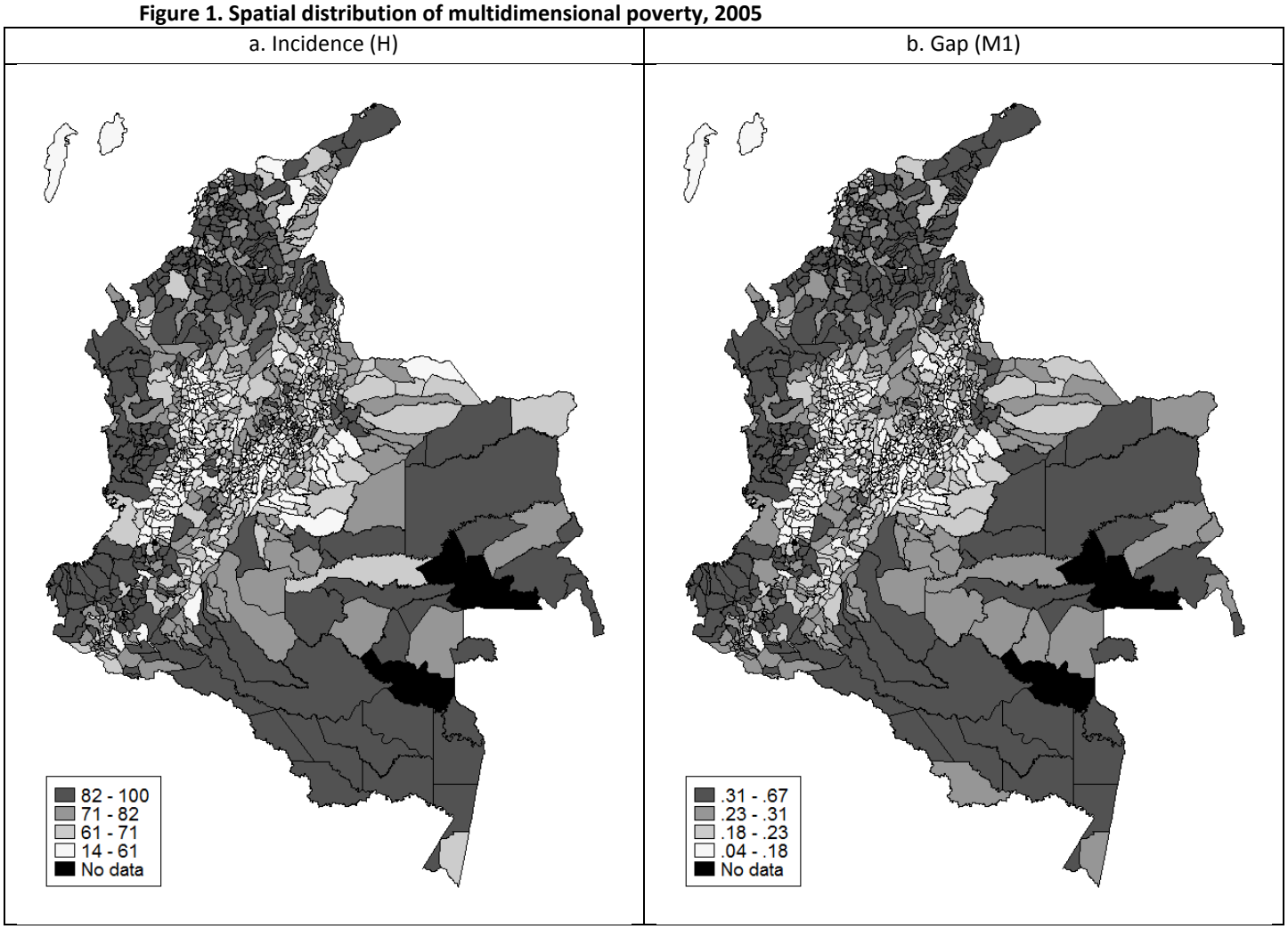
a household Bernoulli selection procedure. The extended questionnaire included information regarding education and labor conditions for each of the household members and allows for municipality figures estimations.

