# Tax Me, But Spend Wisely : The Political Economy of Taxes, Evidence from Brazilian Local Governments*

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**Abstract**

This paper shows that local governments are more accountable when they have more capacity to tax their citizens. I construct a model in which a government is financed by taxes and federal transfers and the latter are imperfectly observed by citizens. Collecting more taxes lowers the share of rents in total public resources diverted by the incumbent politician because taxes lead to less informational rents than transfers. I then consider a program in Brazil that invests in the modernization of local tax administrations and evaluate its impact on both tax collection and local spending outcomes : the provision of education and political corruption. Using panel data on local public finance from 1999 to 2008 I find that the program increased tax collection of local governments by at least 12% after six years. Comparing the impact of an increase in taxes thanks to the program to that of an increase in federal transfers shows, in line with the model's predictions, that taxes lead to more education provision and less corruption than transfers.

**JEL classifications**: D72, D73, H20, H71, H77

*This is a preliminary draft. All comments are welcome (gadenne@pse.ens.fr).

# 1 Introduction

Local governments around the world generate very little of the revenue they spend. Scholars of local governments in developing countries also point out the poor quality of their governance and its impact on local public spending, ranging from carelessness in public good provision to outright diversion of public resources (Rose-Ackerman (1999)). Yet decentralization has been pushed forward for the last 30 years around the developing world as a way of bringing governments and service delivery closer to the people, with mixed results[1]. The idea that how these governments are financed, and in particular how much taxes they collect, may affect the quality of their public spending has been flagged out in the policy and development studies literature (Bird and Smart (2002), Brautigam et al. (2008)). Does this mean that making local governments collect more taxes will improve how they spend their revenues - and if yes, what kind of policy can increase local tax collection? Or will any increase in local budgets just lead to more inefficient spending and resources diversion by local politicians?

This paper provides a first answer to this question using a new political agency model and tests its predictions by looking at the impact of a program that helps local government in Brazil raise more taxes on the provision of local public goods and corruption. It has three main contributions. First, I construct a model that provides theoretical foundations for the long-standing argument in political sciences and development studies that how governments are financed affects their accountability and responsiveness to citizens' needs, with taxation generally seen as leading to better public spending outcomes than natural resources revenues or development aid[2]. I consider one of the characteristic of taxes that makes them different from other sources of revenue : citizens have better information on taxes they pay themselves than on revenue that their government receives without having to interact with them, such as intergovernmental grants. Using a political agency model with rent-seeking politicians who have discretion over how to spend public revenue coming from taxes and grants, I show that when the former are better observed than the latter increasing the amount of taxes collected will lead to a fall in the share of the total budget that is diverted by the politicians. The key prediction is that a policy that lowers the cost of collecting taxes and thus increases local tax collection will lead to a bigger rise in local public good provision, and less increase in resources diversion, than raising grants by the same amount. Using an assumption common in the Public Choice literature - politicians are self-interested agents using the state to pursue private ends - the model therefore leads to a conclusion very distant from the classic Public Choice result that inefficiencies in tax collection may raise welfare by acting as a restrain on government (Becker and Mulligan (2003)) and much closer to the Pigouvian tradition that applauds tax efficiency.

Second, I provide some empirical evidence on how a policy that improves tax administrations is effective in increasing both tax revenues and the provision of public services. Though the importance for development of constructing efficient and fair tax

[1] See Bardhan and Mookherjee (2006) for a review.
[2] See Moore (2007) for a review of this literature.

administrations has long been pointed out in the policy literature there is scant evidence on how this can be achieved[3]. Widely optimistic prognoses on the efficiency of investments in developing countries' tax administrations abound :OECD (2010b) for example reports the words of the President of the African Tax Administration Forum, Oupa Magashula, that investing in public resource mobilization can have up to "a tenfold multiplier effect on states' resources". To the best of my knowledge this is not backed by any empirical investigation of the effectiveness of such investments. I evaluate the impact of a program in Brazil that provides local government with subsidized loans to make such investments. Using a flexible difference in difference methodology and a decade of detailed local public finance data I show that the program increased taxes in participating local governments by more than 12% after six years in the program, with no sign of the program's impact tapering off over time. The 'multiplier' effect of one Real of investment was an extra three Reais of tax collection after 6 years, far from tenfold but very cost-effective. Panel data on local education inputs and reports from the randomized audits of local governments which provide information on the extent of misgovernance - or corruption writ large - of local administrations allow me to consider whether the extra tax revenue was spend in a way that benefits citizens. I find that the program led to a an increase in local school inputs of 5%, suggesting that three-fourth of the increase in taxes was spend on education inputs. There is no increase in the occurrence of audited irregularities due to the program, despite the increase in resources available to the politicians.

Finally, I test the model's main prediction that increasing local taxes will lead to better public spending outcomes than increasing intergovernmental grants - what I call the *accountability effect of taxes on the allocation of public spending*. Instrumenting for tax collection using program participation, and for the amount of federal grants received using a discontinuity in the allocation rule of these grants[4] I compare the impact of a one Real increase in taxes to that of a one Real increase in transfers. I find that transfers lead to more misgovernance and three times less education inputs than taxes.

This paper's theoretical approach is related to previous political economy models which argue that information asymmetries lead to more rent-taking opportunities by politicians (see, in particular, Besley and Smart (2007)), and several empirical articles which have shown that providing citizens with more information leads to better governance outcomes[5]. Strumpf (1998) builds on the idea that citizens may have different information on different sources of local public funds to explain the fly-paper effect, but overall the idea that how governments are financed matters for the quality

[3]See for example OECD (2010b)on the need to build up tax capacity in developing countries, and Besley and Persson (2009) on the role of fiscal capacity in state-building. For a recent effort to consider what type of tax administration facilitates tax enforcement in a developing country setting see Pomeranz (2010).

[4]I follow the method used by Brollo et al. (2010)

[5]In the Brazilian local government context Ferraz and Finan (2008)show that citizens are less likely to re-elect the incumbent when they are given information about its corrupt practices, and even more so in local governments where a local radio is present. See also Reinikka and Svensson (2005) for evidence on how a newspaper campaign providing information on local public funds reduced capture by local officials in Uganda.

of government spending has hardly been addressed in the economic literature. An exception is Zhuravskaya (2000) who finds that Russian cities that have stronger fiscal incentives provide public goods more efficiently. This suggests that letting local governments keep more of the taxes they collect may make them more efficient, but does not address the question of whether increasing local capacity to tax would have the same impact.

One question that has attracted much attention in the literature is the impact on government spending outcomes of an increase in public resources - whatever the origin of those public resources. Other studies using data on Brazilian local governments in particular have provided evidence regarding this question. Brollo et al. (2010) find that higher grants from the federal government leads to more corruption, whilst Litschig (2008a) shows that these grants also lead to better education outcomes. The impact of oil windfalls is explored by both Caselli and Michaels (2009) and Ferraz and Monteiro (2010) who find that they lead to no improvement in local outcomes related to public goods, but to an increase in public employment(Ferraz and Monteiro (2010)). In Indonesia, Henderson and Kuncoro (2004) find that higher local public revenues make local officials ask for less bribes, instrumenting local revenues by past local tax collection levels. This paper provides a theoretical framework that helps explain these previous findings by predicting that revenue sources that are less transparent (oil revenues, intergovernmental grants) will lead to worse public spending outcomes than the more transparent ones such as taxes. It builds on the wealth of available empirical evidence for Brazil by replicating the methodology used by Brollo et al. (2010) and Litschig (2008a) to study the impact of grant revenue on public spending outcomes, and compares it to the impact of taxes .

The outline of the paper is as follows. Section 2 provides an agency model of public finance that relates how governments are financed to how they spend their resources. Section 3 presents the public finances and expenditure responsibilities of Brazilian local governments and the tax capacity program I am interested in. Section 4 introduces the data and econometric strategy, Section 5 presents the results and a series of robustness checks. I conclude with Section 6.

# 2 Model

## 2.1 Set-Up

*Structure and optimal policy*

This model follows the political agency framework of Besley and Smart (2007) in which a representative citizen decides wether to re-elect an incumbent politician without observing part of this politician's actions. To represent the structure of public finance faced by most local governments around the world I assume that the incumbent has discretion over how to spend public resources $R$ which come from taxes $T$ and inter-governmental grants $X$. He chooses how much public good $G$ he will provide

and how much rent $S$ he will divert from the public budget so the government budget constraint is equal to $T + X = R = G + S$. This choice is limited by institutional constraints which make it costly for him to run away with all public resources, so maximal rent taking is $\bar{S} = \alpha R$ where $\alpha < 1$.

The representative citizen derives utility from the provision of public good net of taxes. Her welfare is $W(G, T) = V(G) - \phi C(T)$ where $\phi$ indexes the marginal cost to the citizen of paying taxes, $V$ is increasing and strictly concave, and $C$ increasing and strictly convex.
The socially optimal policy is given by :

$$V_G(G^{opt}) = \phi C_T(T^{opt}),$$

where $G^{opt} = T^{opt} + X$. A benevolent government would capture no rents.

