The Flypaper Effect and Costly Tax Collection*

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March 2010

Abstract

This paper studies the role of costly taxation as an explanation of the flypaper effect. This effect refers to the greater response of public spending to grants than to the tax base. I develop a model of local spending with costly taxation, similar in spirit to Hamilton (1986), and test the model predictions using data from Peruvian municipalities. I find that municipalities with lower tax collection costs increase their spending less in response to additional grants and instead reduce local revenue: a result consistent with a smaller flypaper effect. Differences in tax collection costs explain almost one third of the flypaper effect.
Keywords: flypaper effect, intergovernmental transfers, public finance, fiscal decentralization.
JEL: H71, H77

1 Introduction

One of the most documented empirical regularities in the fiscal federalism literature is the so-called flypaper effect (Hines and Thaler, 1995; Gamkhar and Shah, 2007). This effect refers to the observed greater responsiveness of local government's spending to increases in grants than to increases in the local tax base. However, in the traditional grants-in-aid theoretical framework, these findings are puzzling (Oates, 1999). If money is fungible,

*I would like to thank Timothy Besley, Henrik Kleven, Monica Singhal, two anonymous referees and participants of seminars at LSE for useful comments and suggestions. A previous version of this paper circulated under the title "The Flypaper Effect Revisited"

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a local government representing the interests of the citizens should have the same propensity to spend out of individual income or out of lump-sum grants (Bradford and Oates, 1971).[1]

Some explanations of this paradox focus on flaws in the empirical strategy such as functional miss-specification (Becker, 1996), omitted variables (Hamilton, 1983), reverse causality (Knight, 2002) or measurement error (Moffitt, 1984). Other explanations rely on some sort of political bias due imperfect information (Courant et al., 1979; Oates, 1979), uncertainty (Turnbull, 1998) or the action of agenda setting budget-maximizing bureaucrats (Filimon et al., 1982).[2]

An alternative explanation, first proposed by Hamilton (1986), suggests instead that the flypaper effect is in part due to costly taxation. In Hamilton's original model, the cost of taxation comes from deadweight losses of local taxes. This explanation, however, has been criticized since the magnitude of the distortionary costs of local taxes may be insufficient to account for the observed flypaper effect (Hines and Thaler, 1995, p. 221).

In this paper I evaluate empirically Hamilton's hypothesis. First I develop a model of local public spending with costly tax collection. Then, I test the model predictions using data from Peruvian local governments.

The model is based on Hamilton's contribution and emphasizes the same mechanism -costly taxation- to produce the flypaper effect. There are, however, two relevant differences that make it more suitable for empirical testing. First, the model motivates costly taxation by introducing tax collection costs, such as administrative or compliance costs, instead of deadweight losses. These costs are easier to observe empirically and may be more relevant in the case of local taxes (Slemrod, 1990). Second, it provides a simpler and quantifiable expression of the magnitude of the flypaper effect as a function of tax collection costs and the tax rate. To the best of my knowledge, this result has not been obtained before and it is important since the flypaper paradox is mainly an empirical issue.

The model predicts that local spending will be more responsive to additional grants than to increase of the local tax base, a result contrary to the standard grants-in-aid approach and consistent with the observed flypaper

[1] A similar argument of fungibility is found in the aid literature. See Van de Walle and Mu (2007) for a recent survey of the literature.

[2] For a detailed survey of the literature see Hines and Thaler (1995), Bailey and Connolly (1998) or Gamkhar and Shah (2007)

effect. Moreover, there is a substitution effect: local governments will use the additional grants to reduce costly local taxation.

These effects varies with the tax collection costs and tax rate. In particular, the model predicts that the grant elasticity of spending will be larger for local governments with higher tax collection costs and will decrease with the tax rate. Furthermore, the substitution effect of local revenue by grants will be smaller for local governments with higher tax collection costs.

I test these predictions using data from Peruvian district municipalities. I exploit variation on the Foncomun, a large equalization grant allocated by formula and funded with a share of the national value added tax. As a proxy for tax collection costs and tax rates, I use tenure of administrative tools -such as automated tax systems or an updated cadaster- and local municipal revenue per capita.

I find evidence supporting the model predictions. The grant elasticity of spending for a high cost municipality is 0.756, while for a low cost it is 0.561, almost 25 percent smaller. In contrast, the estimated sensitivity of spending to the local tax base is 0.089. These results suggest that the differences in tax collection costs account for almost one third of the difference on the elasticity of spending. I also find evidence of the substitution effect. Municipalities with high tax collection costs increase their local revenue, and reduce less their taxes, when receiving additional grants.

The results are robust to relevant identification concerns, in particular possible confounding factors driving both the tax collection costs and grant elasticity of spending.

The rest of the paper proceeds as follows. Section 2 develops the analytical framework. Section 3 discusses the institutional background of Peruvian district municipalities. Section 4 presents the empirical strategy while Section 5 presents the main results and robustness checks. Section 6 concludes.

