INSTITUTO DE ECONOMÍA

TESIS de DOCTORADO

2012

Essays on Effects of Intergovernmental Transfers

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Esta tesis se presenta como requerimiento parcial para optar al grado de
Doctor en Economía

Instituto de Economía
PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE

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2012

Abstract
Essays on Effects of Intergovernmental Transfers
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This thesis analyzes intergovernmental grants and their effect on subnational fiscal decisions. On the one hand, explores whether the receipt of transfers may cause an income effect that reduces the collection effort made by municipalities. We find empirical evidence that for Chilean municipalities, unconditional grants have a negative effect on local revenue. On the other hand, equalization grants that are inversely related to collected revenue actually discourage revenue collection. This grant increases the marginal cost of collecting because it taxes the collection itself. We find a negative relationship between the equalization grant's implicit tax and collected local revenue, and this effect is greater when the period of time between collection and the corresponding distribution of grants is shorter and when the political coalition to which the incumbent mayor belongs has a high likelihood of winning the next election and therefore paying this implicit tax in the coming years. In order to identify these effects, we exploit the characteristics of the Chilean distribution formula and the reforms made to it from 1990 to 2007, which could be considered exogenous from the viewpoint of a municipality. Research utilizes data for a panel of 340 Chilean municipalities during the 1990-2007 period.

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Resumen

Essays on Effects of Intergovernmental Transfers

por

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La tesis estudia las transferencias intergubernamentales y sus efectos en las decisiones fiscales subnacionales. Primero se estudia si la recepción de transferencias podría producir un efecto ingreso que disminuye el esfuerzo por recaudar hecho por las municipalidades. Se encuentra evidencia para las municipalidades chilenas que transferencias no condicionadas tiene un efecto negativo en la recaudación local. Segundo, las transferencias que buscan la equidad fiscal y están relacionadas negativamente con la recaudación desincentivan la recaudación de ingresos. Esta transferencia aumenta el costo marginal de recaudar debido a que grava la recaudación. Se encuentra una relación negativa entre el impuesto implícito de la transferencia que busca equidad fiscal y el ingreso local recaudado, y este efecto es mayor cuando el período de tiempo entre la recaudación y la distribución de la transferencia es menor y cuando la coalición política a la cual pertenece el alcalde en ejercicio tiene una alta probabilidad de ganar la siguiente elección y entonces pagar el impuesto implícito en los siguientes aos. Para identificar ambos efectos se explotaron características de la fórmula de distribución de transferencia y las reformas que se implementaron en ella entre los aos 1990 2007 y se utilizó un panel de 345 municipios para el mismo período.

Profesores Guía
Bernardita Vial
Francisco Gallego

To my family and friends

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Acknowledgments

Many people were very important to the development of this thesis. First, I would like to thank my advisors, Bernardita Vial and Francisco Gallego, who have vast knowledge and understanding of economics and were quite influential in what I accomplished, as well as Ignacio Irarrzaval, with whom I share a great interest in local public finance, a field in which he has extensive experience.

I would also to like thank other members of the PUC faculty who contributed to this research through suggestions in seminars and the administrative staff of the PhD program at PUC and the Institute of Economics.

I would like to thank my fellow PhD students at PUC for providing their time and suggestions and especially for their friendship.

I am also grateful to many people outside of PUC for their invaluable support. Officials at SUBDERE helped me obtain and understand municipal data. Finally, I would like to thank my family and friends for keeping me grounded and sane during these past six years.

Chapter 1

A Literature Review of The Effects of Intergovernmental Grants

1.1 Introduction

According to traditional literature on fiscal federalism, one of the benefits of decentralization is more efficient allocation of local public goods. The efficiency level of a local public good varies from one jurisdiction to another; each jurisdiction presents different preferences and cost conditions. As subnational governments are much closer to the population of their jurisdictions, they tend to have greater knowledge about such preferences and cost conditions than central governments do (Tiebout, 1956; Oates, 1999). Moreover, this closeness provides a benefit in terms of accountability (local control over local outcomes). However, since subnational governments have varying fiscal capacities[1] and must carry out the functions assigned to them, fiscal inequalities will arise among these jurisdictions (Buchanan, 1950).

[1]Fiscal capacity is the ability to generate revenue, which depends on resources available within each jurisdictions geographical area. According to Chernick (1998) fiscal capacity can be defined as the ability of a governmental jurisdiction to translate economic activity within its geographic borders into public spending. This concept reflects the differing amounts of revenue jurisdictions could raise, rather than what they actually raise. It is generally measured by the size of the tax base.

Federalism and decentralization generate many fiscal relationships between governments at different levels or between governments at the same level. Economic and fiscal federalism literature have studied extensively these relationships to find causal relationships. For instance, Case et al (1993) investigate the issue of how state level government spending is affected by other states spending and find that a one dollar increase in a state's neighbors expenditures increases its own expenditure by over 70 cents. Besley and Rosen (1998) study a common feature of federal systems: state and federal tax setting decisions are interdependent due to tax bases are joint property. They find that when the federal government increases taxes, there is a significant positive response of state taxes. Chernick (1998) uses a standard state budget constraint model to identify the impact of the major changes in American federal welfare policy and reviews the evidence on state responses to federal incentives for spending on the needy, which varies enormously. A key issue in this literature is how intergovernmental grants, payments from one jurisdiction or government to another, influence the fiscal decisions of the recipient government.

Intergovernmental grants can vary according to the purpose they have, the recipient's degree of autonomy in deciding how to spend them and the level of government involved. The literature emphasizes many potential roles of intergovernmental grants such as fiscal equalization among jurisdictions, internalization of spillover benefits to other jurisdictions, stimulation of local economic development and capacity to cope with idiosyncratic regional income shocks in a federal state (risk-sharing). More recently, Johansson (2003) analyzes intergovernmental grants as a tactical instrument, i.e., finding that politics influence the allocation of governmental resources to regions.

On the other hand, unconditional (or general purpose) grants can be spent as if they were subnational government's own revenues (without strings attached), that is, they can be used in any way that the recipient municipality desires, while conditional (or specific-purpose) grants can only be used for a specific purpose. Unconditional grants are considered an appropriate vehicle for the purposes of fiscal equalization (Oates, 1999). Conditional grants can be non-matching or matching grants. Non-matching grants do not require subnational governments to finance a specified percentage of expenditures using their own resources, while matching grants must be complemented by subnational contributions (grantor jurisdiction sets a rate at which the grants will match contributions

from the grantee jurisdiction). Finally, grants may be vertical (between governments at different levels) or horizontal (between governments at the same level).

1.2 Transfers Effects

There is a great deal of empirical and theoretical research focused on the effects of intergovernmental grants on subnational fiscal decisions, that is, decisions that affect subnational public revenues and spendings. The subnational fiscal variables that can be affected by transfers are determined by the institutional context[2]. We consider two cases: when subnational governments have fiscal autonomy, that is, they control tax rate and assessed valuation; and when subnational governments have not fiscal autonomy and they are responsible for collecting subnational revenue.

In general the effects of transfers that have been studied in public finance literature are two: first, the effect on fiscal subnational variables of receiving more resources and in this case the concern is the use of these resources; second, the effect on fiscal subnational variables of the design of transfers in which case transfers affect relevant relative prices (substitution and incentive effect)[3].

Unconditional grants and non- matching conditional grants just increase the subnational's resources, thus, they only increase the subnational revenue and does not affect relative prices. 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.

Conditional matching grants have two effects: the grant gives subnational government more resources, some of which go to a specific area determined by central government and

[2]OECD (1999) defined the following categories ranked by decreasing order of control that subcentral levels of government (SCG) can exercise over this revenue source: a)SCG sets tax rate and tax base; b)SCG sets tax rate only; c)SCG sets tax base only; d)tax sharing arrangements; and e)central government sets rate and base of SCG tax.

[3]Another issue widely studied is the soft budget constraint in a federation, where there is a moral hazard problem between the central and subnational governments. Because vertical imbalances are resolved by centrally transfers to subnational governments or by subnational borrowing, subnational governments have an incentive to over-borrow if central government has the willingness to bailout subnational governments.

reduces the relative prices of the specific area from a given budget (substitution effect). Both effects stimulate higher spending on a specific area (Shah, 2007). For instance, Slack (1980) analyzes the impact of provincial grants on Canadian local government expenditures in both price and income terms. His model assumes that politicians maximize the utility of citizens in the municipality subject to a budget constraint, which states that total expenditures equal income after taxes residents plus taxes, matching conditional and unconditional grants.