*Rent-seeking politicians and information asymmetries*

Assume now that all politicians are purely rent-seeking. The incumbent chooses $G$ and $S$ to maximize the sum of rents extracted from being in office $S + \sigma Z$, where $Z$ is the value of re-election and $\sigma$ the probability of re-election. Capturing maximal rents is more attractive to the incumbent than getting no rents today but being re-elected for sure, so $Z \leq \alpha(T + X), \forall T$[6]. Challengers in the election would behave in the same way as the incumbent; the election is only a way for the citizen to discipline the incumbent, not to choose the best type of candidate.

The politician has perfect information over all variables. The citizen observes public good provision but does not know the amounts of rents diverted and does not perfectly observe the amount of public resources available. The key assumption is that the citizen has more information on the taxes that she pays than on the grants the politician receives : $T$ is perfectly observed but she only knows about a share $i$ of the grants, where $i \in [0, 1]$ reflects the amount of information she has. She perceives the government budget to be $R_i = T + iX$.

## 2.2 Equilibrium

### 2.2.1 Equilibrium level of taxes and public good provision

The only thing that can make a rent-seeking politician deliver some public good is the possibility of this leading to a re-election. The citizen's strategy is therefore to choose the reelection rule $\sigma(G, T)$ that will induce the politician to provide the policy menu $(G, T)$ that maximizes her welfare. The maximum level of public good $G$ she can obtain from the government when paying $T$ must be so that it leaves the government with enough rent today to make abiding by the re-election rule more attractive than running

[6]This assumption simply says that rents that can be captured from still being in power next period are no bigger than the maximal rents that could be had today and that politicians discount future rents.

away with maximum rents today and forgoing re-election. The citizen perceives this constraint on the re-election rule to be:

$$T + iX - G + \sigma(G, T)Z \geq \alpha(T + iX)$$

Re-electing the incumbent leads to an increase in the public good at no cost to the citizen so that in equilibrium she sets $\sigma(G^*, T^*) = 1$ as long as the government provides

$$G^* = (T^* + iX)(1 - \alpha) + Z, \tag{1}$$

with $T^*$ set such that the marginal value of the public good is equal to the marginal cost of taxation :

$$(1 - \alpha)V_G(G^*) = \phi C_T(T^*). \tag{2}$$

The incumbent is capturing rents equal to :

$$S^* = (T^* + X)\alpha + X(1 - \alpha)(1 - i) - Z \tag{3}$$

Because a share of public resources is diverted towards rents the citizen is paying more taxes and receiving less public good than in the optimal policy. To see this note that if she paid $T^* = T^{opt}$ she would get less public good provision than the optimal $G^{opt}$ violating equilibrium condition (2) : the marginal value of the public good would be higher than the marginal cost of taxation. Equating the marginal cost and the marginal value of public spending in an equilibrium with positive rents thus requires higher taxes and less public good provision than the optimal policy.

The share of public resources diverted towards private rents in equilibrium can be written as

$$s^* = S^*/R^* = \alpha + X^*/R^*(1 - i)(1 - \alpha) + Z/R^* \tag{4}$$

Note that even in a perfect information setting ($i = 1$) the politician captures a share $\alpha - Z/R$ of public funds. This share is composed of 'power rents', those that the incumbent can extract by threatening to forgoe re-election in period 2 and capture maximal rents today. Introducing imperfect information on the amount of transfers received ($i < 1$) allows the politician to capture a higher share in rents, simply due to the fact that it can divert those resources which the citizen does not know it receives.

### 2.2.2 Impact of different sources of public finance on the quality of government spending

Rewriting the share of rents as a function of the share of taxes in total revenue $\theta = T/R$ we see that the structure of public finance (where public revenue comes from) is going to affect the distribution of public spending between rents and public good provision:

$$s^* = S^*/R^* = \alpha + (1 - \theta^*)(1 - i)(1 - \alpha) + Z/R^* \tag{5}$$

I call this is the *accountability effect of taxes on the allocation of public spending* : as the share of taxes in revenue increases, so does the share of revenues that is spend

towards increasing the citizen's welfare. Intuitively, increasing the share of taxes increases the amount of information the citizen has on her government's budget and thus limits the extent to which a rent-seeking politician can capture public funds by 'hiding' them.

The empirical part of this paper looks at the impact of taxes and intergovernmental grants on the total amount of public good provided and the total amount of public resources diverted. Taking derivatives of equations (1) and (3) with respect to both sources of public finance shows that both rents and public good provision are increasing in the level of taxes and grants, but at different rates. A rise in taxes of one unit will lead to a higher increase in public good provision than a rise in transfers of the same amount :

$$\frac{\partial G^*}{\partial T^*} = 1 - \alpha > \frac{\partial G^*}{\partial X} = (1-\alpha)i \tag{6}$$

And similarly, because $\frac{\partial G}{\partial F} = 1 - \frac{\partial S}{\partial F}, \forall F = T, X$ a rise in taxes will lead to less increase in rents than a rise in transfers.

## 2.3 Impact of a reform of the tax administration

Consider now the impact of a reform of the tax administration that makes it more efficient. In this model this will simply take the form of a smaller difference between the cost of taxation borne by taxpayers $\phi C(T)$ and how much taxes go in the government budget $T$ : the reform decreases $\phi$[7]. This makes the citizen more willing to pay taxes in order to get more public good. Using equation (2) the impact of the reform on taxes is given by :

$$\frac{\partial T^*}{\partial \phi} = \frac{C_T(T^*)}{(1-\alpha)^2 V_{GG}(G^*) - \phi C_{TT}(T^*)} < 0 \tag{7}$$

The reform will also lead to an increase in public good provision and rents diverted proportional to the increase in taxes :

$$\frac{\partial G^*}{\partial \phi} = (1-\alpha)\frac{\partial T^*}{\partial \phi} \tag{8}$$

$$\frac{\partial S^*}{\partial \phi} = \alpha \frac{\partial T^*}{\partial \phi} \tag{9}$$

The overall impact on welfare is positive :

$$\frac{\partial W}{\partial \phi} = -C(T^*) \tag{10}$$

This leads to a first testable proposition of the impact of a tax administration reform:

**Proposition 1** *A reform that decreases the cost of paying taxes leads to an increase in taxes.*

[7]One could also model the efficiency of the tax administration by introducing a cost to the government of levying taxes. The reform would then lower that cost leaving the results of this model unaffected.

A second proposition follows from the result above showing that an increase in taxes will lead to a bigger increase in public good provision and a smaller increase in rents diverted than an equivalent increase in grants (equation (6) ). Applying this result to the reform considered we get the following proposition :

**Proposition 2** *The rise in taxes due to this reform leads to more increase in public good provision than a rise in grant revenue of the same amount :* $\frac{\partial G^*}{\partial T^*}\frac{\partial T^*}{\partial \phi} = (1-\alpha)\frac{\partial T^*}{\partial \phi} < \frac{\partial G^*}{\partial X}\frac{\partial T^*}{\partial \phi} = (1-\alpha)i\frac{\partial T^*}{\partial \phi}$. *Conversely the rise in taxes will lead to a smaller increase in rent-taking than an equivalent rise in grants.*

# 3 Context : Brazilian local governments and the PMAT tax capacity program

## 3.1 The Public Finances of Brazilian Local Governments and the PMAT program

The 1988 Brazilian constitution devolved substantial expenditure responsibility and tax autonomy to the country's more than 5,500 local governments[8]. On the tax side this takes the form of quasi complete discretion over three main local taxes : a tax on the sale of services, a tax on urban property, and a tax on the sale of property. The rates and bases of these taxes, as well as the method of tax assessment and collection, are decided by the mayor in conjunction with the local legislature, leading to a great diversity across local governments in both the form of taxation and amounts collected : in 2008 local governments collected anything from 2 to 2000 Rs per capita[9].

There is however a great difference between municipalities' *de jure* tax capacity and their *de facto* tax collection - they collect less than 13% of their total revenue themselves. This has attracted much policy attention in Brazil and is often explained by the poor quality of local tax administrations (Afonso and Araujo (2006)). Little is known about local Brazilian tax administrations, but the few accounts available paint a dire picture of unskilled and overworked staff with outdated tax registers, no institutional memory, a lack of methods to accurately assess tax liabilities, and high costs of understanding and paying taxes for the citizens, pushing them into non-compliance. In BNDES (2002) for example local government officials admit to tolerating a situation of ongoing tax amnesty, where tax arrears are rarely recovered, and an extensive study of the property tax collection in Brazil's largest metropolitan areas estimates that less than 60% of urban property is registered on any tax administration's files (de Carvalho Jr. (2006)).

The remainder of local revenues come from state and federal transfers. The largest one is the *Fundo de Participacao dos Municipios* (*FPM*) which represents 43% of local

[8]Bardhan and Mookherjee (2006) classify Brazil as one of the few developing countries in which local governments have been given substantial tax autonomy.