[3] The official methodology to calculate the CMPI uses the 2003, 2007 and 2010 Colombian Living Conditions Survey (CLCS). For a complete description of the official CMPI see Angulo et al. (2015). The main difference of the CMPI constructed for the purposes of this paper with respect to the official CMPI is that we transform some of the indicators of the household education conditions and access to public utilities and housing conditions, in a way that they can be measured in a cardinal scale, rather than just indicating the presence or absence of a certain attainment. That was not the case with the official CMPI. 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).

This result suggests that the methodology to analyze municipal multidimensional poverty must take into account its spatial interrelation. We return to this issue in greater detail in Section 4, when discussing the methodological strategy that we pursue to estimate the impact of fiscal decentralization on multidimensional poverty. Before doing so, we briefly present the stylized facts that we found when analyzing the observed empirical relationship between fiscal decentralization and multidimensional poverty.

Figure 1. Spatial distribution of multidimensional poverty, 2005



Source: Authors' calculations based on 2005 census. Note: 1,113 municipalities in sample.

3.3 Own municipal resources and multidimensional poverty

Decentralization is meant to serve the poor by improving the population access to social and public services and the accountability on the provision of those services. In this vein, a larger amount of per-capita own resources generated by the municipalities can be understood as a better administrative municipal effort, as well as a larger degree of empowerment and commitment of the population to the provision of services that the municipal authorities provide. Municipal administrations can allocate those revenue sources autonomously to those projects revealed by the local preferences.

As such, the per capita own resources indicator for a municipality is the revenue source that is expected to have greater impact on social objectives. In Colombia, as discussed on Section 2, the municipalities' fiscal effort is mostly based on property tax collection. Hence, we focus our decentralization analysis on the per capita property tax collection for each municipality. Figure 2 shows the per capita tax collection of each municipality plotted against municipal multidimensional poverty in 2005. We observe that in average

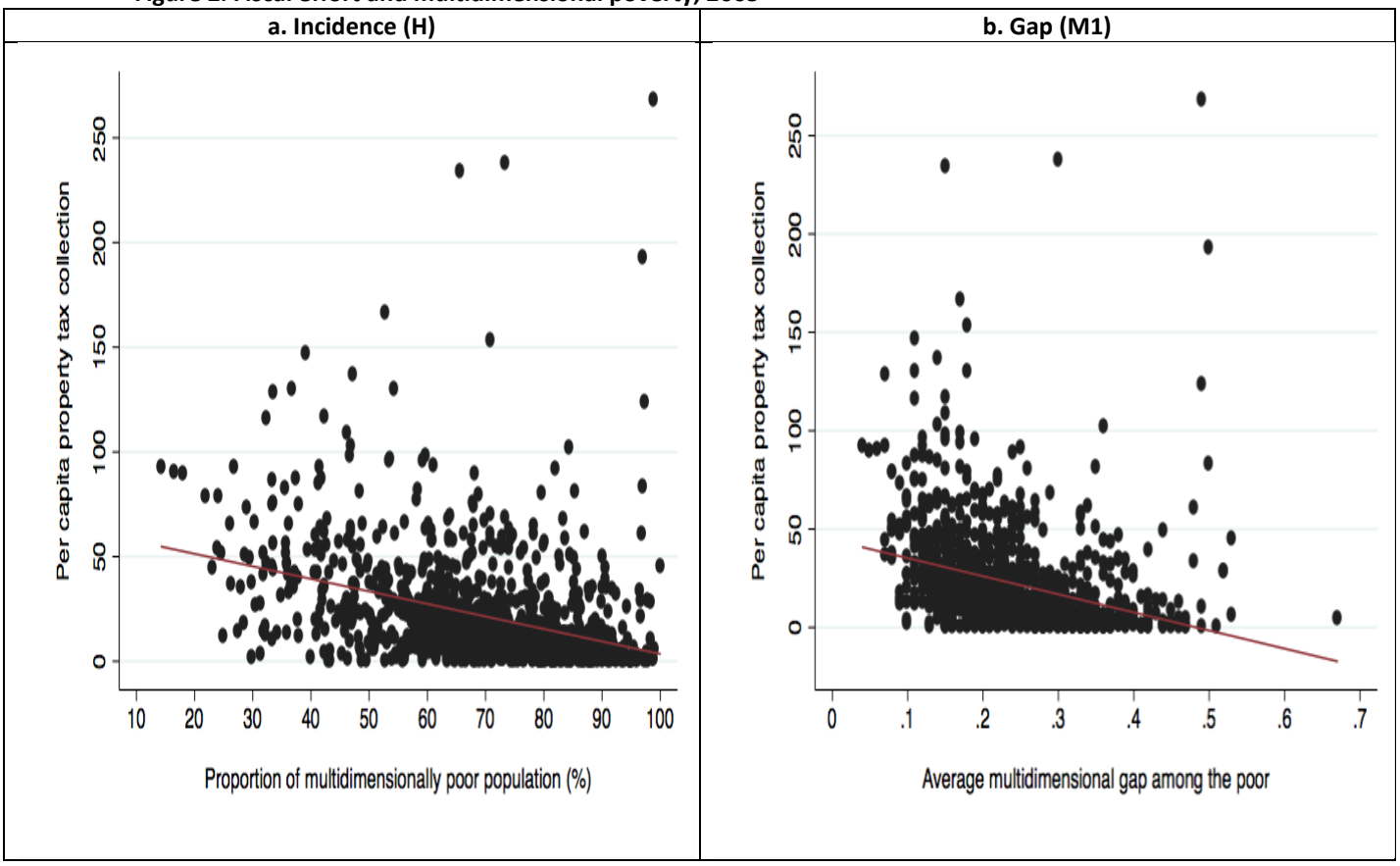
there is a negative relationship between fiscal effort and multidimensional poverty incidence and gap, suggesting that the greater the municipal fiscal effort the lower the multidimensional poverty incidence and gap. This result shed light on the effectiveness of fiscal decentralization to reduce poverty.

