

Bonet, Jaime; Guzman, Karelys; Urrego, Joaquin; Villa, Juan

**Conference Paper**

## Effects of the General System of Royalties on municipal fiscal performance in Colombia: a dose-response analysis

55th Congress of the European Regional Science Association: "World Renaissance: Changing roles for people and places", 25-28 August 2015, Lisbon, Portugal

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

*Suggested Citation:* Bonet, Jaime; Guzman, Karelys; Urrego, Joaquin; Villa, Juan (2015) : Effects of the General System of Royalties on municipal fiscal performance in Colombia: a dose-response analysis, 55th Congress of the European Regional Science Association: "World Renaissance: Changing roles for people and places", 25-28 August 2015, Lisbon, Portugal, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

<https://hdl.handle.net/10419/124617>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Effects of the General Royalties System on Municipal Fiscal Performance: A Dose-Response Analysis

By

Jaime Bonet – Banco de la República (Colombian Central Bank)  
Karelys Guzmán Finol– Banco de la República (Colombian Central Bank)  
Joaquín Urrego – World Bank  
Juan Miguel Villa – Inter-American Development Bank (IDB)

## Abstract

This paper evaluates the effects of the implementation of the General Royalties System on the fiscal performance in 2012, employing a dose-response analysis for a sample of 1,025 municipalities. It was found that in the 93% of municipalities, where the proportion of royalties in their total revenues are less or equal to 20%, the fiscal performance worsens when the dependency on royalties increases. On the other hand, if such proportion is higher than 20%, the fiscal performance improves but the local investment falls. Given that the reform allocated resources but did not guarantee their appropriation by the municipalities, these results can be explained by the low execution of royalties during 2012.

**Key Words:** Dose-Response Analysis, fiscal performance, Generalized Propensity Score, Sistema General de Regalías (SGR).

**JEL:** H21, H71, Q38

## 1. Introduction

There is an extensive literature on the impact of nonrenewable natural resources (NNR) in the fiscal performance of countries.<sup>1</sup> Overall, with few exceptions, the studies suggest an inverse relationship between these two variables. According to the IDB (2013), the presence of NNR can lead to the so called "resource curse", where the abundance of revenue that comes from this source adversely affects institutional capacity, governance, and economic growth.

Some authors have argued that NNR revenues tend to slow the development of other tax sources in economies with a relatively high dotation of these resources. The argument is that governments with a lower share of general taxes tend to be less transparent, accountable, and efficient. In addition, since revenues from NNR tend to be volatile, fiscal risks related to the management of these resources can arise.

Ossowski and Gonzales (2012) compared a group of countries between 1994 and 2010 from Latin America and the Caribbean with high dependence on NNR with others in the same region whose dependence was lower.<sup>2</sup> The authors found that simultaneously with the increase in international oil prices experienced since 2006, tax revenues from other sources in the first group of countries increased to a lesser extent than those of the second. According to their estimates, 1% of GDP increase on the NNR's revenue meant a reduction in general tax revenue of about 0.2% of GDP in countries with availability of NNR.

---

<sup>1</sup> Some of the studies are Barnett and Ossowski (2002), Tijerina-Guajardo and Pagán (2003), Bornhorst, Gupta and Thornton (2009), Ndikumana and Abderrahim (2010), El-Katiri, Fattouh and Segal (2011), Céspedes and Velasco (2014), Obeng-Odoom (2014).

<sup>2</sup> The first group includes Colombia, Bolivia, Ecuador, Mexico, Trinidad and Tobago, Venezuela, Chile and Peru; the second includes Argentina, Brazil, Costa Rica, El Salvador, Honduras, Paraguay and Uruguay.

There is not too much literature about the impact of the relative abundance of NNR on the fiscal performance of sub-national governments and conflicting results have been found. In the case of Brazil, Postali and Rocha (2009) show that municipalities with tax revenue from NNR have lower revenue on property tax. Since these rents were unexpected, the municipalities eased their budget constraint and failed to exploit the potential of existing local taxes. Evidence of fiscal laziness in Brazilian municipalities was given not only by the decrease in the tax efforts, but also in the inadequate allocation of these resources in investments with low social and economic productivity.

In the Peruvian case, Aguilar and Morales (2005) provide a characterization of inter-governmental transfers, which include the NNR tax revenue that the central government reassigns to the departmental governments. These transfers, contrary to what happened in Brazil, positively affect the revenue collected by municipal governments. Something similar happens in Kuwait (El-Katiri, Fattouh and Segal, 2011), where the provision of resources by the central government seems contribute to improving the tax effort of local governments.

In Colombia there is an extensive literature analyzing the ineffectiveness of the royalties on the economic and social development of the territories. Perry and Olivera (2009) argue that those departments receiving royalties show a very poor economic performance, problems of rent-seeking, corruption, and inefficiency in the allocation of the transferred resources. Similar results have been shown by Benavides et al. (2000), Gaviria et al. (2002), Hernández (2004), Sánchez et al. (2005a), Vilorio (2005), Sánchez et al. (2005b), Pearce (2005), Johannesburg (2005), Bonet (2007), Medellín et al (2011), Sánchez and Pachón (2013), and Bonet and Urrego (2014).

Despite all the analysis of the economic and social performance of territories with relative abundance of NNR, there is not much literature focused on assessing the impact on fiscal performance. In particular, if there is any evidence that the presence of these resources results on fiscal laziness in those territories.

Before the Law 1530 of 2012, royalties were distributed to those territories where NNR were extracted and to the maritime or river ports used to transport these resources. With the creation of the General Royalties System (SGR by its Spanish acronym), these resources began to be distributed between all municipalities and departments through various funds and according to the socioeconomic conditions of each territory. This is an excellent opportunity to assess the impact of the new system on the fiscal behavior of local authorities.

As a result of the increased mining and energy production<sup>3</sup>, royalties increased from 0.6% of GDP in 2002 to 1.66% in 2012. These resources are an important source of funding for projects in sub-national governments. For municipalities, these funds are twice the amount collected by two of the most important municipal taxes, property tax and industry and commerce tax.

The aim of this study is to determine the effect of the new SGR on the fiscal performance of municipalities using a dose-response analysis technique based on Hirano and Imbens (2004). Unlike conventional impact evaluations comparing treatment and control groups, the dose-response analysis compares municipalities with higher and lower allocation of royalties. The non-randomness of assignments is controlled by estimating the generalized propensity score. The results indicate

---

<sup>3</sup> Between 2002 and 2012, Colombia went from producing about 500,000 barrels to 950,000 barrels of oil per day, while coal production increased from about 40 million tons to around 90 million tons per year.

that a level of 20% allocation of royalties in the total revenue of the municipalities represents an important threshold performance of these localities.

The document consists of six sections. Section 2 provides a brief overview of the new scheme of royalties' distribution in Colombia. Sections 3 and 4 are, respectively, focused on presenting the estimation methodology and the data used in the calculations. Section 5 presents and discusses the main results. Finally, Section 6 contains the concluding remarks of the study.

## **2. The General Royalties System - SGR**

A general feature of the funds received through the SGR is that they can't be executed until the local authorities have formulated the project where they plan to invest the resources. The project has to improve the living conditions of the population and also must be coordinated with the local development plan. These projects are evaluated according to criteria such as feasibility, prioritization, and coordination with general macroeconomic objectives. The final approval of the projects is given by an organization composed of local and national authorities, which is called *Organismos Colegiados de Administración y Decisión - OCAD*.

The composition of the OCAD varies across the different funds created by the SGR. The objectives of the new system are framed in at least one of the following four pillars: i. Social and regional equity; ii. Saving; iii. Regional competitiveness; and iv. Good governance. The SGR is divided into the following nine categories:

1. Savings and Stabilization Fund (*Fondo de ahorro y estabilización - FAE*).
2. Territorial Pension Fund (*Fondo de ahorro pensional de las entidades territoriales - FONPET*).

3. Science, Technology and Innovation Fund (*Fondo de ciencia, tecnología e innovación* - FCTeI).
4. Regional Development Fund (*Fondo de desarrollo regional* - FDR).
5. Regional Compensation Fund (*Fondo de compensación regional* - FCR).
6. Direct Royalties.
7. Control of exploration and exploitation of NNR deposits and knowledge of oil and geological mapping.
8. System of monitor, control and evaluation.
9. SGR's operation.

For the control of the exploration and exploitation are allocated 2% of SGR; for monitoring, control and evaluation 0.7%; and for the operation 1.3%. In addition to these resources, there is an item that is not in the list above: 0.5% of SGR is allocated to investment projects in the municipalities bordering the Magdalena River. Figure 1 contains the hierarchy and general distribution of the SGR.

## **2.1 Savings and Stabilization Fund - FAE**

This fund sums up to 30% of the resources from the SGR and its main objective is to save some resources for those periods where production or prices decrease. The FAE was intended as a possible mechanism to reduce the variability from the NNR-related revenues through the years; because of their production characteristics and high dependence to external prices are quite unpredictable. By

reducing the volatility of the resources received, a better fiscal management can be accomplished, granting funds stability for a long-run period.

