Substitution (Incentive) Effect of Unconditional Equalization Grants

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Abstract

Equalization grants that are inversely related to the local revenue increase the marginal cost of collecting revenue because they levy a tax on collection. This paper empirically analyzes this incentive effect of equalization grants on the Chilean local revenue by exploiting characteristics of the formula designed for distributing grants and the implemented reforms in this formula in the period 1990 - 2006, which could be considered exogenous from the viewpoint of a municipality. The main finding is evidence for Chilean municipalities that equalization grants have an incentive effect on local revenue. Specifically, there is a negative relationship between this equalization tax and the collected revenue, and this effect is greater when the period of time to pay taxes is shorter and when local authority's coalition has high a likelihood of reelection.

1 Introduction

Intergovernmental unconditional (general purpose) grants, which can be spent as if they were subnational government's own revenues (without strings attached), and non-matching conditional (specific-purpose) grants, which can only be used for a specific purpose but that do not require subnational governments to finance a specified percentage of expenditures using their own resources, increase the subnational's resources[1]. Thus, they have only an income effect and does not affect relative prices. On the other hand, conditional matching grants, which complement subnational contributions, have two effects: the grant gives subnational government more resources, some of which go to the specific area determined by central government (income effect) and reduces the relative prices of the specific area from a given budget (substitution effect). Both effects stimulate higher spending on specific area (Sha, 2007).

However, there are grants that are unconditional and intend to enhance inter-jurisdictional equity which could affect relative prices. In other words, not only do unconditional grants increase the subnational government's total resources (income effect) but also, through their design, they make collection more expensive (substitution effect).

The design of equalization grants requires defining a mechanism that distributes the resources based on a formula that considers the fiscal need and fiscal capacity of each jurisdiction. If fiscal capacity is measured accurately, such transfers will create no disincentive for local governments to raise revenues, because at the margin local governments still bear full fiscal responsibility for expenditure and taxing decisions, essentially because transfers are lump sum in nature (Smart, 2007). Because of data constraints, fiscal capacity is measured by the observed per capita tax base or the actual revenues of each jurisdiction. If local governments can directly or indirectly manipulate the proxies for capacity used in the transfer formula, capacity equalization may induce undesirable incentive effects.

When the measure of fiscal capacity corresponds to collected local revenue, equalization grants are inversely related to the collected local revenue, thus, if a local government

[1]The difference between them is that the first provides subnational governments with maximum flexibility to pursue their own objectives while the latter must be spent on a particular purpose.

increases its collected revenue, the received grant will decrease. This kind of transfers increases the marginal cost of collecting revenue, i.e., levies a tax on collecting local revenue (this tax I will name equalization tax). Then, the distribution formula of equalization grants would discourage local government's revenue collection. In other words, the size of the pie depends on how it is distributed.

There is another case, in which grants' design would discourage local governments collection. Horizontal or self-financing grants require defining a contribution mechanism which indicates the jurisdictions that will provide the resources to others and the amount of their contributions. When this contribution corresponds to a proportion of the collected tax revenue, the marginal benefit of collecting one peso is less than one, i.e., collected revenue is taxed by the contribution rate.

This paper analyzes the incentive or substitution effect of the Chilean equalization grants[2]. Specifically, I focus on the incentives the design of equalization grants create in Chilean municipalities for collecting revenues and I want to asses to what extent differences in collected local revenue are due to the design of these grants.

In Chile, local governments (municipalities) collect most of the local revenue and they can invest resources in tax collection activities (such as updating of land registers) that will increase its own-source tax revenues by increasing the effective size of its base but they do not have tax autonomy. That is, Chilean municipalities don't choose or define the tax rate and/or the tax base, but they are able to improve their collection making greater effort to collect or to update information of its tax base[3]. The equalization grants correspond to the Municipal Common Fund (Fondo Común Municipal, FCM). The distribution formula considers, among others variables, the collected revenue from at least two years before, only for municipalities with per capita local revenue less than national average. For municipalities with per capita local revenue higher than national average, the received grant does not depend on local revenue.

The FCM, in turn, is self-financing: municipalities must provide a share of their main sources of local revenue to the FCM every year. In this setting, the revenue tax imposed

[2]I studied the income effect of these grants in the paper "The effects of intergovernmental grants on local revenue: Evidence from Chile" (2011).

[3]For more detail, see Bravo (2011)

by the distribution formula affects the resources to be received in the future (if local government collects more resources today, this will have a negative impact in the received grant tomorrow) while the tax imposed by contribution mechanism is contemporaneous (if local government collects more resources today, it must shift more resources today.). Smart (2007) says that the poor incentives for local governments to raise their own revenues are most obvious in a system in which a given share of locally collected taxes is distributed among all local governments.

One of my contributions to this literature is to present a very simple dynamic model, unlike what has been done previously, that considers the individual decision of a local government respect to the collected revenue, and that must provide a share of its collected revenue while its future grants are inversely related to the today's collected revenue. Then, this dynamic character of the distribution formula allow us to take both taxes independently, that is, it allows us to separate the incentive effect of the equalization grants, which must be anticipated by the local government, from the incentive effect of the contribution mechanism which is contemporaneous. In this way, I can exploit intertemporal issues for identifying the effect of the equalization tax.

There are several researchers that have highlighted the importance of grants design. According to Bird (2000) intergovernmental transfers must be carefully designed to ensure that, at the margin, the costs and benefits of local fiscal decisions are borne locally. Smart (2007) notes grants can create poor incentives for local governments to raise their own revenues. Thus, to understand how sub national governments respond to intergovernmental grants is essential for the design of grants.

Most empirical and theoretical literature that study the incentive effect of equalization grants is focused on the local taxing autonomy case and on the effect of equalizing transfers on tax rates chosen by local governments. In general, two effects are identified: (1) substitution effect, which captures the effect of a tax change on the transfer volume and (2) income effect which represents the pure transfer component of equalizing grants.

The standard model considers N local economies with private and public goods in which local governments tax a consumer's resource on a source basis. Local governments maximize utility of a representative consumer who is subject to the government's budget

constraint for determining the tax rate. This conventional model assumes that subnational governments have two sources of revenue: tax revenue collection and re-distributive grants; that the government is always on the upward-sloping section of its Laffer curve; and that the marginal cost of public fund[4] increases as the local government increases its tax rate. In this context, it is derived the first order condition of that problem with and without equalizing transfers.

The equalization system postulated by these models, known as representative tax system, sets the transfer to each government equal to the difference between its tax capacity and the average capacity of all jurisdictions, multiplied by some standard tax rate, usually equal to the average of all jurisdictions'tax rates[5]. Besides, most models assume that transfers schemes are budget balancing because this property facilitates the analysis since in this way a federal or central government does not have to be modeled explicitly.

Smart (1998) focuses on the effect of equalization grants on tax rate, assuming that the average capacity and the tax rate of all jurisdictions are invariant to the jurisdiction's tax rate. He shows that this kind of equalization grants lowers the effective marginal cost of public funds which leads to increase local tax rates. In the context of mobile tax bases and tax competition among jurisdictions[6], Kothenburger (2002) analyzes the relationship between fiscal equalization and tax competition in the context of mobile tax base and he asks to what extent equalization systems are able to internalize fiscal externalities and, therefore, promote equity as well as efficiency. He finds that tax base equalization schemes[7] increase the tax rate if jurisdictions behave competitively. Moreover, with the complete equalization of regional tax bases, decentralized tax policy is efficient. On the other hand, in tax revenue equalization schemes[8], the internalization of fiscal externalities

[4]The marginal cost of public funds represents the cost to the private sector of raising an extra dollar of tax revenue through a tax rate increase.