2 A Model of Local Spending

In this section I develop a model of the spending decisions of a local government in the presence of costly taxation. The model provides testable predictions about the magnitude of the flypaper effect as a function of tax

collection costs and the tax rate.[3]

The model emphasizes the role of costly taxation as a mechanism to explain the flypaper effect. This explanation is similar to the one proposed by Hamilton (1986).[4] There are, however, two relevant differences. First, the model uses tax collection costs instead of deadweight losses to introduce costly taxation. Tax collection costs -which include compliance and administrative costs- are easier to observe than distortionary costs. This feature facilitates the empirical evaluation of the model. Moreover, in the context of local public finances, collection costs may be as relevant as the distortionary costs of taxation (Slemrod, 1990, p. 169).[5] Second, it provides a simpler and quantifiable expression of the magnitude of the flypaper effect as a function of tax collection costs and tax rate. To the best of my knowledge, this result has not been obtained before and it is important since the flypaper paradox is mainly an empirical issue.

Consider a community populated by a continuum of citizens of mass one. Citizens have heterogenous income denoted by y_i. In order to abstract from the effect of income inequality, I restrict attention to symmetric distributions such that both the average and median income are equal.[6]

There a two tiers of government: central and local. Both provide public goods, collect taxes and have their representatives elected in general elections. In addition, the central government provides financial support as lump-sum grants to the local government. For the model, I focus on the policy decisions of the local government and take the central government's policies as given.[7]

Citizens derive utility from private consumption c_i and a homogenous

[3]The magnitude of the flypaper effect is the difference between the propensity to spend out of grants and the propensity to spend out of local income (Becker, 1996).

[4]In Hamilton's model, the local public good is financed by a combination of local income taxes and grants from the central government. Local taxation is distortionary and creates a deadweight loss that reduces citizens net income. This feature makes the propensity of spend out of transfers greater than out of local income, because grants allow the local government to reduce distortionary taxation and increase citizens' consumption.

[5]For example, estimates of the compliance and administrative costs of the U.S. federal and state income tax are between 5-10 percent of total tax revenue (Slemrod and Sorum, 1984; Blumenthal and Slemrod, 1992; Slemrod and Yitzhaki, 2002). In the case of local governments, Wicks and Killwort (1967) estimate collection costs for real property taxes of around 9.5 percent of the tax revenue. For an empirical survey of compliance and administrative costs see Sandford (1995).

[6]The results are similar with asymmetric income distributions (see Appendix A.1)

[7]This is a plausible assumption if local governments are unable to, individually, affect central government's policies.

public good g provided by the local government. Preferences are defined by a quasi-linear utility function

$$U_i = c_i + H(g) \tag{1}$$

where the utility from the public good $H(g)$ is an increasing and concave function.

The local government funds the provision of the public good from two revenue sources: a local income tax and a grant from the central government. Tax policy is not targeted and hence the local tax rate $\tau \in (0, 1)$ is the same for all citizens. The local government sets the tax rate and collects the tax revenue. In contrast, the decisions on grant's funding and allocation are made by the central government.

Raising local revenue is costly. In particular, the local government faces a administrative cost of operating the tax system equal to $\Gamma C(\tau)y$ where Γ is a cost shifter and $C(\cdot)$ is an increasing and convex function. $\Gamma C(\tau)$ adopts values strictly between 0 and τ to avoid a corner solution with zero taxation. The administrative cost covers, among others, the cost of processing tax returns, monitoring tax evasion and the required legal proceeds. An alternative way to motivate costly tax collection is to include compliance costs. In the rest of the model I will focus on administrative costs because they are more relevant for the empirical case I study; however, the results using compliance costs are similar (see Appendix A.2).

From (1) and the previous definitions, we can write the indirect utility of citizen i as

$$V_i = y_i \left[1 - \tau\right] + H(g) \tag{2}$$

while the local government's budget constraint is

$$g = y \left[\tau - \Gamma C(\tau)\right] + a \tag{3}$$

where y is the tax base (an also the average income) and a is the lump-sum grant per capita. Note that expression $R \equiv y \left[\tau - \Gamma C(\tau)\right]$ represents the net tax revenue.

Assumption 1 $C' < 1$

This assumption guarantees that the net tax revenue is an increasing and monotonic function of the tax rate.

The political process to define the local tax rate and public spending is one of Downsian electoral competition. There are two office-seeking politicians running for local office, electoral promises are enforceable and the winning candidate is defined by simple majority rule. Politicians are office seeking and choose policy to maximize their vote share. The timing of events is as follows. Firstly, candidates simultaneously announce their policies τ and g. Secondly, local elections are held. Finally, the appointed politician implements her announced policy platform.[8]

This setup is relatively standard in the political economy literature and has been widely used by Persson and Tabellini (2000) in their analysis of public spending and redistributive politics. The only differences are the introduction of grants as an additional source of revenue and costly tax collection.

Equilibrium policy Rearranging the budget constraint (3), we can express τ as a function of g:

$$F(\tau) \equiv \tau - \Gamma C(\tau) = \frac{g-a}{y} \tag{4}$$

where $F' > 0$, $F'' < 0$ by assumption 1 and convexity of $C(\tau)$. Since F is a monotonic function, we can write the tax rate as

$$\tau = f\left(\frac{g-a}{y}\right) \tag{5}$$

where $f(\cdot) = F^{-1}(\cdot)$ and hence $f' > 0$, $f'' > 0$.

The citizen's indirect utility (2) satisfies single-crossing property and allow us to use the median voter theorem.[9] Thus, the politician's program is equivalent to choose a level of public spending to maximize the median voter's utility. In equilibrium, the local public spending satisfies:

$$g^* = \arg\max \; y\left[1-\tau\right] + H(g) \tag{6}$$

[8] To make the model sensible in the case of unanticipated grants , we can assume one of the candidates is the incumbent mayor seeking reelection.