Grants that are unconditional and intend to enhance inter-jurisdictional equity could affect relative prices. Equalization grants requires the definition of a mechanism for distributing the resources[4]. The allocation of equalization grants is often based on a formula that takes into consideration the fiscal need and fiscal capacity of each jurisdiction. However, due to data constraints, fiscal capacity is measured by proxies like the observed per capita tax base or the actual revenues of each jurisdiction . If local governments can directly or indirectly manipulate the proxies for fiscal capacity through fiscal decisions and, in this way, manipulate the size grants, capacity equalization may induce undesirable incentive effects. If fiscal capacity were measured accurately, such transfers would not create incentive effects, 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).

This incentive effect is analogous to the substitution effect identified in the literature that study the impact of welfare system (unemployment or disability insurance) on labor supply, for instance, the negative-income-tax type plans, where families without other income are allowed a certain fixed amount of transfer benefits, and, as family income rises, transfer benefits are reduced by an amount determined by the program's benefit reduction rate (Greenberg et al, 1981). Economic theory implies that such programs likely reduce the labor supply of recipients: the receipt of benefits may engender an income effect that reduces time spent working, while the benefit reduction rate lowers the reward for an hour of work and, consequently, may induce transfer recipients to work less through a substitution effect. Autor and Duggan (2007) observe that all nonwork-

[4]Moreover, if grants are horizontal, they will require a contribution mechanism that determines which jurisdictions will provide resources to others and the amounts of their contributions.

contingent retirement programs discourage work through two channels. First, because the return to work ultimately means sacrificing benefits, recipients face a financial incentive to remain nonemployed (program levies an implicit tax on labor supply). The second is the income effect: given the transfer payments and in-kind services provided by this kind of insurance, beneficiaries may prefer leisure to labor. The distinction between both effects is central to policy (to reduce the implicit tax on work or to reduce the amount benefits)and welfare analysis (whether there is distortion of incentives).

This literature review focus primarily on the effects of receiving transfers and on the effect of the equalization transfers design[5].

1.3 Effect of Receiving Transfers

In this section we present the research related to the effect on fiscal local variables of receiving more resources. This part of the literature we divide in three: income effect or fiscal laziness, which studies if part of the grants is targeted to decrease the subnational collection; flypaper effect, that studies if part of the grants is targeted to private consumption through reductions in tax rates; and papers that have studied the impact of grants on others economic variable of interest.

1.3.1 Income Effect or Fiscal Laziness

The hypothesis that suggests that intergovernmental grants reduce subnational revenue is known as fiscal laziness, which is in the spirit of the discourage to work or to search labor of welfare programs. The relevant institutional context in this case is described below. Subnational governments do not have considerable discretion in their financing decisions: they do not control tax rates or tax bases and their definition are determined by the central government and are the same throughout the jurisdictions. Subnational governments are responsible for collecting taxes and hence, they are not able to distribute federal grants

[5]These transfers are important fiscal instruments as long as a certain minimum level of local public goods is assured. Oates (1999) presents a discussion of the role of equalization grants in fiscal federalism from the perspective of redistributing income and promoting development in poorer regions.

to the local population by way of reducing the income tax. In this context we only expect revenues change due to grants, if tax collectors minimize efforts, for example, to reduce the resources for enforcing the tax law or for updating the assessed valuations.

The literature has focused on studying the effects of grants on local revenue as a proxy for fiscal effort. Theoretically, it is assumed that subnational governments are benevolent, that is, they maximize the utility of representative individual to take their fiscal decisions, and that take as given the fiscal decisions of the others subnational governments. Empirically, there are two challenges that we must face. First, the main challenge for estimating the effect of grants on subnational revenue is the potential endogeneity of grants. Second, subnational revenue collected is a good proxy for fiscal effort when there is no strategic interaction among subnational governments. For instance, when tax base is mobile, subnational revenue collection is affected by collection elsewhere. In this case, if all subnational governments receive more resources, all could simultaneously make less effort without decreasing their collection.

Rodríguez (1998) studies the Chilean case and uses the consumer theory's model applied to the behavior of local government, assuming a benevolent local government that has full information and faces a budget constraint given by the income of its inhabitants. He concludes that the Chilean equalization grants (FCM) meets its redistributive goal, i.e., after the FCM is distributed, municipal revenue distribution is more equitable. In addition, he finds that there is a negative relationship between the local revenue collected and the FCM grants received for the previous two years. This result is valid for the 50% of municipalities that receive more FCM resources, but it does not take into account the grants' endogeneity.

Baretti et al. (2002) study the effects of equalization transfers on German state tax revenue. German states administer tax collection but they do not choose their own tax rates and bases. Baretti et al. assume that state government take as given the fiscal decisions of the federal government and the other states, that states are inhabited by immobile individuals and that state governments maximize the welfare of the representative individual subject to the government budget constraint to determine the optimal level of enforcement activity. Studying annual data from 10 states for the years 1970 to 1998, they find that federal grants have a significant negative effect on state

tax revenue. The main drawback of this research is that it considers grants as exogenous factors that affect state tax revenue.

Aragón and Gayoso (2005) study this relationship with data from 1,400 local governments in Peru from 2000 and 2001. They assume that local governments choose a level of effort to maximize the political revenues, that can be interpreted as more popularity or higher reelection probability, and that depend on local taxes revenue, which depends in turn on fiscal effort, plus transfer from central government, minus cost of effort. They exploit a quasi-experiment and panel data to address the identification problem. In 2001, an additional grant was distributed to local governments in Peru. The authors examine the distribution of these resources, based on the assumption that this distribution is not tied to local tax collection or total expenditures, even though the grant was conferred to local governments which received the minimum equalization grant. They use participation in this program as an instrumental variable since it explains increases in grants but it is not correlated to local tax collection. They find that, in Peru, the elasticity of substitution is around -1. Although they recognize the endogeneity of grants, the validity of their instrument is doubtful because the distribution of the additional grant was not random. Rather, it depended on variables that affected the amount of the equalization grant and therefore local revenue.

1.3.2 Flypaper Effect

Most literature on effects of intergovernmental grants is in the "flypaper effect" spirit which treats subnational tax rate as a choice variable and studies the effect of grants on subnational spending and tax rates. According to Bradford and Oates (1971a, 1971b), who base their work on a median voter model of local public finance, when decentralized governments have already set up an optimal mix of local public and private goods, grants will be distributed to the local population in the form of reduced taxes and fees. That is, grants should be spent just like any other increase in community income[6]. Then, they predict that grants should cause local spending to increase, but by a lower amount than

[6]Grants are expected to be allocated to both local public and private goods in accordance with the income elasticities of the median voter.

the grant (i.e., grants crowd out subnational spending) and produce a negative effect on the tax rate and on collected revenue. For instance, Fisher and Papke (2000) study how local school districts respond financially to intergovernmental transfers from states and federal government in the United States. They summarize the existing empirical findings on that date from states' experiences with different forms of education finance, and they conclude that education grants do induce an increase in school spending but by less than the amount of the grant and any spending increase is accompanied by local tax reduction in nearly every case.

This hypothesis is based on the standard theory of public finances which assumes that, in choosing the level of expenditure, subnational communities act as if they were optimizing the utility function of some "typical" citizen (normally the median voter), subject to the budget constraint faced by this citizen (Melo, 2002). That is, this model assumes a benevolent subnational government that have a homogeneous immobile population that can be represented by the income and preferences of a single resident.

However, there is empirical evidence that does not support this hypothesis; several studies have even found that local public spending increases by an amount equal or greater than the grant (i.e. grants crowd in subnational government spending) and tax rate does not change. The literature refers to this empirical puzzle as the "flypaper effect" because money "sticks where it hits".

Part of literature concludes that the flypaper effect is not an anomaly. Roemer and Silvestre (2002) find that a model which views collective decisions as the outcome of the electoral competition among political parties predicts the nonequivalence of increases in grants and community income. Melo (2002) studies the flypaper effect under different institutional context for Colombia using panel data models and alternative functional forms. She suggests that the responses in subnational taxes and public expenditure to changes in transfers have been affected not only by economic factors but also by institutional and political factors, specially in developing countries. For instance, the fiscal decisions could reflect the preferences of bureaucrats but not of voters. Her results show that intergovernmental transfers tend to stimulate more local public spending than do comparable increases in regional income when subnational entities are highly dependent on intergovernmental transfers.

However, several papers have offered different explanations for this puzzle[7]. On the one hand, it is considered a case of fiscal illusion, in which individuals confuse the average and marginal price effects of unconditional grants. Grants reduce the average price of public goods, and individuals base their decisions on this price rather than on the actual marginal tax price[8]. On the other hand, several authors have argued that the flypaper effect is merely a specification problem in the Bradford and Oates' model.

