Fueling Fiscal Interactions: Commodity Price Shocks and Local Government Spending in Colombia*

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Abstract

This paper explores fiscal interactions in a developing country. We analyze whether public expenditures in neighboring municipalities influence local spending decisions within a comprehensive set of expenditure categories. Our analysis is based on panel data covering the universe of Colombian municipalities from 2000 to 2010. We offer a quasi-experimental identification strategy exploiting exogenous variation in municipalities' exposure to changes in the world market price of oil, depending on the municipalities' endowment with oil resources, and controlling for municipality fixed effects. While we find evidence of strong spatial autocorrelation of total local public spending as well as in almost all expenditure categories, the quasi-experimental approach reveals that there are no significant causal fiscal interaction effects between municipalities. This highlights the importance of quasi-experimental variation for the analysis of fiscal interactions. In the developing country context, our findings suggest that fiscal decentralization policies do not lead to a race to the bottom in local public expenditures.

Keywords: Fiscal interactions, expenditure competition, municipal development, peer effects, spatial econometrics
JEL-Classification: H4, H72, O18, O23, R5

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1 Introduction

In the past four decades, decentralization has been a focal point of policy reform in many developing countries, including South American nations. Policy advisors such as the World Bank and the OECD have advocated the delegation of more fiscal autonomy concerning both public expenditures and revenues away from the central government to local governments, including municipalities. More autonomy of local governments opens up the possibility of local fiscal interactions.

To fully understand the consequences of decentralization, reliable estimates of the extent of strategic fiscal interactions of local governments are crucial, because strong interactions may imply externalities and therefore inefficiencies (e.g., Caldeira *et al.* (2014)). On the revenue side, tax competition has received considerable interest and raised concerns that uncoordinated fiscal autonomy may lead to a race to the bottom of tax revenues. Far less is known about local fiscal interactions on the expenditure side, especially in a developing country context.[1] This is astonishing because strategic competition in expenditures does not necessarily coincide with strategic tax competition (e.g., Wildasin (1988)). Despite the scarcity of evidence, local expenditure spillovers frequently appear in policy debates. For example, local policymakers are often concerned that too generous local welfare spending will draw in welfare migrants from surrounding regions (see Figlio *et al.* (1999) for an analysis of welfare competition at the level of US states). Neighboring regions may then save public funds at the expense of the local taxpayers of the focal jurisdiction. Such considerations may lead to an underprovision of certain public goods if local governments are responsible.

Expenditure interactions may also arise if local policymakers engage in yardstick competition and mimicking of peers.[2] Understanding the way local governments interact in terms of public expenditures is key for implementing development policies which aim to improve local public spending. If local policymakers mimick their neighbors, it might be effective to roll out an innovative budget composition in a local jurisdiction that is used as a benchmark, i.e. that is central in the spillover network. Then the expectation is that the policy spreads out to other regions. If public expenditures are strategic complements, decentralized foreign aid to one municipality may entail fiscal efforts in connected regions and trigger a multiplier effect (Caldeira *et al.*, 2014; Glaeser *et al.*, 2003). Public expenditure interactions may be very different for different types of expenditures. Therefore, it is important to distinguish between various categories of local expenditures.

In this paper, we analyze spatial interactions of different types of local public expenditures among municipalities in Colombia. Our data covers the universe of the more than 1000 Colombian municipalities over eleven years from 2000 to 2010 and distinguishes between the eleven most important expenditure categories. Studying Colombia is highly informative because the country has undergone fiscal decentralization reforms similar to those in many countries in South America and the developing world.

[1] As an illustration, Google Scholar finds 30.000 papers for "tax competition" but only around 600 results each for "expenditure competition" or "spending competition" (September 2016).

[2] The website of the mid-sized municipality Fresno in Colombia suggests that policymakers compete locally: "Municipalities [...] must develop integral systems to generate resources as well as social and economic development based on three basic variables: competitiveness, productivity and employment. Competitiveness is understood as the capacity of the municipality to differentiate itself from the surrounding municipalities to attract investments." `http://fresnoposible.fresnodigital.info/?page_id=56` (accessed 09/10/2016)

The methodological challenge in the literature on spatial spillovers in general and local fiscal interactions in particular is the identification of causal spatial interaction effects. These must be separated from spatial autocorrelation that is due to spatially clustered unobservable factors (Manski, 1993; Gibbons and Overman, 2012; Revelli, 2015). For identification, we exploit the fact that Colombian municipalities receive royalties that depend on revenues from local oil extraction by private companies. Higher local oil revenues thus relax the budget constraint of a municipality and allow an increase in local public spending. To identify expenditure spillovers, we use exogenous variation in the exposure of municipalities to changing world market prices for oil due to their endowments with oil resources (as measured before our observation period). With our spatial panel instrumental variable (IV) estimator, we control for municipality fixed effects as well as department-specific time fixed effects. This accounts for any cross-sectional differences between municipalities with and without oil resources as well as regional business cycle effects and leaves changes in world market prices of oil for exposed municipalities for identification. World market prices for oil are arguably exogenous for Colombia as a relatively small oil extracting country, which is not a member of OPEC, and certainly for Colombian municipalities.

Our results indicate that spatial interactions of total local public expenditures as well as local spending in almost all categories are small and not significantly different from zero when identifying the spillover effects based on quasi-experimental variation. The only exception is public spending for sports and recreation, where we detect significant spatial interactions that can be interpreted as causal. In contrast, when we use a spatial panel estimator without this source of exogenous variation, as done in most of the literature, the results suggest large and significant spatial autocorrelation in total local expenditures and almost all spending categories, even when controlling for municipality and time fixed effects. However, most of these effects are spurious, as we show by comparison to the consistent estimation based on the quasi-experimental instrument. Thus, the main methodological insight from our analysis is that it is crucial to use quasi-experimental variation for the identification of spatial fiscal interaction effects. As spatial interactions are insignificant for total local public spending and most expenditure types, the main policy insight from our paper is that there is no need for concern about a race to the bottom regarding local public expenditures when pursuing decentralization reform in a developing country. On the other hand, one should also not expect that innovative local expenditure policies spread out through mimicking in substantial ways.

With this approach and results, we contribute to a small body of emerging literature that employs quasi-experimental sources of variation for identification in the context of spatial fiscal interactions. Concerning expenditure spillovers, Baicker (2005) uses variation in federally-mandated increases in Medicare spending at the level of US states, and Isen (2014) employs referendum decisions in counties and municipalities in Ohio. While the former author reports considerable spatial spillovers, the latter does not find any significant interaction effects using his identification strategy. We largely confirm the last result in a developing country context and based on a very different source of exogenous variation, but also show that causal fiscal interaction effects can be identified for the category of sports and recreation.

In the context of tax competition, the literature using quasi-experimental approaches has developed more rapidly. Lyytikäinen (2012) uses changes in minimum property tax rates in Finland for identification, and Baskaran (2014) a fiscal equalization reform in

Germany. Both authors report that seemingly large tax interactions become insignificant when using quasi-experimental variation for identification, similar to the result of Isen (2014) concerning public expenditures. Other papers that identify fiscal effects at borders of higher level jurisdictions or language regions report significant strategic tax interactions (Eugster and Parchet, 2013; Parchet, 2014; Agrawal, 2015; Agrawal, 2016)

Most of the literature on spatial fiscal interactions does not use quasi-experimental variation. While that literature is fairly large in the context of tax competition, not many papers exist on public expenditure spillovers. Case *et al.* (1993) provide an analysis at the level of US states. Analyzing spillovers at the municipality-level provides a much larger policy variation compared to the state- or department-level mostly employed in the literature (e.g., Baicker (2005)). Moreover, most papers only analyze few expenditure categories or solely focus on single budgetary items such as health expenditures (Moscone *et al.*, 2007). Borck *et al.* (2007) are among the few authors who use municipality data and distinguish between various spending categories, although only cross-sectional.