However, a worth noting caveat arises in this regard. Although the majority of municipalities show a negative relationship between fiscal own resources and multidimensional poverty incidence, there is also a large variation in this relationship. For municipalities that have similar per capita own resources there are large differences in terms of multidimensional poverty incidence. For some municipalities, there is even a positive relationship between per capita own resources and multidimensional poverty.

Consequently, the relationship between decentralization and social outcomes is yet not univocally determined. At least two elements might drive this complex relationship. First, since most of the transfers from the central government to the municipalities are based on municipality poverty criteria, the most deprived municipalities could be also more dependent on governmental transfers and have less incentive to increase their share of own generated resources. Ramirez and Bedoya (2015) found that a larger dependence from central government transfers is associated with a lower fiscal effort at municipal level. This study also found that the effect coming from royalties is also negative and stronger. Second, since the most deprived municipalities have a smaller base of population and business that contribute to municipality revenues, they indeed have less ability to pay taxes. As a result, the per capita own resources and multidimensional poverty at the municipality level might hold a double causal relationship.

In this context, the relationship between decentralization and deprivation at the municipality level could be catalogued as endogenous, not only because a double causality between both variables, but also because there are factors such as non-observable political forces and elites dynamics at the regional level, that are related to both, decentralization and deprivation. As a result, the assessment of the relationship between fiscal decentralization and multidimensional poverty incidence requires a more rigorous methodology to address this endogeneity problem. In the following section we present the methodological approach that we follow to address this problem, which allow us to provide thorough estimates of the causal effect of fiscal decentralization over multidimensional poverty reduction.

Figure 2. Fiscal effort and multidimensional poverty, 2005



Source: Authors' calculations based on 2005 census and SICEP. Note: 1,060 municipalities in sample.

4. DISENTANGLING THE CAUSAL EFFECT OF FISCAL DECENTRALIZATION ON MULTIDIMENSIONAL POVERTY: METHODOLOGY

This section describes the empirical strategy that we use to quantify the causal effect of municipal fiscal effort on multidimensional poverty headcount and gap. We first present the econometric model and then describe the selected variables to implementing it.

4.1 The model

Since poverty at municipal level is spatially correlated, the estimation procedure that we opt to use takes into account the spatial correlation as well as addresses the endogenous relationship between the per capita tax collection and multidimensional poverty incidence and gap. This section briefly describes this selected methodological approach.