## **2.2 Territorial Pension Fund (FONPET)**

These resources are equivalent to 10% of the SGR and they are intended to cover pension liabilities. The FONPET is a fund that was created in 1999. The proper management of this fund seeks to reduce significantly the pension liabilities of local authorities with major financial obligations. The value allocated to each department and municipality depends on the certification of the Ministry of Finance on the existence of pension liabilities in the immediately preceding term.

## **2.3 Science, Technology and Innovation Fund (FCTeI)**

The FCTeI represents 10% of the SGR and its main objective is to promote science and technology. The departments participate in the distribution of these resources in the same proportion in which the sum of the resources of FCR and FDR is distributed. To this end, the science, technology and innovation OCAD is responsible for the approval of projects to be funded. That is, all projects related to this fund are approved by a committee representative of the national government.

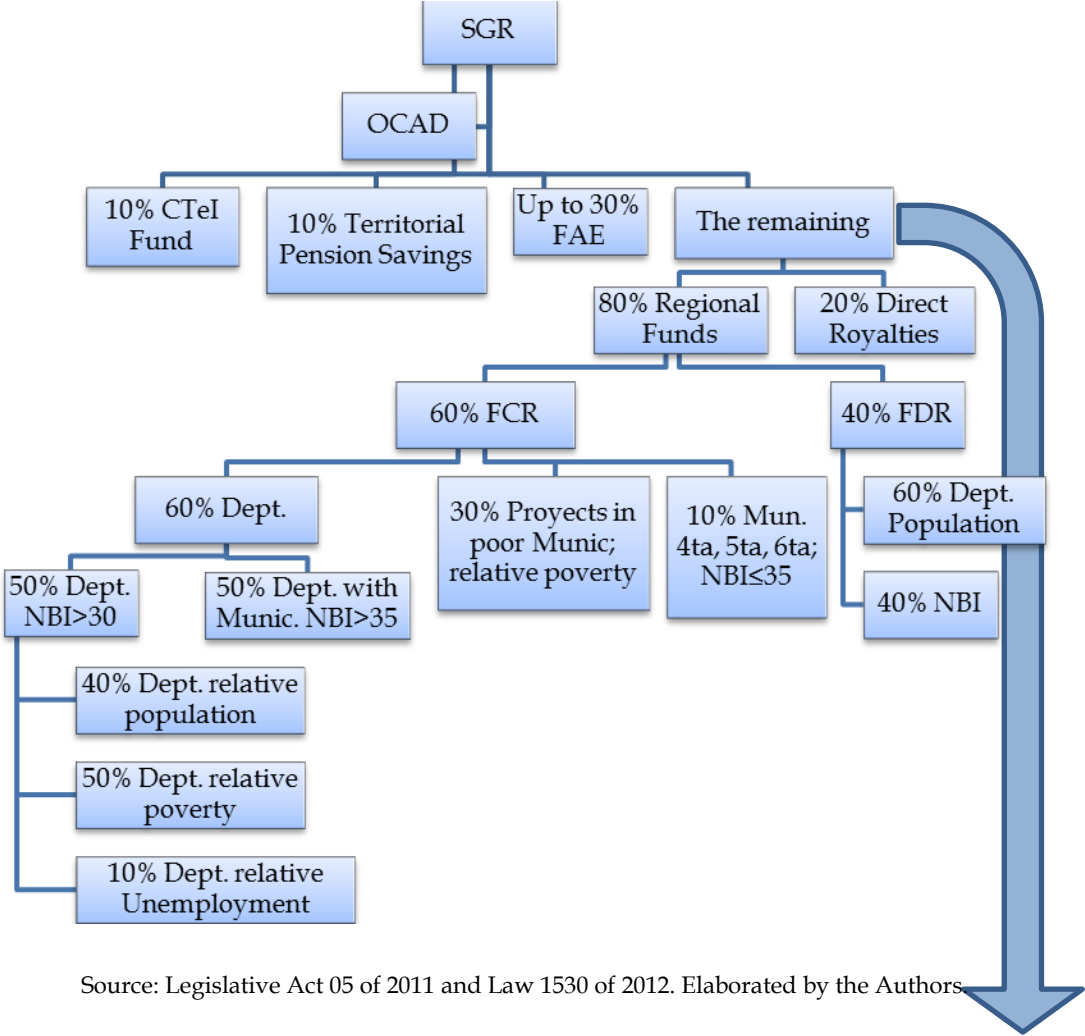
## **2.4 Regional Development Fund (FDR)**

The objective of this fund is to improve regional competitiveness. Its share in the SGR is not fixed as the other funds. To determine its participation, it must be known the amount of resources allocated to FAE (it can't exceed 30% of the SGR). After this percentage is determined, the participation of all the above mentioned funds is subtracted from the total amount of the SGR. The remaining resources,



which cannot be less than 50% of the initial SGR, are then distributed between the direct royalties (20%) and the regionals funds (80%).

**Figure 1: SGR Composition.**



Source: Legislative Act 05 of 2011 and Law 1530 of 2012. Elaborated by the Authors

- Transition mechanism:**
- 2012: 50% Regional Funds, 50% Directly
  - 2013: 65% Regional Funds, 35% Directly
  - 2014: 75% Regional Funds, 25% Directly
  - 2015: 80% Regional Funds, 20% Directly

However, given the abrupt change in the royalties' distribution mechanism, a transitional model shall operate until 2015; the shares for the direct royalties and the regional funds started at 50-50% in 2012, and will gradually change until they arrive in 2015 to the arranged shares of 20-80%, respectively.

There are two regional funds: regional compensation fund (FCR) and regional development fund (FDR). The former accounts for 60% of the disposable resources and the latter the rest. It is for this reason that the share of the FDR varies between fiscal periods. For 2012, it accounted for 12% of the SGR.

The distribution of these resources takes place only between departments and is based on two main criteria: 60% of the resources are distributed according to the proportion of the population of each department in the national population, and 40% by relative poverty, measured as the proportion of the department's NBI in the national total.

## **2.5 Regional Compensation Fund (FCR)**

According to the distribution model made in 2012, the FCR should represent about 18% of the SGR, which makes it the fund with the greater value to finance investment projects. The FCR is divided into 3 additional items. The first one corresponds to 60% of the fund and is distributed among all the departments that fulfill one of these two requirements: 1) The NBI index is above 30%; and 2) The Department contains one or more municipalities whose NBI index is above 35%. The distribution of these resources is made according to population, the proportion of local NBI in the national, and the department's unemployment. The second item corresponds to 30% of the fund and is given to the poorest municipalities (NBI > 35), in order to fund projects with local impact. The remaining 10% of the FCR is also used to finance projects with local impact in municipalities of fourth, fifth or sixth category with NBI index equal to or less than

35%. An additional condition is that these localities didn't receive resources from the 30% corresponding to the second item.

### **3. A Dose-Response analysis in the SGR context**

The dose-response analysis allows an unbiased way of comparing how an outcome variable (the "response") behaves in municipalities with differences in their royalties' allocation as a percentage of total revenues (the "dose"). Since the allocation of resources through the SGR does not imply immediate transfer, the assessment is based on the intention of the treatment. That is, the relevant matter is the assignment and not the execution of the SGR resources by municipalities. As pointed out by Angrist and Pischke (2008), an intervention may cause changes in the behavior of agents about to be treated even if the intervention is never executed. For example, a municipality with a certain allocation of royalties could manifest changes in its expectations of available resources and make modifications to their revenues or expenses, although no funds are executed.

According to Bonet and Urrego (2014), the percentage of resources allocated for 2012 and 2013 that had been transferred to the territories before the end of 2013, reached about 30% of FCTeI, 40% for FDR, and 28% for FCR. Although departments and municipalities had not received the totality of the resources yet, the approval of the law in early 2012 could change their revenue expectation. Municipalities might have expected to receive this additional amount of resources and therefore change their fiscal performance.

The evaluation of the SGR effect on municipalities with different levels of allocation could be biased by the potential endogeneity between the results (the response) and the treatment (the dose). In particular, royalties were assigned in 2012 by using a formula

(and not randomly), where a higher amount of resources was allocated to poorer and more populated municipalities, whose fiscal performance might therefore be worse.

In order to mitigate the existing bias, the method implemented by Hirano and Imbens (2004) and Imbens and Wooldridge (2009) is used. It consists in obtaining the dose-response analysis adjusted for the Generalized Propensity Score (GPS). Unlike the binary case where a propensity to treatment (or propensity score) is estimated, the GPS generalizes the treatment variable to a continuous variable or a “dose”, also obtained with observable characteristics. Therefore, the allocation of royalties becomes random with the GPS methodology. This procedure prevents municipalities with low fiscal performance to not show the negative effect of the SGR. It becomes possible to compare municipalities with different dose-response without the bias generated by the endogeneity problem.