[9] To see this note that $\frac{\partial^2 V}{\partial g \partial y_i} = f'' \frac{g-a}{y^2} > 0$

Using (5) and solving (6) we obtain the equilibrium policy:

$$g^* = h(f'\left(\frac{g-a}{y}\right)) \tag{7}$$

where $h(\cdot)$ is the inverse function of $H'(\cdot)$. Note that $h' < 0$ because H is concave.

2.1 Costless tax collection

Let us first study as a benchmark the case of costless tax collection. In this scenario, expression (7) simplifies to $g^* = h(1)$ and it is easy to see that the effect of lump-sum grants and local tax base on g^* are both identical and equal to zero.[10]

When tax collection is costless, the model predicts that grants from the central government do not affect spending but instead are fully translated to citizens as tax rebates. Moreover, the mechanism to transfer resources becomes irrelevant because both grants and local income are equivalent in terms of their effect on local government spending and taxation.

This result replicates the veil hypothesis which has provided the theoretical basis for the flypaper paradox (Oates, 1999, p. 1129). According to this hypothesis, when the local authority is representative of the citizens both lump-sum grants and local income have similar effect on local spending. Thus, the local government acts only as a *veil* and does not distort the final allocation of resources.

2.2 Costly tax collection

Let us now relax the assumption of costless taxation. Taking total derivatives from expression (7) we can calculate the marginal propensities to spend out of local income and grants:

$$\frac{dg^*}{dy} = -\frac{h'f''}{y-h'f''}\frac{g^*-a}{y} \tag{8}$$

$$\frac{dg^*}{da} = -\frac{h'f''}{y-h'f''} \tag{9}$$

[10]This result is extreme due to the quasi-linearity assumption which eliminates the income effect.

Since $h' < 0$, and $f'' > 0$, these propensities to spend are positive. Thus, in contrast to the benchmark case, the model predicts a local spending increases both with tax base and central government grants. The reason is that grants reduce the tax rate required to fund a given level of spending. In turn, this lowers tax collection costs, reduces the marginal cost of the public good and promotes additional spending.

Expressions (8) and (9) provide a way to compare both marginal propensities to spend and evaluate the magnitude of the flypaper effect. Using both results and definition (4), we can obtain the following expressions:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\frac{1}{\tau^* - \Gamma C(\tau^*)} \tag{10}$$

where τ^* is the equilibrium tax rate and $\Gamma C(\tau^*)$ is the administrative cost as a proportion of the tax base.

Equation (10) provides two important observations. First, the ratio $\frac{1}{\tau^* - \Gamma C(\tau^*)}$ is a measure of the flypaper effect.[11] In most cases, this ratio is quantifiable since both the tax rate and administrative costs are, potentially, observable. This insight suggests a simple way to calculate, ex ante, the propensity to spend out of grants and evaluate the stimulatory effects of intergovernmental transfers.

Second, since $\Gamma C(\tau^*) \in (0, \tau^*)$ and $\tau^* < 1$, the marginal propensity to spend out of grants is *greater* than the marginal propensity to spend out of income (the local tax base).[12] This prediction is consistent with the observed flypaper effect and, contrary to the veil hypothesis, suggests that local income and lump-sum grants are not equivalent.

A corollary of this non-equivalence result is that additional grants reduce local tax revenue, $\frac{dR^*}{da} < 0$. Thus, in the presence of costly taxation, there is is a substitution effect of local taxes by grants. To see this note that:

$$\frac{dR^*}{da} = \frac{dg^*}{da} - 1 \tag{11}$$

Similar to Hamilton (1986), the non-equivalence result is driven by the differences on the cost of funds faced by the local government. In particu-

[11] This closed form result comes at the cost of imposing additional structure to the model.

[12] Moreover, finding similar marginal propensities would be rare since it requires very high tax rates and negligible collection costs.

lar, a local government finds more costly to collect local taxes than to use central government's grants. In the model, this cost difference arise from the inability of the local government to internalize the cost of funding the intergovernmental transfers. This result points out a potential source of inefficiency: local governments may overspend if they do not take into account the tax collection costs incurred by the central government.[13]

Testable Predictions In the empirical section, I use a double logarithmic specification which provides estimates of elasticities instead of propensities to spend.

In order to link the previous results to the empirical exercise, we can rewrite equations (10) and (11) as

$$\varepsilon_a = \varepsilon_y \frac{a}{y} \frac{1}{\tau^* - \Gamma C(\tau^*)} \tag{12}$$

$$\varepsilon_{R,a} = \varepsilon_a \frac{g}{R} - \frac{a}{R}, \tag{13}$$

where $\varepsilon_a \equiv \frac{dg}{da}\frac{a}{g}$ and $\varepsilon_y \equiv \frac{dg}{dy}\frac{y}{g}$ are the grant elasticity and the tax base elasticity of spending, respectively, and $\varepsilon_{R,a} \equiv \frac{dR}{da}\frac{a}{R}$ is the grant elasticity of local tax revenue.

In addition, using (3) we can rewrite (12) as:

$$\varepsilon_a = \varepsilon_y \frac{a}{g-a}, \tag{14}$$

where $\frac{a}{g-a}$ is the ratio of grant to non-grant revenue.