Within the spatial econometric literature several specifications have been proposed and used for a wide variety of economic topics as house pricing, violence and crime, social movements, and political issues, among others. Examples of these are Ioannides (2002), Mears and Bhati (2006), Swaroop and Morenoff (2006) and Franzese and Hays (2008). In particular, due to the features of our data and our interest to understand multidimensional poverty as an economic geography phenomenon with spillovers across geographical units, we focus our interest on a spatial econometric specification that allows 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 spatial autoregressive model with spatial autoregressive disturbances (SARAR). The SARAR model, proposed by Anselin and Florax (1995), accounts

at the same time, for spillover effects in the dependent variable and for spatial autocorrelation of the errors (correlation among unobservables). The SARAR model can be specified as follows:

$$y_i = l \sum_{j=1}^{n} W_{ij} y_j + \sum_{k=1}^{h} b_k x_{ik} + e_i \quad [1]$$

$$e_i = r \sum_{j=1}^{n} M_{ij} e_j + u_i \quad [2]$$

Where y_i refers to the outcome of interest, which in our case refers to the H-multidimensional headcount or the $M1$-average multidimensional gap for each i-municipality. The SARAR model specification accounts for the spillover effect among geographical units considering the interaction among them via the introduction of a spatial lag. In Eq. [1] this spatial lag term is represented by $\lambda \sum_{j=1}^{n} W_{ij} y_j$, where n denotes the total number of observed muicipalities, y_j describes the value of the dependent variable in the *j*-neighbor municipality, W_{ij} represents the ij-element of a W-matrix of spatial weights[4], and λ is the parameter that accounts for the intensity of the spatial correlation of the lagged values of the dependent variable. Then, this spatial lag or lagged values of the dependent variable represents the relation of each municipality with its neighbors and λ is the parameter that captures the spillover effect. Excluding this spatial lag of the estimations, in the presence of spatial autocorrelation in the dependent variable, could imply an omitted variable problem.

In the SARAR model, we control for a set of h different independent variables that take values for each i-municipality. In Eq. [1], each of these independent variables is represented by x_{ik} and is accompanied by a β_k parameter.

To account for the correlation across spatial units among unobservables in the SARAR model, the ε_i - error term of Eq. [1] is expressed (as shown in Eq. [2]) in terms of its lag values (ε_j), the spatial weighting matrix M, the ρ-spatial autocorrelation parameter given by unobservables, and an u_i remaining error term assumed independently and identically distributed.

However, using the spatial lag term in Eq. [1] introduces a double causality between this term and the dependent variable. Two different options for the SARAR model are considered in literature to account for this double causality and obtain consistent estimators. The first one consists on using a maximum likelihood estimation (ML), and the second one consists on using instead the generalized spatial two-stage least squares (GS2SLS). Following Kelejian and Prucha (1999), whom pointed out that there is neither general statistical theory, nor large sample theory for the ML estimator, we opt for using a GS2SLS estimator[5].

Besides the endogeneity that arises from the spatial lag term, and as discussed in Section 3, possible endogeneity might arise from the per capita property tax collection variable, which is indeed our main explicative variables of interest. As a first methodological strategy to tackle this potential problem, we use the lagged values of such variable as a proxy of the contemporary one; meaning that instead of using the 2005 values of it we use the 2003 register. However, this ad-hoc solution for our main parameter of interest could have not only problems of interpretability or precision; also it does not allow us to test further whether the solution deals properly with the problem. Beyond that, we also found statistical evidence that indicated us that our main parameter of interest (the 2003 percapita taxation ability) is not

[4] Each ij-element of the W-spatial weighting matrix describes the relationship among the *ij*-pair of municipalities. Section 4.1 ahead on describes in detail the two alternative W-spatial weighting matrices that we use in our estimations.

[5] 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 lagged dependent variable, 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.

exogenous yet. In particular, we performed a Durbin-Wu-Hausman test[6], which uses as null hypothesis exogeneity of this tax ability variable rejecting such hypothesis under a 1% of statistical significance.

For the specific case when there is evidence of endogeneity from one of the explicative covariates in the context of the SARAR model, Drukker et al (2013) developed the IV-SARAR model, which can be expressed as follows:

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

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

In comparison with Eq. [1], here Eq. [3] includes an additional term: θz_i, which refers to the z_i-endogenous explicative variable (taxation ability for the ith-municipality) and its θ-related parameter. This IV-SARAR model is the specification that we pursue to disentangle the causal effect of fiscal decentralization on multidimensional poverty reduction. The following subsections describe the specification of the spatial weighting matrices, the independent variables and the instruments that we use to operationalize this IV-SARAR model.