Formally, there are random units (municipalities) denoted by  $i = 1, \dots, N$ , an outcome variable (e.g. tax revenues of municipalities), and  $Y_i(t)$  for the treatment  $t \in \tau$ . In both (binary case or continuous case), it is assumed that  $\tau$  lies in the range  $[t_0, t_1]$ . In this case,  $\tau$  is the share of royalties allocated in the total revenue in one municipality. The specific interest of the dose-response analysis is not the effect in each municipality, but the average effect. In particular  $\mu(t) = E[Y_i(t)]$  represents the dose-response function for the average of the municipalities, which could be biased by the endogeneity between  $Y_i$  and  $\tau$ , unless it is controlled by the GPS.

In order to simplify, Hirano and Imbens (2004) refer to the expression  $Y(T)$  that is feasibly computable. The intrinsic assumption behind the analysis is that  $Y$  and  $T$  are independent, given the observable characteristics of the municipalities before the reform (number of inhabitants and NBI, among others):

$$Y(t) \perp T \mid X \text{ for all } t \in \tau \tag{1}$$

The equation 1 indicates what is known as the Conditional Independence Assumption, which leads to set the GPS as:

$$r(t, x) = f_{T|X}(t|x) \quad (2)$$

Where  $r(t, x)$  corresponds to the conditional density of the treatment given the observable characteristics. Similar to the binary case, the balance properties, that are presented later on, meet the following condition:

$$X \perp 1\{T = t\} \mid r(t, X) \quad (3)$$

If the equation 3 holds, it means that the balance property is fulfilled by the GPS. The estimation of the GPS and the mean dose-response function are presented next. First, the following parametrical condition is obtained:

$$T_i|X_i \sim N(\beta_0 + \beta_1'X_i, \sigma^2) \quad (4)$$

The GPS is calculated such that:

$$\hat{R}_i = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} \exp\left(-\frac{1}{2\hat{\sigma}^2} (T_i - \hat{\beta}_0 - \hat{\beta}_1'X_i)^2\right) \quad (5)$$

The next step is to obtain the expected value of the result variable, controlling by the GPS. The functional form selected for this analysis is a cubic one, because it absorbs a generalization of lineal and quadratic forms:

$$E[Y_i|T_i, R_i] = \alpha_0 + \alpha_1 \cdot T_i + \alpha_2 \cdot T_i^2 + \alpha_3 \cdot T_i^3 + \alpha_4 \cdot R_i + \alpha_5 \cdot R_i^2 + \alpha_6 \cdot R_i^3 + \alpha_7 \cdot T_i \cdot R_i \quad (6)$$

Finally the dose-response function is obtained by averaging the equation (6) around several points of interest in the treatment, which, in this case, is the proportion of royalties over the total revenue of the municipalities:

$$E[\widehat{Y}(t)] = \frac{1}{N} \sum_{i=1}^N (\hat{\alpha}_0 + \hat{\alpha}_1 \cdot t + \hat{\alpha}_2 \cdot t^2 + \hat{\alpha}_3 \cdot t^3 + \hat{\alpha}_4 \cdot \hat{r}(t, X_i) + \hat{\alpha}_5 \cdot \hat{r}(t, X_i)^2 + \hat{\alpha}_6 \cdot \hat{r}(t, X_i)^3 + \hat{\alpha}_6 \cdot t \cdot \hat{r}(t, X_i)) \quad (7)$$

Graphic inference using equation 7 will be made in section 5 by constructing 95% confidence intervals using the bootstrap method.

#### 4. Data

In order to develop the dose-response analysis and to perform estimation of the previous equations, several sources of information were integrated for 1.045 municipalities in which the Regional Compensation Fund (FCR) allocated resources<sup>4</sup>. This means that the sample is made by territorial entities that receive royalties directly and may dispose of these resources so long as their investment projects are approved. Because of this, 57 municipalities were extracted from the sample.<sup>5</sup> Even though part of the resources from the Fonpet is also assigned to the municipalities, these have a specific destination which is to cover the pension liabilities. Therefore, these localities can't dispose of those resources to fulfill any other obligation. The resources from the other funds such as the FAE, FCTeI and FDR are distributed between the departmental governments, instead of the municipalities.

---

<sup>4</sup> As it was mentioned, 60% of the FCR is assigned to departments and 40% to municipalities.

<sup>5</sup> The most important cities can be found inside the group of excluded municipalities: Bogotá, Medellín, Cali, Barranquilla, Cartagena, Valledupar, Santa Marta and Bucaramanga. In fact, 43 of the excluded municipalities receive direct royalties.

In order to calculate the GPS, it is essential to control by observable characteristics of the municipalities, because those will be the ones that mitigate the endogeneity problem between the result and the treatment variables. Some of these were considered as a criterion for the allocation of resources of the FCR. As shown in Table 1, the first variables taken into account are associated with the municipality's size and its category in 2012, which is assigned by the National Planning Department (DNP by its Spanish acronym) considering the municipality's population and its revenues with free destination (Law 617 of 2000). The next variable considered was the NBI Index, because of its importance in the process of allocating the resources of the SGR. Third, the total transfer of royalties and the tax revenue of the previous 5 years to the reform were included, but also the amount of royalties assigned to the departments through the various funds that could affect the municipal assignment for 2012. In this way, the estimation takes into account the previous fiscal performance of the municipalities up to five years before the reform was implemented.

It is possible that the political characteristics of a municipality have an impact in their effective allocation of royalties inside their department. For example, if a local government has a better relationship with the departmental government (for instance, both belong to the same political party), it would be expected that the projects presented by the department to obtain resources from the FDR would favor the better related municipalities. Hence, the estimation is controlled by the votes obtained by the Mayor in the 2011 election and his political party.

**Table 1: Variables used in the GPS estimation**

<i>Pre-reform Variables</i>	Mean	Standard Deviation	Minimum	Maximum
Total Population (hundreds of thousands)	0.25	2.13	0.01	68.40
Urban Population (hundreds of thousands)	0.16	2.12	0.00	68.25
<i>Municipal Category</i>				
First	0.00	0.03	0	1
Second	0.00	0.03	0	1
Third	0.00	0.06	0	1
Fourth	0.02	0.16	0	1
Fifth	0.03	0.16	0	1
Sixth	0.94	0.25	0	1
Special	0.01	0.08	0	1
NBI Index	46.13	19.63	8.94	100
<i>Total SGR for the Departments</i>				
Regional Development Fund	32.63	17.63	0.00	69.40
Regional Compensation Fund - Department	30.06	14.29	0.00	57.78
Science and Technology Fund	35.35	12.94	6.78	58.93
Regional Savings	63.92	37.64	7.94	242.82
Regional Pension Fund	17.61	4.52	5.66	25.51
<i>Royalties previously received <sup>a</sup></i>				
Royalties 2007	991.15	4,344.45	0	50,803.04
Royalties 2008	1.40	6.18	0	60.08
Royalties 2009	1.40	6.51	0	76.01
Royalties 2010	1.50	6.07	0	96.11
Royalties 2011	2.09	7.87	0	111.97
<i>Previous tax Revenue <sup>a</sup></i>				
Tax Revenue 2007	4.32E-06	9.96E-05	0	3.22E-03
Tax Revenue 2008	4.77E-06	1.11E-04	0	3.60E-03
Tax Revenue 2009	5.63E-06	1.30E-04	0	4.20E-03
Tax Revenue 2010	5.77E-06	1.28E-04	0	4.15E-03
Tax Revenue 2011	6.54E-06	1.45E-04	0	4.65E-03
<i>Political conditions</i>				
Votes obtained by the Mayor (2011 elections)	4,133.42	22,692.76	1	84,181.00
<i>Mayor's political Party 2011</i>				
<i>AICO</i>				
ASI	0.05	0.22	0	1
Afrovides	0.02	0.13	0	1
Cambio Radical	0.14	0.34	0	1
Conservador	0.18	0.38	0	1
Firmas	0.06	0.24	0	1
Liberal	0.17	0.37	0	1
MIO	0.02	0.15	0	1
MIRA	0.00	0.03	0	1
PIN	0.03	0.18	0	1
Polo democrático alt.	0.01	0.08	0	1
Partido de la U	0.24	0.42	0	1
Verde	0.05	0.21	0	1
Coalition (several Parties)	0.04	0.19	0	1
<i>Observations</i>				1,025

Source: a: Variables at current prices in billions COP. Departamento Nacional de Planeación (DNP); Departamento Administrativo Nacional de Estadísticas (DANE); Registraduría. Estimated by the Authors.



As said, the treatment or dose will be defined by the proportion of royalties' allocation over the municipality's total revenue in 2012. As shown in Table 2, this proportion was on average around 0.11. Nonetheless, its maximum value is 0.91, which indicates that in some locations it represents an important source of resources. This will be a key variable in the GPS estimation.