From equations (12), (13) and (14) it is straightforward to obtain testable predictions about the relation between the elasticities of spending and tax revenue, tax collection costs and actual tax rate. In particular, the model predicts that :

1. $\frac{d\varepsilon_a}{d\Gamma} > 0$: the grant elasticity of spending increases with tax collection costs;
2. $\frac{d\varepsilon_a}{d\tau} < 0$: the grant elasticity of spending decreases with the tax rate;
3. $\frac{d\varepsilon_{R,a}}{d\Gamma} > 0$: the grant elasticity of tax revenue increases with tax collection costs (smaller substitution effect).

[13] Alternatively, the difference in tax collection costs can be due to technological differences. In that case, there would be no inefficiency.

4. $\frac{d\varepsilon_a}{d(a/(g-a))} = \varepsilon_y > 0$: the grant elasticity of spending increases with the ratio of grant to non-grant revenue. This derivative also provides an estimate of ε_y, the tax base elasticity of spending.

In Section 5, I test empirically these model predictions in the context of Peruvian district municipalities.

3 Institutional Background

District municipalities are the lowest tier of autonomous sub-national government in Peru. Their main responsibilities are the provision of local services -such as waste collection, local police and civil register- and development and maintenance of local infrastructure. They do not participate in the provision of education or health services and cannot redistribute cash directly to citizens.

Municipalities finance their budget mostly from two sources: local revenue (such as local taxes, fees, fines and contributions) and transfers from the central government (see Table 1). In the period 1998 to 2001, these two sources represented around 84 percent of the total budget. The remaining budget corresponds mostly to debt, sales of assets and the amount saved from previous years.[14]

Local Taxes The most important local tax is the property tax (*impuesto predial*). The property tax is levied on the estimated value of the real estate property. In 2001, this tax amounted to 80% of total local tax revenue.

Local governments have little control over the property tax rate and tax base. The tax rate is defined by national law while the property value is calculated using criteria defined by a national surveyor agency such as property size, quality and economic use. The amount actually collected, however, depends on the municipality's monitoring and enforcement effort.

A common form of tax evasion is failure of owners to report improvements to existing properties (which could increase the taxable base). To address this problem, local tax authorities usually maintain a register of properties or cadaster, with details about properties' location, size and own-

[14] Any amount of local revenues or transfers not spent in a fiscal year is rolled forward to the next one.

Table 1: Aggregate Municipal Budget 1998-2001, in millions of Nuevos Soles

Source	Annual Budget	% total budget
A. Transfers	1032.5	43.9
Foncomun grant	691.2	29.4
Vaso de Leche	221.9	9.4
Other transfers	119.4	5.1
B. Local Revenue	932.4	39.7
Taxes	368.9	15.7
Service fees	493.5	21.0
Fines and contributions	70.0	3.0
C. Other Revenue	309.7	13.2
D. Previous year balance	76.2	3.2
Total revenue	2350.8	

Source: Municipalities' budget reports.

Note: Other transfers include Canon, Renta de Aduanas and Vaso de Leche. Oher Revenue includes credit and capital income.

ership.[15] As I explain below, I use the tenure of an updated municipal cadaster as one of the proxies for low tax collection costs.

Transfers District municipalities receive several transfers from the central government (see Table 1). The most important are the Foncomun, an equalization grant, followed by the Vaso de Leche (Glass of Milk), a conditional grant earmarked to provide food support.[16] Other transfers include sharing schemes of taxes managed by the central government such as corporate tax of extractive industries and custom duties. These tax sharing schemes are earmarked to capital expenditures. I focus on the Foncomun because it is the largest transfer and the only one that resembles an unconditional grant.

The Foncomun is funded with a fixed proportion of the national value added tax.[17] This tax is managed and collected by the central government without any intervention of local governments.

The Foncomun is allocated by a formula that considers: urban and rural population of a district and children mortality at provincial level.[18]. The allocation weights were calculated by the Ministry of Economics using values from the 1993 Population Census and remained fixed during the period of analysis.[19] There is also a lower bound on the amount of Foncomun a municipality receives. This lower bound is set annually and benefits municipalities with small populations.[20] The amount of Foncomun received in a year does not depend on the previous years spending performance.

Municipalities cannot directly affect the allocation formula or weights. This rule out a possible bargaining mechanism that may difficult the identification of the propensity to spent out of grants, as suggested by Knight (2002).

During the period of analysis, the Foncomun was partially earmarked to capital expenditures. Municipalities should have spent at least 70 percent of

[15]The importance of the cadaster as a tool to implement and operate property tax systems is highlighted in international guidelines of land management. See for example United Nations (2005) and International Federation of Surveyors (2005).

[16]Foncomun stands for *Fondo de Compensación Municipal* or Municipal Compensation Fund

[17]Over the period of analysis this proportion was 2/19.

[18]A province is the immediately superior geographical jurisdiction

[19]The allocation formula for municipalities in Lima - the country's capital and largest city - includes more variables but is essentially very similar.

[20]The value of the lower bound is indexed to a reference value used by the central government agencies to calculate income tax personal allowances, tax brackets and fines.

the transfer on capital expenditures. In practice, however, the compliance with this conditionality was very limited. In aggregate, the proportion of the Foncomun actually spent on capital expenditures decreased from 67 percent in 1998 to 54 percent in 2001. This evidence suggest that the Foncomun may have been de facto treated as an unconditional grant. In 2003, the spending conditionality was completely removed.