[5]That is, $G_i = \bar{t}(\overline{X} - X_i)$ where G_i is the equalization grant for the jurisdiction i, $\bar{t}$ is the standard rate, $\overline{X}$ is the average capacity of all jurisdictions, and X_i is the capacity of the jurisdiction i

[6]In this context, jurisdiction tax policies have external effects on residents of other jurisdictions, as each jurisdiction's choices of tax rates influence the level and tax responsiveness of revenues in other jurisdictions. That is, sub national tax increases generate a positive fiscal externality by expanding the tax base in other sub national governments, which is neglected by each jurisdiction and tax rates tend to be too low in equilibrium from an efficiency point of view.

[7]Tax base equalization schemes are conditioned on the difference in the jurisdiction's tax base relative to that of a representative tax system.

[8]Tax revenue equalization schemes are conditioned on the difference between average and jurisdictional

is counteracted by the fact that this scheme imposes an implicit tax on local tax revenues, then, tax revenue equalization exerts a further downward pressure on tax rates in tax competition. When the effect of changes in local fiscal variables (tax rate or revenue) on average variables is considered both results become ambiguous. Bucovetsky and Smart (2006) arrive to the same conclusion. They establish that an equalization grant could make subnational governments implement efficient policy choices in presence of tax competition and of capital fixed supply to the nation as a whole, but mobile among regions, and when local governments behave non cooperatively, using the source based tax rates as their strategic variables. That is, they find that equalization grants increases tax rate chosen by subnational governments[9].

Summarizing, in the cases analyzed in the theoretical literature, where subnational governments have fiscal autonomy, if the distribution formula depends on the tax base, equalization transfers will increase the subnational tax rate. However, if the distribution formula depends on collected revenue, equalization transfers will encourage a reduce in the collected revenue and then, they will choose lower tax rates.

Alternatively, Dahlby (2008) argues that when subnational governments uses distortionary taxes to finance part of their expenditures, and they receive a lump-sump transfer, they will reduce the resources they devote to tax collection activity. Raising additional revenues through increased enforcement is costly because resources are used in enforcement activity that could be used instead to produce goods and services for consumption. Raising additional revenue through a tax rate increase is costly because of the distortions in the allocation of resource caused by the higher tax rate. The optimal tax rate and the optimal level of tax enforcement effort equalize the marginal costs of raising revenue from these two ways of generating additional funds. A lump-sum transfer will reduce the recipient governments tax enforcement activity because it will reduce its tax revenues, and therefore it will be optimal to have a proportional reduction in tax enforcement activity. In addition, an increase in transfers will reduce the subnational government's marginal cost of public fund, and this will also cause it to reduce its tax enforcement activity. The first effect that

per capita tax revenue.

[9]On the other hand, when taxes have distortionary effects at national level, the full equalization leads to equilibrium tax rates higher than optimal but with partial equalization the equilibrium tax rates can be reached.

Dalhby identifies is what I call the income effect, and the second effect would correspond to the substitution effect. However, the Dalhby's substitution effect arise regardless the design of the transfers.

On the other hand, empirical literature finds that equalizing transfers raise the tax rates chosen by local governments, because the negative effect of higher tax rate on tax base is offset by the equalizing transfers. The main differences among those who have studied this issue are in the identification strategy and how the variables of interest are measured. Specifically, it has been followed two strategies to estimate the effect of equalizing grants: to calculate the rate at which grants decrease due to an increase in tax base or tax revenue and then estimate the effect of this rate on fiscal decisions, and/or to use changes in law that affect the grants formula to identify the effect of interest through a treatment effect model. The main problem with the first one is that this rate is determined simultaneously with the variable in which the impact is measured (tax rate or revenue). Moreover, this variable can not be treated as exogenous, statistically, because it could reflect other relevant variations in the determinants of tax policy. In some cases, the endogeneity of the regressor of interest is a problem not properly solved.

Rodríguez (1998) studies the incentive effect of the FCM grants and postulates that Chilean municipalities could intend to control some variables to maximize their reception of resources. He estimates, for every Chilean municipality, a marginal tax (subsidy) rate which represents the ratio between the change in FCM grants because of local revenue increase and the increase of it, and studies its relationship with the amount of received FCM resources. The estimate considers that the effect is not contemporaneous but it does not take into account that the marginal tax (subsidy) rate is determined simultaneously with the FCM grants. He founds that there is a weak positive relationship between the received FCM resources and this rate. He points that the disincentive for a municipality to collect revenues not only depends on the marginal tax but also depends on the municipality's cost of increasing effort to collect and the additional resources that it could collect from that effort.

Dahlby and Warren (2002) calculate the equalization rate effect[10], the equalization base

[10]That is, the change in an Australian state's grant when it raises its own source tax revenue by one dollar through the increase on the standard rate for that base

effect[11] and the marginal cost of public funds (MCF) for 12 tax bases for eight Australian states, and estimate OLS regressions of tax rates on these variables and state fixed effects. Although they do not give detail how the variables were calculated, they do not consider the potential endogeneity of them. They find relatively weak evidence in support of the hypothesis that the equalization grant formula has a positive effect on Australian states' tax rate. However, the estimated model does not include other variables, such as demographic or political variables.

Baretti et al (2002) present a simple model in which the amount of tax revenue collected in a state depends on the enforcement activity undertaken by the government of this state, and identify a substitution and an income effect of German equalization transfers. For measuring the substitution effect, they define and calculate a marginal tax rate (MTR), that is, the fraction of 1 DM of additional income tax revenue in a state which flows out of the region. Since some German taxes are shared between federal, state and local governments, for calculating the MTR they combine the effect of equalizing and contribution system. Since MTR depends on the tax revenue of a state, they exploit the fact that the MTR tends to be higher in states with a low population. Given this, for checking their results, they use too the size of the population instead of the MTR as explanatory variable. They find that the MTR imposed by the equalization system has a significant negative effect on a states tax revenue: an increase in the MTR by 1% will reduce a state's income tax revenue as a fraction of regional GDP by 0.0096 percentage points. The main problem with these results is that they did not analyze the validity of population as instrumental variable.

Snoddon (2003) uses the variation in incentives due to the 1982 reform of equalization formula in Canada[12] to identify the impact on grant recipients' own source of equalization[13]. Since this reform affects the marginal cost of public funds (MCF), it will alter

[11] the increase in an Australian state's grant caused by the reduction in the state's relative fiscal capacity when it raises an additional dollar of tax revenues from that tax base

[12] Since 1982 to calculate the standard (weighted average) tax base used in equalizing formula it is considered a subset of provinces instead all of them. She distinguishes between included provinces, which refers to those recipients that were part of the calculation of the new standard base, and the excluded provinces, which were removed from the equalization standard in 1982.

[13] She identify two incentive effects: equalization grants distort recipient governments' decisions to alter tax rates and to develop new or existing tax bases.

tax decisions. On the other hand, this reform affects the disincentive to develop new or existing tax bases due to equalization. She finds that for those provinces whose MCF was increased (decreased) by the reform, their revenues are negatively (positively) affected.