[9]All statistics in this section are computed by the author using the FINBRA database on local governments' public finances and program data from the BNDES.

governments' revenues, and is a constitutionally mandated block transfer. This study focuses on this transfer, both because of its share in public revenue and because the amount of *FPM* resources received by each municipality depends on population size in a discontinuous fashion, making it possible to identify the impact of extra grants on public spending outcomes by comparing municipalities around the threshold. This *FPM* allocation rule has been used by two recent papers - Brollo et al. (2010) and Litschig (2008a) -, because using it is not a novelty of this paper the interested reader is referred to the appendix for more details.

The *Programa de Modernizacao de Administracao Tributaria* (PMAT) program was launched in 1998 by the Brazilian Development Bank (BNDES) to increase municipalities' capacity to tax their citizens[10]. It provides local governments with subsidized loans to invest in modernizing their tax administration and is available to all municipalities in Brazil. Administrations have to prepare a detailed tax modernization project which is then assessed by the BNDES to check it qualifies with the program's requirement[11]. The funds are disbursed over a two to four years period, after which local governments have up to 6 years to reimburse the loan. 321 local governments started a PMAT program between 1998 and 2008, for an average loan of 1.6 million 2000 Reais, less than 2% of local revenue. Each local government was left free to choose the type of actions to take to modernize its tax administration but 'best practices' spread as the same firms or civil servants were involved in the development of several PMAT projects.

## 3.2 Expenditure responsibilities of Brazilian Local Governments

This project focuses on two aspects of the expenditure side of local governments' budgets : their spending on education inputs, and the extent to which public resources are wasted or diverted by local politicians. This is justified by data availability and the importance of both in the allocation of public revenue and Brazilian debates about fiscal federalism, as explained below.

The Brazilian constitution stipulates that states and municipal governments share the responsibility for the provision of primary and secondary education. In practice state governments manage secondary schools, while municipal governments generally manage primary schools (*ensino fundamental*). By 2005, approximately 85% of all grade 1 to 4 schools were run by local governments (the remainder being private or state primary schools) which are responsible for providing school infrastructure, school lunches and transportation, and hiring, training, and paying teachers (see Ferraz et al. (2009)). Education is the largest budget item of local governments, representing nearly 30% of expenditures. There is a growing concern with the poor quality of the provision

[10]For more on the program and the context of its creation see Santos et al. (2008), BNDES (2002) and Afonso and Serra (1999).

[11]Projects were never directly rejected by the BNDES which only requires that funds are spend on modernizing the tax administration, though lack of proof of compliance to some federal regulations (for example the existence of overdue debt payments to a federal agency) did make some local governments ineligible.

of primary education by local governments in Brazil (Ferraz et al, 2009), fueled in part by numerous cases of mayors diverting resources from educational block grants[12].

This embezzlement, or misuse more generally, of public funds, is the second major characteristic of Brazilian local governments this project considers. There is considerable information on how local governments divert public resources away from public uses in Brazil thanks to the anti-corruption program launched by the federal government in 2003. Since then over 1800 local governments have been randomly chosen by lottery to be audited by staff of the *Corregedoria Geral da Uniao* (CGU), an independent audit agency. They audit the use of federal transfers by local governments for the last two years by collecting administrative documents and interviewing citizens and administrative staff; they check for example whether spending can be accounted for by receipts, whether program rules are met, and whether procurement of public works is done competitively. The results of those audits are publicly available records, from which an index of corrupt/wasteful practices can be built and several conclusions regarding the prevalence, and determinants, of corruption 'writ large' have been drawn[13]. Ferraz and Finan (2009) estimate using this data that approximately 1.5 Billion Reais was diverted by local governments in 2002.

It is important to note that the CGU's mission is to audit only how federal transfers assigned to a specific expenditure function are spend : the use of public funds over which local governments have full discretion (unconstrained public funds) is not audited, except when they are used to co-finance projects using specific federal funds. Those unconstrained public funds are made up of local tax collection and *FPM* grants[14], the two types of local resources I consider. There is thus no reason to expect an automatic relationship between an increase in either of those resources and the likelihood that the CGU audits report irregularities in the use of federal funds (in other words the CGU does not have more to audit when taxes or *FPM* grants go up). In the analysis below I use variations in the quantity of irregularities reported as evidence regarding the overall level of abuses of public funds by local politicians, as the theory predicts that grants and taxes should have different impacts on the share of rent-taking in total public resources, not just in total tax or grant revenue.

[12]Transparencia Brazil estimates that 13% to 55% of the country's largest educational transfer between 2001 and 2003 was embezzled (Transparencia Brazil, 2005).

[13]Apart from the Brollo et al. (2010) paper referred to above, Ferraz and Finan (2009) show using data compiled from those reports that mayors with re-election incentives misappropriate less resources, and that access to information strengthens the role of electoral incentives. Ferraz and Finan (2008) find that the release of audit outcomes has a significant impact on the incumbent's electoral performance, whilst Ferraz et al. (2009) argue that corruption significantly reduces the school performance of primary school students.Litschig and Zamboni (2008) find that the presence of judicial institutions in the municipality significantly reduces the extent of irregularities committed by civil servants.

[14]Local governments are supposed to spend at least 15% of their *FPM* grants on health care and on education provision but this requirement is not enforced, and *FPM* transfers are never audited separately by the CGU.

# 4 Data and empirical strategy

## 4.1 Data

Data on participation to the PMAT program, date of program uptake, and amount borrowed through the program have been collected by the author at the BNDES. I use public finance data for the years 1999-2008 from the FINBRA dataset of the *Tesouro Nacional* to get the detailed revenue sources of local governments, in particular total amount of tax collected and total amount of FPM transfers received. Data on public spending outcomes comes from two sources. Panel data on education inputs come from the yearly *Censos Escolar* which contains information on Brazilian schools and indicates which institution (private, local, state or federal government) is in charge of the school. I use the number of school employees and the number of school classrooms per thousand school-age (under 15) inhabitants as indicators of how much local governments are spending on education inputs. I have public finance and education data for 5224 municipalities over the period 1999-2008. These constitute the large sample used for most of the analysis, which covers nearly 95% of Brazilian local governments. Data on the extent of misappropriation/irregular use of public funds comes from the irregularities recorded by the CGU in its corruption audits for the years 2003-2006, and was obtained from Litschig and Zamboni (2008). It is available for a smaller sample of 971 municipalities, 54 of which joined the program. I construct a 'misgovernance' index from this data by scaling the number of irregularities by the number of potential 'offenders'- civil servants in the local government administration[15] - and the total amount of government revenue audited to control for the intensity of the search for irregularities undertaken by the CGU.

In all my specifications I control for a large number of municipal characteristics that are likely to be correlated with both public spending outcomes and tax collection at the local government level. Panel type controls include municipal GDP per capita, local population, density, and the share of agriculture and services in GDP, all obtained from the municipal level estimates published yearly by the Brazilian Statistical Institute (IBGE) . The share of agriculture is generally considered to be a proxy for the share of the informal sector in the economy, considered harder to tax, whilst having a large share of services in GDP is likely to increase local tax collection (one of the main local taxes is a service tax) and higher population density could make tax collection easier. The 2000 Census provides a series of variables generally considered to affect the ease of collecting taxes, the quality of government, and/or local demand for public goods : median education level, inequality (Theil index) and life expectancy. Finally I use variables specifying the type of political incentives faced by the incumbent government which are available for each municipal term in my period (1997-2000, 2001-2004, 2005-2008): the extent of political competition (Herfindhal index[16]), the mayor's political party, and whether the mayor faces a term limit.

[15] This is obtained from the dataset *Perfil dos Municipios Brasileiros* 1998, published by the IBGE.

[16] The Herfindhal political competition index is defined as one minus the sum of squares of the vote shares of each candidate running in the election. It is increasing in political competition.

Table 1: Descriptive Statistics, 1999-2008

| | Control | Treated | Difference |
|---|---|---|---|
| **Large Sample** | | | |
| Taxes per capita | 37.5 (71.8) | 108 (91) | 59.5*** |
| Nb Classrooms | 16.3 (7.4) | 10.9 (4.7) | -5.4*** |
| Nb School Employees | 48.3 (24) | 34.7 (16) | -13.7*** |
| GDP per capita | 4461 (5065) | 7636 (6355) | 3174*** |
| Population | 21756 (66841) | 198205 (729726) | 175*** |
| Agr\GDP (%) | 24.9 (15.7) | 10(12.3) | 14.8*** |
| Serv\GDP (%) | 55.3 (14.2) | 55(12.1) | 0.3 |
| Density | 77.7 (443) | 549.8(1468) | 472*** |
| Income per capita | 2001 (1067) | 3596 (1455) | 1594*** |
| Inequality (Theil index) | 52.3 (11.2) | 53 (11) | 0.009*** |
| Median Education level | 4 (1.2) | 5.7 (1.2) | 1.7*** |
| Political competition (Herfindhal index) | 0.51 (0.12) | 0.58 (0.1) | 0.06*** |
| Term limit | 0.21 (0.40) | 0.21 (0.40) | 0.006 |
| Nb municipalities | 321 | 4903 | |
| **Small Sample** | | | |
| Misgovernance index | 183.1(443) | 74.5(173) | 108.7* |
| Nb municipalities | 958 | 54 | |

Tax GDP and income variables are per capita and in 2000 Rs. The number of classrooms and the number of school employees is per thousand under 15 inhabitants. The governance index is the number of irregularities reported in the corruption audits per million 2000 Rs audited and per 100 civil servants. Income per capita, inequality and median education level are Census variables available for the year 2000 only. Political competition and the second term variable take one value per 4 year mayoral term. All other variables are panel variables, averages taken for 1999-2008.