The main specification problem identified is the endogeneity of the grants which arises from the omission of variables which affect grants and spending, and from the simultaneity of both variables. For example, Becker (1996) offers evidence that the flypaper effect disappears when instrumenting the federal grant and using a nonlinear functional form for the relationship between grants and spending. Knight (2002), incorporating the political determination of federal grants, provides a theoretical framework for selecting instruments which correct for grant endogeneity and finds no statistical evidence of a flypaper effect. On the contrary, Dahlberg et al. (2008), who study the causal effects of unconditional grants on local spending and tax rates[9], find empirical evidence that supports the flypaper hypothesis. They use a panel of 279 Swedish municipalities observed over nine years. The Swedish grant system is horizontal and consists of different kinds of grants, including cost equalization grants, aimed at reducing differences in structural cost conditions across municipalities. This kind of grant has a specific, self-financed element to compensate for outmigration of persons from local jurisdictions. Municipalities with a net outmigration above 2% receive extra grants whereas municipalities with a net outmigration below 2% do not. This formula for the distribution of funds is used as an excluded instrument in an IV estimation. Since the net outmigration rate might have a direct effect on local spending and taxes, they control for these variables directly in both the first and the second stage of the IV estimation. Finally, they find that federal grants are used to increase local spending, rather than to reduce local taxes.

Despite their differences in the institutional context and in terms of the variable by which

[7]Hines and Thaler (1995) provide a review of this literature and some explanations for the flypaper effect.

[8]Dollery and Worthington (1995) work with a model of federal expenditure and fiscal illusion and provide empirical support for the existence of the flypaper effect in Australia.

[9]Swedish municipalities are free to determine the tax rate of the main source of local government revenues.

the impact is measured, the flypaper effect and the income effect hypothesis are related. When subnational authorities do not have power to establish tax rates and bases, the total tax revenue can shift just by changes in the process of tax collection. The traditional theory assumes that intergovernmental transfers will replace subnational income: transfer of resources from the central government is accompanied by a weakening in the collection of subnational taxes. In this case, the increase in subnational spending will be lower than the increase in grants. In this sense, the income effect hypothesis can be considered contrary to the "flypaper effect": A part of the grants is targeted to private consumption through reductions in the collection effort.

1.3.3 Others Effects of Receiving Transfers

Gordon (2004) studies the impact of Title I, a non matching grants to school districts that must be used so that educationally disadvantaged children receive compensatory evaluation, on school spending and examines if local and state governments, who transfer resources to school districts, offset Title I revenue. She uses sharp changes in per pupil grant amounts surrounding the release of decennial census data to identify these effects. She finds that state and local revenue efforts initially are unaffected by Title I changes, but that local governments substantially and significantly crowd out changes in Title I within in a 3-year period.

Guryan (2003) estimates the effect of a marginal increase in education spending on students' outcomes. To identify the effect of interest, he uses the formulas of two equalization state grants as instruments of per-pupil classroom expenditure; these are nonlinear, discontinuous functions of indicators constructed for each district. In the first stage and the second stage estimation, he controls for continuous function of the indicators and variables the formulas are based on. He finds that increases in per-pupil spending led to significant increases in math, reading, science and social studies test score.

Kalb (2010) studies the effect of an increase in the amount of grants for the German local governments and finds a negative impact on the technical efficiency in the local jurisdictions, that is, increases in expenditures lead to a waste of resources and losses in productive efficiency. They use a simple bureaucracy model (where local government

maximize the utility function of the bureaucrat to determine the level of public output instead of meeting the wishes of the median voter) and assumes that a higher amount of intergovernmental grants leads to an underestimation of the true tax price by the citizens and therefore to a higher demand of public output.

1.4 The effect of the Design of Equalization Grants: The Incentive Effect

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 that 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.

We divide this section in theoretical and empirical literature because they present important differences. 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.

1.4.1 Theoretical Literature

There is consensus that the mobility of consumers and producers in response to fiscal incentives is a distinctive character of the study of local public finance. The theoretical literature of the impact of equalization grants take this issue into account and hence, is closely related to the tax competition literature. According to Wilson (1999) the common feature of most of the models considered in tax competition literature is that each government independently (or non-cooperatively) chooses its tax to maximize the welfare of residents within the region, and its choices affects the size of the mobile tax bases available to other governments. 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, subnational 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 and public expenditures levels tend to be too low in equilibrium from an efficiency point of view[10].

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[11] who is subject to the government's budget constraint for determining the tax rate, taking as given the other jurisdictions' tax rates. This conventional model assumes that subnational governments have two sources of revenue: tax revenue collection and equalization grants; that the government is always on the upward-sloping section of its Laffer curve; and that the marginal cost of public fund[12] increases as the local government increases its tax rate. 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. In this context, it is derived the first order condition of that problem without and with equalization transfers. In the former, the marginal rate of substitution between public and private spending equals the marginal cost of public funds that takes into account the response of the tax base to tax rate and then the tax rate in equilibrium is low from an efficiency point of view. In the latter, equalization lowers the effective marginal cost of public funds and then the local government will set a higher tax rate.

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

[10]Wilson and Gordon (2002) reach a different conclusion. They assume that residents directly control tax rates and government officials control expenditure who can easily spend tax revenue on perks instead of public goods. Residents then face the problem of designing the incentives faced by public officials, to push them to spend tax revenue on public goods rather than perks. In this context the tax structure can provide a form of incentive contract. If the official provides more public goods, the tax base will rise, generating additional tax revenue. As a result, waste in government will fall when mobility across jurisdictions is greater, for any given tax rate.

[11]In general, it is assumed that the utility of the representative consumer is additively separable in public goods consumption and it is considered the indirect utility from private consumption of the representative agent.

[12]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.

equal to the average of all jurisdictions'tax rates[13]. The equalization rate, i.e. the rate at which a sub-central government's additional revenue is equalized away, is one of the most debated issues in fiscal equalization. Strong equalization may dampen sub-central governments' efforts to increase their fiscal base and to go for regional growth. According to Blochliger and Charbit (2008) the marginal equalization rate (or equalization tax, tax back or compensation rate), i.e. the amount of equalization grants a sub-central government looses if it increases its own tax revenue, varies considerably across countries.

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. 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[14] 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[15], the internalization of fiscal externalities 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[16].

[13]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

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

[15]Tax revenue equalization schemes are conditioned on the difference between average and jurisdictional per capita tax revenue.

[16]On the other hand, when taxes have distortionary effects at national level, the full equalization leads

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.

There is another case in which grants' design would discourage local governments collection, which has not been studied extensively in the literature. 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. The total amount of resources to be distributed can be determined by the contribution of all or some jurisdictions. This contribution may take the form of a lump sum or a proportion of the tax revenue collected. 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.

1.4.2 Empirical Literature

The most important difference between theoretical and empirical literature of the effect of equalization grant is that the latter consider simplified models in which competition aspects are considered but the empirical analysis examine the impact of equalization on the reduced form tax rates without regard for the structural interactions among tax rates.

Empirical literature finds that equalization 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 equalization 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

to equilibrium tax rates higher than optimal but with partial equalization the equilibrium tax rates can be reached.

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 (2003) calculate the equalization rate effect[17], the equalization base effect[18] 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), as noted in the previous section, 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 an incentive and an income effect of German

[17]This effect arises because an increase in a state's tax rate will increase the standard tax rate for that base in proportion to that state's share of the tax base

[18]This effect measures the increase in a state's grant caused by the reduction in the state's relative fiscal capacity when it raises an additional dollar of tax revenue

equalization transfers. For measuring the incentive 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[19] to identify the impact on grant recipients' own source of equalization[20]. Since this reform affects the marginal cost of public funds (MCF), it will alter 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 were 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 an incentive 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"

[19]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.

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

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 with a reduction in the tax rate by 1.45 percentage points.

Finally, Egger et al (2010) empirically analyze the incentive effect 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[21] 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 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.

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

Chapter 2

Local Governments and Intergovernmental Grants in Chile

2.1 Introduction

The aim of this paper is to present the institutional context of the Chilean local governments. Chile is a unitary country organized territorially and politically into 15 regions and 345 municipalities (local governments), characterized by a high territorial heterogeneity (Valenzuela, 2008). In this paper, first we describe the municipal sources of revenue, the official definition of municipal revenue and the definition of what we consider as local revenue collected by municipalities. The second section describes the Chilean horizontal equalization grant, Municipal Common Fund (FCM), that includes a detailed description of the equalization component's formula.