The literature on fiscal interactions largely ignores developing countries since large and complete fiscal policy datasets are rarely available in these regions. It is important to investigate developing countries separately because they are in the focus of decentralization reform efforts. Additionally, they differ from developed countries in their forms of decentralization and institutional as well as budgetary constraints. Akin *et al.* (2005) investigate health care budgets in less than 30 districts in Uganda and Arze del Granado *et al.* (2008) local public spending based on cross-sectional data from Indonesia. Agostini *et al.* (2016) and Yu *et al.* (2016) analyze spatial spending interactions in China. Caldeira *et al.* (2014) use a panel of 77 communes in Benin and report strategic complementarity of local public spending. The significant fiscal externalities found in this paper question the efficiency of decentralization reform in developing countries. In contrast to our paper, the existing literature in the developing country context does not use quasi-experimental variation for identification and may therefore overestimate expenditure interactions.[3]

Our paper is also related to studies using an identification strategy similar to ours based on Colombian data. Martínez (2016) shows that local governments in Colombia perform better in providing public goods if more revenues come from their own taxes rather than oil royalties. He exploits exogenous variation in oil revenues for identification. Dube and Vargas (2013) investigates effects of income on civil conflict in Colombia using commodity price shocks.

This paper proceeds as follows: The next section reviews the theoretical literature, while Section 3 introduces the relevant Colombian context. Sections 4 and 5 present the data and empirical strategy before we discuss our results in Section 6. Section 7 concludes the analysis.

2 Theory of expenditure interactions

There are at least three different reasons why expenditures might be linked among municipalities. First, Yardstick competition (Shleifer, 1985; Besley and Case, 1995) may induce local politicians to mimic their neighbors' policies. This is because voters can assess the

[3]Yu *et al.* (2016) find spatial interactions within, but not across Chinese provinces, which supports their conclusion that Chinese local leaders engage in tournament competition.

quality of their incumbent politician only by observing policies in neighboring jurisdictions. The theory was originally developed to explain spillovers in local tax-setting and has been subject to vast empirical tests (see Allers and Elhorst (2005) for an overview). The mechanism may also apply to local public spending and result in positive interactions among local expenditures.

Second, expenditures may be linked due to competition for attracting a mobile tax base as suggested by Tiebout-type models (Tiebout, 1956). For instance, municipalities could compete for company settlements or highly-skilled workers (Borck *et al.*, 2007) by investing in their communication infrastructure or education system. In this case, the interjurisdictional spending is positively correlated. The classic model of fiscal spillovers by Zodrow and Mieszkowski (1986) shows how local governments competing for mobile capital will underinvest in public services. Keen and Marchand (1997) argue that non-coordinated spending of local governments under tax competition may be downward biased relative to the efficient level. They also posit that the underprovision of public consumption-oriented investment compared to public production inputs is relatively more pronounced. This is because capital is assumed to be more mobile than households and thus receives a more favorable treatment by the government.

A third explanation for correlated expenditures are the externality-producing nature of public investments (Case *et al.*, 1993), which may either be substitutes or complements to spendings in other regions. The correlation direction implied by this channel is ambiguous: On the one hand, a neighboring hospital might be sufficient to fulfill the regional demand for health services, making additional investment in another hospital obsolete. Investments then are substitutes and expected to be negatively correlated among neighbors. On the other hand, if a road construction project is supposed to link two municipalities, public local investments are likely to be complementary and positive expenditure interactions are expected. Hence, investments likely differ in their external effects, which is why we study different spending categories separately.

Fiscal competition in developing countries may differ from the case of developed economies usually studied. Caldeira *et al.* (2014) emphasize that poor municipalities in developing countries may be restricted in their spending choices and develop a model of expenditure competition with a constrained Nash equilibrium. One implication of the model is that there may be no strategic interaction despite positive externalities if the level of fiscal resources is insufficient. However, for the case of Benin, the authors empirically find significant strategic interaction in terms of complements.

3 Fiscal policy in Colombian municipalities

Colombia has been a politically, administratively and fiscally centralized country throughout most of its history. However, as in many other Latin American countries, the government phased in important policies towards decentralization starting from the mid eighties. The goal of the reforms was to delegate more functions to lower tiers of government, namely its 32 departments and more than 1000 municipalities. To this end, in 1991, a new constitution introduced a number of provisions regarding the delegation of administrative and fiscal duties from the central to the lower tiers of government. Among them were increases in the amount of transfers to local and regional governments and rules on how to spend these resources. In 2001, a unified system to transfer the resources to the

lower tiers of government called *General System of Participations* (SGP by its initials in Spanish) was created.

All of these reforms have had a large impact on the income and responsibilities of the municipalities. They left them, for the time span of our study, with three main sources of income. First, municipalities obtain the aforementioned transfers from the central government. Second, municipalities have their own revenues coming from local taxes, mainly the property tax and the ICA tax (a tax on industrial and commercial activities). Third, municipalities receive royalties from the exploitation of natural resources. Each source accounts roughly for 50%, 30%, and 5% of the total amount received by the municipalities respectively (Bonet *et al.*, 2014). The remaining revenue comes from non-tax income such as capital dividends, leased property or fees from construction permits.

Royalties from oil extraction are particularly relevant for our analysis as we use them as our source of exogenous variation. In Colombia, private companies extract oil, and municipalities receive royalties determined as

$$Royalty_{i,t} = output_{i,t} \times world\ market\ price_t \times exchange\ rate_t \times fixed\ royalty\ rate \quad (1)$$

For those municipalities extracting oil or with an oil port, royalties are very important, accounting for 23% of their total revenues. Oil is the most important natural resource in Colombia and accounts for 69% of royalties, followed by coal with 23% (Martínez, 2016).

There are specific rules on how to spend the revenues from the different sources of income. According to a law introduced in 2001[4], 4% of federal transfers were to be used for special purposes like food programs in schools or indigenous reservations. Of the remaining 96%, 58.5% had to be used for education, 24.5% for health, and 17% for a general purpose category, including water and sanitation, housing, and agricultural investments, among other items. In 2007 a new change in the legislation[5] gave continuity to the transfers system, marginally modified the growth rate of the transfers to each category, separated the water and sanitation category from general purpose and assigned it 5.4% (leaving 11,.6% for general purposes). After the allocation of the transfers to the different categories, the ministries in charge distribute them between the municipalities. In terms of own revenue, municipalities have almost complete freedom to spend the money they collect in taxes. The only provision in this regard is a minor transfer they have to make to their respective regional environmental agency.

Concerning expenditure of direct royalties from the exploitation of natural resources, legislation mandates that municipalities spend at least 75% in the achievement of coverage goals for health and child mortality, education, and water and sanitation.[6] In the following, we refer to the corresponding spending categories health, education and water as earmarked categories. If all the goals are achieved, local governments can use all the royalty revenues as desired.