Buettner (2006) summarizes the German municipality's total revenue from intergovernmental transfers by a linear function relating grants to tax base considering not only received grants but also the shifted contributions. The intercept of this function measuring an income effect, is called "virtual grants" i.e. the amount of grants the jurisdiction would receive if its tax base were actually zero; while the slope of the function measuring a substitution effect, is called "marginal contribution rate", i.e. the extent to which an increase in the tax base results in lower grants. Because he notes that "virtual grants" and "marginal contribution rate" depend on local conditions that would be correlated with tax rate, he exploits the fact that "virtual grants" and "marginal contribution rate" are discontinuous functions of relative fiscal capacity which allows employing regression discontinuity (RD) estimation techniques to estimate the effect of these variables on tax rate. Alternatively, he exploits the variation in both variables due to changes in the law over time. He calculates the compensated effect of the "marginal contribution rate" by means of a Slutzky decomposition, assuming that the observed response to an increase in virtual grants captures the income effect. He finds that an increase in the marginal contribution rate by 1 percentage point is associated with an increase in the tax rate by .121 -.142 percentage points, whereas an increase in virtual grants by €1000 per capita is associated eith a reduction in the tax rate by 1.45 percentage points.

Finally, Egger et al (2010) empirically analyze the incentive effects of equalization transfers on local business tax policy by exploiting a natural experiment in the state of Lower Saxony (Germany) which changed its equalization formula as of 1999. Regular equalization transfers are available to municipalities whose fiscal capacity falls below a target level, while supplementary transfers are targeted at municipalities with considerably lower than average fiscal capacity. The effect of the 1999 reform was to reduce the equalization rate[14] facing municipalities eligible for supplementary transfers, while increasing the equalization rate for other, ineligible municipalities. They use a within-state and across-state difference in difference estimator where the treatment was defined as receiving supplementary

[14]Rate at which deficiencies in local fiscal capacity are compensated through the transfer formula.

transfer. Because they note that supplementary transfer status may be partly influenced by a municipality and, hence, would be endogenous, they use various available techniques to address this problem, for instance, limiting the econometric analysis to those municipalities for which self selection is very unlikely. The average treatment effect that they find is about -1.2 percentage points.

In this paper, in order to analyze the incentive effect of FCM transfers empirically, I exploit the fact that not all municipalities pay a positive equalization tax but only those that have their revenue lower than national average. Moreover, the equalization tax that each municipality must pay depends on how much grants change because of a change in the collected revenue, which in turn depends on the difference between municipality's revenue and national average, and the relative importance of the resources coming from equalization respect to the sum of revenue collection and FCM grant. Since municipalities that pay positive tax could have unobservable characteristics in common, which would explain in part why the revenue is lower than the average, endogeneity problems could arise. Then, I consider municipal fixed effects and to measure the distribution tax I consider the revenue measure used in the distribution formula and not the revenue collection (or the lagged revenue collection) although both variables are highly correlated. Besides, I exploit reforms in the distribution formula that underwent in the period 1990 - 2006 for identifying the effect of interest. Specifically, it is possible to compare revenue collection between years when the revenue collection affects future grants and years when it does not. In this case for all municipalities the tax equal zero. Since the period of time to pay taxes change, it is possible to distinguish the incentive effect when the year in which municipalities must pay taxes is closer (2 years later) from the incentive effect when the year in which municipalities must pay taxes is 3 or 4 years later.

I find empirical evidence for Chilean municipalities that FCM has an incentive effect on local revenue. Specifically, this effect is decreasing respect to the period of time before municipalities pay taxes. An increase in tax of one standard deviation is associated with a decrease in local per capita revenue between 0.29 and 0.18 standard deviations. This effect is greater when local authority's coalition has high a likelihood of reelection. I study robustness checks like controlling for socioeconomic variables, I also use alternative measures of tax and distinguish between municipalities with greater benefit of exerting

greater effort and those with lower benefit, and falsification check like using as dependent variable a proxy for municipal revenue that does not depend on collecting effort.

The remainder of the paper is organized as follows. Section 2 presents a simple theoretical model for formalizing and motivating the empirical results. Section 3 briefly describes the Chilean distribution formula and the reforms implemented during the period 1990 - 2006. Section 4 describes the identification strategy. Section 5 describes and presents the data. Section 6 reports the results. Finally, section 7 concludes.

2 A motivating theoretical model

I present a very simple dynamic model that considers the individual decision of a local government respect to the collected revenue when it must provide a share of its collected revenue and future grants are inversely related to the today's collected revenue. I will analyze the potential incentive effect on collected local revenue of this transfers design.

2.1 Local government net utility

A local government's decision maker must decide how much to collect, X_t, in each period t = 0,1,2,...,∞, which is costly. Let Z_t the spending on public good which yields utility, then it has the following function of net benefits:

$$U_t = f(Z_t) - e(X_t) \tag{1}$$

where $f(\cdot)$ is increasing and concave ($f'(\cdot) > 0$ and $f''(\cdot) < 0$)[15]. $e(\cdot)$ is increasing and convex ($e'(\cdot) > 0$ and $e''(\cdot) > 0$)[16].

Net utility is assumed to be separable, that is, marginal utility of spending today depends on today's spending only and marginal cost of collecting today depends on today's collection only. When local government evaluates net utility in the future, it is discounted

[15]I assume decreasing marginal utility
[16]I assume increasing marginal cost.

by a constant factor $\delta < 1$, assuming spending in the future is not valued as much as today. The objective is to maximize the present discounted value of future net utility:

$$\sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t) \right) \tag{2}$$

2.2 Local government budget constraint

The local government has two sources of revenue to finance local public good spending in each period t, local revenue and equalization grants:

$$Z_t = (1 - \alpha_t) X_t + G_t \tag{3}$$

where α_t denotes the proportion of local revenue that is shifted by local government to total fund in t. G_t denotes the equalization grants received in t, which has two components: first, the component that depends on exogenous variables (fixed component) and, second, the component that depends negatively on past local revenue:

$$G_t = K_{t-1} + b_t \beta_t(X_{t-1}) \tag{4}$$

where K_{t-1} denotes the component that depends on exogenous variables determined in t-1 (fixed component), b_t represents the weight of the local revenue component, and $\beta(\cdot)$ denotes the component that depends on the past local revenue X_{t-1}. I assume that $\frac{\partial \beta(\cdot)}{\partial X_{t-1}} < 0$ and $\frac{\partial^2 \beta(\cdot)}{\partial X_{t-1}^2} < 0$. Section 3 presents a simplified Chilean version of this component.

2.3 Optimal local revenue

The local government decision-maker problem may be written:

$$\underset{\{X_t, Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t) \right) \tag{5}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + $b_t\beta_t$ (X_{t-1})

The local government decision-maker chooses collection and local public spending in each period to maximize its net utility. The solution is a sequence of variables X_t and Z_t for all time periods t = 0,1,2,...,∞.