2.2 Chilean Local Revenue

Table 2.1 summarizes the municipal structure of revenue and below we will describe the most important characteristics of each item. Tax revenue consists of taxes on assets: Property taxes, Business tax (Patentes Municipales), Vehicle tax (Permisos de circulación),

Taxes on gambling and Mining and aquaculture licenses[1].

Property taxes, which are set by the central government at the national level, are the main source of tax revenue. Taxpayers must pay taxes to the municipality in which properties are located. The central government also determines which properties are tax-exempt[2]. The tax base corresponds to the assessment of properties carried out by the Internal Revenue Service (Servicio de Impuestos Internos, or SII) every five years but mayors are who ultimately decide whether the update is carried out. This tax revenue is collected by the national Treasury while municipalities are responsible for providing information to update property assessment surveys (cadastre)[3]. According to the law of property tax, cadastre updating should be done based on information provided by the owners, public deeds and inscriptions in the real estate register, by the selective control of SII and by municipalities. In practice, municipalities are the sole providers of this information.

Although some authors have suggested that the role of the municipality is quite passive in the management and implementation of tax property, municipalities since 1990 can sign an agreement with the SII to open and finance a Municipal Agreement Offices (Oficinas de Convenio Municipal, or OCM) in which community members can carry out property-related transactions[4] within that municipality and it is responsible for raising the necessary information to update the cadastre. Today, 65 municipalities have an OCM. Figure 2.1 shows the evolution of per capita property tax collected on average by these 65 municipalities compared to the evolution of 65 municipalities that have not signed such an agreement with SII. The selection of these municipalities was based upon propensity score matching method with treatment defined as having OCM (one to one matching). Municipalities with OCM have been able to almost double the average raised by municipalities without OCM. Other actions that a municipality can perform to affect property tax collections are: to amend the master plan of the municipality to allow the construction of housing and enhance the construction of shopping centers and offices not

[1]Taxes on gambling and mining and aquaculture licenses became municipal revenue sources after 2008, thus they are not included in this research.

[2]According to Horst (2009) 80% of housing is exempt. The wealthier is the municipality the lesser they lose from the exemptions (Huntzinger and Prud'homme, 2004).

[3]Scarpaci and Irarrázaval, 1994

[4]The transactions that can be requested are modification of a property assessment and obtaining a prior history for the tax appraisal statement.

pertaining to exemption from property tax, and to deliver information on building permits, final receipts and audits conducted by municipal works management to the SII.

Municipalities collect revenues from business tax and vehicle tax. For the former, municipalities can set the tax rate within a range[5] and it is levied on the value of business equity (capital propio) of all types of enterprises whatever their activities. In the majority of cases municipal councils have been asked by mayors (alcaldes) to stick to the top-rate (Huntzinger and Prud'homme, 2004). Businesses must pay taxes to the municipality in which they are located. The rate of the vehicle tax is set by the SII according to the vehicle value, although the vehicle owner may pay the tax in any municipality, that is, there is no strong territorial linkage between the place where one pays the tax which leads to some competition between municipalities eager to attract car drivers (Huntzinger and Prud'homme, 2004)[6]. As for the two others taxes, the tax rate is the same for all municipalities.

The municipal revenue department's functions include collecting business tax, keeping updated business register, processing applications for operating tax for the exercise of commercial activities and giving, renewing or expiring alcohol patents. On the other hand, in both cases the municipalities are able to increase revenue through others activities: municipalities can improve services provision to taxpayers and can carry out administrative and judicial collection of taxes and rights which are unpaid or in arrears. For instance, in 2000 the municipality of Quinta Normal created a department of audit and collection that supports the department of municipal revenue in addition to signing an agreement with SII. To accomplish this initiative the municipality had to train staff and develop a mechanism of economic incentives. The number of business tax paid increase almost 100% between 2000 and 2007. In recent years the municipality of Peñalolén established a community incentive policy for neighborhood councils to attract new vehicle registration. It also developed a personalized attention plan at vehicle sale points and a loyalty plan through a call center that facilitates the process of renewal and finally a quality improvement plan

[5]The tax rate must be between 0.25 and 0.5%, and the tax amount may not be less than 1 UTM or greater than 8.000 UTM.

[6]Since 2007, the Ministry of the Interior (Ministerio del interior) has prohibited municipalities from advertising to attract taxpayers and allows them only to deliver information about places and hours for making tax payments.

for service. The vehicle tax revenue increased almost 50% in 4 years.

Municipal rights (derechos municipales) correspond to the funds collected for the use of municipal goods, services or institutions by third parties (concessions, licenses, service charges). Waste removal is the most important municipal right, due to its magnitude and complexity. Other municipal rights are: driver licenses, urbanization and construction permits, provisional licenses, vehicle transfers, sales of goods, use of public spaces, advertising in public spaces, etc. The municipal department of finance is responsible for the collection of municipal rights, among other functions such as maintaining the register of advertising print exhibited in the jurisdiction. Pino (1994) presents the strategy implemented by the municipality of Santiago since 1990 in which innovative systems were developed, new technologies were implemented and the staff was encouraged in order to increase revenue.

The Municipal Common Fund (Fondo Comn Municipal, or FCM) is a horizontal, equalization unconditional grant. Municipalities are required to contribute to the FCM part of the revenue collected. Below we will describe with more detail.

Transfers and Competitive Funds from the Office of the Undersecretary of Regional Development (Subsecretaría de Desarrollo Regional, or SUBDERE) such as Urban Improvement and Municipal Equipment Program (Programa de Mejoramiento Urbano y Equipamiento Comunal, or PMU), Neighborhood Improvement Program (Programa de Mejoramiento de Barrios, or PMB) and National Fund for Regional Development (Fondo Nacional de Desarrollo Regional, or FNDR) mainly finance investment projects and are competitive funds which municipalities must apply for. They are administered by regional governments, that is, regional governments determine which projects will be developed and in what order. Transfers from the PMU and PMB are included in municipal financial statistics.

Transfers from other ministries, such as Governmental Competitive funds (Fondos Concursables) and Central government programs, correspond to funds for specific projects and programs and are not administered as part of the municipal budget because their allocation depends on the central government.

Transfers for education consist of a per-student subsidy (voucher) for public schools which

are managed by local governments. Transfers for primary healthcare are funds directly allocated to municipalities which operate primary healthcare facilities, based on a per capita formula. Transfers for education and for primary health are specific-purpose funds, that is, they are intergovernmental transfers specifically allocated to these areas and are treated separately from the municipal budget. Finally, another source of local revenue are fines and interest .

2.2.1 Permanent Own Revenues

SUBDERE defines Permanent Own Revenues (Ingresos Propios Permanentes, or IPP) as those revenue items which are generated by local sources and which remain with the municipality. That is, revenue from property tax, vehicle tax and business tax which is not shared with the FCM, and revenue from municipal rights, fines and other fees. In this context, the first three represent around 65% of the IPP[7] [8]. The FCM uses this definition for redistributing resources.

Further, tax revenues, municipal rights and FCM represent in the municipal budget what is referred to as "own resources" (recursos propios). These resources, by law, belong to the Chilean municipalities.

2.2.2 Collected Local Revenue

This research focuses on total tax revenue and municipal rights as the definition of collected local revenue ; in other words, the revenue included the IPP definition plus the resources shifted to the FCM. There are two reasons for adopting this definition: first, IPP collection and resources shifted to the FCM both depend heavily on the collection effort of the municipalities. Second, since transfers and competitive funds from SUBDERE and other ministries or for delegated or demandated services are generally not recorded in municipal

[7]Specifically, property tax which is not shared with the FCM represent around 28% of the IPP, vehicle tax not shared with the FCM represent around 8% of the IPP and business tax not shared with the FCM represent around 28% of the IPP.

[8]Since 2008, this definition has included taxes on gambling and mining and aquaculture licenses.

Budget Implementation Balances[9], there is little public information about their magnitude and evolution. Thus, for this study local revenue is defined as tax revenue, municipal rights and fines and interest. In Table 2.1 we highlight with gray the part this investigation studies.

2.3 Municipal Common Fund (FCM)

Because of this local revenue structure and the highly geographically concentrated nature of Chilean tax bases, there are dramatic differences among municipal revenues. In 2007, considering property taxes, business taxes and vehicle taxes, just 36 municipalities, representing 10% of all municipalities, collected 70% of revenue, while more than half of the municipalities collected just 5% of revenue (Horst, 2009). Thus, there is a need for redistribution of resources among governments at the same level.

The Fondo Común Municipal (FCM) is the Chilean system grant used for re-distributing revenue among municipalities[10]. FCM was created in 1979[11]. According to the Municipalities Division of SUBDERE, FCM constitutes the main source of revenue of Chilean municipalities. In 2007, its relative share of the total municipal budget, aside from external resources[12] was 32%, whereas the share of IPP was close to 40%.