The rules on how certain revenue types have to be spent could limit the potential for expenditures interaction across municipalities. However, despite the regulations, evidence shows that local governments in Colombia have considerable leeway in the composition of

[4]Law 715, 2001

[5]Law 1176, 2007

[6]The minimum coverage goals for health, child mortality, education, and water are respectively: 100% of health insured population, less than 1% of child mortality before reaching the second year of life, 90% of school enrollment, and 70% of the population with access to clean water.

their spending. Drazen and Eslava (2010) demonstrate that incumbents increase expenditure in public goods that are more visible to citizens in a bid to increase their vote shares before elections. According to Sánchez *et al.* (2002, p. 3), relatively rich municipalities "are able to relocate their own-source revenues to undo the effects of conditionality, and there is considerably more fungibility in grants than a strict reading of the law would suggest". Thus, municipalities can direct some of their investments according to their own desires, leaving the door open for expenditure interactions between local governments.

Nevertheless, according to Perotti (2005), the central government's attempt to force municipalities to spend disproportionately more on categories such as health and education has prevented local governments from using resources in other areas like social programs. These might have had a larger impact on local poverty reduction and therefore on the welfare of individuals. By identifying categories of public spending where local governments in Colombia compete, this paper informs policymakers in the central government about which spending areas local governments are focusing on, in turn revealing local electorates' preferences.

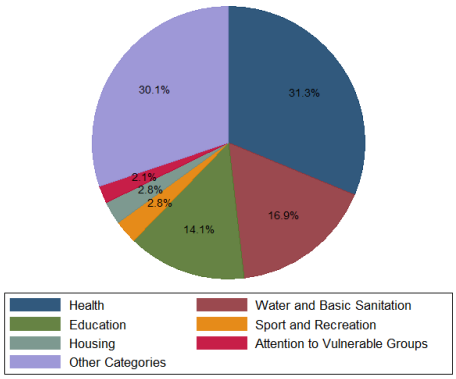
4 Data

To pursue our analysis of spatial interactions in municipal spending, we require four types of data: Public spending data at the local level, varying over time and across municipalities; information on municipalities' oil extraction; time-series data on world market oil prices; and cross-sectional geo-information on the municipalities' locations to construct spatial weighting matrices.

We retrieve local public spending data from the Center for Studies on Economic Development (CEDE) of the University de los Andes, which in turn collected the information from government agencies. The data contain a wide range of government-related variables from the full universe of Colombian municipalities over the years 1993 to 2013. This dataset has previously been used to analyze the effects of fiscal decentralization (Soto *et al.*, 2012), income shocks (Dube and Vargas, 2013) and political stability (Acemoglu *et al.*, 2013b), among other studies. As full coverage is not given for all years and to avoid large differences in the institutional setting, we focus on the period between 2000 and 2010. This results in a strongly balanced panel of 1093 municipalities over eleven years. The data allow us to differentiate between eleven major spending categories at the municipality level. We express all variables in real per capita Colombian Pesos (COP) with the base year 2008 if not stated otherwise.

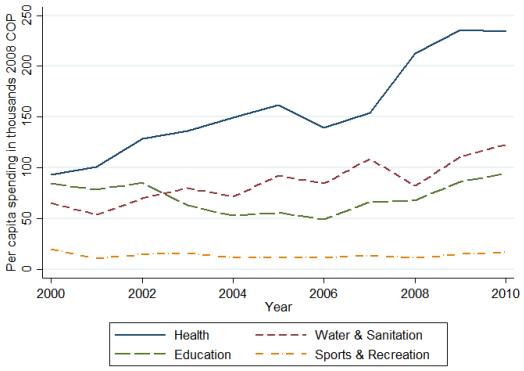
Figure 1a shows the largest expenditure categories in terms of their average shares in total local public spending. About 31% of a municipalities' expenditures go into the area of *health*. Spending in *water and basic sanitation* as well as in *education* account for another 17% and 14%, respectively. The remaining funds are spent for *sport and recreation*, *housing*, *attention to vulnerable groups*, *municipal facilities*, *agriculture*, *disaster prevention*, *community development*, *justice and security* as well as further smaller categories. Figure 1b shows that there was an increase in local real expenditures since the year 2000, mirroring the Colombian decentralization process. Table A.1 in Appendix A describes the spending categories in more detail and provides some examples.

The data are very complete and has an exceptionally high quality for a developing country context. We did not detect systematic trends of missing values and had to



Note: Relative shares of spending types per capita, averaged over 2000-2010.

(a) Relative shares of expenditure categories



Note: Annual averages across categories given, 2000-2010.

(b) Expenditures over time

Figure 1: Local public expenditures of Colombian municipalities

impute less than 3% of the observations by linear intrapolation (see Appendix B). From CEDE, we also retrieve the total transfers to municipalities from the central government and other sources, and the municipalities' total and rural population.

We retrieve information on oil extraction by private companies within a municipality from the Federal Ministry of Finance. To get an exogenous indicator of oil extraction, we create a binary variable equaling one if oil was extracted on a municipality's soil at any time during the years 1990 to 1999, the decade preceding our analysis.

To obtain a measure of the value of the oil extracted, we use the oil basket price in USD provided by OPEC. According to Colombian law,[7] the exchange rate used to calculate the value of the royalties is the average of the daily official exchange rate between the USD and the COP calculated by the Financial Superintendence of Colombia. Thus, we convert oil prices into COP applying the official exchange rate. Finally, we collect the cross-sectional geographical information on municipalities from the Colombian Geographic Institute Agustin Codazzi (IGAC).

Table 1 summarizes descriptive statistics of the major variables from the final sample. Figure 2 depicts the spatial distribution of local total public expenditures in Colombian municipalities and suggests spatial clustering. In our econometric analysis we investigate whether this is due to causal expenditure interactions.

[7]Law 141 of 1994, law 756 of 2002.

Table 1: Descriptive Statistics

	Mean	Std. dev.
Total Investments	507.92	441.15
Health	158.87	89.92
Water and Basic Sanitation	85.84	137.99
Education	71.46	101.10
Housing	14.05	32.87
Sport and Recreation	13.99	23.53
Agriculture	12.77	22.40
Municipal Facilities	12.32	29.90
Attention to Vulnerable Groups	10.60	17.08
Justice and Security	5.59	12.45
Disaster Prevention	3.99	14.21
Community Development	1.72	7.94
Federal Transfers	390.42	268.46
Oil production status (1990-99)	0.06	0.24
Population	39.08	235.98
Rural population share	582.27	236.14

Notes: The table provides averages over the entire sample period 2000-2011. Expenditures and transfers are real per capita values in thousand 2008 COP. Population in thousand inhabitants. $N = 1093$ municipalities.

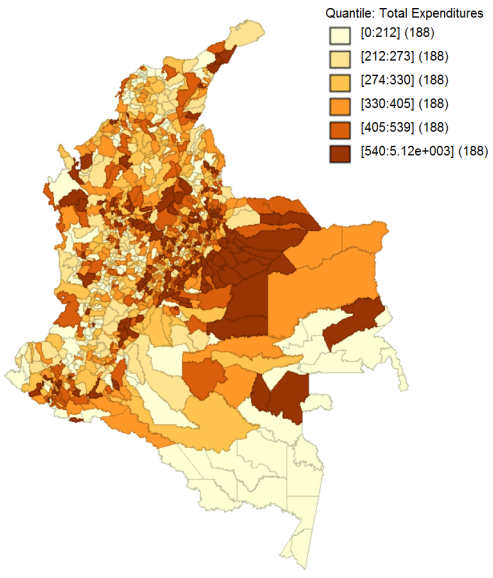


Figure 2: Total expenditures per capita by quantiles, 2005

5 Empirical strategy

5.1 Model of spatial expenditure interaction

To estimate the effect of neighboring municipalities' spending on the spending of the focal municipality, we consider the following model:

$$Y_{i,d,t} = \delta WY + \eta\ oil_i \times p_t^{oil} + WX\theta + X_{i,t}\beta + \alpha_i + \tau_{d,t} + \varepsilon_{i,d,t} \tag{2}$$