For solving this problem I use the dynamic programming approach. Then, for each period, the Bellman equation is:

$$v(X_{t-1}) = \underset{\{X_t, Z_t\}}{Max} \left(f(Z_t) - e(X_t)\right) + \delta v_{t+1}(X_t) \tag{6}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + $b_t\beta_t$ (X_{t-1})

where X_t and Z_t correspond to control variables and X_{t-1} is the state variable. The solution of this problem will be the desired level of collection and local public spending as a function of state variables, that is, a policy function.

I substitute the constraint into the objective function, and thereby eliminate the local public spending as a variable to choose. So the first order condition becomes:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta)\frac{\partial v_{t+1}}{\partial X_t} \tag{7}$$

This equates the marginal net utility of collecting current revenue to the lost marginal utility of receiving less grant next period. The Beveniste-Shienkman condition is:

$$\frac{\partial v_t}{\partial X_{t-1}} = \frac{\partial f}{\partial Z_t} b_t \frac{\partial \beta_t}{\partial X_{t-1}} \tag{8}$$

Shifting up one period:

$$\frac{\partial v_{t+1}}{\partial X_t} = \frac{\partial f}{\partial Z_{t+1}} b_{t+1} \frac{\partial \beta_{t+1}}{\partial X_t} \tag{9}$$

Then, the FOC can be written:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) = \frac{\partial e}{\partial X_t} - \delta \frac{\partial f}{\partial Z_{t+1}} b_{t+1} \frac{\partial \beta_{t+1}}{\partial X_t}(X_t) \tag{10}$$

This condition says that the local government decision-maker will raise collection until the point where if it raise collection one more peso today, the gain in utility no longer exceeds the cost (disutility) of collecting that peso today plus the loss in utility tomorrow (because grant will be lower tomorrow). $b_{t+1}\frac{\partial \beta_{t+1}}{\partial X_t(X_t)}$ represents the rate at which the grants decrease in t+1 by an increase in local revenue in t. Note that due to the dynamic structure of the model, it is possible to separate the equalization tax ($\delta \frac{\partial f}{\partial Z_{t+1}} b_{t+1} \frac{\partial \beta_{t+1}}{\partial X_t(X_t)}$), which must be anticipated by the local government, from the contribution tax $(1-\alpha_t)$ which is contemporaneous. In a static model, this is not possible (see appendix A). The size of the equalization tax depends not only on the rate at which the grants decrease in t+1 by an increase in local revenue in t, but also on the factor of discount δ which implies that the greater the number of years between the year when the revenue collection decision is taken and the year when the transfer is affected (i.e. the year when the tax is paid), the lower the equalization tax (see appendix B the case where the equalization grants depends on X_{t-2}).

To analyze the incentive effect, let us consider the case where the received grant is independent of revenue collection, that is, $\beta(\cdot) = 0$. The optimal condition for determining the revenue collection is that marginal benefit from public spending equals marginal cost of collecting revenue:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) = \frac{\partial e}{\partial X_t} \tag{11}$$

Equalization grants that depend negatively on local revenue will discourage the collection of local revenue. To see this compare Eq. (10) and Eq. (11). In the former, the cost of collecting revenue is greater than the latter because municipalities must pay the equalization tax.

3 Equalization grants in Chile

The Fondo Común Municipal (FCM) is the Chilean system grant used for re-distributing revenue among municipalities. The FCM resources received by each municipality are determined by a formula which has among its components an equalization component.

A complete description of the components and the distribution formula of the FCM is presented in Bravo (2011). The FCM, in turn, is self-financing: municipalities must provide a share of their main sources of local revenue to the FCM every year.

The equalization component of the distribution formula works only for municipalities that have per capita local revenue less than national average, thus their future received grants depend positively on the difference between the national average and their per capita local revenue. The IPP definition, which corresponds to those revenue items which are generated by local sources and remain with the municipality, that is, they are not shifted to FCM (Bravo, 2011), is used by the FCM for measuring revenue. Besides, FCM has had two dynamic considerations: (1) the IPP per capita used in the distribution formula corresponds to that from at least two years ago and (2) the update of information is not made every years, that is, the same information has been used over a year to distribute FCM resources. Below, I present a more formal and simplified description of the FCM grant and its equalizing component.

Let the IPP per capita of the municipality i in the period t, Y_{it}, and $\overline{Y}_{Nt}$ the national average IPP per capita in the period t, if $Y_{it} < \overline{Y}_{Nt}$, municipality i receives the grant G_{it+1} in the period t+1 that is determined by the formula:

$$G_{it+1} = K_{it} + \frac{b_{t+1}(\overline{Y}_{Nt} - Y_{it})}{\sum_{j=1}^{M_t}(\overline{Y}_{Nt} - Y_{jt})} = K_{it} + \frac{b_{t+1}}{M_t}\frac{(\overline{Y}_{Nt} - Y_{it})}{(\overline{Y}_{Nt} - \overline{Y}_{Mt})} \tag{12}$$

where j=1, ..., M_t is the number of municipalities that have IPP per capita less than the national average in the period t, $\overline{Y}_{Mt}$ is the average IPPP of the municipalities that have IPP per capita less than the national average in the period t with $\frac{\partial \overline{X}_{Mt}}{\partial X_{it}} = \frac{1}{M_t}$ and $\frac{\partial \overline{X}_{Nt}}{\partial X_{it}} = \frac{1}{N_t}$, K_{it} represents the other components different from revenue which depends on period t's information, and b_{t+1} is the weight of the revenue component.

Otherwise, the received grant is $G_{it+1} = K_{it}$.

Bravo (2011) shows the relationship between equalization component and the IPP per capita used in the distribution formula: for municipalities with IPP per capita above the national average this component equals zero, while for municipalities with IPP per capita below the national average this component is inversely related to the IPP per

capita. Then, municipalities with IPP per capita closer to the national average have their equalization component closer to zero. That is, the smaller the relative deficit, the smaller the equalization tax.

When $X_{it} < \overline{X}_{Nt}$, the rate at which the grants decrease in t+1 by an increase in local revenue in t is:

$$\frac{\partial G_i t+1}{\partial X_i t} = -b_{t+1}[\frac{(1-\frac{1}{N_t})(\overline{X}_{Nt}-\overline{X}_{Mt})-(\frac{1}{M_t}-\frac{1}{N_t})(\overline{X}_{Nt}-X_{it})}{M_t(\overline{X}_{Nt}-\overline{X}_M)^2}] \tag{13}$$

According to Eq.(13), the impact of revenue on future grants could be positive or negative, however, if we consider Chilean data, this effect is always negative.

During the period 1990 - 2006, the distribution mechanism underwent mainly two reforms that affected the information used in the distribution formula, the components' weight and the formula itself. Below, I will describe each one, highlighting the aspects that I exploit in the empirical strategy.

Until 1995, the information used in the distribution formula was updated every three years and the revenue component considered the IPP per capita measured two years before the updating year, that is, if the updating year is t, the grant in the years t, t+1 and t+2 considered the IPP per capita of the year t-2. Then, since the updating years in the period 1990 - 1995 were 1990 and 1993, only 1991 and 1994 were relevant years for the distribution of resources in that period. On the other hand, the weight of the equalization component was 36%.