**Table 2. Treatment and result variables used in the GPS and Dose-Response function estimations**

Variable	Mean	Standard Deviation	Minimum	Maximum
<i>Treatment Variable:</i>				
SGR Transferences / Total Income	0.111	0.077	0.008	0.916
<i>Result Variables:</i>				
<i>From the IDF:</i>				
Modified IDF	65.57	6.918	37.88	91.67
Self-financing of the Operative Expenses	-0.656	20.15	-64.20	253.6
Debt Service Back up	1.051	6.894	-61.53	89.07
Own Resources Generation	-0.902	11.56	-62.00	58.30
Investment Magnitude	0.518	14.61	-32.18	95.29
Saving Capacity	2.582	14.75	-44.53	73.83
<i>From the Budget Performances <sup>a</sup>:</i>				
Total Tax Revenue	2,150	4,577	21	68,212
Property Taxes	625.5	1,571	0	32,995
Industry and Commerce	644.5	2,041	0	37,480
Gas Surcharge	292.0	606.5	0	10,269
Cofinancing	577.4	1,470	0	21,249
Current Expenses	14,563	26,005	1,019	428,463
Investment Expenditure	12,662	23,866	628	398,389
Fiscal Balance	870.5	7,655	-66,325	202,501
Own Resources Indicator	16.27	13.06	0.260	87.07
<i>Observations</i>				1,025

Source: a: Variables at current prices in billions COP. Departamento Nacional de Planeación (DNP); Departamento Administrativo Nacional de Estadísticas (DANE). Estimated by the Authors.

As result variables, two groups of variables were taken into account as possible indicators of fiscal performance. The first group is related to the Fiscal Performance Index (IDF by its Spanish acronym) calculated for the year 2012 by DNP (DNP, 2013). This index summarizes six different indicators that measure the public financial management done by the territorial entities. One of them is precisely the proportion of transfers and royalties received over the total revenue. In order to avoid the endogeneity problem that would exist between the result and dose variables, the IDF was recalculated without this indicator, and the new measure will be called “modified IDF”.<sup>6</sup> Hence, a first result variable would be the modified IDF. The other set of variables that form this group are the rest of the indicators involved in the IDF estimation, which means that every one of its components is taken as a response.

The second group of result variables comes from the budget performances published by DNP and contains: (i) the total tax revenue; (ii) the property tax revenue; (iii) the industry and commerce tax revenue; (iv) the gas surcharge revenue; (v) the co-financing funds; (vi) the current expenses; (vii) the investment expenditure; (viii) deficit or surplus during each year; and (ix) an indicator on generation of their own resources, which is calculated as the ratio between current and total revenues.<sup>7</sup>

With the treatment (dose) and result (response) variables, the GPS and the dose-response can now be estimated. From the 1045 selected municipalities, over 20 were excluded because of their lack of information on the respective variables, which leaves a total of 1025 territorial entities.<sup>8</sup> The details and results of this exercise are presented next.

---

<sup>6</sup> To understand how the modified IDF was recalculated, see Appendix 1.

<sup>7</sup> The current revenues are the sum of the tax and non-tax revenues, while the total revenues are the sum of the current and the capital revenues. The last calculation excludes royalties.

<sup>8</sup> It is worth noting that San Andrés is one of the 20 municipalities excluded from the study.

## 5. Results

The estimation of the dose-response function is developed in several stages.<sup>9</sup> First the parametric condition (4) is estimated, taking as the dependent variable the proportion of SGR transferences on the municipality's total revenue, and as independent variables all the exposed in Table 1. This estimation is shown in the Appendix 2 for the 1.025 municipalities using a lineal regression analysis and with standard errors calculated using the bootstrap method. These results allow us to calculate the GPS (5) and to run the balance test (3), for which the idea proposed by Imai y Dyk (2004) has been followed. The results show that by controlling for the GPS, most of the observable characteristics appear in the regression as not significant, which corroborates this test (Appendix 3).

The estimation of the dose-response function (7) is presented in the Appendix 4. According to it, some of the result variables were not related to the share of revenue obtained through royalties in 2012. These were the co-financing funds, the industry and commerce tax revenue, the gas surcharge revenue, the current expenses and the investment spending. Due to the fact that the reform came out that same year, the local governments probably didn't have the time to modify their budgets significantly, at least in the previously mentioned variables. Nonetheless, all the estimations are controlled by a variable that indicates if the municipality receives royalties directly.

This section analyzes the graphs corresponding to the dose-response functions for those indicators where the treatment variable turned out significant, in other words, the estimations for 2012 where the proportion of royalties on the municipality's total revenue had any effect (Appendix 4). Among the variables obtained from the IDF are: the modified IDF, the self-financing of the current expenses, the generation of its own

---

<sup>9</sup> The Stata program command *doseresponse.ado* developed by Bia and Mattei, (2008) was used in order to estimate the dose-response function.

revenue, the magnitude of the investment spending, and the saving capacity. The variables taken from the municipal budget databases published by the DNP are the tax revenue, the property tax revenue, the financial balance (deficit or surplus), and the own-resources indicator calculated by the authors.

In the Graphs 2 and 3, it can be seen that the direction of the response, or the distribution of the municipalities, changes on the share of royalties in the municipality's total revenue. This inflection point, or critic value, stands on average in a 20% level, and allows us to identify two groups of municipalities: the ones on the left of this value and the ones on the right. This critic value can be 15% when the interest variable is the DNP's indicator of own resources generation, or up to 24% when it is the magnitude of investment spending (Table 3)<sup>10</sup>.

**Table 3. Share of royalties in the municipality's total revenue where the tendency of the response variable changes**

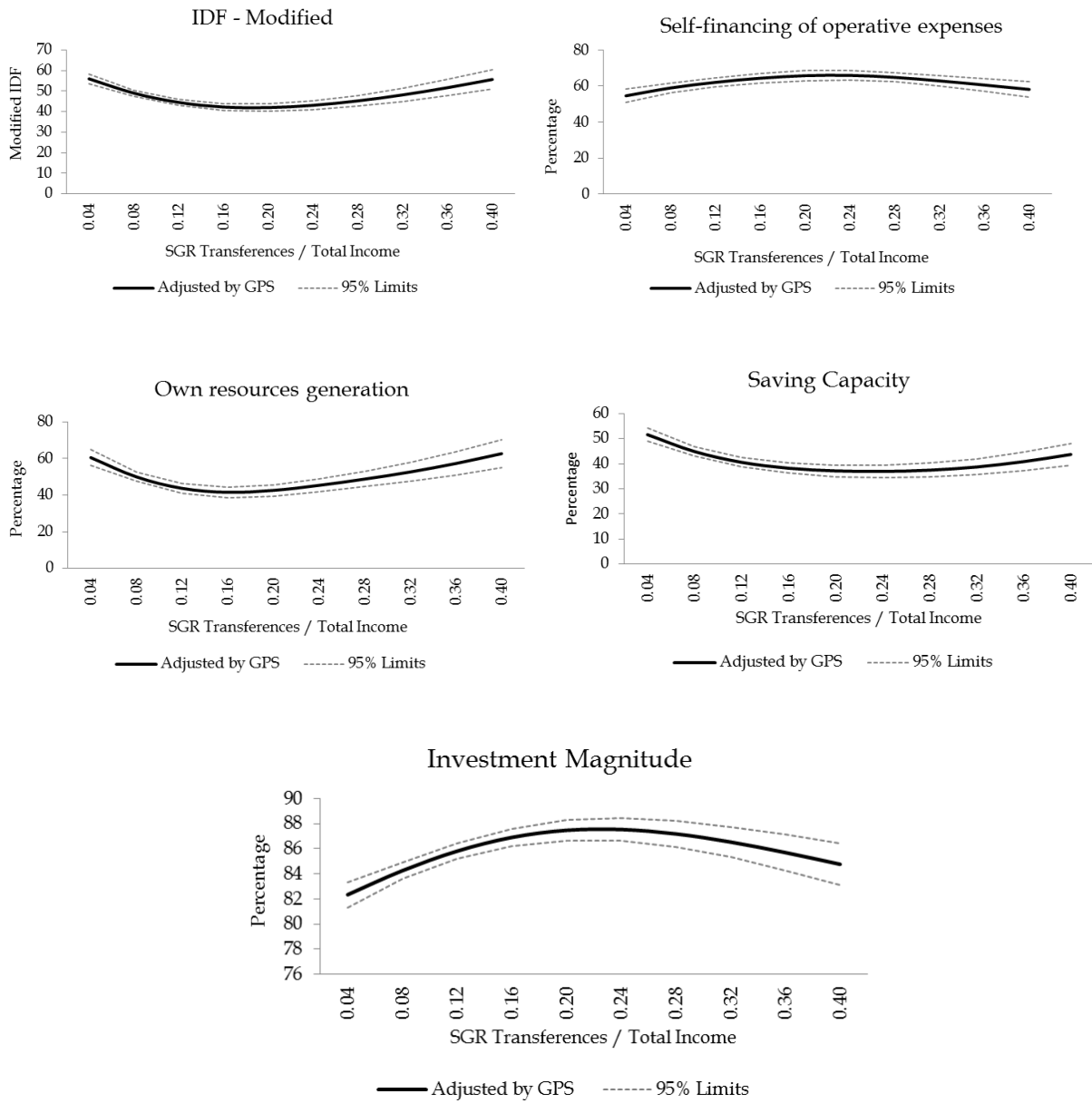
Response Variable	Critic Value
<i>From the IDF</i>	
Modified IDF	19%
Self-financing of the Operative Expenses	23%
Own Resources Generation DNP	15%
Investment Magnitude	24%
Saving Capacity	23%
<i>From the Budget Performances</i>	
Tax Revenue	18%
Property Tax	17%
Financial Balance	21%
Own Resource Generation (Authors)	19%

Source: Departamento Nacional de Planeación (DNP). Calculated by the Authors.