where $Y_{i,d,t}$ is the natural log of local public spending per capita (total spending or one of the spending categories) in municipality i of department d in year t. WY denotes the spending in neighboring municipalities (total or in the respective category), where W is a spatial weighting matrix. The coefficient of interest is the spatial autocorrelation coefficient δ, which measures potential spatial interaction effects. The dummy oil_i equals 1 if oil was exploited within a municipality between 1990 and 1999. p_t^{oil} is the natural log of the world market price of oil converted to real COP. The interaction of the previous two variables accounts for differential effects of oil price changes on oil endowed and non-endowed municipalities primarily due to the receipt of royalties. The vector $X_{i,t}$ collects additional time-variant covariates: Total spending of a municipality on all categories other than the focal category Y, population of the municipality and its square, the local share of the rural population, and transfers from higher levels of government. We also include the spatial lags WX of all X variables (Spatial Durbin Model). This accounts for the possibility that changes in neighboring municipalities such as population growth directly influence a focal municipality's spending. Municipality fixed-effects α_i capture time-invariant unobserved factors such as the distance to the capital, geographical size and climatic conditions. Department-year fixed effects $\tau_{d,t}$ control time variation that affects all municipalities within a department in the same way such as regional economic shocks and changes in department-level regulations.

5.2 Oil price shocks as exogenous variation in local spending

In Equation (2), WY is endogenous due to the simultaneous influence of neighboring municipalities on one another. Furthermore, unobserved factors that change over time with variation within departments are contained both in WY and the error term $\varepsilon_{i,d,t}$. To account for this endogeneity, our empirical strategy employs an instrumental variable approach that isolates exogenous variation in municipal spending.

Similar to Acemoglu *et al.* (2013a), we exploit oil price shocks that affect the finances of some but not all municipalities. We do so by combining information on oil endowments of municipalities with variation in oil prices on the world market over time to extract quasi-experimental variation in spending changes of neighboring municipalities.

In the 2SLS estimation, the first stage is given by

$$WY = \gamma\ oil_i \times p_t^{oil} + Woil \times p_t^{oil}\lambda + WX\theta + X_{i,t}\rho + \alpha_i + \tau_{d,t} + \vartheta_{i,d,t} \tag{3}$$

where neighboring oil endowment (before the observation period) interacted with current international oil prices in real COP ($Woil \times p_t^{oil}$) is used as the instrument for neighboring spending.

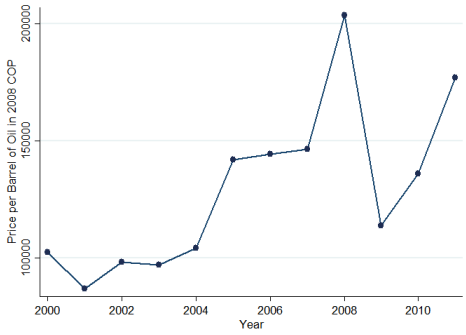


Figure 3: Oil price in 2008 real COP (OPEC basket)

The validity of the instrument relies on two requirements. First, the combination of oil endowment and oil prices must be correlated with local spending (instrument relevance). Oil prices are linked to local spending as Colombian municipalities receive royalties from oil extracted on their soil, which relaxes their budget constraint. The federal law mandates the royalty payments to depend on extracted quantities as well as current world market prices (see Section 3). We therefore expect the instrument to be relevant for total local public expenditures as well as its components. To obtain a strong instrument, the movements of the global oil price must provide sufficient variation to substantially influence spending of oil-endowed municipalities. Depicting the evolution over time, Figure 3 illustrates that oil prices were very volatile over the sample period and thus introduce plenty of variation.

Concerning single expenditure categories, municipalities are supposed to spend 75% of the royalties for the earmarked categories health, education and water as long as coverage goals have not been achieved, as explained in Section 3. Therefore, we expect the instrument to be strong for the earmarked categories. As explained in section 1, royalties can potentially also be used for expenditures in non-earmarked categories, so we test the strength of the instruments for these categories as well. Statistical tests of the strength of the instrument are satisfactory for total expenditures and the earmarked categories, but not for most non-earmarked categories; we discuss this in more detail in Section 6.

The second requirement for a valid instrument is that conditional on the covariates included, the IV must not correlate with the error term in the second stage (exogeneity assumption). As we control for municipality fixed effects, time-invariant differences between oil-endowed municipalities and other municipalities are accounted for. The spatial distribution of oil reserves is not under the control of local governments. Potentially endogenous efforts in oil discovery do not affect our identification because we use oil extraction indicators from 1990 to 1999, the decade preceding our period of analysis. Moreover, municipalities cannot manipulate the extracted quantities as private companies negotiate drilling contracts with the central government. The federal law regulates the royalties paid to the municipalities. Regarding the oil price on the world market, municipalities in Colombia are price takers. Although crude oil is the country's most important export good, Colombia does not rank among the major exporting nations and is not part of OPEC.

The spatial lag of a municipality's total expenditures (excluding the focal category Y) is a potentially important control variable, because oil royalties received by neighboring municipalities are likely to influence their spending not only in the focal category, but

also in other categories. If these other spatially lagged expenditures were omitted from the regression, our instrument could potentially be correlated with the error term in the second stage equation. In Section 6.3, we explore the sensitivity of our results when we treat total expenditures and its spatial lag as endogenous and when we include spending in all categories and their spatial lags separately in the regression.

In Table 2, we assess the structural similarity of oil-endowed and non-endowed municipalities using an additional source of data, the Colombian census conducted in 2005. The comparison shows that the two groups of municipalities are observationally equivalent concerning demographic and socio-economic characteristics. The good balance indicates that both municipality types are very similar except for their oil endowments, which supports our identification strategy. Figure 4 depicts the two groups of municipalities within a map of Colombia. This map reveals that oil extracting municipalities are somewhat clustered, but sufficiently scattered over the country to obtain a broad coverage of our instrument.

Table 2: Treatment - Control Balance in Observables

	Mean		t-test
Variable	Endowed	Non-endowed	p >t
Poverty rate	0.69	0.69	0.92
Informal employment share	0.95	0.95	0.51
Economic dependence share	0.54	0.54	0.81
Illiteracy share	0.28	0.29	0.46
Child labor share	0.06	0.06	0.59
Children w/o access to education, share	0.14	0.13	0.54
Children w/o access to care services share	0.21	0.20	0.56
Household share w/o health insurance	0.28	0.30	0.35
Household share w/o access to health	0.09	0.09	0.42
Household share w/o access to clean water	0.36	0.37	0.66
Household share w/o a sewage system	0.31	0.34	0.21
Household share w/o floors	0.19	0.21	0.27
Household share w/o walls	0.07	0.07	0.63

Notes.– All rates and shares refer to the households within a municipality. A municipality is defined as endowed if oil was extracted on its soil at any time between 1990 and 1999. Means are unweighted averages across municipality groups. The table shows p-values for t-tests of equal means between the two groups. Variables based on the Colombian 2005 census (cross-section).