Between 1995 and 2006, the information used in the distribution formula was updated every three years again, but in this period the equalization component considered the average IPP per capita of the three years starting from two years before the updating year, that is, if the updating year is t, the grant in the year t, t+1 and t+2 considered the average IPP per capita of the years t-2, t-3 and t-4. The updating years in this period were 1996, 1999 and 2003. The main difference between the first and the second period is that in the latter every year is relevant for the distribution formula, although among them there are differences with respect to the number of years between the collection of revenue and the update of information. For instance, the revenue collection in the years 1995,

1996 and 1997 is used in grants distribution made in the period 1999-2002, then in 1995 municipalities knew that their collection would affect the future grants after 4 years (or in other words: municipalities knew that tax would be payed after 4 years), in 1996 after 3 years and in 1997 after just 2 years. Moreover, in the years 2002 and 2006 the update was delayed by one year. This decision was informed to municipalities only at the end of 2001 and 2005, respectively. This kind of reforms changes the number of years between the collection of revenue and the update of information for the remaining years. In this period, the weight of the equalizing component was 31.5%.

In 2007 took place another reform[17] but I do not consider it, although I have data for this year, because it was established a sophisticated compensation mechanism for the municipalities in which the transfer falls, then the calculation of equalization tax is not clear.

Figure 1 shows the main aspects that characterize these two periods. In this diagram each dotted line is associated with an arrow, which represents the relationship between the years when the revenue is collected (dotted line) and the year when the information is updated or the tax is payed (arrow). Besides, each dotted line shows the number of years until the transfer is affected. This relationship is defined considering the available information for municipalities in the respective year. For instance, during most of 2001 municipalities knew that in 2002 the actualization would be made, then the collected revenue in 2001 would have impact from 2005 to 2007 (that is, in four years' time). Since the update was delayed by one year, which was known at the end of 2001, in 2002 the collected revenue affected the grant distribution after 4 years again. The collected revenue in 2001 affected finally the grant distribution in 2003, which was known ex-post and that is the reason why it is not presented in the diagram. The actual years of update are indicated with the letter A, while the years when municipal elections were held are indicated with the letter E.

[17]Since 2007, the information used in the distribution formula is updated every year and the revenue component considers the IPP per capita measured two years before the updating year, that is, if the updating year is t, the grant in the year t consider the IPP per capita of the year t-2. Then, since 2007 every year is relevant for the distribution formula and the number of years between the collection of revenue and the update of information will be always 2 years. Finally, the weight of the equalizing component is 35%.

In summary, during the period 1990 - 2006 it is possible to distinguish five kinds of years: (1) years when the revenue collection is not relevant for future grants (1990, 1992 and 1993); (2) years that belong to period 1 and when the revenue collection affect grants distribution after two years (1991, 1994); (3) years that belong to period 2 and when the revenue collection affect grants distribution or the tax is payed after two years (1997, 2000 and 2004); (4) years when the revenue collection affect grants distribution or the tax is payed after three years (1996, 1999 and 2003); and (5) years when the revenue collection affect grants distribution or the tax is payed after four years (1995, 1998, 2001, 2002, 2005 and 2006).

4 Empirical Strategy

To analyze the incentive effect of the equalization grants FCM, I estimate the effect of equalization tax on collected revenue. Although the equalization tax is unobservable for the researchers, I assume that it is determined by the rate at which the future grant decrease by an increase in present local revenue, the municipalities' factor of discount (see Eq. 10), and the relative importance of the resources due to equalization respect to the sum of revenue collection and FCM grant.

Every year the equalization component works only for a group of municipalities, specifically, for those municipalities with IPP per capita used in the distribution formula below national average. In other words, these municipalities pay positive equalization tax, while municipalities with IPP per capita used in the distribution formula greater than national average pay tax equal zero. Since municipalities that pay positive equalization tax could have unobservable local characteristics which could be time-variant and time-invariant and would explain in part why the revenue is lower than the average, endogeneity problems could arise. That is, the municipalities with positive tax were not chosen randomly.

On the other hand, the equalization tax is heterogenous, because how much grants change due to a change in the collected revenue depends on, among other variables[18], the relative

[18]Other determinants are the number of municipalities (N_t) and the number of municipalities that are

deficit of each municipality (which affects negatively the rate at which the future grant decreases), and the relative importance of the resources coming from equalization that is different among municipalities. However, both variables are simultaneously determined by the revenue collection. For instance, those municipalities with IPP per capita closer to national average have an equalization component very small with respect to the sum of FCM and collected revenue but they have the highest rate at which the future grant decreases. Then the effect of interest could be measuring the mechanical relationship that exist between the dependent variable (local collected revenue) and the equalization tax.

Part of the empirical strategy used in this research is based on the characteristics of the Chilean distribution formula. First, I use municipal fixed effects to control for unobservables variables that affect tax and collected revenue and that are time invariant. Second, to measure the rate at which the future grant decreases I consider the revenue measure used in the distribution formula in the last update and not the revenue collection (or the lagged revenue collection). For instance, for measuring the equalization tax in 1996 I consider the average IPP percapita of the years 1992, 1993 and 1994. Although both variables are highly correlated, there is another difference between the percapita local revenue and the IPP per capita used in the distribution formula: the way the population is measured. For per capita local revenue, the projected population over the 1990-2006 time period was considered, based on censuses through 2002, whereas the latter includes the projected population based on the latest censuses, which changes depending on the updating year. In Bravo (2011) thw data used in every update is specified.

Third, my identification strategy exploits, in turn, the implemented reforms in the distribution formula in the period 1990 - 2006 which could be considered exogenous from the viewpoint of a municipality. Specifically, I compare revenue collection between years when the revenue collection affects future grants and years when it does not, in this case for all municipalities the tax equals zero. Moreover, to consider the effect of discount factor and that the tax that will be payed later is of minor importance, I exploit the fact that the period of time to pay taxes change. In this way, it is possible to distinguish the incentive effect when municipalities must pay closer (2 years later) from incentive effect when municipalities must pay taxes 3 or 4 years later. For doing this, I define the following

treated (M_t)

dummies variables: (1) $tt1$ which equals 1 if the year belongs to period 1 and when the revenue collection affect grants distribution after two years (1991 and 1994) (2)$tt2$ which equals 1 if the year belongs to period 2 and when the revenue collection affect grants distribution after two years (1997, 2000 and 2004) (3) dummy $tt3$ which equals 1 when the revenue collection affect grants distribution after three years (1996, 1999 and 2003), and (4) dummy $tt4$ which equals 1 when the revenue collection affect grants distribution after four years (1995, 1998, 2001, 2002, 2005 and 2006). I distinguish between $tt1$ and $tt2$ because I consider the former as a special regime because in period 1 not all years were relevant and in this case municipalities would not be concerned about the effect on future transfer.

I consider the following specification for measuring the incentive effect of FCM on per capita collected local revenue:

$$x_{it} = \gamma + \beta_0 * IPPPd_{it} + \beta_1 * tt1 * tax_{it} + \beta_2 * tt2 * tax_{it} + \beta_3 * tt3 * tax_{it} + \beta_4 * tt4 * tax_{it} + \theta_0 \alpha_{it}^{proptax} + \theta_1 \alpha_{it}^{munlic} + t_t + \mu_i + \epsilon_{it} \quad (14)$$

Where x_{it} is the per capita local revenue collected by the municipality i in year t; $IPPPd_{it}$ refers to the IPPP used in the distribution formula,tax_{it} is the payed tax by municipality i in the year t, tt_j corresponds to dummy that equals 1 when the revenue collection affect grants distribution after j years, $\alpha_{it}^{proptax}$ is the proportion of property tax revenue transferred from municipality i to the FCM in year t, α_{it}^{munlic} is the proportion of municipal license revenue shifted by municipality i to the FCM in the year t, t_t is the year fixed effect, μ_i municipality fixed effect, and ϵ_{it} is a random error term.