<sup>10</sup> The inflection point was calculated by locating the minimum value of the dose-response function using the estimated coefficients.

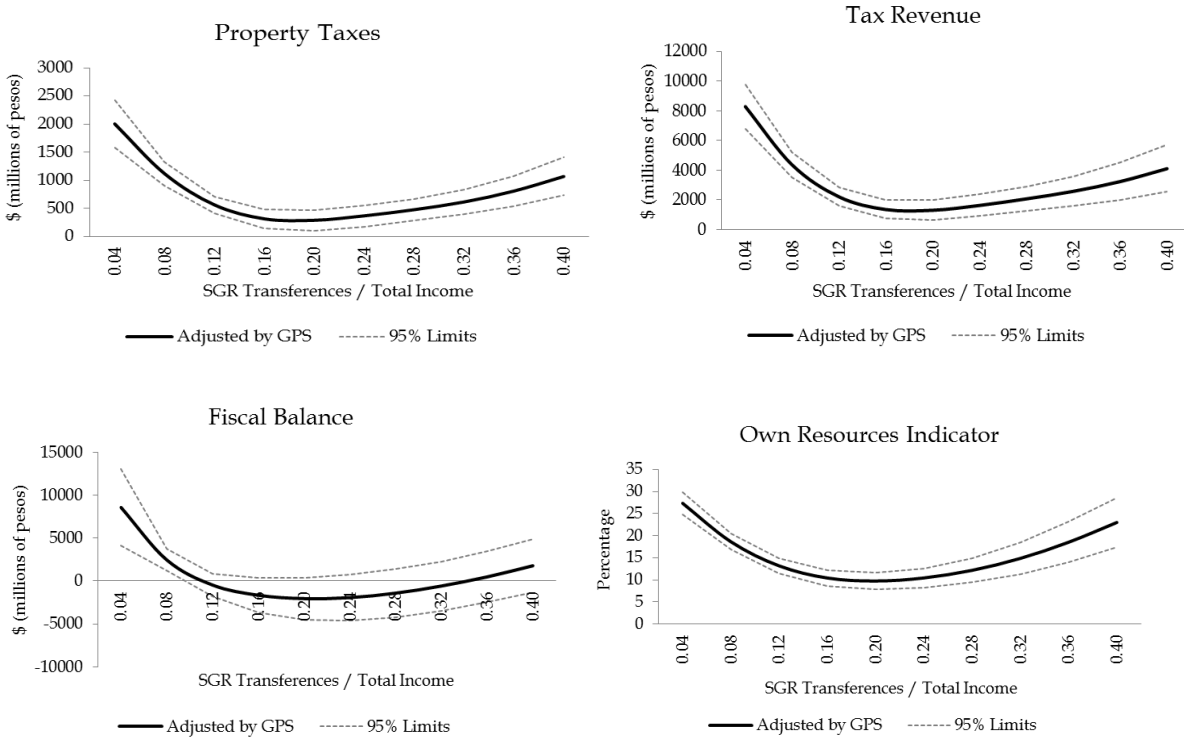
From the 1.025 municipalities in the sample, 956 (93%) have a share of royalties in their total revenue smaller than or equal to 20%, while in 69 territorial entities said participation is greater than 20%. From the first group, 47% receive royalties directly. This percentage is 93% for the second group. Likewise, the municipalities denominated in the sixth category represent 95% and 86% in each group, respectively. The Map 1 identifies each type of municipality in the national territory. Royalty's dependence lies between the 5% and the 10% in the 49% of the localities in the sample.

**Graph 2. Estimation of the Dose-Response functions using the variables obtained from the IDF.**



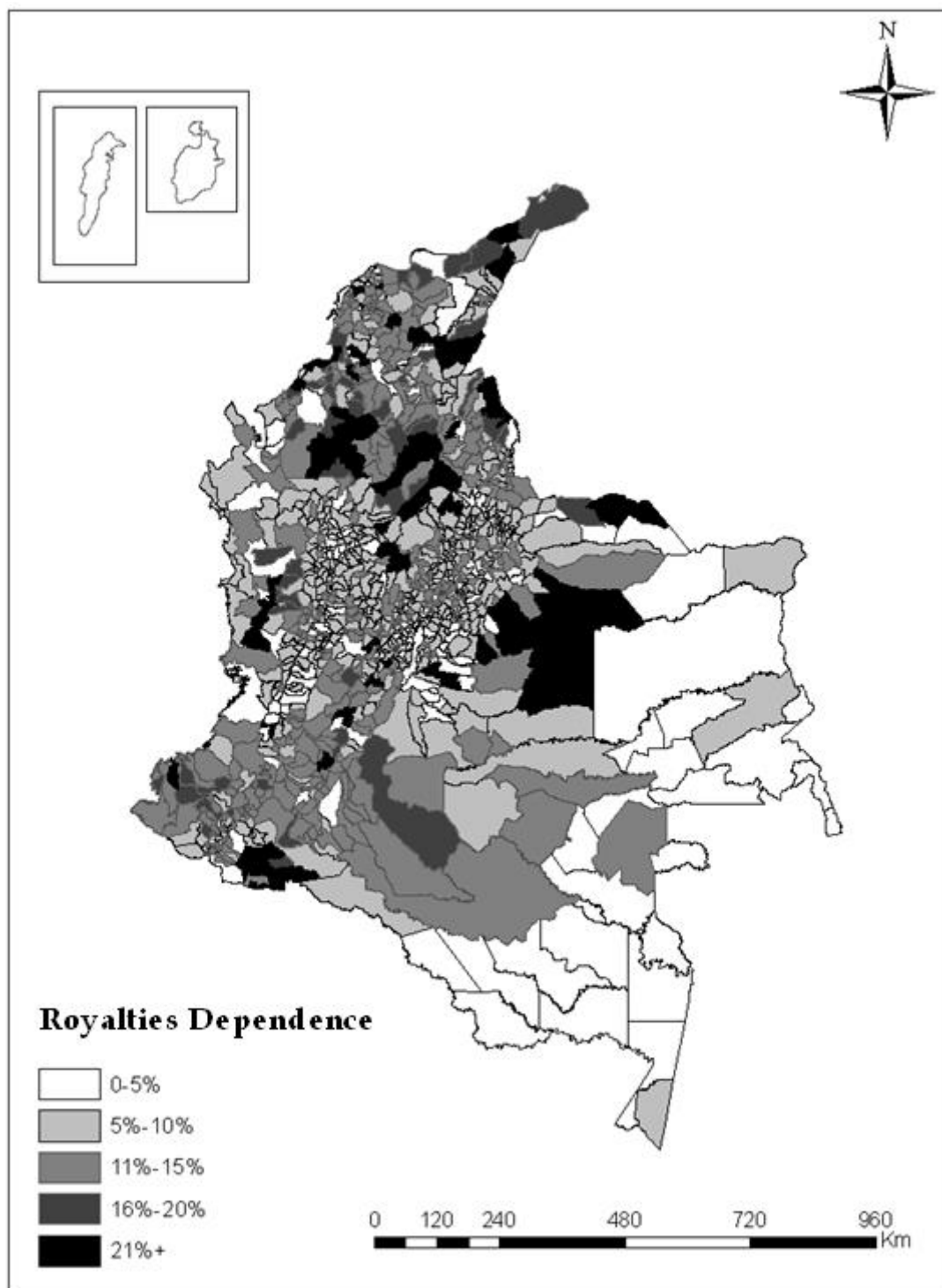
Source: Departamento Nacional de Planeación (DNP). Estimated by the authors.

**Graph 3. Estimation of the Dose-Response functions using the variables obtained from the Budget Performances**



Source: Departamento Nacional de Planeación (DNP). Estimated by the authors.

Map 1. Share of royalties in total revenue 2012



Source: Departamento de Planeación Nacional (DNP). Own elaboration.



If the critic value of the share of royalties in the total revenue is taken as 20%, different scenarios can be described inside each group of municipalities in the following way:

A. Municipalities with a share of royalties in their total revenue smaller than 20% in 2012 (93% of the sample).

It is evident that, as the municipality's dependence to royalties (dose) increases, the following results emerge, according to the group of response variables:

*Variables obtained from the IDF*

1. The share of resources with no specific destination spent in the central administration's operating expenses increases.
2. The amount of own resources decreases (the response is the same if any of the two indicators included is used as reference).
3. The share of the investment in the municipality's total expenses increases<sup>11</sup>.
4. The saving capacity of the municipalities decreases.