Our estimation approach differs from the traditional spatial IV estimator. The latter uses all spatially lagged covariates WX to instrument the neighboring endogenous variable WY, in our case spending (see Anselin, 2008, for an overview). However, it is questionable whether all WX can be excluded from the second stage equation (Gibbons and Overman, 2012; Revelli, 2015). For example, population changes in neighboring municipalities may well have a direct effect on spending decisions of the focal municipality or be correlated with spatially clustered time-varying unobserved factors, which would invalidate the traditional instruments. Therefore, we safely control for all WX in the second stage equation. The only excluded instrument is the interaction term of oil endowment of neighboring municipalities before the observation period with the international oil price. As we control for the interaction of the oil endowment of the focal municipality with the oil price as well as municipality and department-time fixed effects in the second stage,

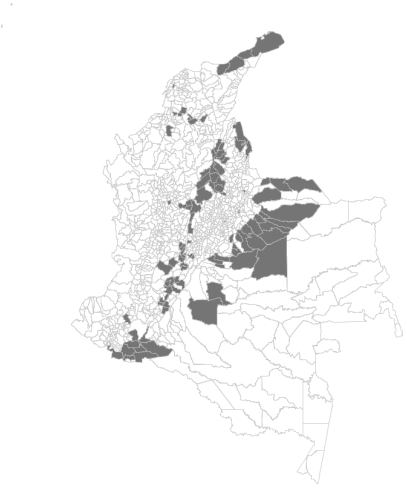


Figure 4: Geographical distribution of municipalities producing oil between 1990 and 1999 (in dark)

the argument of exogeneity of this selected instrument is very strong. In Section 6.2, we compare the results from our preferred IV estimator with the results from the arguably inconsistent traditional IV estimator.

To construct the spatial weighting matrix, we use the 5-nearest neighbor (NN) criteria as our main approach because the average municipality has five neighbors. As robustness checks, we compare the results to estimations using 4-NN and 6-NN matrices and an economic proximity matrix based on municipalities' average per capita income. As a safeguard against potential serial correlation, we report standard errors clustered at the municipal level throughout the paper.

We contrast our IV results with the traditional spatial econometric estimators that use the Quasi Maximum-Likelihood method to estimate fiscal spillovers (Anselin, 2010). We follow the model selection procedure suggested by Elhorst (2010). Starting from OLS and going through the Spatial Lag (SAR), Spatial Error (SEM) and Spatial Durbin Model (SDM), we test hypotheses whether and what kind of spatial terms should be included. The tests indicate that the SDM is the preferred model and thus confirm our initial model choice.[8] Thus, we estimate Equation (2) by QML, but without the oil-related variables.[9] For the QML-estimation to be consistent, knowledge of the true data generating process including the spatial weights must be assumed, as criticized by Gibbons and Overman (2012). Therefore, we prefer our IV estimator and present results from the potentially inconsistent QML estimator for comparison only.

[8]Detailed results are available from the authors on request.

[9]Moreover, for computational reasons, the year fixed effects are not department-specific in the QML estimations. This does not drive our results, however, because the IV estimates remain similar if we use country-level instead of department-level year fixed effects, see Section 6.3. In order to make our IV and QML estimations comparable, in our tables we want to report estimations based on the same sample. Therefore, we do not apply the bias corrected QML estimator suggested by Lee and Yu (2010) because this would imply losing one year of observations. However, we obtain similar results when implementing the bias correction. The small impact of the bias correction can be explained by our relatively large sample size.

6 Empirical results

6.1 Results based on the quasi-experimental instrument

Table 3 reports the main (second stage) results from estimations of Equation (2) using our preferred IV estimator. In this table we present estimates for total local public expenditures, the three categories earmarked for spending royalty income, all non-earmarked categories combined, as well as the specific non-earmarked category sport & recreation. The first row contains the estimated parameter of interest δ, which captures spatial public spending interaction. The results indicate that there are no significant spatial interactions in total expenditures, the earmarked categories, and the non-earmarked categories combined. The point estimate of spatial interactions for total local public spending is particularly close to zero (-0.081). The exception is the category of local public spending for sport & recreation, where local governments respond significantly to spending decisions of neighboring municipalities; we discuss this result further below.

Table 3: Main Estimation Results of Expenditure Interactions

	Total	Health	Education	Water	Non-earmarked	Sport & rec.
W_y	-0.081	-0.140	0.282	0.358	0.492	1.257**
	(0.499)	(0.540)	(0.238)	(0.413)	(0.663)	(0.576)
Oil extraction x oil price	0.302***	0.405***	0.921***	0.505***	-0.277**	-0.185
	(0.080)	(0.117)	(0.135)	(0.157)	(0.115)	(0.129)
Total excl. y		0.260***	0.418***	0.587***	0.108***	0.555***
		(0.035)	(0.034)	(0.034)	(0.031)	(0.030)
W_total excl. y		0.087	-0.059	-0.147	-0.047	-0.702**
		(0.129)	(0.114)	(0.261)	(0.076)	(0.303)
Population	6.175***	4.625	16.350***	-7.207**	0.808	0.003
	(2.359)	(3.373)	(4.668)	(3.001)	(3.168)	(3.823)
Population squared	-2.996***	-2.120	-7.159***	3.191**	-0.768	-0.287
	(1.088)	(1.564)	(2.161)	(1.402)	(1.482)	(1.781)
Share of rural population	-0.596***	-0.377**	-1.147***	0.027	-0.182	0.139
	(0.144)	(0.166)	(0.244)	(0.164)	(0.176)	(0.165)
Transfers	0.029***	0.012***	0.020***	0.017***	0.027***	0.012***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
W_population	0.444	-2.140	-10.329	1.750	0.166	-4.647
	(5.820)	(6.037)	(8.862)	(6.878)	(6.885)	(8.744)
W_population squared	0.136	1.119	5.378	-0.628	0.294	2.520
	(2.678)	(2.806)	(4.028)	(3.189)	(3.336)	(4.173)
W_share of rural population	-0.508	-0.082	-0.637	0.177	0.003	0.086
	(0.430)	(0.428)	(0.516)	(0.408)	(0.357)	(0.334)
W_transfers	0.008	-0.006	-0.009	-0.016	-0.004	-0.014*
	(0.018)	(0.010)	(0.009)	(0.011)	(0.026)	(0.009)
Observations	12,023	12,023	12,023	12,023	12,023	12,023
Number of municipalitites	1,093	1,093	1,093	1,093	1,093	1,093
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Department - year FE	Yes	Yes	Yes	Yes	Yes	Yes
AP F-statistic excl. inst.	16.26	22.25	83.01	24.09	9.035	13.99

Notes: Second stage IV estimation results of spatial expenditure interactions. The columns show results for different local public expenditure variables Y. Excluded IV for WY: Endowment of neighboring municipalities with oil in the 1990s interacted with the current world market price for oil. 5-NN spatial weighting matrix. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. The Angrist-Pischke (AP) first-stage F-statistic of the excluded instrument is also reported. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

The control variables confirm expectations. Higher total expenditure as a measure

of a municipality's budget (excluding the focal spending category to avoid endogeneity) increases spending in the focal category as well. Similarly, higher transfers from higher levels of government increase total spending and spending in all categories. When the population in a municipality grows, total public expenditures increase, but at decreasing marginal rates, which is likely due to economies of scale. A larger share of rural population decreases local public spending.