The coefficients of interest are: β_1 which corresponds to the incentive effect when the update or tax pay will take place in two years and the municipalities are period 1 ; β_2 which corresponds to the incentive effect when the update or tax pay will take place in two years and the municipalities are in period 2 ; β_3 corresponds to the incentive effect when the update or tax pay will take place in three years and β_4 corresponds to the incentive effect when the update or tax pay will take place in four years . I would expect that these coefficients were negative and decreasing, that is, a major disincentive to collect revenue

the closer the tax pay is due to the existence of the discount factor.

Municipality fixed effects and year fixed effects are included in the regression because they control for time-invariant unobserved municipal characteristics and for shocks that affecting all municipalities equally or economic growth. Finally, the proportions of property tax revenue and municipal license revenue that are shifted to FCM are included in the regression because in this way it is controlled for the contribution mechanism.

Another way of studying the incentive effect of the FCM and its intertemporal dimension is to adjust the tax measure for the probability that municipal authority' political coalition actually pay the equalization tax. This probability depends on whether or not there are municipal elections before the year of updating, and on the probability of reelection of the municipal authority's political coalition. If there is not municipal election before the year of updating, the likelihood of municipal authority's coalition pays the tax will be one. If there is municipal election before the year of updating, the likelihood of municipal authority's coalition pays the tax will depend on the likelihood of reelection of the municipal authority's political coalition. The effect of having a low likelihood of reelection is similar to having a higher discount factor (the extreme case of this is when the likelihood of reelection is close to zero, then $\delta \longrightarrow \infty$, that is, the future tax does not really matter in the collection decision).

In this case, I consider the following specification:

$$\begin{aligned} x_{it} = \gamma + \beta_0 * IPPPd_{it} + \beta_1 * tt1 * tax_{it} + \beta_2 * tt2 * tax_{it} + \beta_3 * tt3 * tax_{it} + \beta_4 * tt4 * tax_{it} \\ + \lambda_0 * paytax + \lambda_1 * tax * paytax_{it} \\ + \theta_0 \alpha_{it}^{proptax} + \theta_1 \alpha_{it}^{munlic} + t_t + \mu_i + \epsilon_{it} \end{aligned} \tag{15}$$

Where $paytax_{it}$ is the likelihood of paying future tax for the authority's coalition of the municipality i in the year t.

5 Data

In this research, data on 340 Chilean municipalities over the time period 1990 - 2006 was used. As in Bravo (2011), five municipalities were identified as outliers because in some years they present an observation of per capita local revenue that does not belong to the same distribution as their revenue.

Table 1 presents descriptive statistics for the dependent variable (per capita collected local revenue, x_{it}),the IPPP used in the distribution formula ($IPPPd_{it}$), the regressor of interest (tax_{it} and tax_{it}), the relevant year dummies ($tt1$, $tt2$, $tt3$, and $tt4$), the likelihood of paying future tax ($paytax_{it}$) and high likelihood of paying future tax dummy ($dhigh_{it}$) , the proportions of local revenue shifted to the FCM (property taxes, municipal permits, vehicle registration fees, all decimalized), socioeconomic variables used to control and test robustness (poverty rate, population, exempt properties, low proportion of exempt properties dummy, municipal school enrollment) and the diferent kinds of collected revenue (property tax, municipal license, vehicle registration fee and other revenue) . Table 2 presents the same information that presents table 1 but only considering municipalities that pay positive tax.

Close to 80% of the municipalities pay positive equalization tax. The equalization tax exhibit considerable differences among them with respect a their magnitudes and scale.

SUBDERE's Division of Municipalities provided the revenue data for the 1990-2001 time period, whereas the National System of Municipal Information (Sistema Nacional de Información Municipal, or SINIM) provided the information for 2002-2006. The SINIM, which is administered by SUBDERE, receives financial information from the municipalities. These variables are measured in Th$ 2007. Besides, SUBDERE provides official reports of the "IPPP used in distribution formula" through which were calculated the equalization tax.

The poverty data is provided by the Socioeconomic Identification Survey (Encuesta de Caracterización Socioeconómica, known as CASEN). For the years in which this information is not available, the value of the preceding year was assigned. Municipalities for which this information was not available were assigned the regional poverty data.

Population data was obtained from the National Institute of Statistics (Instituto Nacional de Estadísticas, or INE), exempt properties data was obtained from the Internal Revenue Service (Servicio de Impuestos Internos, or SII) and municipal school enrollment was obtained from the Ministry of Education's web page.

Information related to elections (municipal, presidential and parlamentiary) was obtained from the web page www.elecciones.gov.cl. To calculate the likelihood of paying tax, I use Figure 1 which easily identifies the relationship between updating year and election year. For determining the probability of reelection of the municipal authority's political coalition, I assume that municipal authorities have rational expectations and I estimate a probit regression where the dependent variable is a dummy that equals 1 if the municipal authority's coalition is reelected in the nearest future election. The explicative variables change every year because I consider all the available information that a municipal authority could have. For instance, for the year 1999 I estimate a probit regression for the probability of being reelected in 2000 and consider the following explicative variables: coalition's percentage obtained in municipal election in 1992 and 1996, coalition's percentage obtained in municipal election in 1992 and 1996, coalition's percentage obtained in parliamentary election in 1989, 1993 and 1997, coalition's percentage obtained in presidential election in 1989 and 1993, coalition's percentage obtained in 1988 plebiscite, change in the proportion of municipal school enrollment with respect to the last election year (in this case between 1996 an 1999), change in municipal poverty considering the available information, in this case between 1996 and 1998, and the change relevant in municipal school's SIMCE scores (which represent a municipal schools' quality measure). For the year 2000 I estimate a probit regression for the probability of being reelected in 2000 and consider the same explicative variables that I consider in 2009 with the exception of: change in the proportion of municipal school enrollment with respect to the last election year (in this case between 1996 an 2000), and the change relevant in municipal school's SIMCE scores (inthis case between 1999 and 1996). Finally for the year 2001 I estimate a probit regression for the probability of being reelected in 2004 and consider the same explicative variables that I consider in 2000 plus the coalition's percentage obtained in municipal election in 2000 and with the exception of: change in municipal poverty considering the available information, in this case between 1998 and 2000; change in the proportion of municipal school enrollment with respect to the last

election year (in this case between 2000 an 2001), and the change relevant in municipal school's SIMCE scores (inthis case between 2000 and 1997).

To calculate the likelihood of paying tax I have to consider that the information updating is every three years. For instance, in 1991 the likelihood of paying tax equals the probability of reelection of the municipal authority's political coalition in 1991 because the tax must be paid in 1993, 1994 and 1995 and the nearest municipal equation is in 1992, while in 1994 the likelihood of paying tax equals the average of 1 and two times the probability of reelection of the municipal authority's political coalition in 1994 because the tax must be paid in 1996, 1997 and 1998 and the nearest municipal equation is in 1996 (at the end of the year) then the first pay of tax has probability equals 1.