*Variables obtained from the Budget Performances*

5. The property tax revenue (and in general the tax revenue) decreases.

---

<sup>11</sup> To calculate this indicator, DNP takes investment not only as the Gross Fixed Capital Formation (GFCF), but also what is known as social investment, which includes payrolls from teachers and doctors, trainings, subsidies and finally scholar endowments, regardless of the source of financing (DNP, 2011).

6. The deficit on the municipalities' financial balance becomes larger: or the magnitude of the surplus decreases.

7. This is consistent with deteriorated fiscal performances by municipalities.

B. Municipalities with a share of royalties in their total revenue over 20% in 2012 (7% of the sample).

In this case, when the municipality's dependence to royalties increases, the effect seen in this group is the opposite. According to the response variables, an increase in the dose (a bigger share of royalties in their total revenue) results in:

*Variables obtained from the IDF*

1. The share of resources with no specific destination spent in the central administration's operating expenses decreases, which improves the indicator of self-financing.

2. The amount of own resources obtained by the municipality increases (regardless of the base indicator used).

3. The magnitude of the investment spending is reduced.

4. The saving capacity increased.

*Variables obtained from the Budget Performances*

5. Increase municipalities revenues from total taxes.

6. The municipalities' financial balance improves: the deficit's size is reduced with some localities even reaching surplus.

7. Because of all this, the municipalities reach better fiscal performances (as seen in the indicators).

**Table 4. Response of some indicators to a higher municipal dependence to the royalties**

Indicator	Dose	
	Dose less than 20%	Dose more than 20%
	Response	
<i>From the IDF</i>		
Fiscal performance (Modified IDF)	worsens	improves
Self-financing of the Operative Expenses	worsens	improves
Own Resources Generation	worsens	improves
Investment Magnitude	increases	decreases
Saving Capacity	decreases	increases
<i>From the Budget Performances</i>		
Tax Revenue	decreases	increases
Property Tax	decreases	increases
Financial Balance	worsens	improves

\* Both indicators (from the DNP and calculated by the Authors) produce the same response. Source: Departamento Nacional de Planeación (DNP). Elaborated by the Authors.

In conclusion, it can be said that, when the share of royalties in the entities' total revenue is over 20%, its fiscal performance improves as the fiscal dependence on royalties increases. The opposite is the case of the group of municipalities with a share of royalties in the entities' total revenue less than 20% (Table 4): an increase in the fiscal

dependence deteriorates its performance. This result is consistent when considering different types of fiscal performance indicators. An exception is the case of the indicator that captures the investment magnitude (the participation of the investment in the municipal expenses). It worsens when the share of royalties in the municipality's total revenue increases, in the case of a dose over the 20% threshold.

This could reflect the results found in studies outlined above, which highlight investment quality problems, rent-seeking, and lack of transparency in those areas with a high share of royalties on their total revenue. On the other hand, it could be related to the fact that the resources from the FCR had not been entirely sent to the municipalities when the 2013 term was over. This situation deserves attention because much of the motivation behind the reform to the royalties system was precisely to promote regional development through investment.

## **6. Conclusions**

The analysis about the impact of the new royalty system on fiscal performance of municipalities casts three key messages. First, a weakening on fiscal performance was observed in those municipalities that have, on average, up to 20% of share of royalties in total revenues (which represent 93% of the sample). These municipalities are mostly in territories that did not receive royalties during the previous regime, but under the new one they do.

Second, we find opposite results in those municipalities with a greater share than 20%, which corresponds mainly to the former beneficiaries of the previous regimen. However, fiscal management indicators do not reached to those observed in the municipalities where the royalties represent less than 20% of their total revenue.

A third notable result is the behavior observed on investment spending. The group of municipalities with a share of royalties in their total revenue less than or equal to 20% show that there is an increase in the participation of investment in total expenditures, while this ratio tends to be reduced when the municipalities have a share of royalties than greater 20%.

These findings have implications on the public policy for the new SGR. A first element arises from the heterogeneity observed across the municipalities. Different behaviors arise as royalties increase their participation in the municipal total revenue. These may be associated with the presence of institutional weaknesses in some municipalities, which is required to be considered when designing schemes that promote decentralized execution of resources. The SGR must incorporate institutional differences to establish different rules according to the administrative and fiscal capacity of each territory.

To sum up, there is evidence that increases in royalties may impair the fiscal performance of some municipalities. Because of this, a future reform of the SGR should include a mechanism that encourages an optimal fiscal performance in the municipal governments, i.e. through the distribution of a percentage of the resources to municipalities that exhibit the best fiscal management.

## References

- Aguilar, G., & Morales, R. (2005). Las transferencias intergubernamentales, el esfuerzo fiscal y el nivel de actividad. Instituto de Estudios Peruanos IEP (working paper), consultado el 16 de abril de 2014, en <http://lanic.utexas.edu/project/laoap/iep/ddt144.pdf>
- Angrist, J.D., Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Barnett, S., & Ossowski, R. (2002). Operational aspects of fiscal policy in oil-producing countries. International Monetary Fund (working paper), consultado el 16 de abril en <http://www.imf.org/external/pubs/ft/wp/2002/wp02177.pdf>
- Benavides, J.; Carrasquilla, J.; Zapata, G.; Velasco, A. (2000), "Impacto de las regalías en la inversión de las entidades territoriales", Bogotá, Fedesarrollo.
- Bia, M., Mattei, A. (2008). A Stata package for the estimation of the dose-response function through adjustment for the generalized propensity score. *Stata Journal* 8, 354-373.
- Bonet, J. (2007). "Regalías y finanzas públicas en el Departamento del Cesar". Documentos de trabajo sobre Economía Regional, 92, Banco de la República, Cartagena, Centro de Estudios Económicos Regionales.
- Bonet, J., Urrego J. (2014). El Sistema General de Regalías: ¿mejoró, empeoró o quedó igual?, "Documento de trabajo sobre Economía Regional", núm 198, consultado el 2 de febrero de 2014, en [http://www.banrep.gov.co/sites/default/files/publicaciones/archivos/dtser\\_198.pdf](http://www.banrep.gov.co/sites/default/files/publicaciones/archivos/dtser_198.pdf)
- Bornhorst, F., Gupta, S., & Thornton, J. (2009). Natural resource endowments and the domestic revenue effort. *European Journal of Political Economy* 25(4), 439-446, consultado el 16 de abril en <http://www.sciencedirect.com/science/article/pii/S0176268009000068>
- Céspedes, L. F., & Velasco, A. (2014). Was this time different?: Fiscal policy in commodity republics. *Journal of Development Economics*, 106, 92-106, consultado el 16 de abril de 2014, en <http://www.sciencedirect.com/science/article/pii/S0304387813001119>

- Contraloría General de la República (2013). *Ley 1530 de 2012 Sistema General de Regalías: Un año después* (en línea), Bogotá, [contraloriagen.gov.co](http://contraloriagen.gov.co), consultado el 13 de noviembre de 2013, en <  
[www.contraloria.gov.co/documents/155638087/176618096/informe+SGR+un+a%C3%B1os+despues+web.pdf/f01f95d6-510a-4ab5-a6e0-4cb51a56cb08](http://www.contraloria.gov.co/documents/155638087/176618096/informe+SGR+un+a%C3%B1os+despues+web.pdf/f01f95d6-510a-4ab5-a6e0-4cb51a56cb08)>.
- Departamento Nacional de Planeación (2013a). *Informe de monitoreo a los recursos del Sistema General de Regalías destinados al ahorro pensional de las entidades territoriales con corte al 30 de septiembre de 2013* (en línea), Bogotá, [sgr.gov.co](http://sgr.gov.co), consultado el 10 de enero de 2014, en <  
[www.sgr.gov.co/LinkClick.aspx?fileticket=cvghGue1S8A%3D&tabid=249](http://www.sgr.gov.co/LinkClick.aspx?fileticket=cvghGue1S8A%3D&tabid=249)>.
- DNP, (2013). *Desempeño Fiscal de los Departamentos y Municipios 2012*, Informe del Departamento Nacional de Planeación. Departamento Nacional de Planeación.
- DNP, (2011). *Desempeño Fiscal de los Departamentos y Municipios 2011*, Informe del Departamento Nacional de Planeación. Departamento Nacional de Planeación.
- El-Katiri, L., Fattouh, B., & Segal, P. (2011). *Anatomy of an oil-based welfare state: Rent distribution in Kuwait*. LSE Global Governance, consultado el 16 de abril en <http://www.lse.ac.uk/IDEAS/programmes/kuwait/documents/Fattouh.pdf>
- Gamarra, J. (2005), "La economía del Cesar después del algodón", *Revista del Banco de la República*, 934, 28 - 111, Bogotá.
- Gaviria, A.; Zapata, J.; González, A. (2002), "Petróleo y región: El caso del Casanare", *Cuadernos de Fedesarrollo*, 8, Bogotá, Fedesarrollo.
- Hernández, G. (2004), "Impacto de las regalías petroleras en el departamento del Meta", *Ensayo sobre Economía Regional*, Banco de la República, Villavicencio, Centro Regional de Estudios Económicos.
- Hirano, K., Imbens, G.W. (2004). *The Propensity Score with Continuous Treatments*, in: Gelman, A., Meng (Eds.), *Missing Data and Bayesian Methods in Practice: Contributions by Donald Rubin's Statistical Family*. Wiley, New York.
- Imai, K., Dyk, D.A.V. (2004). *Causal Inference with General Treatment Regimes: Generalizing the Propensity Score*. *Journal of the American Statistical Association* 99, pp. 854-866.
- Imbens, G.W., Wooldridge, J.M. (2009). *Recent Developments in the Econometrics of Program Evaluation*. *Journal of Economic Literature* 47, 5-86.