Table 1 presents descriptive statistics for the 5224 municipalities in the sample, 321 treated municipalities which joined the program before 2008, and 4903 control municipalities. The treated municipalities are different from the control ones amongst nearly all dimensions relevant to the analysis, the most striking facts being that they are nearly twice are rich and ten times more populated. They also have a better educated population and a more industrial economy, characteristics that are expected to increase tax collection and may improve the quality of the government; and they are a little more unequal and have more competitive elections (with no impact on the likelihood that a mayor gets re-elected). Outcome measures are also significantly different for treated and control municipalities, though some of these differences existed before the program started and will be controlled for in the identification strategy. Treated local governments collect on average nearly 110 Reais per capita in taxes, nearly three times more than the average control governments. They have on average 10 classrooms and 30 teachers per thousand school age inhabitants, significantly less than control municipalities, and have a lower occurrence of offenses committed by civil servants.

## 4.2 Empirical Strategy

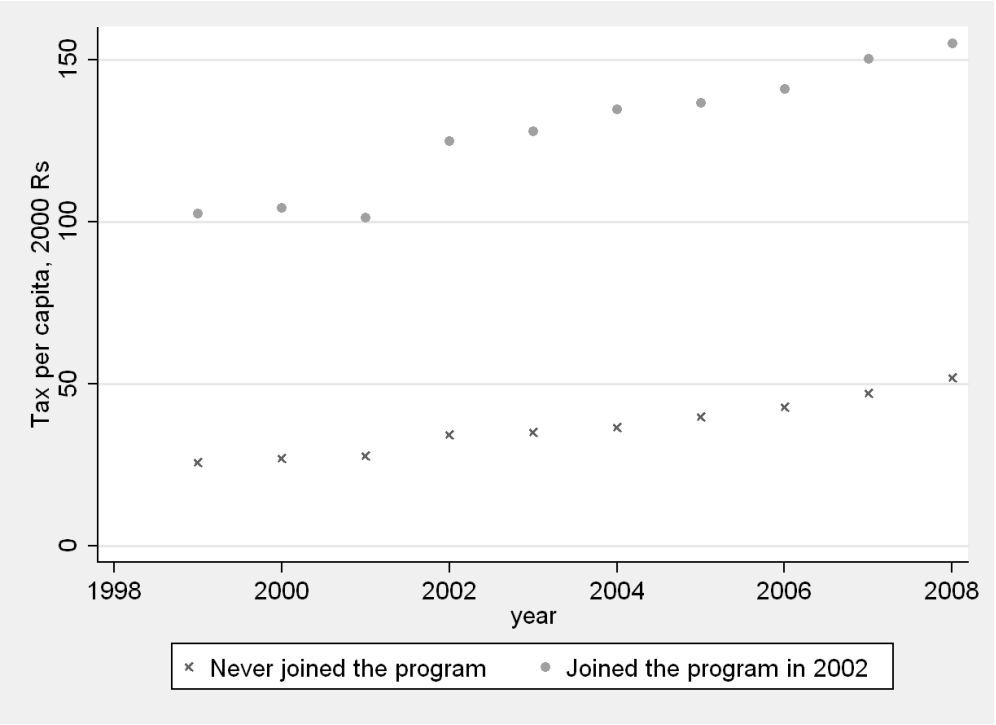
I test the model's predictions in two steps. The the first part considers whether the program increased tax collection and public spending outcomes (Proposition 1 above). The second tests for the accountability effect of taxes on the allocation of public spending by comparing the impact of an increase in taxes thanks to the program to an increase in grants on local spending outcomes.

### 4.2.1 Impact of the program on tax collection

The first part of my empirical strategy uses a flexible difference-in-difference methodology by comparing the evolution of several outcomes between control and treated municipalities. The type of variation used to identify the impact of the program is apparent in figure 1 which plots tax collection per capita for each year from 1999 to 2008 for municipalities which never joined the program (control municipalities) and for the 63 municipalities which joined in 2002. We see that treated municipalities started with much higher tax collection in 1999, and that both groups experience an increase in their tax collection over the period. There is however a clear jump of about 25 Reais in tax collection for the treated municipalities in the year in which they join the program, and not for the control municipalities. This is followed by an increase in tax collection from 2002 to 2008 that follows a steeper trend than that experienced by municipalities which never joined the program.

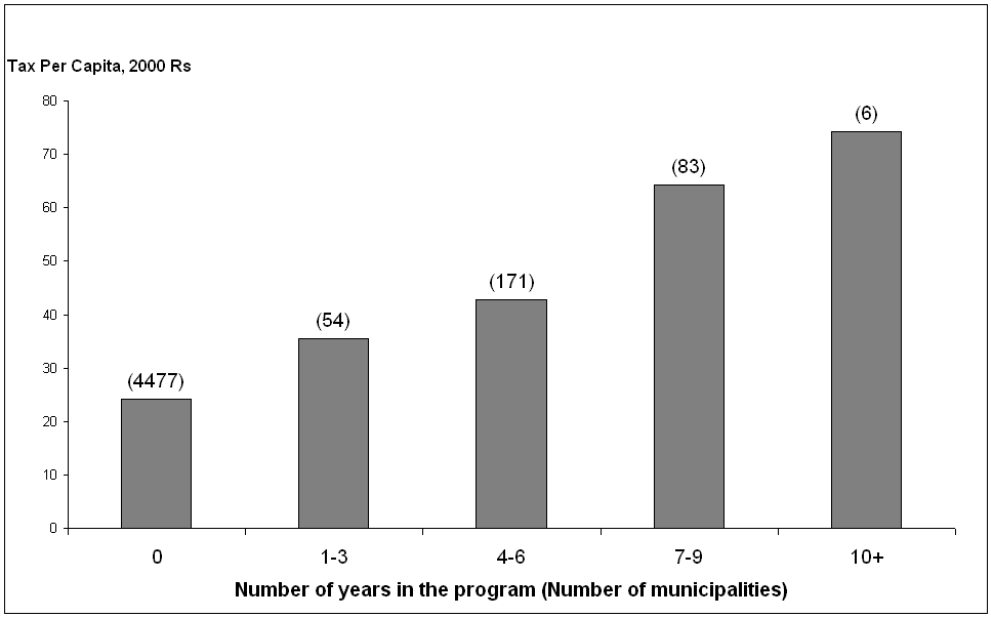
Figure 2 illustrates the need to allow the program's impact to be dynamic. It presents the increase in taxes per capita between 1999 and 2008 for municipalities as a function of the amount of time spend in the program. Municipalities which never joined (0 years) saw their tax collection increase by 25 Reais per capita. It is clear that municipalities which joined the program experienced a larger increase in tax collection, the more so the longer they were in the program : municipalities which

Figure 1: Taxes per capita in control municipalities and municipalities that joined the program in 2002, 1999-2008



joined the program in and after 2006 (1 to 3 years in the program) saw their taxes rise by 37 Reais per capita on average, but the 6 municipalities which joined in 1998 or 1999 (10 years or more in the program) increased their taxes by nearly twice as much. This suggests that the full impact of the program on tax collection is not immediate, and that it could still be leading to increases in tax collection many years after all the program money has been spend. This isn't surprising given the flexibility offered by the program (some municipalities waited four years after the signature of the project to spend all their funds) and the nature of the investments in tax administration undertaken by the municipalities. Actions like the decentralization of tax offices and the simplification of the tax payment procedures take time to be fully implemented. Other actions, like the improvement of the system for collecting tax arrears, are likely to affect the citizens' attitudes towards paying taxes by making non-compliance less attractive, a process likely to take time to materialize.

Figure 2: Change in tax revenue between 1999 and 2008 by number of years spend in the program




I thus estimate the impact of the program on tax collection by running the following regression :

$$Y_{i,t} = \beta_0 + \beta_1 P_{i,t} + \beta_2 Status_i + \delta Z_{i,t} + \gamma_t + \mu_s + \epsilon_{i,t} \quad (11)$$

where $Y_{i,t}$ is either tax collected per capita in 2000 Rs in municipality $i$ in year $t$, the number of school employees per thousand school age inhabitants, the number of classrooms per thousand school age inhabitants, or the misgovernance index described above. $P_{i,t}$ is a dummy equal to 1 if the municipality is in the program at year $t$,

$Status_i$ a dummy equal to one if the municipality joins the program at some point between 1998-2008, $\gamma_t$ a set of year dummies, $\mu_s$ a year of state dummies, and $Z_{i,t}$ is a set of municipal characteristics. To estimate the dynamic impact of the program I replace the treatment variable $P_{i,t}$ by dummies equal to 1 if the municipality has been up to 3 years in the program, between 3 and 5 years, and 6 years or more. The cost-effectiveness of the program is of interest, so I also estimate the impact of one Real per capita lend to the municipality through the program by interacting the program dummy (or dummies, for dynamic impact) with the amount lend.