The F-statistic of excluded instruments is sufficiently large in all columns of this table except for the non-earmarked composite. Table 4 presents the corresponding first stage results in more detail. As expected, the interaction of oil extraction of neighboring municipalities with the oil price is positive and highly significant when total spending or the earmarked spending categories of the neighboring municipalities are the dependent variables in the first stage. This indicates that municipalities spend more on the earmarked categories and also spend more in total when they receive more royalties from the extraction of oil. Thus, they largely seem to follow the federal laws regulating the spending of royalty income. In contrast, neighboring municipalities spend less on the non-earmarked categories when they receive more oil royalties. A potential explanation is that the increased expenditures in earmarked categories triggered by higher royalty income directs attention of local politicians and thus spending away from non-earmarked categories.[10]

Table A.2 in Appendix A shows the second-stage results for all single non-earmarked categories, where each row represents a separate estimation for the indicated category. We only present the most relevant coefficients and statistics in the columns. For most of these non-earmarked categories, the F-statistic indicates that the instrument is weak, except for the categories sport & recreation and municipal equipment. Thus, our identification strategy allows us to identify the presence of expenditure interactions for total expenditures and the earmarked categories as well as for the two non-earmarked categories mentioned. For municipal equipment, we do not find significant spatial spending interactions.[11]

For the category of sport & recreation, the size of the significant coefficient of spatial interaction can be interpreted as follows. When the five nearest neighboring municipalities increase their spending for sports & recreation by 1%, this causes the focal municipality to increase its spending in the same category by 1.25%. As there is no spatial interaction in total local spending, the interaction in this category reflects a change in the composition of the local budget. Given the importance of sports and recreational activities all over Colombia, at least three factors may explain the presence of expenditure interactions in this category. Firstly, because this category includes items such as playgrounds or sports fields and instructors, these expenditures are very visible to the local voters and could therefore be used by incumbent local politicians to secure votes in future municipal elections, as argued by Drazen and Eslava (2010). Because of its visibility and voters' awareness, spending in this category may be used primarily in yardstick competition. Secondly, positive interactions could also arise because of complementarities in expenditures in this category between neighboring municipalities. For example, neighboring municipalities might cooperate in certain sports events or programs or jointly build and use sports

[10]For the strength of the instrument, it is only important that it is strongly correlated with spending of neighboring municipalities; the sign of the relationship is irrelevant.

[11]There appears to be weak evidence of significant fiscal interactions also in the category of spending for justice and security, but this result must be interpreted with caution because of the weak instrument for this category.

Table 4: Main Specification: First Stage

	W_total	W_health	W_education	W_water	W_non-earmarked	W_sport & rec.
Oil extraction x oil price	-0.020	0.035	-0.034	0.026	-0.045	-0.095**
	(0.031)	(0.042)	(0.058)	(0.061)	(0.049)	(0.041)
W_Oil extraction x oil price	0.281***	0.361***	0.980***	0.582***	-0.291***	-0.322***
	(0.070)	(0.076)	(0.108)	(0.119)	(0.097)	(0.086)
Total excl. y		-0.004	0.011	-0.000	0.010**	-0.014*
		(0.007)	(0.008)	(0.010)	(0.005)	(0.008)
W_total excl. y		0.234***	0.462***	0.622***	0.109***	0.522***
		(0.019)	(0.021)	(0.023)	(0.015)	(0.019)
Population	-0.121	-0.221	-0.063	1.305	-0.918	0.632
	(1.279)	(1.507)	(1.650)	(1.513)	(1.908)	(1.467)
Population squared	0.127	0.155	0.226	-0.596	0.458	-0.270
	(0.600)	(0.702)	(0.770)	(0.710)	(0.901)	(0.687)
Share of rural population	-0.032	-0.066	-0.228***	-0.094	0.121	0.042
	(0.058)	(0.063)	(0.083)	(0.081)	(0.075)	(0.074)
Transfers	0.001	-0.001	-0.001	-0.000	0.003**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
W_population	8.399***	3.912	11.793***	-4.401	6.386*	7.630***
	(2.279)	(3.008)	(3.567)	(3.094)	(3.423)	(2.935)
W_population squared	-3.867***	-1.835	-4.501***	2.103	-3.287**	-3.797***
	(1.062)	(1.404)	(1.654)	(1.443)	(1.599)	(1.363)
W_share of rural population	-0.691***	-0.586***	-1.685***	-0.458***	0.070	0.178
	(0.121)	(0.135)	(0.181)	(0.147)	(0.149)	(0.140)
W_transfers	0.036***	0.012***	0.021***	0.020***	0.039***	0.008***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Observations	12,023	12,023	12,023	12,023	12,023	12,023
R-squared	0.069	0.042	0.212	0.126	0.049	0.113
Number of municipalities	1,093	1,093	1,093	1,093	1,093	1,093
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Department - year FE	Yes	Yes	Yes	Yes	Yes	Yes
AP F-value excl. inst.	16.26	22.25	83.01	24.09	9.04	13.99

Notes: First stage IV results; the second stage is reported in Table 3. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. The Angrist-Pischke (AP) first-stage F-statistic of the excluded instrument is also reported. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

stadiums. A third reason for the interaction could be competition between municipalities to attract a mobile tax base. For example, bigger and better recreational facilities might attract businesses to the municipality that value employee wellbeing. In this case, municipalities have an incentive to respond to expenditures of their neighbors in this category. Each of these explanations is consistent with the positive estimated interaction effect.

6.2 Classical spatial econometric approaches

For comparison with our preferred IV estimates, Table 5 presents the estimation results using the traditional QML estimator with municipality and year fixed effects. Based on this estimator that does not exploit quasi-experimental variation, the results suggest highly significant spatial autocorrelation between neighboring municipalities in total local public expenditures as well as all the earmarked categories and the combined non-earmarked categories (as well as sport & recreation).[12]

Table 5: QML Results of Expenditure Interactions

	Total	Health	Education	Water	Non-earmarked	Sport & rec.
W_y	0.182***	0.116***	0.148***	0.126***	0.147***	0.0685***
	(0.0147)	(0.0157)	(0.0158)	(0.0148)	(0.0148)	(0.0148)
Total excl. y		0.262***	0.433***	0.587***	0.116***	0.534***
		(0.0350)	(0.0343)	(0.0367)	(0.0304)	(0.0263)
W_total excl. y		-0.000665	0.0537	-0.00902	0.0198	-0.0635
		(0.0357)	(0.0390)	(0.0455)	(0.0199)	(0.0389)
Population	6.910***	4.293	19.30***	-5.039	1.138	1.479
	(2.453)	(3.619)	(4.936)	(3.502)	(3.164)	(3.237)
Population squared	-3.360***	-1.994	-8.497***	2.200	-0.959	-1.001
	(1.129)	(1.672)	(2.281)	(1.642)	(1.470)	(1.495)
Share of rural population	-0.501***	-0.313*	-0.986***	0.0308	-0.0938	0.261*
	(0.147)	(0.170)	(0.246)	(0.152)	(0.159)	(0.150)
Transfers	0.0283***	0.0135***	0.0177***	0.0165***	0.0271***	0.0101***
	(0.00259)	(0.00330)	(0.00330)	(0.00361)	(0.00359)	(0.00299)
W_population	-4.206	-9.690*	-8.972	7.029	1.196	4.388
	(4.083)	(5.759)	(7.909)	(6.884)	(5.558)	(6.673)
W_population squared	2.284	4.705*	4.887	-3.101	-0.462	-2.115
	(1.873)	(2.664)	(3.668)	(3.191)	(2.575)	(3.099)
W_share of rural population	-0.00124	0.138	-0.101	0.255	0.116	0.423
	(0.240)	(0.267)	(0.310)	(0.312)	(0.308)	(0.280)
W_transfers	-0.00285	-1.20e-05	-0.0156**	-0.0129**	0.00313	-0.00649
	(0.00441)	(0.00718)	(0.00634)	(0.00650)	(0.00672)	(0.00545)
Observations	12,023	12,023	12,023	12,023	12,023	12,023
Number of municipalitites	1,093	1,093	1,093	1,093	1,093	1,093
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: QML estimation results of spatial expenditure interactions. The columns show results for different local public expenditure variables Y. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

From these estimates alone, one would be tempted to conclude that significant spatial interaction is present in all these categories of local public expenditures. However, the results from using exogenous variation in the previous section show that this spatial autocorrelation does not indicate causal effects. This methodological comparison highlights

[12]This also holds when we use the SAR or SEM models or different weighting matrices.

the importance of relying on quasi-experimental variation in the causal analysis of fiscal interactions.