4 Empirical Strategy

4.1 Data

I use a panel data set of around 1350 Peruvian district municipalities with information about annual budgets, administrative resources and socio-demographic characteristics.[21] The budgetary information covers four years (1998 to 2001), while the data on administrative resources and socio-demographics is a cross section with data observed in 1999 or 1993. Table 2 presents summary statistics of the main variables.

I use the value of expenditure per capita and Foncomun per capita as measures of local spending (g) and grants (a). I then use these variables to estimate the grant elasticity of spending. To evaluate the substitution effect of grants on local taxes, I use the value of local revenue per capita as a measure of local tax revenue (R). As previously mentioned, this revenue category includes local taxes, fees, fines and contributions. I also evaluate the results using only the value of local taxes per capita.

The budgetary information comes from annual reports prepared by the local governments. These reports have official status and are used for national accounting and auditing by different government agencies [22]. They include detailed information on municipalities revenues and expenditures, including the amount received in different transfers.[23] I express the revenue and expenditure variables in per capita values using population estimates for 1999.

I also collect data on the municipality administrative resources such as

[21] The sample size is smaller than the universe of 1650 municipalities due to lack of budgetary information for some small municipalities.

[22] The budget reports I use correspond to the copy sent to the Ministry of Economy.

[23] I compared the amount of transfers registered in the budget reports with the records from the Ministry of Economy -the office in charge of distributing the transfers- and I found similar values.

having an updated cadaster -a register with details about properties' location, size and ownership- or automated administrative systems. The data comes from surveys conducted in 1999 by the National Statistics Institute to assess the resources and capabilities of district municipalities.[24] The results of the survey were not intended to affect the transfers' allocation or the implementation of other governmental programs. Participation in the survey was compulsory for all district municipalities and the questionnaire was completed by the local authority or a representative.

I complement the data set with socio-demographic variables from several sources. I obtain measures of population density and percentage of urban population from the 1993 Population Census, as well as population estimates for 1999 from the National Statistics Office. Poverty headcount and access to utilities are estimates for 1999 from Foncodes -a public body in charge of several antipoverty programs- and used for the prioritization of public works and development projects.

Measures of tax collection cost and tax rate I use the tenure of tax administration tools as a proxy for tax collection costs. In particular, I construct a dummy named *high cost* equal to one if a municipality *does not* have an automated tax system or an updated cadaster.[25] In terms of the model, values of *high cost* equal to one correspond to having a higher value of Γ. In the sample, around 68 percent of municipalities are classified as high cost.

The rationale for using tenure of these administrative tools as indicators for lower tax collection costs is that they may simplify tax management or facilitate tax monitoring. The focus on the cadaster is particularly motivated by the importance of property tax in the Peruvian local finances.

As a proxy for the tax rate, τ, I use the average tax per capita collected during the period 1998-2001.[26] The model also provides predictions about the heterogenous grant elasticity by the ratio of grant to non-grant revenue, $\frac{a}{g-a}$. I use the ratio of Foncomun to non-Foncomun revenue as proxy for

[24]The survey is called *Registro Nacional de Municipalidades* or the National Municipality Register. It covers areas such as human resources, equipment, municipality services, local infrastructure and current investment projects.

[25]The results are similar when I use the components of the dummy (having an automated tax system or an updated cadaster) separately.

[26]I also use both the average value of local revenue per capita and the property tax per capita for the year 2001, the only date available. The results, not reported, are similar.

this variable.

Table 2 presents summary statistics of the measures of tax collection costs and the tax rate, and compares municipalities with low and high cost. There are significant differences between low and high cost municipalities. As expected, low cost municipalities collect more taxes and local revenue per capita. They receive smaller amounts of Foncomun per capita, but the expenditure is similar. In terms of socio-demographic characteristics, low cost municipalities have larger populations, are more urban, more dense, less poor and have better access to basic utilities. As I discussed below, this systematic differences raise relevant concerns.

4.2 Econometric Specification

The purpose of the empirical exercise is to estimate the grant elasticity of spending (ε_a) and grant elasticity of local tax revenue ($\varepsilon_{R,a}$), and evaluate how they vary by tax collection costs and tax rate.

The model predicts that ε_a would be larger for municipalities with high collection cost and decrease with the tax rate. These results imply a larger flypaper effect for high cost municipalities. A corollary of the model is that the substitution of local taxes by grants will be smaller for high cost municipalities.

To these these predictions, I estimate the following regression:

$$\ln y_{idt} = \beta_0 \ln a_{it} + \beta_1 \ln a_{it} \times X_i + \gamma \mathbf{S}_i + \eta_d + t_d + \epsilon_{it} \tag{15}$$

where y_{it} is either the expenditure per capita or the local revenue per capita of municipality i, in department d in year t.[27] a_{it} is the amount of Foncomun per capita and X_i is an interaction term reflecting tax collection costs, the tax rate or a measure of . $\mathbf{S}_i$ is a set of municipality characteristics such as: population density, percentage of urban population, poverty head count and access to basic utilities. I also include an indicator if the municipality receives the minimum amount of Foncomun. All regressions include department fixed effects (η_d) and department-specific trends (t_d). I cluster the standard errors by municipality to account for possible serial autocorrelation

[27] A department is the largest sub-national administrative unit. Many central government spending projects are targeted at this level.