This method identifies the program's impact under the assumption that the evolution of outcomes in municipalities which join the program would have been the same in the absence of the program as the evolution in municipalities that never joined the program[17]. The fact that local governments did not all join the program in the same year allows for additional flexibility compared to a standard difference in difference approach. It allows me to control for a (quadratic) specific time trend for the municipalities which join the program, despite the fact that my sample starts after the launch of the program in 1998. This trend is estimated thanks to the municipalities which join the program later in the sample[18]. The difference in timing of entry into the program also introduces a new source of potentially misleading variation. If municipalities which joined early collect more taxes than those which joined late regardless of the program my estimate of $\beta_1$ will be biased upwards. I therefore allow for pre-existing differences not only between treated and control municipalities (control $Status_i$ in (11)) but also for pre-existing differences between municipalities which started a program at different dates, in an alternative specification with replaces variable $Status_i$ by a set of cohort fixed effects - dummies $SJ_i$ equal to 1 if municipality $i$ joined the program in year $J$. Note that controlling for cohort fixed effects and specific time trend is only appropriate when I allow the impact of the program to be dynamic. Both these types of control are otherwise likely to capture part of the dynamic effect of the program, biasing the coefficient on static program impact (downwards if the impact of the program is increasing over time) - see Wolfers (2006) for a discussion of treatment dynamics in a difference-in-difference context.

#### 4.2.2 Impact of an increase in taxes and an increase in transfers on education inputs and corruption

The second part of my empirical strategy estimates the impact of an increase in different types of revenue (taxes or federal $FPM$ grants) on public expenditure outcomes through equations of the form :

$$Y_{i,t} = \pi_{0F} + \pi_F F_{i,t} + \eta_F Z_{i,t} + \gamma_{Ft} + \mu_{Fs} + v_{i,t} \forall F = T, X, \tag{12}$$

where $Y$ is education inputs per capita or the misgovernance index, $F$ is either taxes or $FPM$ grants per capita, and the other variables are as in equation (11). It is likely that

[17] Standard errors are clustered at the municipality level to avoid the bias due to serial correlation pointed out by Bertrand et al. (2004).

[18] In 2002 for example 70% of the treated municipalities have not joined the program yet.

unobservable characteristics determining public spending outcomes also determine the amount of taxes or transfers available to local governments. We can think for example that in municipalities where the administration is known to be less corrupt citizens are more willing to pay taxes, and the federal government is more willing to provide discretionary transfers. I therefore use two different instrumentation strategies to estimate the impact of taxes and transfers on $Y_{i,t}$.

To identify the impact of collecting more taxes I use program status (the three dummies for having been in the program a certain number of years) as an instrument for tax collection. Equation (11) above is thus the first stage of an instrumental variable estimation strategy that considers how an increase of 1 Real in taxes thanks to the program affects education inputs and the misgovernance index. The estimated equation is

$$Y_{i,t} = \pi_{0T} + \pi_T T_{i,t} + \eta_T Z_{i,t} + \gamma_{Tt} + \mu_{Ts} + v_{i,t}, \tag{13}$$

where $T_{i,t}$ is instrumented for using the dummies for program status. This identifies the impact of an increase in taxes thanks to the program under the assumption that the evolution of the public expenditure outcome considered would have been the same in program municipalities in the absence of the program than in the municipalities which never joined the program. The controls used to estimate the impact of the program are also necessary here : I estimate equation (13) controlling for pre-existing differences between treated and control municipalities (dummy for program status or cohort fixed effects) and a quadratic specific time trend.

The impact of intergovernmental grants is identified using the exogenous variations in the amount of $FPM$ grants received generated by the transfer allocation rule outlined in the appendix. This rule specifies that all municipalities in the same state and in a given population bracket should receive the same amount of transfers. Appendix figure 3 shows that, although there are multiple cases of misassignments around the thresholds, the amount of FPM transfers received by municipal governments displays clear jumps at each threshold. Following Brollo et al. (2010) I therefore use a fuzzy regression discontinuity approach, using the amounts that the rule predicts each municipality should receive (theoretical transfers) as an instrument for the grants actually received and controlling for a high-order polynomial in population size. The estimated equation for transfers is

$$Y_{i,t} = \pi_{0X} + \pi_X X_{i,t} + \eta_X Z_{i,t} + \gamma_{Xt} + \mu_{Xs} + v_{i,t}, \tag{14}$$

where $X_{i,t}$ is $FPM$ resources per capita, instrumented for using the amount of $FPM$ per capita the municipality should have received according to the rule.

# 5 Results

## 5.1 Evaluating the impact of the program

### 5.1.1 Impact on taxes

Table 2 presents the results from estimating equation (11) under different specifications. Column 1 shows that being in a PMAT program on average increased taxes by nearly 15 Rs per capita. Tax collection per capita was just under 100 Rs per capita on average in treated municipalities the year before they join the program so this corresponds to a 15% increase. The second column allows for the impact of the program to be dynamic. We see that the increase in tax collection happened gradually over time and that there is no sign of it being a mere temporary increase : whilst half the average impact of the program is obtained during the first two years of the program it keeps increasing tax collection at least until the 6th year in the program. Investments in the tax administration take time to reach their full collection potential, which is coherent with the fact that these are long-term investments, as discussed above. The total impact of the program after 6 years is given by adding the coefficients for the three program dummies and suggests an increase in tax collection of 30%. Columns 3 and 4 consider the cost effectiveness of the program by looking at the impact of one Real per capita loaned through the PMAT program. On average one Real of loan led to an extra 1.8 Real per capita of tax collection, making the program highly cost effective (the real interest rate paid by municipalities over the period was around 4%). The dynamic impact is clear here again, as column 4 suggests that an investment of one Real led to three times more tax collection after 6 years in the program.

The specification used controls for pre-existing differences between treated and control municipalities. The coefficient for the status variable (dummy equal to 1 if the municipality joins the program at some point during the period) is always negative and significant pointing out that, controlling for all other determinants of tax collection, municipalities which joined a PMAT program started with lower tax collection than the average. The program has enabled them to catch up with, and even overtake, other municipalities with the same characteristics. All other controls have the expected sign and significance[19]. Income, density, the share of services in the economy and education level all increase tax collection, and inequality and the share of agriculture in GDP decrease it. The positive impact of term limit on tax collection is coherent with the results in Besley and Case (1995) who find that US governors who face a binding term limit will levy more taxes.

The coefficients presented in table 2 may be capturing a time trend specific to treated municipalities or the fact that municipalities that joined the program earlier collect more taxes. Table 3 shows the impact of the program controlling for these potential sources of biases. Column 1 allows for the level of tax collection before joining

[19]The mayor's political party affiliation never has any significant impact in the estimated equations, so the results for these variables are omitted from the tables. This may be explained by the fact that Brazil has a weakly institutionalized party system with a lack of strong ideological platform - none of the 27 party is particularly pro-tax or more associated with corrupt practices than the others.

Table 2: Impact of the Program on Tax Collection

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent Variable : | Program dummies | | Loan pc*Program dummies | |
| **Program Impact** | | | | |
| All years | 14.950*** | | 1.840*** | |
| | (2.686) | | (0.501) | |
| Years 1,2 | | 7.868*** | | 1.036*** |
| | | (1.717) | | (0.369) |
| Years 3,4,5 | | 6.966*** | | 0.660*** |
| | | (1.813) | | (0.199) |
| Years 6+ | | 17.787*** | | 1.473*** |
| | | (5.663) | | (0.497) |
| Total impact 6+ | | 32.621*** | | 3.169*** |
| **Controls** | | | | |
| Status | -8.627** | -8.512** | -10.109*** | -9.492*** |
| | (3.433) | (3.428) | (3.497) | (3.442) |
| GDP pc | 0.004*** | 0.004*** | 0.004*** | 0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Population | -0.015 | -0.019 | -0.012 | -0.014 |
| | (0.012) | (0.012) | (0.012) | (0.012) |
| Agr\GDP | -17.446*** | -17.831*** | -17.587*** | -17.876*** |
| | (5.699) | (5.701) | (5.701) | (5.705) |
| Serv\GDP | 36.558*** | 36.525*** | 36.468*** | 36.451*** |
| | (13.399) | (13.401) | (13.405) | (13.407) |
| Density | 0.004** | 0.004** | 0.004** | 0.004** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Income pc | 0.044*** | 0.044*** | 0.043*** | 0.043*** |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Inequality | -68.385*** | -68.001*** | -66.887*** | -66.485*** |
| | (8.378) | (8.393) | (8.521) | (8.551) |
| Education | 7.595*** | 7.602*** | 7.515*** | 7.490*** |
| | (1.793) | (1.792) | (1.794) | (1.794) |
| Pol. competition | 2.402 | 2.569 | 2.499 | 2.596 |
| | (7.302) | (7.292) | (7.294) | (7.287) |
| Term limit | 2.001*** | 2.018*** | 2.024*** | 2.031*** |
| | (0.738) | (0.737) | (0.738) | (0.738) |
| Observations | 49951 | 49951 | 49951 | 49951 |
| Municipalities | 5224 | 5224 | 5224 | 5224 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include state and year fixed effects. Standard errors are clustered at the municipality level.