- Medellín, M.; Vesga, A.; Mejía, A.; Ríos, F. (2011). "Reforma a las regalías: ¿hacia una menor disparidad regional?. *Asobancaria, Semana Económica*, 28 de marzo.
- Ministerio de Hacienda y Crédito Público (2013). *Fondo de Ahorro y Estabilización del Sistema General de Regalías – FAE: informe de desempeño tercer trimestre de 2013*, (en línea), Bogotá, [minhacienda.gov.co](http://minhacienda.gov.co), consultado el 18 de noviembre de 2013, en [www.minhacienda.gov.co/portal/page/portal/HomeMinhacienda/SistGralRegalias/Distribuciones%20y%20giros1/FondoSGR/REPORTE%20TERCER%20TRIMESTRE%202013.pdf](http://www.minhacienda.gov.co/portal/page/portal/HomeMinhacienda/SistGralRegalias/Distribuciones%20y%20giros1/FondoSGR/REPORTE%20TERCER%20TRIMESTRE%202013.pdf). Ministerio de Hacienda y Crédito Público (2013). *Decreto 1399 del 28 de Junio de 2013*.
- Ndikumana, L., & Abderrahim, K. (2010). Revenue mobilization in african countries: does natural resource endowment matter? *African Development Review*, 22 (3), 351- 365, consultado el 16 de abril, en <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AFDR%20Vol%2022%20No%203.pdf>
- Obeng-Odoom, F. (2014). Urban property taxation, revenue generation and redistribution in a frontier oil city. *Cities*, 36, 58–64, consultado el 16 de abril de 2014, en <http://www.sciencedirect.com/science/article/pii/S0264275113001571>
- Ossowski R., Gonzáles A. (2012). The impact of nonrenewable resource revenues on the other revenues of resource exporters in Latin America and the Caribbean. IDB Working paper series, núm. IDB-WP-337, consultado el 11 de marzo de 2014, en <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=37033394>
- Pachón, M.; Wills, L.; Sánchez, F. (2013). *Dinámicas políticas alrededor de la administración y uso de las regalías* (en línea), Bogotá, Universidad de los Andes, consultado el 13 de noviembre de 2013, en [economia.uniandes.edu.co/content/download/47341/395872/file/Pachon\\_Wills\\_Sanchez\\_Mayo2013\\_Dinamicaspoliticasalrededordelaadministracionyusodelasregalias.pdf](http://economia.uniandes.edu.co/content/download/47341/395872/file/Pachon_Wills_Sanchez_Mayo2013_Dinamicaspoliticasalrededordelaadministracionyusodelasregalias.pdf).
- Pearce, J. (2005), "Más allá de la malla perimetral, El petróleo y el conflicto armado en Casanare, Colombia", Bogotá, CINEP.
- Perry, G.; Olivera, M. (2009). "El impacto del petróleo y la minería en el desarrollo regional y local en Colombia" (working paper), CAF.
- Postali, F., & Rocha, F. (2009). Resource windfalls, fiscal effort and public spending: evidence from Brazilian municipalities. XXXVII Encuentro Nacional de



Economia-ANPEC. Foz do Iguacu, consultado el 16 de abril de 2014, en <http://www.anpec.org.br/encontro2009/inscricao.on/arquivos/000-57a3f78d68459cf502d0031d123473a1.pdf>

Sánchez, F.; Mejía, C.; Herrera, F. (2005a), "Impacto de las regalías del carbón en los municipios del Cesar 1997 - 2003", Bogotá, Cuadernos PNUD, investigaciones sobre desarrollo regional.

Sánchez, F.; Martínez, M.; Mejía, C. (2005b), "La estructura económica actual del Casanare y posibilidades futuras de crecimiento y competitividad", Documento CEDE, 2005-24, Bogotá, Universidad de los Andes.

Tijerina-Guajardo, J., & Pagán, J. (2003). Government spending, taxation, and oil revenues in Mexico. *Review of Development Economics*, 7(1), 152-164, consultado el 16 de abril de 2014, en <http://onlinelibrary.wiley.com/doi/10.1111/1467-9361.00182/abstract>

Viloria, J. (2005), "La economía de Barrancas y Tolú en función de las regalías: Un camino construido entre la abundancia y el despilfarro", en María M. Aguilera (editor), *Economías locales en el Caribe colombiano: Siete estudios de caso*, Banco de la República, Cartagena, Centro de Estudios Económicos Regionales.

## Appendix 1. Methodology used to estimate the modified IDF

The IDF estimated by the National Planning Department (DNP) through the principal components methodology is a variable that summarizes six indicators into a single measure with a scale of 1 to 100. The indicators are:

1. Self-financing of the operating expenses = (operating expenses / current revenue with free destination).
2. Debt Service Backup = (debt service / available revenue) \* 100.
3. Fiscal dependence on the national transfers and royalties = [(transfers + royalties) / total revenue] \* 100.
4. Generation of own resources = (tax revenue / current revenue) \* 100.
5. Magnitude of investment = (investment spending / total expenses) \* 100.
6. Saving capacity = (current saving / current revenue \* 100).

The estimation of the modified IDF only used five indicators, discarding the number three in order to avoid the endogeneity problem that would occur between the result variable and the dose. To this end the database calculated by the DNP with the indicators<sup>12</sup> for 2012 was used.

Following the DNP (2011), it was necessary to re-scale some of the variables so that they all lied in the range of values between 0 and 100. Thus, values that are close to zero

---

<sup>12</sup> It can be downloaded at:

<https://www.dnp.gov.co/Programas/DesarrolloTerritorial/Evaluaci%C3%B3nySeguimientodelaDescenralizaci%C3%B3n/Desempe%C3%B1oFiscal.aspx>

mean a lower performance while values close to 100 a better performance. This was accomplished as follows:

A. Self-financing operating costs = 100 if the indicator value is less than or equal to a limit, which is set according to their category: the special category, 50%; the first category, 65%; and the territorial entities of categories two and three, 70%.

In the event that the municipality does not meet with the limit for the category to which it belongs, the indicator value would be equal to:  $[100 - (\text{original value} - \text{limit indicator}) / \text{limit}]$ .

B. Debt service Backup<sub>re-scaled</sub> = 100 - Backup debt service

With five indicators already organized, the principal component technique was used to add them all in a single synthetic indicator, as follows:

$$\text{IDF}_{\text{modified}} = \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5$$

Where every  $\alpha$  is the weighting factor assigned by the DNP to each indicator. Because these weights were not available for the modified IDF estimation, the same weight factor was assigned to each indicator.

This synthetic indicator measures fiscal performance overall achieved in 2012 and it was also re-scaled so that its values were on a scale of 0 to 100, where values close to 0 reflected poor fiscal performance and values close to 100 a better fiscal performance, in terms of the indicators were that taken into account.