The definition of the dummy that equals one if the likelihood of paying tax is high consider a 70% threshold. This threshold was defined on the basis of the average proportion of municipalities where the municipal authority's coalition was reelected and the distribution of the predicted likelihood of paying tax in every year. For instance, if the average proportion of municipalities where the municipal authority's coalition was reelected is close to 60%, then I define the threshold as the predicted likelihood that corresponds to the centile 40 which is close to 70%.

6 Results

Table 3 presents the results of the estimation of Eq. 14 and Eq. 15. In the column (1) and (2) present the estimates of the parsimonious model which only includes for municipality fixed effect and years dummies. In this case all the coefficients of interest are negative and statistically significant. The results are measure in termsd of standard deviations. Speciffically, this effect is decreasing respect to the period of time before municipalities pay taxes. An increase in tax of one standard deviation is associated with a decrease in local per capita revenue between 0.29 and 0.18 standard deviations. This effect is greater when local authority's coalition has high a likelihood of reelection (see columns 4, 5, 6 and 7).

In table 4, I use alternative measures of tax and in table 5 I control for socioeconomic

variables and the results remain. In table 6 and 7 I distinguish between municipalities with greater beneffit of exerting greater effort and those with lower beneffit. In the former the results remain and the latter the tax is not significant, as I expect. Finally in table 8 I present a falsiffication check using as dependent variable a proxy for municipal revenue that does not depend on collecting effort, that is the transfer for education. As I expect, the tax in this case is not relevant.

7 Conclusions

This paper analyzes the incentive or substitution effect of the Chilean equalization grants. When redistributive grants are inversely related to the collected local revenue, if a local government increases its collected revenue, the received grant will decrease. This kind of transfers increases the marginal cost of collecting revenue, i.e., levies a tax on collecting local revenue.

This paper exploits the fact that not all municipalities affect the future transfer with their collection decision but only those that have their revenue lower than national average. Moreover, the tax is heterogeneous. Since that endogeneity problems could arise, the identification strategy exploits, in turn, reforms in the distribution formula that underwent in the period 1990 - 2006 for identifying the effect of interest. The main finding is evidence for Chilean municipalities that FCM has an incentive effect on local revenue.

Appendix A: Static Model

I present the results of a static model to compare them with those obtained with the dynamic model. In this case, the local government decision-maker problem is:

$$\underset{X}{Max} f(Z) - e(X) \tag{16}$$

s.t. $Z = (1\text{-}\alpha\ )X + K + b\beta\ (X; \overline{X})$

The FOC of this problem is:

$$\frac{\partial f}{\partial X}(1 - \alpha - b\frac{\partial \beta}{\partial X}) = \frac{\partial e}{\partial X} \tag{17}$$

In this context, both the redistributive tax and the contribution tax lower the marginal benefit of public spending, and it is not worth distinguish between them.

Appendix B: Optimal Local Revenue with $G_t = f(X_{t-1}, X_{t-2})$ and $G_t = f(X_{t-2})$

Case 1: $G_t = f(X_{t-1}, X_{t-2})$

$$\underset{\{X_t, Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t)\right) \tag{18}$$

s.t. $Z_t = (1\text{-}\alpha_t\ )X_t + K_{t-1} + b_t\beta_t\ (X_{t-1};\ X_{t-2})$

The Bellman equation is:

$$v(X_{t-1}, X_{t-2}) = \underset{\{X_t, Z_t\}}{Max} \left(f(Z_t) - e(X_t)\right) + \delta v_{t+1}(X_t, X_{t-1}) \tag{19}$$

s.t. $Z_t = (1\text{-}\alpha_t\ )X_t + K_{t-1} + b_t\beta_t\ (X_{t-1};\ X_{t-2})$

The first order condition becomes:

$$\frac{\partial f}{\partial Z_t}(1 - \alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta)\frac{\partial v_{t+1}}{\partial X_t} \tag{20}$$

The Beveniste-Shienkman conditions are:

$$\frac{\partial v_t}{\partial X_{t-1}} = \frac{\partial f}{\partial Z_t} b_t \frac{\partial \beta_t}{\partial X_{t-1}} + \delta \frac{\partial v_{t+1}}{\partial X_{t-1}} \tag{21}$$

$$\frac{\partial v_t}{\partial X_{t-2}} = \frac{\partial f}{\partial Z_t} b_t \frac{\partial \beta_t}{\partial X_{t-2}} \tag{22}$$

Then, the FOC can be written:

$$\frac{\partial f}{\partial Z_t}(1 - \alpha_t) - \frac{\partial e}{\partial X_t} = -\delta \frac{\partial f}{\partial Z_{t+1}} b_{t+1} \frac{\partial \beta_{t+1}}{\partial X_t} - \delta^2 \frac{\partial f}{\partial Z_{t+2}} b_{t+2} \frac{\partial \beta_{t+2}}{\partial X_t} \tag{23}$$

Case 2: $G_t = f(X_{t-2})$

$$\underset{\{X_t,Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t)\right) \tag{24}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + $b_t\beta_t$ (X_{t-2})

The Bellman equation is:

$$v(X_{t-2}) = \underset{\{X_t,Z_t\}}{Max} \left(f(Z_t) - e(X_t)\right) + \delta v_{t+1}(X_t - 1) + \delta^2 v_{t+2}(X_t) \tag{25}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + $b_t\beta_t$ (X_{t-2})

The first order condition becomes:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta^2)\frac{\partial v_{t+2}}{\partial X_t} \tag{26}$$

The Beveniste-Shienkman condition is:

$$\frac{\partial v_t}{\partial X_{t-2}} = \frac{\partial f}{\partial Z_t} b_t \frac{\partial \beta_t}{\partial X_{t-2}} \tag{27}$$

Then, the FOC can be written:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -\delta^2 \frac{\partial f}{\partial Z_{t+2}} b_{t+2} \frac{\partial \beta_{t+2}}{\partial X_t} \tag{28}$$

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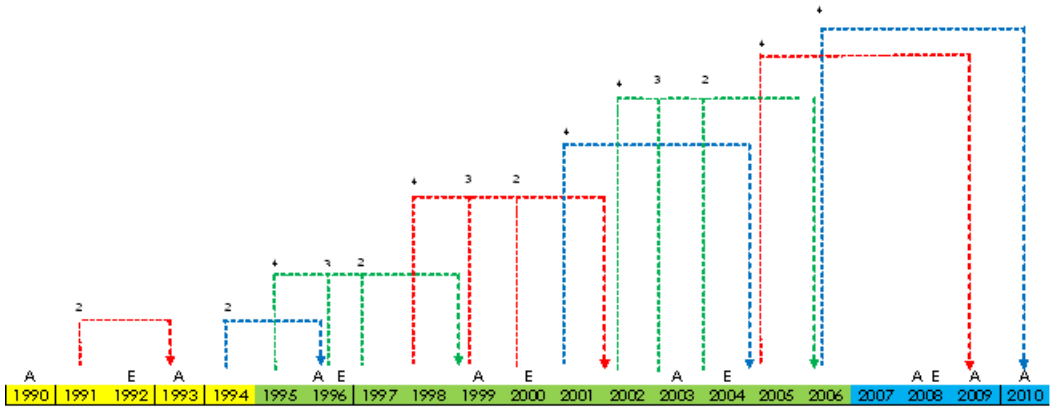