the program to differ depending on when the municipality joined (cohort effects). We see that the total impact of the program after 6 years becomes smaller, and indeed coefficients for the cohort dummies suggest that municipalities that joined early (2000 and 2002) collected more taxes previous to joining (results not shown). Column 2 introduces a quadratic time trend specific to treated local governments which mostly affects the immediate impact of the program. This suggests that it takes 3 years for the program to have an impact, which is coherent with what we know about the timing of program investments. I allow for both cohort effects and a quadratic specific time trend in column 3 : results using this specification present a less optimistic picture of the impact of the program, but its total effect after 6 years is still to increase tax collection by more than 12%. Finally column four considers the cost-effectiveness of the program allowing for both cohort effects and a specific time trend. The coefficients are close to the ones obtained without these additional controls : one Real invested in tax administration thanks to the program leads to nearly three extra Reais of tax collection after 6 years. This table suggests that treated municipalities may have experienced a different evolution over the decade even without the program, and supports the idea that municipalities which joined earlier were different from those which joined later. I therefore control for both these effects in all the following results.

Table 3: Impact of the Program on Tax Collection : Robustness Checks

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent Variable : | Program dummies | | | Loan pc*Program dummies |
| Years 1,2 | 7.024*** | 5.855 | -0.518 | 0.778* |
| | (1.400) | (3.635) | (1.513) | (0.445) |
| Years 3,4,5 | 6.629*** | 8.645** | 3.503* | 0.699** |
| | (1.646) | (3.440) | (1.925) | (0.296) |
| Years 6+ | 12.514*** | 20.212*** | 9.527*** | 1.357*** |
| | (3.022) | (7.456) | (3.437) | (0.434) |
| Total impact 6+ | 26.167*** | 34.621*** | 12.512*** | 2.834*** |
| Status | | -18.034*** | | |
| | | (5.104) | | |
| Cohort effects | Yes | No | Yes | Yes |
| Specific time trend | No | Yes | Yes | Yes |
| Observations | 49951 | 49951 | 49951 | 49951 |
| Municipalities | 5224 | 5224 | 5224 | 5224 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Specifications in columns 3 and 4 include a quadratic time trend specific to treated municipalities, and columns 2 and 4 include fixed effects for the year in which the municipality joined the program. All regressions include state and year fixed effects and controls for municipal GDP per capita, population size, the share of agriculture and services in local GDP, density, income per capita, inequality, median education, political competition and a dummy equal to 1 if the mayor is in his second term. Standard errors are clustered at the municipality level.

### 5.1.2 Impact on local governance outcomes

I now consider whether the extra public revenues generated by the program were spend in a way that benefited local populations, a non trivial question in the context of corrupt local governments described above.
Table 4 presents the results from estimating equation (11) using local education inputs and the governance index as dependent variables, both with and without a specific time trend and cohort fixed effects. The first two columns consider the impact of the program on the number of school employees : without cohort effects and the specific time trend the program leads to the hiring of 4 more school employees per 1000 school age inhabitants after 6 years in the program, but the more demanding specification in column 2 suggests the real effect of the program is closer to an extra 1.6 employee, a 5% increase compared to pre-program level of 30 for treated municipalities. Columns 3 and 4 present a similar picture for the number of classrooms, with the preferred specification indicating an extra 0.4 classrooms per thousand inhabitant, again a 5% increase compared to the initial level of 9. Note that these results are coherent with the previous results concerning the increase in tax collection. Education spending constitutes 30% of total municipal revenue and nearly 20% of municipal revenue comes from taxes in treated municipalities : if the entire increase in taxes due to the program had been used to finance increases in education inputs we would estimate an increase of 6.8% ($10\% * 3/2$) in both the number of classrooms and the number of school employees. The results in table 4 suggest that nearly 75% of the increase in taxes were used to finance extra education inputs.

Finally, column 5 presents the results from estimating equation (11) using the governance index as the dependent variable. These results must be treated with caution as the sample size is now much smaller : there are only 971 municipalities that were audited between 2003 and 2006, and only one observation per municipality[20]. 18 municipalities were audited before they started a PMAT program, and 36 once they had started a program, making the estimation of dynamic effects, as well as a pre-program time trend specific to treated municipalities and cohort fixed effects difficult[21]. Nevertheless, the results in column 5 indicate that the program has not led to any increase in the number of irregularities observed by the CGU audit teams. The absence of data on every type of goods or services that could be purchased with local public funds makes it impossible to say precisely what the extra tax revenue generated by the program was used for. However results on existing data suggest they were not used for any visible increase in rent-taking by politicians, but did lead to the purchasing of more school inputs.

[20]The author is currently updating the dataset by coding the reports of the audits undertaken since 2006. Future results using a larger sample are forthcoming.

[21]The small sample size makes the precise separate estimation of any significant coefficients in the most demanding and preferred specification unlikely. Adding cohort effects and a quadratic specific time trend, and allowing for dynamic effects, indeed does not change the result for the governance index whose coefficient(s) remains highly insignificant. Results are available from the author upon request.

Table 4: Impact of the Program on Local Education Inputs and the Governance Index

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable : | Nb school employees | | Nb classrooms | | Misgovernance index |
| All years | | | | | -64.110 |
| | | | | | (46.671) |
| Years 1,2 | 0.297 | -0.057 | 0.406** | -0.115 | |
| | (0.512) | (0.413) | (0.164) | (0.140) | |
| Years 3,4,5 | 0.901** | 0.470 | 0.488*** | 0.167 | |
| | (0.444) | (0.467) | (0.123) | (0.145) | |
| Years 6+ | 3.408*** | 1.179* | 1.407*** | 0.395* | |
| | (1.256) | (0.697) | (0.325) | (0.217) | |
| Total impact 6+ | 4.606*** | 1.592*** | 2.301*** | 0.447*** | |
| Status | -3.580*** | | -1.412*** | | 63.156 |
| | (0.949) | | (0.282) | | (40.467) |
| Cohort effects | No | Yes | No | Yes | No |
| Specific time trend | No | Yes | No | Yes | No |
| Observations | 49955 | 49955 | 49955 | 49955 | 971 |
| Municipalities | 5224 | 5224 | 5224 | 5224 | 971 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include state and year fixed effects and controls for municipal GDP per capita, population size, the share of agriculture and services in local GDP, density, income per capita, inequality, median education, political competition, a dummy equal to 1 if the mayor is in his second term, and dummies for the mayor's political party. Standard errors are clustered at the municipality level.

## 5.2 The different impact of taxes and transfers on local governance outcomes

I now turn to the estimation of the impact of an increase in taxes and an increase in federal grants on local governance outcomes. Table 5 presents the results from estimating equations (13) and (14) with taxes per capita or grans per capita as explanatory variable for local spending outcomes using OLS. It is clear from the first four columns in the table that taxes are associated with more local education inputs than grants : one Real more in taxes gives on average 0.04 more school employees, and nearly 0.01 classrooms, per thousand school age population, whereas one extra Real in grants does not seem to be correlated with school inputs. On the contrary, taxing more is not associated with more occurrence of irregularities in the audit reports (column 5) whereas higher grants is (column 6). The coefficients for population and GDP controls are as expected : richer municipalities have more school inputs, and larger (and more densely populated) ones have less school inputs, possibly due to economies of scale. More surprising is the fact that municipalities with a higher share of local value-added coming from industry seem to have both less education inputs and worse governance as measured by the audits, whilst having a more educated population or more competitive elections leads to less education inputs.

These OLS results may be due to unobservable characteristics affecting both the amount of public resources local governments can access and the quality of governments, or the demand for local public goods. I therefore use exogenous variations in the amount of FPM grants due to the allocation rule, and plausibly exogenous variation in the amount of taxes collected thanks to the program to identify the impact of an extra Real of local resources. The results for the first stage for the taxes equation are in column 3 of table 2 which established that the program increased taxes by 13% after 6 years. The first stage for the grants equation is in appendix table 8 where I regress the amount of FPM grants actually received by local governments on the theoretical amounts they should have received had the rule been perfectly enforced (the appendix also explains how those theoretical amounts are constructed). Actual grants increase one for one with theoretical grants. Table 6 presents the instrumental variable results. An overidentification test is available for the taxes equations, because there are three instruments (the three dummies capturing the dynamic impact of the program) for one endogenous variable. The p-value for the Hansen statistic strongly accepts the null of exogeneity of these instruments[22], and p-value for the Kleibergen-Paap LM statistic strongly rejects the null of underidentification at least for the regressions using local school inputs as dependent variables, suggesting the instruments are valid.[23]The p-value for the underidentification test for the regressions using the misgovernance index only allows us to reject the null at the 10% level. This is a consequence of the fact that there are only 54 municipalities which both took part in the program and were

[22]This may not be enough to convince us of their exogeneity, as I discuss below.