Table 2: Summary Statistics and Mean Comparison

Variable	Total	High cost		Difference
		No	Yes	
A. Revenue and expenses				
Expenditure per capita	179.5	187.9	175.5	12.4
	(321)	(369.9)	(294.6)	(9.2)
Foncomun grant per capita	99.1	87.9	104.5	-16.6
	(95.6)	(84.6)	(100.1)	(2.7)**
% received min. Foncomun	58.7	51.9	61.9	-0.1
	(49.2)	(50.0)	(48.6)	(0.0)**
Local revenue per capita	28.7	37.8	24.3	13.5
	(217.6)	(106.4)	(254.2)	(6.3)*
Foncomun/Non Foncomun	2.161	1.766	2.347	-0.581
revenue $(a/(g-a))$	(1.954)	(1.671)	(2.048)	(0.052)**
B. Measures of collection cost and tax rate				
% has automated tax	32.0			
system or cadaster	(46.6)			
Average tax per capita	13.8	18.9	11.3	7.6
	(100.3)	(50.6)	(116.6)	(2.7)**
C. Socio-demographic characteristics				
Population	10978.5	20280.8	6593.5	13687.3
	(35790.5)	(58525.6)	(14514.8)	(937.6)**
Population density	347.8	910.5	79.4	10.9
	(2074)	(3505.5)	(520.9)	(0.8)**
% urban population	40.3	47.7	36.8	831.1
	(30.1)	(33.2)	(27.9)	(54.6)**
Poverty headcount	46.8	42.4	48.8	-6.3
	(14.2)	(15.5)	(13.1)	(0.4)**
% access electricity	61.9	60.4	62.7	-2.3
	(33.1)	(32.3)	(33.5)	(0.9)**
% access water	26.0	31.2	23.5	7.6
	(31.1)	(33.1)	(29.8)	(0.8)**
% access sewage	38.3	45.6	34.8	10.7
	(34.8)	(35.3)	(34)	(0.9)**

Notes: Standard deviation in parentheses, * significant at 5%; ** significant at 1%. *High cost* is a dummy equal to one if a municipality does not have neither an automated tax system nor an updated cadaster.

Following Becker (1996) I use a double logarithmic specification. This functional form reduces concern of flypaper due to mis-specification and produces measures of elasticities instead of propensities to spend.

When we use expenditure per capita as dependent variable, the estimate of the grant elasticity of spending (ε_a) is $\widehat{\beta_0} + \widehat{\beta_1} \times X_i$. $\widehat{\beta_1}$ provides a way to evaluate how the grant elasticity changes with either tax collection costs or the tax rate. In particular, the model predicts that when X_i is the indicator of high tax collection costs, $\widehat{\beta_1} > 0$; while when X_i is the tax rate, $\widehat{\beta_1} < 0$. When X_i is the ratio of grant to non-grant revenue, $\widehat{\beta_1}$ has a nice interpretation because it equals the sensitivity of local spending to changes on the tax base, ε_y, and we could expect this estimate to adopt positive values.

When we use local revenue per capita, $\widehat{\beta_0} + \widehat{\beta_1} \times X_i$ becomes the grant elasticity of local tax revenue ($\varepsilon_{R,a}$). In this case, the model predicts $\widehat{\beta_1} > 0$.

The features of the setup -a grant allocated by formula and financed by a national tax- reduce concerns about endogenous transfers that may bias the estimates of the grant elasticities (Hamilton, 1983; Knight, 2002). There are, however, relevant concerns regarding omitted variables. These concerns are partially addressed by including the vector of control variables; but they may be insufficient. I discuss in more detail these concerns in section 5.1 and provides additional evidence.

5 Main Results

Table 3 presents the main results. Columns (1) and (2) estimate the grant elasticity of spending (ε_a) and how it varies with tax collection costs and the tax rate. Consistent with the model predictions, $\widehat{\beta_1}$ is positive, which implies that ε_a is significantly larger for municipalities with high tax costs and decreases with the tax rate. For example, the estimated ε_a for a high cost municipality is 0.756, while for a low cost it is 0.561, almost 25 percent smaller.

Column (3) uses the ratio of Foncomun to non-Foncomun revenue, a proxy for $a/(g-a)$, as the interaction term. Consistent with the previous results, the value of $\widehat{\beta_1}$ is positive. Furthermore, we can interpret this estimate as the sensitivity of spending to changes on the local tax base, $\widehat{\varepsilon_y}$.

We can see that there is is a flypaper effect. The estimate of ε_a ranges

from 0.561 to 0.756 while the estimate of ε_y is around 0.089.[28] Moreover, we can do a back of the envelope calculation to evaluate how much of the flypaper effect is explained by tax collection costs. Using the estimates of ε_a from column (1) and ε_y from column (3), I find that the difference on tax collection costs accounts for almost one third of the difference on elasticities of spending.

Column (4) and (5) explore the model predictions about the role of tax collection costs on the substitution of local taxes by grants. In column (4) I use the value of local revenue, which include taxes and other sources, while in column (5) I narrow down the definition to include only local taxes. In both columns, we observe that there is a negative, though not significant, relation between grants and tax revenue ($\widehat{\beta_0} < 0$). High cost municipalities, however, exhibit a smaller substitution effect ($\widehat{\beta_1} > 0$).[29] This result is consistent with the previous findings and the model predictions: municipalities with high tax collection cost seems to use additional grants increase local spending instead of reducing taxes.