4.2 The spatial weighting matrices

In general, the specification of the W-spatial weighting matrix can be considered arbitrary and the results obtained from the IV-SARAR model could be heavily determined by the specification of the weighting matrix in use. We therefore use two alternative specifications of W to test the validity of our results. First, we use the most common specification of W within the spatial econometric literature, which is a contiguity-based matrix. In such a 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 describes the relationship between municipalities intending to capture the intensity of such connection using economic geography indicators. As such, we built this economic geography matrix by combining into a single indicator that ranges from 0 to 1 and that was constructed as an additively separable linear transformation of the four following indicators: (i) a dummy indicator of presence or absence of common boundary among municipalities, (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.

4.3 The independent variables

Besides our main explanatory variable of interest, which is the taxation ability of each municipality (expressed as the per capita property tax collection), we control for a set of other decentralization aspects, location and size indicators, demography, connectivity of the municipality and other controls. Table A2 within the Annexes presents the descriptive statistics of these variables used in our analyses. The following paragraphs briefly discuss the relevance of them.

Decentralization controls. As pointed out by Von-Braun and Grote (2000), Sánchez and Pachón (2013) and Bardhan and Mookherje (2005), fiscal decentralization cannot be studied as an isolated policy mechanism; it needs to be accompanied considering the political and administrative components as well. As such, we control by other sources of income of local governments (per capita governmental transfers and per capita royalties) and also by the political and administrative components of the decentralization process. Regarding administrative decentralization we use an indicator of administrative capacity, which ranges

[6] For a comprehensive explanation of the Durbin-Wu-Hausman test see Cameron (2005).

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 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.

Other controls. To control for economic geography variables we use 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, a the rurality index, a variable that accounts for the kilometers of primary and secondary roads per squared kilometers of the municipality. In addition, we use two dummy variables of demographic characteristics, an initial state of deprivation using the 1993 rate of population under Unmet Basic Needs Indicators, a variable to account for the variability induced by the spread of violence in the territory, 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 county dummies and a dummy variable that indicates whether or not the municipality has an important presence of agricultural activities.

4.4 The instruments

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 takes in average to update its cadastral register is 6.2; this variable ranges from zero years, because they did the last update 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 is therefore related with the taxation ability. 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.

5. RESULTS

In this section we discuss the econometric results obtained from modeling the multidimensional poverty headcount ratio and the average multidimensional poverty gap. Specifically, Section 5.1 presents the proven specifications of determinants for these two outcomes. However, since the results reported by our models do not correspond strictly to elasticities, in this section we analyze these results only in terms of statistical significance and sign. Then, to produce more policy informative results, Section 5.2 presents the estimated elasticity for our parameter of interest (taxation ability) and Section 5.3 shows the results of some evaluated public policy counterfactual scenarios.

5.1 Determinants of municipal multidimensional poverty

Table 2 includes the Ordinary Least Squares (OLS), the SARAR and the IV-SARAR estimations for the multidimensional poverty headcount ratio and the average multidimensional poverty gap (S and IV-S, in the table). For the SARAR and the IV-SARAR estimations we consider both specifications of the spatial-weighting-matrix, the contiguity based matrix (Cont.) and the economic geography based matrix (EG).

When regressing our two outcomes of interest, H and $M1$, against the set of measures of fiscal, administrative and political decentralization -models (1) to (3) in Table 2-, we found a negative and statistical significant effect of those variables over both outcomes of interest. 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 proven specifications for both outcomes.

Furthermore, when cleaning the endogeneity 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 reduced multidimensional poverty incidence and gap as a result of exhorting greater taxation ability. Fiscal decentralization policies that increase the local governments' taxation ability in Colombia have shown to serve the poor by reducing the proportion of multidimensionally poor population and the average multidimensional poverty gap. These results hold when controlling 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. Sections 5.2 and 5.3 discuss in depth the implications of these results and the derived policy lessons.