[23]Comparing the values taken by the Kleibergen-Paap Walkd F statistics by the critical values suggested by Stock and Yogo (2002) also confirms that there is no problem of weak identification in the regressions for school inputs. The instruments for taxes in the regression for the misgovernance index do not pass all tests, as explained above.

Table 5: Impact of an Increase in Taxes and an Increase in Grants on Local Governance Outcomes : OLS results

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variable : | Nb school employees | | Nb classrooms | | Misgovernance index | |
| Taxes pc | 0.038*** | | 0.009*** | | -0.112 | |
| | (0.013) | | (0.003) | | (0.158) | |
| Grants pc | | 0.003 | | 0.001 | | 0.628*** |
| | | (0.002) | | (0.001) | | (0.119) |
| GDP pc | 0.001*** | 0.001*** | 0.000*** | 0.000*** | 0.022 | 0.015 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.019) | (0.020) |
| Population | -0.028*** | -0.125*** | -0.008*** | -0.039*** | -2.099*** | -9.020*** |
| | (0.006) | (0.012) | (0.002) | (0.003) | (0.666) | (1.814) |
| Agr\ GDP | 24.995*** | 18.504*** | 12.535*** | 10.540*** | 720.723** | 409.149 |
| | (2.400) | (2.499) | (0.739) | (0.775) | (311.562) | (320.207) |
| Serv\ GDP | 21.571*** | 20.423*** | 6.314*** | 5.825*** | 433.563* | 267.681 |
| | (3.112) | (3.094) | (0.836) | (0.825) | (244.781) | (249.690) |
| Density | -0.002*** | -0.001* | -0.001*** | -0.000* | 0.002 | -0.011 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.011) | (0.008) |
| Income pc | 0.003 | 0.005*** | 0.001* | 0.002*** | -0.087 | -0.066 |
| | (0.002) | (0.002) | (0.000) | (0.000) | (0.055) | (0.051) |
| Inequality | -27.695*** | -30.303*** | -7.513*** | -8.096*** | -108.754 | 25.597 |
| | (3.778) | (3.746) | (1.044) | (1.018) | (90.148) | (73.655) |
| Education | -2.354*** | -0.542 | -1.268*** | -0.716*** | 2.062 | -7.569 |
| | (0.508) | (0.510) | (0.165) | (0.163) | (20.942) | (19.920) |
| Pol. competition | -9.580*** | -7.382*** | -3.648*** | -2.960*** | -174.852* | -47.010 |
| | (1.589) | (1.619) | (0.501) | (0.511) | (95.644) | (89.588) |
| Term limit | -0.532 | -0.403 | 0.036 | 0.070 | 19.756 | 21.285 |
| | (0.325) | (0.321) | (0.105) | (0.103) | (29.231) | (28.863) |
| Observations | 49951 | 49951 | 49951 | 49951 | 971 | 971 |
| Municipalities | 5224 | 5224 | 5224 | 5224 | 971 | 971 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include state and year fixed effects and controls for municipal GDP per capita, population size, the share of agriculture and services in local GDP, density, income per capita, inequality, median education, political competition, a dummy equal to 1 if the mayor is in his second term, and dummies for the mayor's political party. Standard errors are clustered at the municipality level.

audited, as explained above, so program uptake is a relatively poorer predictor of tax collection in this sample. Results for the misgovernance index should therefore again be considered with caution.

From the first four columns of table 6 we see that instrumenting leads us to find a much larger impact of taxes on local education inputs. One extra Real in taxes thanks to the program lead to 0.14 extra school employees and 0.05 extra classrooms per thousand school age inhabitants, consistent with the results in table 4 for the impact of the program on local spending outcomes. The difference between OLS and IV results may be due to the fact that, as we saw in table 4, around 75% of the extra taxes generated by the program are spend on education, whereas it is likely that a lower share of the average tax Real collected by municipalities -the effect estimated with OLS - is spend on education (30% of total revenue is spend on education). Turning to the results for grant revenues (columns 2 and 4) we see that instrumenting leads to a positive impact of grants on local school inputs : one real of extra grant resources thanks to the allocation rule leads to 0.02 more school employees (column 2) and 0.007 extra classrooms (column 4) per thousand school age inhabitants. One extra Real of taxes will thus lead to at least three times more education inputs than one extra Real of grants.

The last two columns consider the impact of both resources on the occurrence of irregularities in the corruption reports. IV results overall confirm the OLS results above. Like Brollo et al. (2010), whose instrumentation strategy I replicate, I find that higher FPM grants increase the number of irregularities. Note from table 7 in the appendix that those grants increase by around 10 Real per capita on average at each population threshold; an estimated coefficient of 0.4 suggests that irregularities will increase by 4 on average whenever the rule specifies that more FPM grants should be allocated to a municipality. This is a 6% increase compared to the median value of 64 irregularities per million Reais audited and hundred local public servants[24]. Taxes, on the other hand, lead to no increase in the index.

The results from tables 5 and 6 appear to validate the predictions of the model : an increase in taxes per capita thanks to the program leads to more provision of public goods (here education inputs) than an equivalent increase in grants, and no increase in the occurrence of corruption writ large in the audit reports, whilst an increase in grants systematically increases the misgovernance index.

[24]This is lower than the results in Brollo et al. (2010) who find that an increase in grants by 10% leads to a 12% increase in irregularities. These results cannot be compared directly with mine however, as their sample is smaller (only municipalities with less than 51,000 inhabitants) and their coding of the CGU audit reports likely different.

Table 6: Impact of an Increase in Taxes and an Increase in Transfer on Local Governance Outcomes : IV results

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variable : | Nb school employees | | Nb classrooms | | Misgovernance index | |
| Taxes pc | 0.139* | | 0.048* | | -6.673 | |
| | (0.081) | | (0.027) | | (6.174) | |
| Grants pc | | 0.024*** | | 0.007*** | | 0.420*** |
| | | (0.004) | | (0.001) | | (0.135) |
| Cohort effects | Yes | No | Yes | No | Yes | No |
| Specific time trend | Yes | No | Yes | No | Yes | No |
| Observations | 49951 | 48460 | 49951 | 48460 | 971 | 948 |
| Municipalities | 5224 | 5087 | 5224 | 5087 | 971 | 948 |
| Hansen p.value | 0.855 | | 0.762 | | 0.859 | |
| K-P underidentification p.value | 0.000 | 0.000 | 0.000 | 0.000 | 0.089 | 0.000 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The specification used in columns 2, 4 and 6 in which the amount of FPM grants received by the municipality is instrumented for using the theoretical grants the municipality should have received according to the rule includes a high-order polynomial in population size. All regressions include state and year fixed effects and controls for municipal GDP per capita, population size, the share of agriculture and services in local GDP, density, income per capita, inequality, median education, political competition, a dummy equal to 1 if the mayor is in his second term, and dummies for the mayor's political party. Standard errors are clustered at the municipality level.

# 6 Discussion and conclusions

The empirical results in this paper provide positive conclusions regarding the impact of a tax modernization program on Brazilian local governments - at least 13% more taxes, more public spending on education, and no increase in the incidence of a broad measure of corruption. They also validate the theoretical prediction that, due to differences in how much information citizens have on tax and grant revenues, an increase in the former will be spend more towards public good, and less towards political rent taking, than an increase in the latter. Selection into the program is voluntary however, making the identification of the results above necessarily less robust than if it were to have taken place in a quasi-experimental setting. Though my identification strategy controls for the fact that the 321 municipalities which joined the program have different characteristics from the ones who never joined, and the overidentification tests for the validity of my exclusion restrictions provide reassurance, I cannot completely rule out the possibility that my results are capturing some change in the local administration which happened simultaneous to joining the program.

It seems however highly unlikely that the increase in tax collection observed was not a consequence of the program - it would be hard to explain why local governments would choose to get into debt to finance a tax administration project if they could have increased their tax collection without the loan. More problematic is the idea that, over the period 1999-2008, some Brazilian local administration started a process which made them more efficient at providing local public goods and less corrupt/careless in the way they spend public funds, and that as they started this process they also decided to join a PMAT program. Allowing for a flexible different time trend for the treated municipalities partially controls for the effect of such a simultaneous process. The fact that the dynamics of the increase in local education inputs closely follows the dynamics of the increase in tax collection - the increase in education inputs is only significant after 6 years, which is also when the effect of the program on tax collection reaches its highest level - also hint that it is the increase in tax collection driving the increase in education input, and not some unobserved simultaneous process. In the absence of pre-existing evidence on the impact of resources mobilization programs and the returns in terms of public good provision of different sources of public revenue this paper provides some first results which are plausible answers to the questions asked. More research is called for on whether taxes lead to better government spending and on the effectiveness of tax capacity programs, to see whether these results can be replicated in other contexts and using different identifying assumptions.