Taken together, the results support the model predictions and the argument that costly tax collection is a relevant determinant of the flypaper effect. The grant elasticity of spending is larger for local governments with higher tax collection costs and decreases with the tax rate. Moreover, the substitution effect of local revenue by grants is smaller among local governments with higher tax collection costs.

5.1 Additional Checks

There are at least two potential concerns with the previous results. First, municipalities with low and high tax collection costs differ systematically in several observable dimensions (see Table 2). To the extent that these variables only affect the level of spending, their effect is controlled by including the vector of control variables S_i. A main concern, however, is that they may also affect the grant elasticity of spending. In that case the results obtained in Table 3 could not be attributed entirely to differences on tax collection costs.

I address this source of spurious correlation by including as additional

[28] More formally, I test of the null hypothesis $\beta_0 = \beta_1$ in column (3) Note that $\widehat{\beta_0}$ provide a lower bound for the value of $\widehat{\varepsilon_a}$. This test is easily rejected with a F-statistics of 100

[29] The estimate in column (5) is significant only at 10%

controls the interaction terms between the ln(Foncomun per capita) and all the variables in vector S_i. If the variable *high cost* is just picking up these municipality features, the estimates of β_1 should become insignificant.

Second, there may be common factors driving both the variation on expenditure and grants per capita. I partially address this concern by including the vector of control variables $\mathbf{S}_i$. This vector include socio-demographic variables and the components of the allocation formula of the Foncomun (namely percentage of urban population, a measure of poverty and whether it receives the minimum amount).[30] This approach absorbs most of the variation of Foncomun between municipalities and leave the temporal variation as the main source of identification.

There may be, however, unobservable omitted variables which would lead to biased estimates of the grant elasticities. To address this concern, I include flexible trends interacted with X_i. This procedure effectively allow for municipalities with different tax collection costs to have different trends of spending and controls for unobservable trends correlated with the interaction term Ln(Foncomun per capita)$\times X_i$.

Table 4 displays the results of these robustness checks. In all cases, the results are similar to the baseline regressions: the grant elasticity is larger for high cost municipalities and decreases with the tax rate.

[30] I do not include population size since all the variables are expressed as per capita values.

Table 3: Main Results

	Ln (expenditure per capita)			Ln (revenue per capita)	Ln (tax per capita)
	(1)	(2)	(3)	(4)	(5)
Ln (Foncomun grant per capita)	0.561	0.717	0.64	-0.151	-0.096
	(0.059)**	(0.021)**	(0.048)**	(0.095)	(0.108)
Ln (Foncomun grant per capita) $\times$ X_i	0.195	-0.001	0.089	0.214	0.217
	(0.056)**	(0.000)**	(0.009)**	(0.103)*	(0.122)
Interaction term (X_i)	High cost	Average tax per capita	Average $\frac{a}{g-a}$	High cost	High cost
Observations	5422	5427	5429	5321	4666
R-squared	0.716	0.785	0.754	0.551	0.515

Notes: Robust errors in parentheses. Standard errors are clustered by municipality. * significant at 5%; ** significant at 1%. All regressions include a set of municipality socio-demographic characteristics, department fixed effects and department-specific trends. $\frac{a}{g-a}$ is equal to the ratio of Foncomun and non-Foncomun revenue. High cost is a dummy equal to one if a municipality does not have neither an automated tax system nor an updated cadaster.

Table 4: Additional Checks

	Ln (expenditure per capita)					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln (Foncomun grant per capita)	0.315 (0.125)*	0.412 (0.100)**	0.559 (0.060)**	0.722 (0.021)**	0.58 (0.043)**	0.722 (0.019)**
Ln (Foncomun grant per capita) × X_i	0.087 (0.036)*	-0.001 (0.000)*	0.2 (0.058)**	-0.001 (0.000)**	0.158 (0.041)**	-0.002 (0.000)**
Ln (Vaso de Leche per capita) × X_i					-0.178 (0.115)	0.001 (0.000)*
Interaction term (X_i)	High cost	Average tax per capita	High cost	Average tax per capita	High cost	Average tax per capita
Ln (Foncomun grant per capita) x district charac.	yes	yes	no	no	no	no
Flexible trend x Xi	no	no	yes	yes	no	no
Observations	5422	5427	5422	5427	5419	5424
R-squared	0.753	0.808	0.716	0.787	0.724	0.794

Notes: Robust errors in parentheses. Standard errors are clustered by municipality. * significant at 5%; ** significant at 1%. All regressions include a set of municipality socio-demographic characteristics, department fixed effects and department-specific trends. High cost is a dummy equal to one if a municipality does not have neither an automated tax system nor an updated cadaster. District characteristics in columns 1 and 2 include: poverty headcount, population density, percentage of urban population, and access to water, sewage, electricity and a dummy equal to one if the municipality receives the minimum amount of Foncomun.