The FCM is self-financing: municipalities must provide a share of their main sources of local revenue to the FCM every year. On the other hand, the FCM resources received by each municipality are determined by a formula which has among its components an equalization component. Certain municipalities provide a greater amount of funding than that which they receive (that is, the net grant is negative; these are known as net contributors) while others receive more than they contribute (that is, the net grant is

[9]The municipalities report their revenues accounts in Budget Implementation Balances (Balances de Ejecución Presupuestaria, or BEP).

[10]According to Chile's Political Constitution, Article 22, the FCM is a "mechanism of solidarity redistribution of own revenues among the country's municipalities". According to Law No 18,695, The Organic Constitutional Law of Municipalities, the aim of the FCM is "to ensure achievement of the goals of the municipalities and their proper functioning".

[11]Law Decree No 3,063.

[12]Excluding resources from the FNDR, transfers from other ministries and transfers for delegated or demandated services.

positive; these are called net receivers). Given the unequal distribution of income, in 2007, 50 municipalities were net contributors and 295 were net receivers. The following subsections describe the mechanism of contribution, the formula of distribution and, in greater detail, the equalization component and the changes that it has undergone over time.

2.3.1 Contribution Mechanism

FCM is self-financed; that is, all municipalities contribute resources. The resources transferred from municipalities to the FCM represent proportions of certain tax revenue. The FCM composition mechanism underwent some changes from 1990 to 2007. Table 2.2 presents the proportion of different local revenues which have been provided by municipalities to FCM over that period. In 2006, resources from property taxes represented 50% of the total fund, while revenue from business taxes represented close to 12% and vehicle taxes close to 20%.

2.3.2 Distribution Formula

The distribution formula results in a distribution coefficient for each municipality; this coefficient represents the proportion of the total fund that corresponds to each municipality. To calculate this coefficient, first a coefficient is calculated for each of the components included in the formula. Finally, the weighted sum of the component coefficients is calculated, resulting in the distribution coefficient. That is, if the distribution formula is comprised of J components, the distribution coefficient of municipality i is:

$$\text{Distribution coefficient}_i = \sum_{j=1}^{J} \text{component weight}_j \times \text{component coefficient}_{ji}$$

During 1990-2007, two distribution coefficients are considered: one used to distribute 90% of the fund and the other used to distribute the remainder (10%). The 90% coefficient was calculated every three years and aimed at redistributing revenues in a stable fashion,

whereas the 10% distribution coefficient was calculated annually and designed to encourage efficiency and for coping with emergencies. Table 2.3 shows the period covered by each 90% distribution coefficient over the years 1990-2007. The components included in the 90% distribution coefficient are described below.

The Number of municipalities component corresponds to $\frac{1}{\text{No Municipalities}}$. The idea behind this component is to distribute resources equally.

For the Number of inhabitants (population) component, the larger the population, the higher the component's coefficient. The formula of this component's coefficient takes into consideration the population projection provided by the National Institute of Statistics (Instituto Nacional de Estadísticas, or INE) on June 30 of the penultimate year of the immediately preceding triennium, plus the estimated floating population[13]. The projected population is updated with data from the population censuses which take place every 10 years. Between 1990 and 2007, two censuses were applied, in 1992 and 2002. Table 2.4 presents the data used in every triennium.

For the Exempt properties component, the higher the number of tax-exempt properties with respect to the total, the higher the component's coefficient. The formula for this coefficient considers the exempt properties reported by the SII on December 31 of the penultimate year of the immediately preceding triennium. Table 2.5 presents the data used in every triennium.

For the Relative poverty component (percentage of people living in poverty within the municipality, compared to the overall percentage for the country), the higher the relative poverty, the higher the component's coefficient. From 1996 through 2007, this component's coefficient is based on a municipal poverty index estimated by SUBDERE. This index considers mother's schooling and height-age deficit of children between 0 and 6 years[14].

[13]The floating population is included only if a municipality is categorized as a summer resort (balneario), that is, it receives a significant flow of temporary residents at certain times of the year. This categorization is done by SUBDERE. Summer resort municipalities may be classified as touristic municipalities or municipalities with social tourism. In a touristic municipality, the floating population is estimated as four-thirds of the municipality's total properties on December 31 of the penultimate year of the immediately preceding triennium. In municipalities with social tourism, the floating population is estimated as eight-thirds of the municipality's total properties on December 31 of the penultimate year of the immediately preceding triennium.

[14]This information is reported by the National Education and Scholarships Board (Junta Nacional de

Table 2.6 presents the data used in every triennium. Since 2007, this component includes the poverty index reported by the Socioeconomic Identification Survey (Encuesta de Caracterización Socioeconómica, known as CASEN).

For the IPP per capita (IPPP) component, the higher the IPPP, the lower the component's coefficient. For each municipality, this component's coefficient includes the average IPPP of the three years prior to the final year of the immediately preceding triennium[15]. In this paper, this average is referred to as the "IPPP used in the distribution formula" (or IPPPd). The population considered in this component is adjusted by the floating population. Table 2.7 presents the data used in every triennium. This component works if the IPPPd of a municipality is lower than the national average IPPPd ($\overline{IPPPd}_N$). More formally, the IPPP component has the following rule:
If $IPPPd_i > \overline{IPPPd}_N$, then IPPP component's coefficient$_i = 0$.
If $IPPPd_i \leq \overline{IPPPd}_N$, an index ($IPPPindex_i$) is calculated for municipality i using the following formula:

$$IPPPindex_i = (\overline{IPPPd}_N - IPPPd_i) \times \text{Population}_i \tag{2.1}$$

Then, the IPPP component's coefficient for municipality i is:

$$\text{IPPP component's coefficient}_i = \frac{\text{IPPP index}_i}{\sum_{i=1}^{M} \text{IPPP index}_i} \tag{2.2}$$

where $i = 1, 2, ..., M$ with M = number of municipalities with $IPPPd_i \leq \overline{IPPPd}_N$.

In the latter case, the size of the IPPP component's coefficient is proportional to the difference between the IPPPd and its national average.

Finally, Table 2.8 presents the weights of each component included in the 90% coefficient of distribution. For instance, the grant received by municipality i from the distribution of

Escolaridad y Becas, or JUNAEB).

[15]From 1990 to 1995, only the IPPP of the year preceding the final year of the immediately preceding triennium is included.

90% of the common fund (FCM) for the 1996-2007 period is the following:

$$\begin{aligned}\text{FCM90\% grant}_i = 0.9 \times FCM \times [&0.1 \times (\text{equal parts component's coefficient}_i)+ \\ &0.15 \times (\text{population component's coefficient}_i)+ \\ &0.3 \times (\text{non taxable property component's coefficient}_i)+ \\ &0.3 \times (\text{relative poverty component's coefficient}_i)+ \\ &0.35 \times (\text{IPPP component's coefficient}_i)]\end{aligned} \tag{2.3}$$

Every time the distribution coefficients were calculated during this period, some municipalities received a lower amount of funds because they obtained a lower distribution coefficient. To offset this, the central government passed laws to provide them with additional resources from the same fund.

Until 1995, the 10% distribution coefficient was known as the "coefficient of annual participation due to lower resources for adjusted operating expenses" and was intended to cover possible operational deficits in some municipalities[16]. Starting in 1996, this annual coefficient was divided in two: 50% to promote efficiency in municipal management and 50% for emergency expenses[17][18].

Since 2008, there has been only one distribution coefficient for the 100% of the common fund which is calculated once per year. This decision was made on the basis that having one instrument (the FCM) with multiple objectives (redistribution, emergencies and efficiency) was a structural weakness of the system (Valenzuela, 2008).

[16]That is, to finance personnel, goods and services expenditures. In some circumstances, it could finance investment, transferred services such as healthcare and education, emergencies, etc.

[17]The coefficient of the former had the following components and weights: 30% for real increase of IPPP, 10% for increased SIMCE test scores, 10% for annual expenditure on staff training relative to total annual personnel expenditures, 15% for operational surplus, 10% for spending to benefit the community, 10% for growth of real investment per capita, 10% for not owing pension payments to municipal workers. The formula of the latter had the following components and weights: 30% for financing emergency prevention projects, 10% for reduction in IPPP, 20% for population growth, 20% for coping with natural catastrophes and 20% for offsetting changes in the distribution coefficients.

[18]The emergency coefficient was used several times to offset changes in the distribution coefficient.