As another comparison, Table A.3 in Appendix A provides results from the traditional spatial IV estimator that uses spatial lags of all control variables as excluded instruments. As argued in Section 5.2, we expect this estimator to be inconsistent, like the QML estimator. The results suggest significant spatial interaction in local spending on education. However, our preferred IV estimator that uses quasi-experimental variation suggests that this correlation is spurious.[13]

6.3 Robustness checks

We assess the sensitivity of the results from our preferred IV estimator by employing alternative weighting matrices and specifications. Table 6 summarizes the first set of robustness checks for total local public expenditures (first two columns) and local spending for sport & recreation (two rightmost columns). In the first three table rows, we vary the number of neighbors included for constructing the k-nearest neighbor weighting matrix. In row four, we use an inverse distance weighting matrix where distance is defined in an economic way by the difference in income between municipalities.[14] The results show that fiscal interactions in total spending are always insignificant. The point estimate also indicates strong spatial interactions in sports & recreation in all specifications. Only when using the six-NN matrix, the coefficient looses statistical significance. This suggests that municipalities only interact with neighboring municipalities in this category as long as these peers are sufficiently close.

To present a specification fully comparable with our QML estimation, we also run a version of our main IV model where year fixed effects replace department-year fixed effects (again using our preferred 5-NN weighting matrix). The estimates show that this alternation leaves the main results unchanged.

Next, we assess whether the Colombian civil war that started in the 1960s influences fiscal interactions. The violence was particularly severe during the late 1990s and early 2000s. Civil conflicts in a certain region could induce spatially correlated public spending patterns. Therefore, we include civil war related casualties in the municipality and its spatial lag as additional covariates in our model. Following Dube and Vargas (2013), we retrieve the casualties variable from the Conflict Analysis Resource Center (CERAC) which provides the most comprehensive and independent source of civil war related data. However, the coefficients of these additional controls turn out to be insignificant, and the inclusion of the variables does not affect the estimates of the fiscal interaction coefficients. The inclusion of the variables does not alter the findings in the QML specifications either (results not tabulated). Thus, our results are robust to the inclusion of civil war related variables.[15]

[13] Furthermore, when using the traditional spatial IV estimator, the point estimate of the spatial interaction in total local public spending increases, but remains insignificant, and the spatial interaction in sport & recreation looses significance.

[14] Geographical distance is not suitable in the Colombian context because municipalities vary extremely in their area size, see Figure 2.

[15] As we cannot rule out potential endogeneity of civil conflict, we do not employ this covariate in our main specification but only as a robustness check within this section.

Table 6: Robustness Checks: Different Matrices and Specifications

Specification	W_total	AP F total	W_sport & rec.	AP F sport & rec.
4-nn weighting matrix	-0.010	13.09	1.188**	17.49
	(0.499)		(0.539)	
5-nn weighting matrix	-0.081	16.26	1.257**	13.99
	(0.499)		(0.576)	
6-nn weighting matrix	-0.132	22.87	0.859	23.30
	(0.496)		(0.533)	
Inv. income distance w. matrix	0.526	11.17	0.729*	7.976
	(0.403)		(0.408)	
Country-level year fixed effects	-0.294	18.68	1.188***	28.40
	(0.548)		(0.375)	
Controlling for conflict	-0.099	15.82	1.263**	13.32
	(0.510)		(0.594)	

Notes: Each row represents a different specification and shows the spatial autocorrelation coefficient for total local public spending and sport & recreation as dependent variables (separately estimated) and the corresponding Angrist-Pischke (AP) first-stage F-statistics of the excluded instrument. Excluded IV for WY: Endowment of neighboring municipalities with oil in the 1990s interacted with the current world market price for oil. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Another concern regarding our model could be potential endogeneity of the total expenditure covariate and its spatial lag. Although we exclude the category of interest Y from the total expenditure controls to avoid a mechanical correlation with the dependent variable, one may be concerned about simultaneity of choices. Therefore, for these two potentially endogenous covariates, we consider using their one-year time lags as excluded instruments. On this basis we conduct a Hausman test of endogeneity of the two covariates.[16] The test results indicate that the null hypothesis of exogeneity of total expenditure and its spatial lag cannot be rejected. Therefore, our more efficient baseline estimator that treats these controls as exogenous is preferred.

We also estimate more flexible specifications where we include each of the ten other public spending categories and their spatial lags separately in the model as control variables when a specific spending category is the dependent variable. Table A.4 in Appendix A reports the results; we do not report the coefficients of the spatial lags of the spending categories for brevity. The findings confirm that there are no significant spatial interactions for the earmarked categories, and they also replicate the size and significance of the interaction in spending for sport & recreation.[17] In summary, we conclude that the main results are robust to specification choices as long as identification relies on our quasi-experimental instrument.

[16]We run this test for the spending category of sport & recreation, where we found the significant spatial interaction effect.

[17]However, this specification does not seem to be suitable for the health category, where the standard error and the point estimate increase a lot. When we treat all expenditure categories and their spatial lags as endogenous and instrument them with their on-year time lags, the point estimate of the spatial interaction in health spending decreases to -0.08, so the large point estimate seems to be biased.

7 Conclusion

This paper investigates spatial interactions in local public expenditures in a developing country using a quasi-experimental identification strategy. We use panel data on the universe of the more than 1000 municipalities in Colombia over a period of eleven years to estimate spatial interaction effects in total local expenditures and the more than ten most important spending categories. For identification, we rely on exogenous variation in the exposure of individual municipalities to shocks in oil prices on the world market due to their local endowment with oil resources.

For total local public expenditures and most spending categories, the estimates of spatial interactions are small and not significantly different from zero. The notable exception is public expenditures for sports & recreation, where we detect significant and large causal spatial interactions. In contrast, when we use spatial econometric estimators that do not employ quasi-experimental variation, we find strong and significant spatial autocorrelation in almost all categories of public expenditures. Our comparison of methods shows that this spatial autocorrelation cannot be interpreted causally. Therefore, our results highlight the importance of using quasi-experimental variation for causal inference on fiscal interactions. This is in line with the results of Isen (2014) concerning spending competition and of Lyytikäinen (2012) regarding tax competition, although we do find evidence for significant causal expenditure interactions in the spending category of sport & recreation.

Our findings have important policy implications. When pursuing fiscal decentralization reform in developing countries, the results imply that policymakers do not need to fear a general race to the bottom concerning local public expenditures due to strategic interactions of local governments. Our findings lend support to decentralization reform in developing countries as they alleviate concerns about inefficiencies implied by fiscal externalities. On the other hand, one also cannot expect that innovative expenditure policies rolled out in a municipality, perhaps in the context of decentralized foreign aid, will spread out in a substantial way to neighboring municipalities through mimicking of local expenditure policy.

More research is needed to investigate whether these findings also hold in other countries, for other fiscal variables, and using different quasi-experimental setups. Further research should also address the significant causal spatial interactions in local public expenditures for sport and recreation and examine the mechanisms leading to this novel empirical result.