## Appendix 2. Treatment estimation given the observable characteristics

Dependent Variable: SGP Transferences / Total Income (treatment)	Coefficient
Total Population	0.041 (0.046)
Urban Population	-0.034 (0.046)
Municipal Category	
Second	0.212 (0.230)
Third	-0.025 (0.203)
Fourth	0.088 (0.240)
Fifth	0.066 (0.235)
Sixth	0.105 (0.239)
Special	0.142 (0.240)
NBI Index	0.000 (0.000)
Total SGR for the Departments	0.000 (0.000)
Regional Development Fund	0.000 (0.000)
Regional Compensation Fund - Departments	0,001*** (0.000)
Science and Technology Fund	-0,004** (0.001)
Regional Savings	(0.002) (0.001)
Regional Pension Fund	0,007** (0.002)
Royalties previously received <sup>a</sup>	
Royalties 2007	-0,007*** (0.001)
Royalties 2008	0,014*** (0.002)
Royalties 2009	-(0.001) (0.002)
Royalties 2010	(0.001) (0.004)
Royalties 2011	(0.000) (5.620)

Appendix 2 (continuation). Treatment estimation given the observable characteristics

Variable	Coefficient
Previous tax Revenue <sup>a</sup>	
Tax Revenue 2007	3,898 (7,365)
Tax Revenue 2008	7,365 (7,008)
Tax Revenue 2009	-4,198 (8,366)
Tax Revenue 2010	-8,026 (5,783)
Tax Revenue 2011	-4,026 (5,485)
Political conditions	
Votes obtained by the Mayor (2011 elections)	(0.000) (0.000)
Mayor's political Party 2011	
ASI	0,015*** (0.009)
Afrovides	(0.012) (0.010)
Cambio Radical	0,014* (0.009)
Conservador	0,020** (0.007)
Firmas	(0.005) (0.008)
Liberal	(0.010) (0.009)
MIO	(0.011) (0.012)
MIRA	0,050*** (0.007)
PIN	0,035** (0.015)
Polo democrático alternativo	-(0.003) (0.025)
Partido de la U	0,018** (0.009)
Verde	0.007 (0.011)
Coalition (several Parties)	0.009 (0.009)
<i>Observations</i>	1,025
<i>R-2</i>	0.53

Source: a: Variables in current prices. Departamento Nacional de Planeación; Departamento Administrativo Nacional de Estadísticas; Registraduría;  
Notes: Coefficients estimated by a linear Regression. Standard Errors robusts to a Departmental level. \* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

### Appendix 3. Balance Tests

<i>Pre-reform Variable</i>	Treatment	GPS Treatment
Total Population	-1,147 (0,868)	-0,186 (0,190)
Urban Population	-1,257 (0,865)	-0,236 (0,149)
Municipal Category		
First	-0,011 (0,013)	-0,009 (0,015)
Second	-0,010 (0,013)	-0,008 (0,015)
Third	0,089 (0,025)	0,081 (0,029)
Fourth	0,170*** (0,063)	0,045 (0,074)
Fifth	-0,139*** (0,065)	-0,212 (0,077)
Sixth	-0,117** (0,099)	0,039 (0,116)
Special	0,038 (0,031)	0,065 (0,036)
NBI Index	50,36*** (7,715)	45,045 (27,266)
Total SGR for the Departments	248,0*** (58,475)	158,931 98,898
Regional Development Fund	-28,13*** (7,081)	-16,620 (13,292)
Regional Compensation Fund - Departments	38,50*** (5,609)	32,806 (24,867)
Science and Technology Fund	6,015 (5,194)	9,648 (12,047)
Regional Savings	69,30*** (14,909)	44,600 (34,68)
Regional Pension Fund	4,676** (1,543)	5,163 (4,192)
Royalties previously received <sup>a</sup>		
Royalties 2007	1,803*** (3,221)	30,127 (19,761)
Royalties 2008	1,451*** (43,29)	40,73 (31,76)
Royalties 2009	2,116*** (46,29)	42,04 51,92
Royalties 2010	2,218*** (45,90)	43,23*** 12,47
Royalties 2011	2,005*** (48,11)	42,617 (25,146)

### Appendix 3 (continuation). Balance Tests

<i>Pre-reform Variable</i>	Treatment	GPS Treatment
Previous tax Revenue <sup>a</sup>		
Tax Revenue 2007	0,000 (0,000)	0,000 (0,000)
Tax Revenue 2008	0,000 (0,000)	0,000 (0,000)
Tax Revenue 2009	0,000 (0,000)	0,000 (0,000)
Tax Revenue 2010	0,000 (0,000)	0,000 (0,000)
Tax Revenue 2011	0,000 (0,000)	0,000 (0,000)
Political conditions		
Votes obtained by the Mayor (2011 elections)	-11.692 (9.208)	-4.013 (3.288)
Mayor's political Party 2011		
AICO	-0,023 (0,038)	-0,011 (0,044)
ASI	-0,002 (0,088)	-0,061 (0,102)
Afrovides	0,091* (0,054)	0,167 (1,064)
Cambio Radical	-0,019 (0,142)	-0,096 (0,167)
Conservador	-0,003 (0,155)	0,099 (0,182)
Firmas	-0,220** (0,093)	-0,169 (0,109)
Liberal	-0,057 (0,149)	-0,081 (0,174)
MIO	-0,056 (0,060)	-0,090 (0,070)
MIRA	0,004 (0,013)	0,011 (0,015)
PIN	0,208*** (0,071)	0,121 (0,083)
Polo democrático alt.	0,016 (0,035)	-0,015 (0,042)
Partido de la U	0,295* (0,171)	0,388* (0,201)
Verde	-0,093 (0,084)	-0,118 (0,099)
Coalition (several Parties)	-0,140* (0,072)	-0,145 (0,847)

Sources: Departamento Nacional de Planeación; Departamento Administrativo Nacional de Estadísticas; Registraduría; Notes: (1) Coefficients estimated by linear regression. (2) GPS Coefficients omitted (3) Standard Errors obtained by bootstrapping with 200 repetitions. (4) \* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%. (5) a: Variables at current prices.

### Appendix 4. Dose-Response Function Estimation

<i>Dependent Variable</i>	Treatment	Treatment <sup>2</sup>	Treatment <sup>3</sup>	GPS	GPS <sup>2</sup>	GPS <sup>3</sup>	Treatment*GPS	R-2
<i>From the IDF:</i>								
Modified IDF	-251,1*** (60,20)	805,3*** (219,8)	-602,2*** (225,2)	0,665 (4,446)	-0,481 (0,952)	0,05 (0,067)	-1,00 (5,411)	0,16
Self-financing Operative Expense	190,0*** (7,382)	-507,7*** (23,78)	341,9*** (21,44)	5,219*** (1,013)	-1,333*** (0,231)	0,1 (0,016)	-5,977*** (0,736)	0,03
Debt Service Back up	-30,65 (65,22)	113,7 (224,8)	-60,73 (241,5)	-2,547 (2,606)	0,661 (0,447)	-0,046 (0,030)	1,395 (5,484)	0,06
Transferences Dependency	389,5*** (9,871)	-1,297** (42,55)	1,032** (40,13)	-3,734*** (0,922)	1,180*** (0,205)	-0,102*** (0,015)	0,174 (0,731)	0,16
Own Resources Generation	-333,5*** (17,60)	1160*** (48,92)	-906,1*** (40,49)	5,724*** (1,114)	-2,769*** (0,253)	0,255*** (0,019)	-1,629 (1,693)	0,09
Investment Magnitude	65,04*** (2,441)	-222,0*** (8,214)	185,7*** (7,347)	-1,178*** (0,325)	0,130* (0,077)	-0,010* (0,006)	3,926*** (0,227)	0,10
Saving Capacity	-264,6*** (6,142)	782,4*** (21,68)	-565,0*** (19,92)	2,510*** (0,774)	-0,874*** (0,164)	0,052*** (0,012)	6,487*** (0,581)	0,07
<i>From the Budget Performances:</i>								
Total tax Revenue	-144.282*** (26.105)	349.911*** (87.439)	-229.611** (89.294)	-2.653 (2.341)	-107,6 (459,5)	28,49 (32,48)	8.786*** (2.835)	0,20
Property Tax	-28.931*** (6.776)	83.302*** (22.374)	-61.760*** (20.634)	333,7 (486,7)	-187,9* (103,6)	17,74** (7,841)	168 (552,4)	0,09
Industry and Commerce	-74.423*** (20.613)	170.754*** (60.657)	-104.925 (64.446)	-2.315** (1.096)	173 (185,8)	-2,678 (12,40)	6.012*** (2.150)	0,35
Gas Surcharge	-8.887** (3.746)	21.471* (12.129)	-14.291 (11.977)	64,38 (250,9)	-77,82 (51,31)	7,651** (3,754)	254,9 (312,4)	0,06
Cofinancing	-11.961 (11.196)	49.590 (34.014)	-43.981 (28.434)	-9,046 (605,6)	-21,78 (122,6)	2,576 (8,797)	183,1 (1.026,0)	0,02
Current Expenses	-382.593** (178.706)	490.677 (542.198)	-125.482 (554.129)	-23.247* (12.525,0)	1.421 (2.551)	17,06 (182,800)	36.578** (14.913,0)	0,10
Investment Expenses	-335.549** (146.830)	374.142 (394.330)	-46.150 (342.356)	-22.378* (11.906)	1.504 (2.433,0)	1.620 (174,900)	34.600** (13.974)	0,10
Fiscal Balance	-286.914* (152.270)	687.175* (360.659)	-475.614*** (108.317)	-10.617 (6.538)	1.347 (884,2)	-74,99 (50,550)	28.012* (15.765,0)	0,41
Own Resources Indicator	-340,8*** (70,35)	1.067*** (307,4)	-802,8** (333,2)	1,447 (4,631)	-0,768 (0,973)	0,068 (0,069)	4,699 (5,337)	0,16

Source: Departamento Nacional de Planeación; Departamento Administrativo Nacional de Estadísticas; Registraduría; Notes: (1) Coefficients estimated by linear regression. (2) Standard Errors obtained by bootstrapping with 200 repetitions. (3) Estimations controlled if the entity received the royalties directly. (4) \* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.