2.3.3 Equalization Component

The equalization component of the distribution formula works only for municipalities that have per capita IPP less than national average, thus their future received grants depend positively on the difference between the national average and their per capita IPP. 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:

$$G_{it+1} = K_{it} + \frac{b_{t+1}(\overline{Y}_{Nt} - Y_{it})}{\sum_{j=1}^{M_t}(\overline{Y}_{Nt} - Y_{jt})} = K_{it} + \frac{b_{t+1}}{M_t}\frac{(\overline{Y}_{Nt} - Y_{it})}{(\overline{Y}_{Nt} - \overline{Y}_{Mt})} \tag{2.4}$$

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 $G_{it+1} = K_{it}$.

For municipalities with IPP per capita below the national average the equalization 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.

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

$$\frac{\partial G_i t+1}{\partial Y_i t} = -b_{t+1}[\frac{(1-\frac{1}{N_t})(\overline{Y}_{Nt} - \overline{Y}_{Mt}) - (\frac{1}{M_t} - \frac{1}{N_t})(\overline{Y}_{Nt} - Y_{it})}{M_t(\overline{Y}_{Nt} - \overline{Y}_{M})^2}] \tag{2.5}$$

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 equalization 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[19] 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 2.1 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 considered 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. The letters P, S and D indicate the years when presidential, senatorial and parliamentary (diputados) elections were held, respectively.

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 and then for all municipalities the equalization tax equals zero (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

[19]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%.

distribution or the tax is payed after four years (1995, 1998, 2001, 2002, 2005 and 2006).

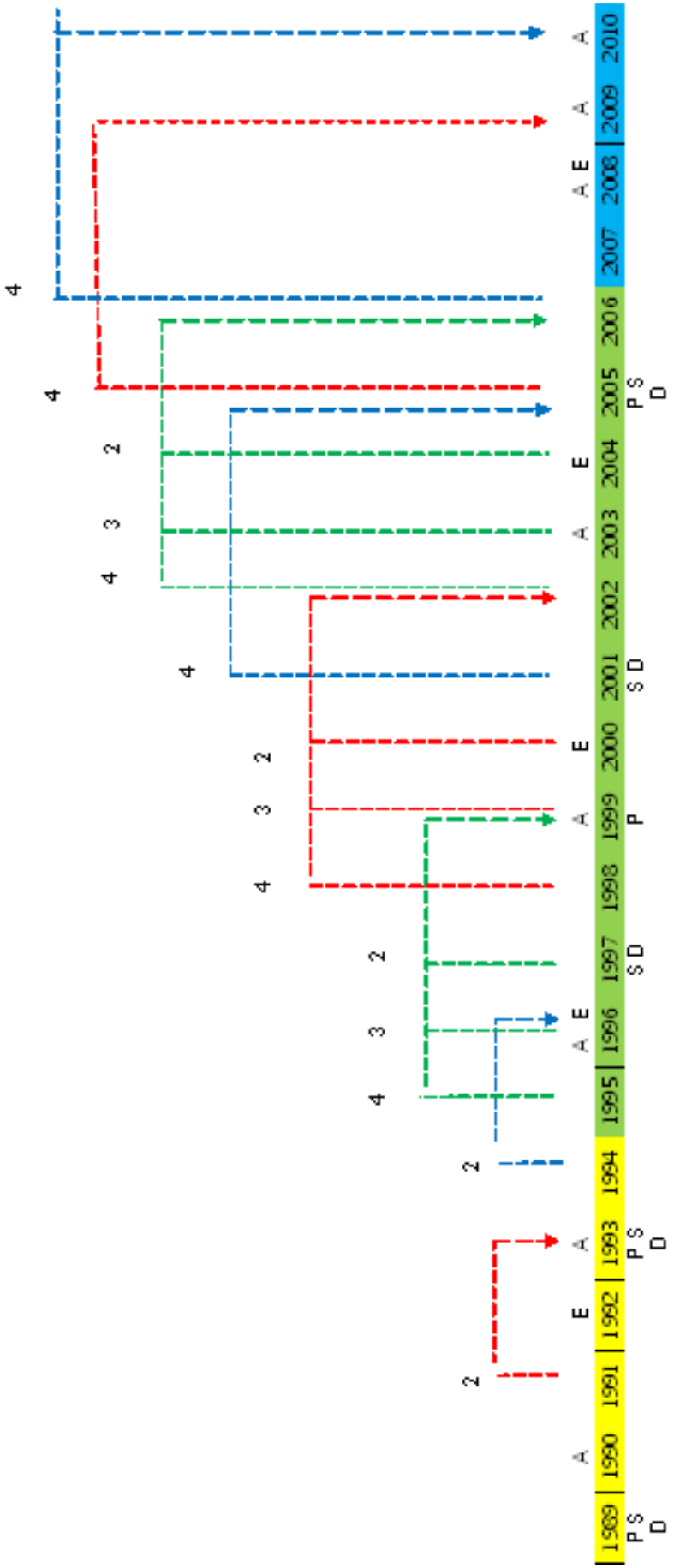

Figure 2.1: Effects of Revenue Collection on Grant Distribution

Tax Revenue	Municipal Rights	Municipal Common Fund (FCM)	Transfers from SUBDERE	Transfers from others ministries	Transfers for delegated services
Property tax	Waste removal		PMU	Competitive funds	Education
Business Tax	Other rigths		PMB	Central government programs	Primary Health
Vehicle Tax			FNDR		
Tax on Gambling					
Mining and aquaculture licenses					

Table 2.1: Main Local Revenue

Component	1987-1995	1996-2000	2001-2002	2003-2005	2006-
Property tax	60%	60%	60% and 65% Las Condes, Vitacura, Stgo., Providencia	60% and 65% Las Condes, Vitacura, Stgo., Providencia	60% and 65% Las Condes, Vitacura, Stgo., Providencia
Vehicle registration fee	50%	50%	62.5%	62.5%	62.5%
Municipal License Fee	45% Stgo. and 65% Las Condes, Providencia	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura
Transfers of Vehicle Tax		50%	50%	50%	50%
Fotorradares Fines				100%	100%
Fiscal Contribution	Determined by law	Determined by law	Determined by law	Determined by law	216.000 UTM

Table 2.2: Composition formula FCM

Period (triennium)	Years
1	1990 - 1992
2	1993 - 1995
3	1996 - 1998
4	1999 - 2002
5	2003 - 2007

Table 2.3: Duration 90% distribution coefficients

Period (triennium)	Data
1 (1990 - 1992)	Projected population of 1988 based on Censuses 1982
2 (1993 - 1995)	Preliminary count Censuses 1992
3 (1996 - 1998)	Projected population of 1994 based on Censuses 1992
4 (1999 - 2002)	Projected population of 1997 based on Censuses 1992
5 (2003 - 2007)	Population Censuses 2002

Table 2.4: Population Component

Period (triennium)	Data
1 (1990 - 1992)	Total and Exempt properties of 1988
2 (1993 - 1995)	Total and Exempt properties of 1991
3 (1996 - 1998)	Total and Exempt properties of 1994
4 (1999 - 2002)	Total and Exempt properties of 1997
5 (2003 - 2007)	Total and Exempt properties of 2001

Table 2.5: Exempt Properties Component

Period (triennium)	Data
1 (1990 - 1992)	
2 (1993 - 1995)	
3 (1996 - 1998)	Mothers schooling and height-age deficit of children between 0 and 6 years 1992 and 1993
4 (1999 - 2002)	Mothers schooling and height-age deficit of children between 0 and 6 years 1996 and 1997
5 (2003 - 2007)	Mothers schooling and height-age deficit of children between 0 and 6 years 2000 and 2001

Table 2.6: Relative Poverty Component

Period (triennium)	Data
1 (1990 - 1992)	IPP 1988 and Projected population of 1988 based on Censuses 1982
2 (1993 - 1995)	IPP 1991 and Preliminary count Censuses 1992
3 (1996 - 1998)	Average IPP 1992, 1993 and 1994 and Projected population of 1994 based on Censuses 1992
4 (1999 - 2002)	Average IPP 1995, 1996 and 1997 and Projected population of 1997 based on Censuses 1992
5 (2003 - 2007)	Average IPP 1999, 2000 and 2001 and Population Censuses 2002

Table 2.7: IPPP component

Component	**1987-1995**	**1996-2007**	**2008**
No of Municipalities (equal parts)	10%	10%	25%
No of inhabitants (population)	20%	15%	
No of exempt properties	30%	30%	30%
IPP per capita (IPPP)	40%	35%	35%
Relative Poverty		10%	10%

Table 2.8: Distribution Formula FCM

Chapter 3

The Income Effect of Unconditional Grants: A Reduction in the Collection Effort of Municipalities

3.1 Introduction

Intergovernmental transfers increase the total revenue available to subnational governments. In this paper, we study how this extra revenue affects subnational governments' incentives to collect revenue. When subnational governments are responsible for collecting taxes and tax rates and tax bases are determined centrally, subnational governments can only change their revenue through their own collection and enforcement efforts. Since revenue collection is a costly activity for subnational governments, we expect that, due to an income effect, an exogenous increase in resources (a gift, in terms of consumer theory) will encourage jurisdictions to reduce collection efforts and collect less revenue.