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A Appendix: Supplementary Tables

Table A.1: Variable Description

Variable	Description
Total	Total amount of money invested in the different categories of each municipality.
Health	Funds invested in health. Includes investment in new infrastructure, maintenance of existing infrastructure, promotion programs, as well as the salaries of the health centers' employees.
Education	Funds invested in education. Includes investment in new infrastructure, maintenance of existing infrastructure, promotion programs, as well as the salaries of teachers.
Water	Municipal investment in aqueducts, sewage systems, garbage collection, new sanitation infrastructure and maintenance of the existing one.
Housing	Accounts for subsidies to buy or improve houses for the poor and expenditures to improve housing conditions of the general population.
Sport and recreation	Funds used to promote sport and leisure activities including infrastructure, programs and instructors.
Agriculture	Payments made to improve the productivity of the agricultural sector like infrastructure, experimental farms and consultants.
Community development	Investment in programs to support public engagement and active citizenship.
Municipal equipment	Investment on municipal buildings, like public offices, market places, cemeteries, public places and slaughter houses.
Vulnerable groups	Investments used for programs directed towards vulnerable groups, including children, elderly, single mothers, displaced and disabled people.
Justice and security	Money used to pay the salaries of police officers and sheriffs, doctors, social workers, and psychologists working for the family service agency.
Disasters prevention	Investment used for disaster relief and prevention.

Source: Based on Acevedo and Bornacelly (2014).

Table A.2: Results for All Non-earmarked Categories

	W_y	Total excl. y	W_total excl. y	AP F-statistic excl. inst.
Housing	-2.091	0.498***	1.043	3.631
	(1.531)	(0.047)	(0.711)	
Agriculture	-2.690	0.371***	1.083	0.791
	(4.193)	(0.103)	(1.732)	
Com. development	1.757	0.144***	-0.324	2.824
	(1.650)	(0.030)	(0.305)	
Sport & rec.	1.257**	0.555***	-0.702**	13.99
	(0.576)	(0.030)	(0.303)	
Equipment	0.606	0.488***	-0.336	33.75
	(0.392)	(0.035)	(0.210)	
Vuln. groups	-2.600	0.353***	1.100	0.513
	(4.584)	(0.053)	(1.818)	
Justice	1.873*	0.309***	-0.496*	4.591
	(1.107)	(0.033)	(0.285)	
Dis. prevention	1.097	0.333***	-0.421	3.811
	(1.101)	(0.028)	(0.370)	

Notes: Each row represents a separate estimation for different non-earmarked spending categories. IV specification as in Table 3. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. The Angrist-Pischke (AP) first-stage F-statistic of the excluded instrument is also reported. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.3: Spatial Lags as Instruments

	Health	Education	Water	Non-earmarked	Sport & rec.
W_y	0.130	0.372***	0.091	0.169	-0.100
	(0.136)	(0.073)	(0.071)	(0.124)	(0.075)
Population	5.036	17.598***	-5.832**	0.828	0.902
	(3.258)	(4.442)	(2.899)	(2.988)	(3.120)
Population squared	-2.287	-7.621***	2.618*	-0.713	-0.684
	(1.508)	(2.035)	(1.356)	(1.384)	(1.445)
Share of rural population	-0.362**	-1.171***	-0.021	-0.173	0.192
	(0.166)	(0.243)	(0.155)	(0.159)	(0.145)
Transfers	0.012***	0.020***	0.017***	0.028***	0.010***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Total excl. y	0.265***	0.424***	0.592***	0.110***	0.531***
	(0.035)	(0.036)	(0.033)	(0.030)	(0.026)
Observations	12,023	12,023	12,023	12,023	12,023
Number of municipalies	1,093	1,093	1,093	1,093	1,093
Municipality FE	Yes	Yes	Yes	Yes	Yes
Department - year FE	Yes	Yes	Yes	Yes	Yes
AP F-statistic excl. inst.	46.46	198.4	189.2	42.95	168.3

Notes: In contrast to the main specification in Table 3, here, the spatial lags of all control variables are used as excluded instruments (traditional spatial IV estimator). Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. The Angrist-Pischke (AP) first-stage F-statistic of the excluded instrument is also reported. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.4: All Expenditure Categories as Separate Control Variables

	Total	Health	Education	Water	Non-earmarked	Sport & rec.
W_y	-0.081	2.114	0.304	0.282	0.550	1.391***
	(0.499)	(3.036)	(0.246)	(0.537)	(0.883)	(0.469)
Health			0.312***	0.318***		0.070***
			(0.019)	(0.020)		(0.014)
Education		0.326***		0.211***		0.089***
		(0.022)		(0.018)		(0.016)
Water		0.296***	0.181***			0.184***
		(0.029)	(0.015)			(0.014)
Sport & rec.		0.077***	0.079***	0.190***		
		(0.024)	(0.013)	(0.014)		
Housing		0.000	0.017***	0.032***		0.044***
		(0.012)	(0.005)	(0.006)		(0.007)
Agriculture		0.065***	0.071***	0.076***		0.109***
		(0.020)	(0.011)	(0.012)		(0.012)
Community development		-0.021*	0.018*	0.038***		0.031***
		(0.012)	(0.010)	(0.009)		(0.011)
Equipment		0.000	0.021***	0.035***		0.061***
		(0.010)	(0.006)	(0.006)		(0.007)
Vulnerable groups		0.007	0.008	0.075***		0.063***
		(0.017)	(0.008)	(0.009)		(0.010)
Justice		0.036	0.025**	0.074***		0.065***
		(0.039)	(0.010)	(0.010)		(0.012)
Disaster prevention		0.001	0.035***	0.031***		0.032***
		(0.012)	(0.008)	(0.008)		(0.010)
Observations	12,023	12,023	12,023	12,023	12,023	12,023
R-squared	0.045	-0.219	0.357	0.388	-0.041	-0.034
Number of municipalities	1,093	1,093	1,093	1,093	1,093	1,093
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Department - year FE	Yes	Yes	Yes	Yes	Yes	Yes
AP F-statistic excl. inst.	16.26	1.139	82.96	13.96	5.186	19.67

Notes: In contrast to the main specification in Table 3, here, for each expenditure category on the left hand side, all other spending categories and their respective spatial lags are included in the estimation as separate control variables. The respective spatial lags of the spending categories on the right hand side are also included in the estimations but are not displayed in the table for brevity. Expenditures and transfers are real per capita values in 2008 COP. All continuous variables in logs. The Angrist-Pischke (AP) first-stage F-statistic of the excluded instruments is also reported. Standard errors given in parentheses are clustered on the municipality level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

B Appendix: Data editing and imputation

From the total number of 1122 annual observations, we drop twenty units as they maintain a special territorial status different from municipalities, being situated in very remote and sparsely populated areas. We also delete four new municipalities established after 2007, two remote islands and three municipalities left without direct neighbors. This still leaves us with 1093 municipalities in our sample.

Missing values in expenditure variables account for less than 3% of the total municipality-year observations. In about 90% of the municipalities with missing values, we are still left with at least nine years of available observations. Therefore, we decide against listwise deletion of municipalities with missing values and opt for imputation. Specifically, we use linear intrapolation to fill the gaps.

We check the data for measurement error by comparing it with a similar data base from the Colombian National Planning Department (DNP). While the overall consistency is very favorable, the comparison leads us to consider some minor outlier corrections. We impute a linear intrapolation for all values that are larger than twenty times a municipality's median in that expenditure category. This leads to an intrapolation of another approximatively 3% of the observations and to an evident improvement of the data balance. Despite these needs for correction, the resulting dataset as described in Table 1 still has an exceptional quality given the developing country setting. One qualification remains: For the years 2006 and 2007, a total of 73 municipality-year pairs exhibit zero expenditures as the data collection for those years took place before some municipalities had carried out their investments.