6 Conclusion

This papers presents robust evidence consistent with costly tax collection being a determinant of the flypaper effect -the observed greater responsiveness of local government's spending to increases in grants than to increases in local income. In particular, the spending of municipalities with higher tax collection costs -proxied by the lack of administrative tools- exhibit a larger sensitivity to additional grants. I also find evidence of substitution of local revenue by grants, which is weaker among high cost municipalities.

The analytical framework simplifies previous models and provide a quantifiable expression of the magnitude of the flypaper effect as a function of tax collection costs and the tax rate. Moreover, it makes explicit the role of heterogenous funding costs as an explanation for the lack of fungibility. Grant recipients may be more responsive to increases in transfers because they are marginally cheaper than other revenue sources. This phenomenon is not exclusive of local public finances but also observed in the context of development aid.

In the model, the cost difference between transfers and local taxes is driven by the local government's failure to internalize the cost of funding the transfer scheme. This result points out a potential source of inefficiency in fiscal decentralization processes with overspending at local level.

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A Model extensions

A.1 Asymmetric income distribution

In the baseline model I assume a symmetric income distribution, such that the income of the average and median voter are the same. Let us relax this assumption and consider a more general case. Denote the median income as y_m and the average income as y, and define the ratio $k \equiv \frac{y_m}{y}$. I assume that k can be affected by changes on average income and that $0 < k < 1$. In this setup k captures the degree of income inequality between the average taxpayer and the median voter. The rest of the setup is the same.

With this modification, the government's budget constraint remains the same, $g = y\left[\tau - \Gamma C(\tau)\right] + a$, and the tax rate can still be written as $\tau = f(\frac{g-a}{y})$. However the equilibrium policy becomes

$$g^* = \arg\max \; y_m\left[1-\tau\right] + H(g)$$

because the politician maximizes the median voter's indirect utility.

Solving the maximization problem we can rewrite the equilibrium policy as:

$$g^* = h(kf'(\frac{g-a}{y})) \tag{16}$$

Recall that $h' < 0$ and thus the level of public spending decreases with income inequality k.

Taking total derivatives to (16) we obtain the propensities to spend out of local income and grants:

$$\begin{aligned} \frac{dg^*}{dy} &= \frac{yk'h'f'}{y - kh'f''} - \frac{kh'f''}{y - kh'f''}\frac{g^*-a}{y} \\ \frac{dg^*}{da} &= -\frac{kh'f''}{y - kh'f''} \end{aligned}$$

From these two expressions and definition (4) we can relate both propensities to spend to obtain the magnitude of the flypaper effect:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}(-\frac{k'}{k}\frac{f'}{f''}y + \tau - \Gamma C(\tau))^{-1} \tag{17}$$

Note that, similar to the case of symmetric income distribution, the magnitude of the flypaper effect is increasing on the administrative costs

shifter Γ. Moreover, in the particular case when the income distribution is unaffected by changes on average income, $k' = 0$, expression (17) becomes identical to (10).

A.2 Compliance and administrative costs

Consider a more general case with both compliance and administrative costs. In particular, for citizen i the compliance cost is $\Gamma_c C_c(\tau) y_i$ while for the tax authority the administrative cost represents a proportion $\Gamma_a C_a(\tau)$ of the tax base. Both $\Gamma_c C_c(\tau)$ and $\Gamma_a C_a(\tau)$ are increasing and convex functions and adopt values strictly between 0 and τ.

Given the previous assumptions, we can re-write equations (2) and (3) as

$$\begin{aligned} V_i &= y_i[1 - \tau - \Gamma_c C_c(\tau)] + H(g) \\ g &= y\left[\tau - \Gamma_a C_a(\tau)\right] + a \end{aligned}$$

Rearranging the budget constraint, we can express τ as a function of g:

$$F(\tau) \equiv \tau - \Gamma_a C_a(\tau) = \frac{g - a}{y} \tag{18}$$

where $F' > 0$, $F'' < 0$ by assumption 1 and convexity of $C_a(\tau)$. Since F is a monotonic function, we can write the tax rate as

$$\tau = f\left(\frac{g - a}{y}\right)$$

where $f(\cdot) = F^{-1}(\cdot)$.

It follows that the median citizen's indirect utility can be written as

$$y\left[1 - f - \Gamma_c C_c(f)\right] + H(g) \tag{19}$$

The maximization of equation 19 with respect to g provides the level of public spending in equilibrium;

$$g^* = h((1 + \Gamma_c C_c')f') \tag{20}$$

where $h(\cdot)$ is the inverse function of $H'(\cdot)$.

Calculating comparative statics from (20), we obtain:

$$\frac{dg^*}{dy} = -\frac{h'A}{y - h'A}\frac{g^* - a}{y} \tag{21}$$

$$\frac{dg^*}{da} = -\frac{h'A}{y - h'A} \tag{22}$$

where $A = (1 + \Gamma_c C_c')f'' + f'f'\Gamma_c C_c''$

From visual inspection of (21) and (22), and using definition (18), we obtain the following relation between both propensities to spend:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\frac{1}{\tau - \Gamma_a C_a(\tau)} \tag{23}$$

Note that the magnitude of the flypaper effect is similar to the obtain in the case without compliance costs. However, the propensities to spend are different.

Note that in the special case of no administrative costs, $\Gamma_c = 0$, expression (23) becomes:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\frac{1}{\tau^*}$$

Similar to the model only with administrative costs, this extension predicts a propensity to spend out of grants larger than the propensity to spend out of local income.