The findings of this paper, which are based on data for a panel of 340 Chilean municipalities during the 1990-2007 period, include empirical evidence that intergovernmental grants have a negative effect on local revenue in Chile. Specifically, an increase in the per capita grant amount of one standard deviation is associated with a decrease between

0.25 and 0.32 standard deviations in local per capita revenue. The main challenge in estimating this effect is to address the potential grants' endogeneity, since that revenue is partly determined by unobserved subnational characteristics that are related to the grant amounts.

As in most countries, intergovernmental grants represent a significant source of local revenue in Chile. In Chile, tax rates[1] and bases are defined by the central government while local governments (municipalities) collect most local tax revenue: they are responsible for collecting business taxes, vehicle taxes and other revenue related to service charges. With respect to property tax, they are responsible for gathering information to update property assessment surveys carried out by a central government agency, among other activities that might affect assessed value. For property and business taxes, there is territorial linkage between the place where taxpayers are located and the place where the tax is paid, whereas the taxpayer can choose any municipality to pay vehicle taxes and certain service charges.

Given the local revenue structure and the highly geographically concentrated nature of Chilean tax bases, the Municipal Common Fund (Fondo Comn Municipal, or FCM) was created. It provides unconditional grants to all municipalities with the aim of fiscal equalization and is self-financing (municipalities must contribute a share of local revenue to the FCM).

We use FCM grants to determine the causal relationship between grants and collected local revenue because they have two convenient features. First, the FCM is an unconditional grant, that is, the funds may be spent as if they were the municipality's own revenue and municipalities are not required to finance a percentage of expenditures using their own resources which enables me to focus on income effect[2]. Second, we exploit a kink in a component of the FCM formula for resource distribution to identify the effect of interest. This component is related to the local revenue collected during at least the previous two

[1]Municipalities can set the business tax rate within a range, but in practice almost all municipalities have chosen the upper limit of this range

[2]Conditional matching grants, which must be complemented by subnational contributions, have two effects: the grant gives subnational governments more resources, some of which are allocated to a specific item determined by the central government (income effect) and it also reduces the relative prices of the specific item from a given budget (substitution effect).

years and functions only for municipalities with per capita local revenue that is below the national average. Otherwise, this component equals zero. Further, we use the grant from local revenue component as an excluded instrument and control for local per capita revenue during at least the previous two years. Therefore, the residual variation in grants from the local revenue component is driven by the shape of the formula, which is unrelated to unobserved determinants of local revenue. The identification strategy used is based on the same condition for identification that underlies regression kink design method (Card, Lee and Pei, 2009). Research using this identification strategy includes Dahlberg et al. (2008) who study the effect of Swedish unconditional grants on local spending and tax rates and Guryan (2003) who estimates the effect of an increase in education resources on student achievement.

These results are maintained for revenue-generating taxes for which collection is a good proxy of the collection effort[3], and for municipalities that have sufficient fiscal capacity[4] On the other hand, given this identification strategy, this estimation is local, that is, it compares municipalities whose revenue is close to the national average. This group of municipalities is heterogeneous with respect to the region in which they are located, their size (population) and level of rurality[5].

Only a few studies have investigated this income effect but they not been very successful in identifying an exogenous change in transfers. Baretti et al. (2002) study the effects of equalizing transfers on German state tax revenue[6]. Using annual data from 10 states for 1970-1998, they find that federal grants have a significant negative effect on state tax revenue. The main drawback of this research is that it considers grants as exogenous factors that affect state tax revenue. Aragón and Gayoso (2005) study this effect with data from 1,400 local governments in Peru from 2000 and 2001. They exploit a quasi-experiment to address the identification problem: They assume that an additional grant

[3]When the tax can be paid in any municipality and there is a low tax evasion rate, if all municipalities receive more grants, all municipalities could simultaneously make less effort without decreasing the amount they collect.

[4]According to Chernick (1998) fiscal capacity can be defined as the ability of a governmental jurisdiction to translate economic activity within its geographic borders into public spending. This concept reflects the differing amounts of revenue jurisdictions could raise, rather than what they actually raise.

[5]In the Chilean case, there is no evidence that the increased grant revenue is used to selectively reduce tax payments by the collectors' preferred constituents.

[6]German states manage tax collection but they do not choose their own tax rates and bases.

distributed extraordinarily to local governments was not tied to local tax collection or total expenditures, even though the grant was conferred to local governments that had received the minimum equalization grant. They use participation in this program as an instrumental variable and find that in Peru the elasticity of substitution is around -1, which is greater than in Chile[7]. Although they recognize the endogeneity of grants, the validity of their instrument is doubtful because the distribution of the additional grant was not random. Rather, it depended on variables that affected the amount of the equalization grant and therefore local revenue. In Chile, there is little empirical evidence to support the existence of this income effect, although the potential incentive of the FCM is mentioned regularly in debates about decentralization in Chile. This research contributes to this literature by providing the first instrumental variable estimates of the effect of FCM grants on local revenue in Chile.

There is a great deal of empirical and theoretical research focused on the effects of intergovernmental grants in a context of fiscal autonomy, that is, assuming that subnational governments are allowed to determine tax rates and/or tax bases. This literature is in the spirit of the "flypaper effect" which examines whether a part of the grants is targeted to private consumption through reduced tax rates (like any other increase in community income) as predicted by the standard theory of public finances (Bradford and Oates, 1971 a,b) and by empirical evidence based on other theoretical frameworks (Knight, 2002) or is targeted to local public consumption (money "sticks where it hits") as shown by empirical evidence (Roemer and Silvestre, 2002; Melo, 2002, Dahlberg et al., 2008)[8].

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 Chilean local government and its intergovernmental grants system and presents the grant formula used in IV estimation. Section 4 describes the identification strategy. Section

[7]My estimate of the elasticity of substitution for Chile is -0.20.

[8]Despite their differences in the institutional context and in terms of the variable by which the impact is measured, the flypaper effect and the income effect hypothesis are related. According to the latter, the transfer from the central government is accompanied by a weakening in the collection of subnational taxes, and thus the increase in subnational spending will be lower than the increase in grants. In this sense, the income effect hypothesis can be considered contrary to the "flypaper effect": A part of the grants is targeted to private consumption through reductions in the collection effort.

5 describes and presents the data. Section 6 reports the results and several robustness checks. Finally, section 7 presents our conclusions.

3.2 A motivating theoretical model

We present a simple model to facilitate understanding of the empirical results. The model considers the individual decision of a local government with respect to the revenue collected when it receives a grant, given that the tax rate and base are determined centrally and revenue collection is costly.

3.2.1 Representative household utility

Assume that a representative household has the following utility function[9]:

$$U = f(Z) \tag{3.1}$$

where Z denotes the public good spending. The function $f(\cdot)$ is increasing and concave ($f'(\cdot) > 0$ and $f''(\cdot) < 0$). That is, decreasing marginal utility is assumed.

3.2.2 Collection effort

Assume that the local government's collection effort is costly:

$$C = c(X) \tag{3.2}$$

where X denotes the local revenue collected. $c(\cdot)$ is the cost function (or disutility function) and is increasing and convex ($c'(\cdot) > 0$ and $c''(\cdot) > 0$). That is, increasing marginal cost is assumed.

[9] If we assume an additively separable utility function in private and public good, the results do not change.

In a general case, X would depend on tax rate (r), tax base (B) and collect effort (e), that is $X = X(r, B, e)$, but in the Chilean case, r and B are determined exogenously from the point of view of local governments, so X only depends on collection effort and we use X as a proxy for the latter.

3.2.3 Local government budget constraint

Local governments have two sources of revenue for financing local public good spending: local revenue and grants[10].

$$Z = X + G \tag{3.3}$$

where G denotes the received grants.