Figure 1: Effects of Revenue Collection on Grant Distribution

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
x	5980.000	44.005	28.425	61.792	7.966	125.756
ipppd	6026.000	22.621	15.849	27.100	4.351	61.349
tax	6120.000	0.000	0.000	0.000	0.000	0.000
tax2	5967.000	0.000	0.000	0.000	0.000	0.000
tt1	6120.000	0.167	0.000	0.373	0.000	1.000
tt2	6120.000	0.167	0.000	0.373	0.000	1.000
tt3	6120.000	0.167	0.000	0.373	0.000	1.000
tt4	6120.000	0.333	0.000	0.471	0.000	1.000
taxpay	6029.000	0.527	0.619	0.423	0.000	1.000
dhigh	6120.000	0.472	0.000	0.499	0.000	1.000
aproptax	5980.000	0.600	0.600	0.003	0.600	0.600
avehreg	5980.000	0.549	0.500	0.061	0.500	0.625
amunlic	5980.000	0.007	0.000	0.064	0.000	0.000
poverty	6024.000	27.823	28.950	11.837	8.890	47.065
pop	6024.000	44837.287	16896.500	69179.380	2197.000	1.87e+05
exprop	6029.000	8173.192	3593.000	12642.592	522.000	32781.000
lowexprop	6120.000	0.494	0.000	0.500	0.000	1.000
munenroll	5977.000	5581.895	2689.000	7492.402	349.000	22786.000
proptax	5980.000	18.710	11.173	33.039	1.357	49.691
munlic	5983.000	7.120	3.239	17.192	0.635	21.739
vehreg	5984.000	9.985	5.360	19.202	1.230	34.724
orev	5981.000	8.338	4.916	12.525	0.821	26.456

Table 1: Descriptive Statistics

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
x	4664.000	26.942	23.670	17.828	7.117	56.383
ipppd	4699.000	14.030	12.933	7.356	3.859	28.412
tax	4699.000	0.000	0.000	0.000	0.000	0.000
tax2	4657.000	0.000	0.000	0.000	0.000	0.000
tt1	4699.000	0.163	0.000	0.370	0.000	1.000
tt2	4699.000	0.171	0.000	0.376	0.000	1.000
tt3	4699.000	0.171	0.000	0.376	0.000	1.000
tt4	4699.000	0.340	0.000	0.474	0.000	1.000
paytax	4660.000	0.525	0.597	0.419	0.000	1.000
dhigh	4699.000	0.458	0.000	0.498	0.000	1.000
aproptax	4664.000	0.600	0.600	0.000	0.600	0.600
avehreg	4664.000	0.551	0.500	0.061	0.500	0.625
amunlic	4664.000	0.000	0.000	0.000	0.000	0.000
poverty	4695.000	29.578	30.100	11.250	11.510	47.460
pop	4695.000	40915.905	17050.000	65820.309	3704.000	1.72e+05
exprop	4688.000	8053.495	3771.000	12641.957	865.000	30642.000
lowexprop	4699.000	0.423	0.000	0.494	0.000	1.000
munenroll	4667.000	5205.907	2727.000	6499.106	611.000	20980.000
proptax	4664.000	10.918	9.381	8.432	1.308	26.092
munlic	4667.000	4.266	2.789	4.816	0.600	11.964
vehreg	4668.000	6.166	4.582	7.704	1.082	15.392
orev	4665.000	5.656	4.179	6.057	0.774	14.235

Table 2: Descriptive Statistics for municipalities that pay positive equalization tax

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-0.14***		-0.04		
tax*tt1		0.01		0.06	0.05
tax*tt2		-0.29***		-0.23***	-0.24***
tax*tt3		-0.21***		-0.20***	-0.21***
tax*tt4		-0.18***		-0.13***	-0.14***
tax*taxpay			-0.11taxpay***	-0.08taxpay****	
tax*dhigh					-0.06***
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Socioeconomic variables	No	No	No	No	No
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	5,639	5,639	5,639	5,639	5,639
No of comuna	340	340	340	340	340

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Incentive Effect of FCM on local revenue

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-0.10***		-0.03		
tax*tt1		0.06		0.11	0.09
tax*tt2		-0.35***		-0.30***	-0.31***
tax*tt3		-0.31***		-0.26***	-0.28***
tax*tt4		-0.22***		-0.17***	-0.19***
tax*taxpay			-0.11taxpay***	-0.09taxpay****	
tax*dhigh					-0.06***
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Socioeconomic variables	No	No	No	No	No
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	5,639	5,639	5,639	5,639	5,639
No of comuna	340	340	340	340	340

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Incentive Effect of FCM on local revenue using alternative tax measure

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-0.11***		-0.04		
tax*tt1		0.01		0.06	0.05
tax*tt2		-0.29***		-0.23***	-0.24***
tax*tt3		-0.25***		-0.20***	-0.21***
tax*tt4		-0.18***		-0.13***	-0.14***
tax*taxpay			-0.10taxpay***	-0.08taxpay****	
tax*dhigh					-0.06***
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Socioeconomic variables	Yes	Yes	Yes	Yes	Yes
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	5,639	5,639	5,639	5,639	5,639
No of comuna	340	340	340	340	340

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Incentive Effect of FCM on local revenue controlling for socioeconomic variables

Dependent Variable	TaxProp	Munlic	Veh Reg	Other Rev	
	(1)	(2)	(3)	(4)	
tax	-0.08*	-0.03	-0.14**	-0.13***	
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Observations	5,639	5,639	5,639	5,639	5,639
No of comuna	340	340	340	340	340

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Incentive Effect of FCM on different kinds of local revenue

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-0.16***		-0.05		
tax*tt1		-0.06		0.03	0.01
tax*tt2		-0.38***		-0.27***	-0.28***
tax*tt3		-0.28***		-0.18***	-0.20***
tax*tt4		-0.19***		-0.10	-0.11
tax*taxpay			-0.17taxpay***	-0.14taxpay****	
tax*dhigh					-0.13***
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Socioeconomic variables	No	No	No	No	No
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	2,963	2,963	2,963	2,963	2,963
No of comuna	168	168	168	168	168

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Incentive Effect of FCM on local revenue considering municipalities with low proportion of exempt properties

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-0.05		-0.06		
tax*tt1		-0.00		-0.01	0.00
tax*tt2		-0.08		-0.09	-0.08
tax*tt3		-0.11**		-0.13	-0.11
tax*tt4		-0.09**		-0.10	-0.09
tax*taxpay			-0.01taxpay	0.02taxpay	
tax*dhigh					-0.00
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes
Socioeconomic variables	No	No	No	No	No
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	2,963	2,963	2,963	2,963	2,963
No of comuna	168	168	168	168	168

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Incentive Effect of FCM on local revenue considering municipalities with high proportion of exempt properties

Dependent Variable	Ln Municipal Shool Enrollment	
	(1)	(2)
tax	-0.00	
tax*tt1		-0.003
tax*tt2		- 0.005
tax*tt3		0.001
tax*tt4		0.003
Fixed effects	Yes	Yes
Time Dummies	Yes	Yes
% revenue shifted to FCM	Yes	Yes
Observations	5,639	5,639
No of comuna	340	340

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Incentive Effect of FCM on proxy of Education Transfer