On the other hand, in terms of the geographical pattern, when we test for spatial spillovers of deprivation across neighboring municipalities we found a statistically significant effect (λ-lambda coefficient) in all proven specifications. The specifications that use the economic geography based matrix for the spatial interrelation among municipalities capture a greater spillover effect than the specifications that use a simple contiguity based relationship among municipalities. Additionally, despite that 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 (ρ-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 (λ-lambda coefficient) along with the results concerning the ρ-rho coefficient, are present across the two different specifications of the spatial weighting matrix. But, our results suggest that modeling the spatial relation among municipalities using only a contiguity criterion could downward bias the captured geographical effect. Operationalizing the municipalities' relationship in economic based terms rather than by a simple contiguity based relationship seems to capture in a better manner the geographical pattern of deprivation.

When analyzing the regression 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 indicates that despite governmental transfers do not correlate with multidimensional poverty, they are negatively associated with reductions of the depth of poverty -models (4) to (8)-.

In addition, governmental transfers for other uses as well as administrative ability, as expected, reduces statistically significantly the incidence of multidimensional poverty and gap to achieve social minimums, but the strength of this relationship diminishes after controlling for spatial correlation and it gets rolled out after controlling for our set of covariates.

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 citizens participation 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 poverty 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 poor 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 poverty 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 poverty 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.

5.2 The measured taxation ability impact

To provide policy informative figures of the impact of a taxation ability increment in each municipality over our two outcomes of interest, we calculated the elasticity from an increment of one thousand Colombian pesos in per capita terms of own resources across the 1060 municipalities under study. This increment represents approximately an increase of 40 billion Colombian pesos in higher own resources. We evaluated such a scenario over the results of the IV-SARAR model that uses an economic geography-weighting matrix (model 8 in Table 2). Table 3 below presents the total effect and their decomposition into direct and indirect effects. While the direct effect reflects the reduction in each municipality of multidimensional poverty given by the increment in its own taxation ability, the indirect effect reflects the reduction in multidimensional poverty given by a reduction in multidimensional poverty in the neighboring municipalities - the spillover effect.

We found that an increment of one thousand Colombian pesos in per capita terms of own resources produces 0.214 percentage points of reduction in the average poverty headcount, and 0.008 percentage points of average reduction in the multidimensional average gap. Out of those 0.214 points of reduction in the incidence of poverty, 45% of the total effect is given by the spillover effect. Our results suggest that public policies that seek to strength the municipality fiscal capacity have statistically significant and important effectiveness reducing multidimensional poverty and achieving convergence to social minimums. More than two thirds of the total effect associated with increments in the taxation ability would redound on reductions of multidimensional poverty in the spatially interrelated municipalities.

This important size of the obtained indirect effect highlight the possible relevance of fiscal decentralization policies that take into account the geographical relationship of deprivation among municipalities. We test this policy implication in the next section below.

Table 2. Determinants of multidimensional poverty (Headcount ratio and Gap)

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

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.

5.3 Counterfactual policy scenarios

In this section we analyse the possible effect of three alternative geographically differentiated policies compared with a decentralization policy that does not take into account the geographical relationship among municipalities. For this purpose we implemented four different counterfactual policy scenarios. The first scenario (Policy A) corresponds to the non-geographically designed policy, which is based on an increment of 1.5% of the per-capita own resources per each municipality in the country. The subsequent three scenarios correspond to geographically sensitive policies. On one hand, the first geographically differentiated scenario (Policy B), focused on main urban areas, concentrates the same fiscal effort of Policy A but only 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.

Table 3. Decomposition of the total impact of taxation ability across direct and indirect

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

The second spatially differentiated policy, Policy C, concentrates the same fiscal effort of Policy A and B, but now over the 300 most spatially correlated municipalities in terms of multidimensional poverty. 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.

Table 4 below presents the results of these counterfactual policy scenarios. The table shows 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 the least effective policy in reducing multidimensional poverty corresponds to Policy B. Indeed, 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.

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).

Table 4. Mean change effect of each simulated policy over multidimensional poverty

			All municipalities	The 18th Centroids	The 300 most correlated municipalities	The 300 most correlated municipalities (NSC)
			(1)	(2)	(3)	(4)
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)
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)

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

By all means and as expected, the most effective policy in reducing multidimensional poverty across all municipalities (Column 1) is Policy D. 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 this 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 total amount of 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 poverty.

6. CONCLUDING REMARKS

This paper disentangled the effect of decentralization on multidimensional poverty incidence and gap at municipal level in Colombia. Specifically, we assessed the causal effect of taxation ability, measured as the per capita municipal own resources, over multidimensional poverty.