This paper's theoretical framework and empirical evidence speak directly to debates about the right form of decentralization. The existence of a large 'fiscal gap' between the expenditures and the tax collection of local governments is an ubiquitous characteristic of local governments around the world. In developing countries in particular local governments have recently been granted substantial responsibilities, with taxation responsibilities generally lagging behing. This paper suggests that narrowing this fiscal gap by empowering local governments to levy more revenue is likely to make them more accountable and efficient in their spending decisions. Substantial local tax

collection - complemented by intergovernmental grants for revenue equalization purposes - may be a necessary feature of a successful decentralization that strives to bring government 'closer to the people'.

Moving up from the local government level the mechanisms explored in this paper also contribute to debates on how to finance development. One of the central recommendation of the 2005 report on achievement of the Millenium Development Goals is that developing countries should mobilize increased domestic resources by up to four percentage points by 2015 (UnitedNations (2005)), yet there is very little research on how this aim could be achieved. What's more, technical aid on public sector financial management has always been the poor parent of budget support type official development aid[25] This paper has shown that one type of resource mobilization program, in place in Brazil for more than a decade, has been successful in providing long term sources of funds to local governments. It suggests more widely that technical help in tax capacity building may lead to an increase in public resources which is potentially more conducive to the type of public spending that benefits citizens than traditional development aid.

[25]See OECD (2010a) for a discussion of the different forms of aid in public sector financial management.

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# Appendix : The FPM allocation rule

The most important source of municipal revenue is the *Fundo de Participacao dos Municipios* (FPM), an automatic federal transfer established by the Brazilian Constitution. The FPM allocation mechanism divides local governments into population brackets which determine the share of their state's total FPM resources they will receive. Smaller population brackets are allocated lower shares. Each of the 26 states receives a different share of the total FPM resources in the federal budget, so two municipalities will receive the same amount only if they are in the same population bracket and state. The revenue sharing mechanism determining the amount $FPM^s_{i,t}$ received by government $i$ in state $s$ is

$$FPM^s_{i,t} = \frac{f(pop_{i,t})}{\sum_{j \in s} f(pop_{j,t})} FPM^s \tag{15}$$

where $f(pop_{i,t})$ is the coefficient corresponding to the population bracket in which the local government's population is found. Table 7 presents the population brackets and associated coefficients[26] in its first two columns. The *Tribunal de Contas Uniao* (TCU) determines how much each municipality will receive each year using the population estimates calculated by the Brazilian Statistical Institute (IBGE). I construct the amounts of theoretical FPM grants each municipality is allocated according to the above rule depending on its state and population size for each year. Table 7 reports the average of those theoretical grants as well as the average actual grants received by municipalities in each population bracket.

It is clear from the table that population and state do not perfectly predict the FPM grants each municipalities receives, due to several reasons. Various law amendments during the 1990s froze the FPM allocations for some municipalities (in particular, the ones that split over the period). Even for municipalities not affected by those amendments the rule is not perfectly enforced : Litschig (2008b) presents some evidence of manipulative sorting above the FPM thresholds for the years 1989 and 1991, evident from the official TCU population estimates used to calculate the allocation of FPM resources each year. The official TCU estimates and the IBGE population estimates used in this paper indeed do not coincide, suggesting potential manipulation at the TCU level. Nonetheless, real FPM grants received do increase substantially at each population threshold. Figure 3 displays the scaterplot of received and theoretical FPM transfers received by municipalities in the state of Minas Gerais in 2008[27]; the vertical lines represent the population thresholds. Both figures display visible jumps at the thresholds, though there are cases of misassignment around the cutoffs in the graph for actual FPM transfers.

To identify the causal impact of an increase in FPM transfers on local spending outcomes I use variations in the amounts of theoretical grants municipalities should

[26] Set by Decree No. 1881/81 and unchanged since 1981.

[27] The sample is restricted to one year and state (Minas Gerais, which contains the most municipalities) to limit the variation in grants received and make the graphs easier to understand. All year/state combinations provide similar graphs.

Figure 3: Real and Theoretical FPM Transfers for the state of Minas Gerais in 2008

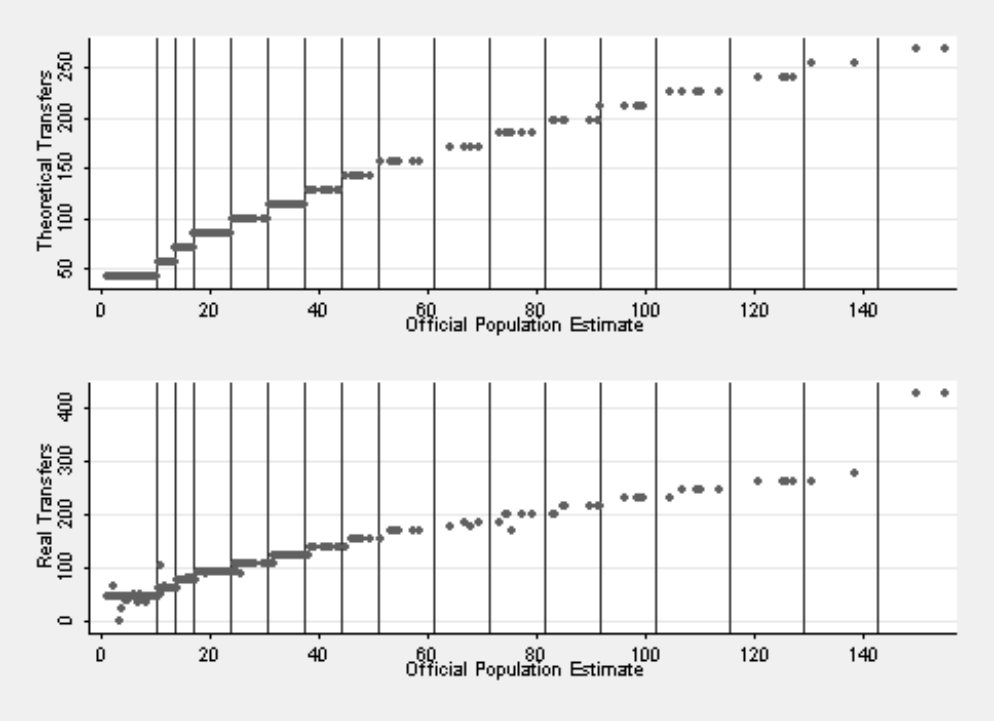

Table 7: Real and Theoretical FPM Transfers and Coefficients

| Population | Coefficient | Real Transfer | Theoretical Transfer |
|---|---|---|---|
| <10,189 | 0.6 | 22.5 | 21.8 |
| 10,189-13,584 | 0.8 | 31.2 | 30.5 |
| 13,585-16,980 | 1 | 39 | 39.1 |
| 16,981-23,772 | 1.2 | 46.9 | 47 |
| 23,773-30,564 | 1.4 | 53.5 | 54.6 |
| 30,565-37,356 | 1.6 | 62.2 | 63.7 |
| 37,357-44,148 | 1.8 | 69.3 | 71.7 |
| 44,149-50,940 | 2 | 78.5 | 80.6 |
| 50,941-61,128 | 2.2 | 84.7 | 87.8 |
| 61,129-71,316 | 2.4 | 90.9 | 94.8 |
| 71,317-81,504 | 2.6 | 99.3 | 103.7 |
| 81,505-91,692 | 2.8 | 102.8 | 107.5 |
| 91,693-101,880 | 3 | 117.9 | 125.6 |
| 101,881-115,464 | 3.2 | 127.8 | 134.8 |
| 115,465-129,047 | 3.4 | 132.6 | 135.3 |
| 129,048-142,632 | 3.6 | 144.4 | 146.1 |
| 142,633- 156,216 | 3.8 | 209.1 | 166.1 |
| ≥156,217 | 4 | 350.7 | 349.2 |

Population is the official population estimate from the IBGE. The coefficient are obtained from official documents of the *Tribunal de Contas Uniao* and used to estimate the theoretical FPM transfer allocated to each municipality. Real FPM transfers received are from the *FINBRA* database.

have received, controlling for any impact of the variables determining the allocation by using state fixed effects and a high-order polynomial in population size. Table 8 presents the first stage of this identification strategy. We see that the actual amount of FPM transfers received increases one for one with the theoretical amounts. None of the control variables have any impact on the amounts received, suggesting that manipulations of the rule are rare and/or unrelated to the variables which affect the dependent variables of interest in this paper.

Table 8: First Stage Regression for FPM Transfers

| | Dep. var : Real FPM Transfer pc |
|---|---|
| Theoretical FPM pc | 1.046*** |
| | (0.074) |
| GDP pc | 0.000 |
| | (0.001) |
| Population | 0.550 |
| | (2.815) |
| Agr\ GDP | -40.937 |
| | (36.303) |
| Serv\ GDP | 2.319 |
| | (32.428) |
| Density | 0.003* |
| | (0.002) |
| Income pc | 0.003 |
| | (0.003) |
| Inequality | 12.010 |
| | (12.195) |
| [1em] Education | -9.097 |
| | (6.218) |
| Pol. competition | 20.313 |
| | (15.806) |
| Term limit | -4.982 |
| | (4.837) |
| Observations | 48460 |
| Municipalities | 5087 |

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The regression includes state and year fixed effects as well as a high order polynomial in population size.