Multidimensional poverty was found not randomly distributed in the Colombian territory; it tends to concentrate in the peripheral areas more than in the center. 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. The results of these econometric estimations show, consistently across all the specifications, that the municipalities per capita own resources have a strong negative causal effect over multidimensional poverty. 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.

The findings of the paper also suggest some topics that should be part of an agenda for adjusting and reforming decentralization models. 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 could 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. 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.

In terms of other decentralization aspects, our results indicate that other fiscal decentralization strategies, as 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. This result might suggest that central government transfers could be not as effective as the strengthening of the taxation ability and the autonomy of municipalities. Political decentralization, measured by citizen participation in local elections, also shows a negative and significant effect on poverty gap, but not on poverty incidence.

Finally, we found that economic geography strongly correlates with multidimensional incidence and gap. Higher incidence and gap are associated with: a) a higher degree of rurality (lower population densities and/or larger distances to cities); 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. These results highlight the need for strategies to overcome poverty designed under a territorial approach. 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.

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Annexes

Table A1. 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. (2015) 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.

Table A2. Descriptive statistics

Variable		N	Mean	Std. dev	Min	Max	Units	Source
Dependent variables								
Multidimensional poverty	Incidence	1,113	69.5	16.4	14.3	100.0	Percentage share (0-100)	2005 Census
	Gap	1,113	0.2	0.1	0.0	0.7	Percentage points	2005 Census
Independent variables								
Taxation ability	Per capita property tax revenue	1,075	15.35	19.68	0.00	295.09	Per capita thousand Colombian pesos	NPD, 2003
Other decentralization indicators	Per capita investment financed by SGP	1,094	214.70	132.57	0.00	1063.45	Per capita thousand Colombian pesos	NPD, 2003
	Per capita investment financed by royalties	1,094	29.58	166.91	0.00	3838.00	Per capita thousand Colombian pesos	NPD, 2003
	Administrative ability	1,098	51.66	18.84	0.00	85.48	Index that ranges from 0 to 100	NPD (Overall performance index)
	Share of total votes over electoral potential	1,111	58.00	14.40	0.20	96.4	Percentage share (0-100)	National Registry Department, 2003
Location and size	Urbanization	1,111	43.10	24.70	0.00	100.00	Percentage share (0-100)	2005 Census
	Dummy of population size	1,111	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	1,111	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	1,111	46.68	12.58	0.00	100.00	Index from 0 to 100	2005 census and geographical information
	a. Population density	1,092	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	1,092	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	1,092	151.07	117.49	0.00	980.37	Kilometres	
	d. Mean distance to municipalities between 200 and 399 thousand inhabitants	1,092	399.12	107.81	270.41	1147.87	Kilometres	
	e. Mean distance to the 50% closest municipalities between 100 and 199 thousand inhabitants	1,092	244.72	84.94	155.61	1007.62	Kilometres	
Connectivity / development	Kilometres of primary and secondary roads per squared kilometres of the municipality	1,096	1.23	0.88	0.00	13.33	Kilometres	IGAC and System of cities
Demography	Share of population 5-15 years old	1,097	22.80	2.61	12.43	30.68	Percentage share (0-100)	2005 census
	Share of population under 5 years old	1,097	11.11	2.74	5.51	26.70	Percentage share (0-100)	
Other controls	Population share with unmet basic needs, 1993	1,103	53.85	19.44	9.20	100.00	Percentage share (0-100)	DANE

Variable	N	Mean	Std. dev	Min	Max	Units	Source
Violence. Number of attacks from FARC, ELN and paramilitary groups from 1998-2002	1,111	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 acción*	1,111	178.67	306.60	0.00	2609.27	Number	NPD, 2003
Agro-concentration	1,111	0.20	0.40	0.00	1.00	Dummy, 1=municipalities with greater concentration of agricultural activity. 0=municipalities without agricultural vocation	NPD

Acronyms: NPD refers to Colombian National Planning Department. DANE refers to the Colombian National Institute of Statistics. IGAC (Colombian Geographical Institute Agustin Codazzy). FARC (The Revolutionary Armed Forces of Colombia). ELN (Colombian National Liberation Army). SGP (Colombian central government transfers to municipalities).