3.2.4 Optimal local revenue

At the local government level, the decision-maker chooses the level of local revenue that maximizes the representative household utility minus cost effort:

$\underset{x}{Max}$ U = f(Z) - c(X) s.a. Z = X + G

This maximization with respect to X yields the following first-order condition (FOC):

$$f'(Z) \times [1] - c'(X) = 0 \tag{3.4}$$

The first term corresponds to the marginal utility of increasing collection of local revenue, that is, the marginal utility of an increase in local public good spending multiplied by the marginal benefit of collecting revenue. The second term corresponds to the marginal cost

[10]We assume that the budget constraint is satisfied with equality because in Chile municipalities may not take on debt, although some Chilean municipalities run large deficits. If we include debt as a third source of revenue, the income effect would also exist.

of collecting local revenue. Optimal local revenue is achieved when both terms are equal. From (4), the optimal local income can be derived (X^*).

The second-order condition (SOC) for optimal local revenue becomes:

$$f'' - c'' < 0 \tag{3.5}$$

3.2.5 Comparative statics

Using comparative statistics, this paper investigates the effect on local revenue collected (X^*) of an exogenous change in grants (G). An increase in G is expected to have an income effect that increases total revenue (Z=X + G), decreasing the marginal utility ($f'(Z)$) and thus decreasing the local revenue collected.

The impact on X^* of a change in G is:

$$\frac{\partial X^*}{\partial K} = \frac{-f''}{f'' - e''} < 0 \tag{3.6}$$

The denominator corresponds to the SOC and therefore is negative, while the numerator consists of $-f'' > 0$ and is positive. Thus, the relationship between local revenue collected and grants would be unambiguously negative, because the grants have a negative income effect. The empirical analysis of this paper focuses on this income effect, that is, the effect of exogenous variation in grants.

3.3 Local governments and intergovernmental grants in Chile

Local governments (municipalities) in Chile are quite diverse and characterized by high territorial heterogeneity (Valenzuela, 2008). The municipal structure of revenue consists of local tax revenue, municipal rights, an important horizontal equalization grant (among municipalities) and vertical conditional grants (from central government). The vast

majority of theses vertical transfers correspond to social and investment programs that are operated by municipalities but are not recognized in their budgeting exercise. This implies that there is no record of them and therefore they cannot be considered in this study.

This study defines collected revenue as the sum of the three most important taxes (property tax, business tax and vehicle tax) and municipal rights[11]. Allocation of these resources, which are the largest source of municipal revenues[12], is subject to the discretion of municipal decisionmakers.

The main determinants of tax revenue are the tax rate, tax base and the collection effort. For the three local taxes, tax base is defined by the central government. The tax rate, set by the central government is the same for all municipalities, with the exception of the municipal license, in which case municipalities may set the rate between 0.25 and 0.5%. However, in most cases municipal councils maintain the maximum rate (Huntzinger and Prud'homme, 2004). Finally, tax collection is the responsibility of municipalities with the exception of the property tax, but municipalities are responsible for providing information for the assessment of property values carried out by the Internal Revenue Service (Servicio de Impuestos Internos, or SII)[13]. It follows that, although municipalities have a limited range of financial resources and administrative autonomy[14], they are able to affect the collected revenue when they have available fiscal capacity[15].

[11]These correspond to funds collected for use of municipal goods, services or institutions by third parties (concessions, licenses, service charges).

[12]These represent 72% of municipal revenues recognized in their budget exercise.

[13]Although some authors have suggested that the municipality's role in management and implementation of property tax is quite passive, since 1990 municipalities have been permitted to sign an agreement with the SII to open and operate a Municipal Agreement Office (Oficina de Convenio Municipal, or OCM) which is responsible for gathering the necessary information to update property surveys. Appendix A presents the evolution of per capita property tax collected on average by municipalities with OCM compared to "similar" municipalities without OCM. Other actions that a municipality can take to affect property tax collection are: amend the municipal master plan to allow construction of housing and enhance the construction of shopping centers and offices not exempt from property tax and deliver information on building permits, final reception and audits conducted by municipal works management to the SII.

[14]However, their authority to control spending ranges from basic urban services such as garbage collection to certain administrative functions such as housing permits. In addition, the central government has delegated to local governments responsibility for providing primary and secondary education and primary public healthcare

[15]Given the high degree of territorial heterogeneity that characterizes Chilean municipalities, some

As mentioned previously, for property and business taxes, there is a territorial linkage between the location of taxpayers and the place where the tax is paid, while on the other hand, the vehicle tax and certain service charges may be paid in any municipality. In the latter case, since there is a low tax evasion rate, if all municipalities receive more grants, all municipalities could simultaneously make less effort without decreasing the amount they collect. Therefore, tax collection is not a good proxy of the collection effort.

The FCM equalization grant is horizontal and each municipality contributes resources in proportion to its local revenue[16]. With respect to distribution of the FCM, on the one hand all municipalities receive FCM grants, enabling measurement of the income effect of grants. On the other hand, the distribution formula depends on[17]: the number of municipalities, population, exempt properties, poverty and local revenue (the equalization component). The equalization component is positive if the measure of local revenue of a municipality, per capita permanent own revenues (ingresos propios permanentes per capita, or IPPP) is lower than the national average($\overline{IPPP}_N$). The IPPP corresponds to the property, vehicle and business tax revenue collected during at least the previous two years which is not shared with the FCM, and revenue from municipal rights, fines and other fees. The instrument used corresponds to the part of the grant which is due to the IPPP component, referred to as the IPPP grant (IPPPg).

More formally, the IPPP grant received by municipality i has the following rule:
If $IPPP_i > \overline{IPPP}_N$, then IPPP grant$_i = 0$.
If $IPPP_i \leq \overline{IPPP}_N$, an index ($IPPPindex_i$) is calculated for municipality i using the following formula:

$$IPPPindex_i = (\overline{IPPP}_N - IPPP_i) \times \text{Population}_i \tag{3.7}$$

municipalities have low fiscal capacity and are therefore are not able to collect more tax revenues.

[16]The proportion of resources shifted to FCM varies among municipalities and among different kinds of revenue (property taxes, municipal licenses, vehicle registration fees, etc.) and over time.

[17]These variables are used to distribute 90% of the fund, while the distribution formula for the remaining 10% is designed to encourage efficiency and to address emergencies.

Then, the IPPP grant for municipality i is:

$$\text{IPPP grant}_i = FCM * \frac{\text{IPPP index}_i}{\sum_{i=1}^{M} \text{IPPP index}_i} \tag{3.8}$$

where $i = 1, 2, ..., M$ with M = number of municipalities with $IPPP_i \leq \overline{IPPP}_N$ and FCM is the total Fund.

Figure 3.1 plots IPPP grants received by the municipalities against the IPPP for a typical year (2003). The vertical line in the figure represents the national average. As the figure shows, there is a well-defined cut at the national average. Municipalities with IPPP above the national average receive IPPP grants equal to zero, whereas those with IPPP below the national average receive IPPP grants that are proportional to the difference between the IPPP and the national average.

3.4 Identification strategy and empirical model

3.4.1 Sources of endogeneity

The endogeneity of intergovernmental grants is a common problem for fiscal federalism's empirical literature. Grants have two potential sources of endogeneity. First, variation in grants can be explained by time variant or time invariant unobserved variables that influence local revenue. The income of the local population and fiscal capacity are unobserved time variant variables that are positively correlated with local revenue collection but negatively correlated with grants. Therefore, grants are endogenous to local revenue and OLS estimates will produce downward-biased estimates of the causal effect of grants on local revenue.

Alternatively, municipalities with good governance and in which a significant fiscal effort is exerted by local authorities will collect high revenues[18]. If a municipality receives a higher grant, the local authorities can manage those resources so that indirectly this

[18]These variables could be considered time invariant during the period in which the local administration does not change.

management exerts a positive effect on local revenue. For example, if grants improve the quality or quantity of local public goods, communities might show greater willingness to pay taxes. In these cases where the unobserved variable's partial effect on local revenue is positive and the unobserved variable and grants are positively correlated, OLS estimates of the causal effect of grants on local revenue could be biased upward.

A second source of endogeneity arises because of the equalization goal of the Chilean grants system, where municipalities that collect less local revenue and have lower fiscal capacity receive higher grants. This simultaneity problem or reverse causality will also produce downward-biased estimates. Moreover, if the distribution of resources is based on factors that discourage the exertion of more effort to increase local revenues, such as through non-taxable property and local revenue, the simultaneity problem is more significant. Thus, the estimates from an OLS specification would be biased due to an omitted variable problem or simultaneity problem. Moreover, not only is it difficult to identify the different possible forms of endogeneity but also to know what will be the net bias of the OLS estimates.

3.4.2 Identification strategy

This paper proposes using an instrumental variable (IV) estimator to identify an exogenous variation in FCM grants. The main estimating equation is:

$$X_{it} = \theta_0 + \theta_1 FCM_{it} + \delta f(IPPP_{it}) + \theta_2 \alpha_{it}^{proptax} + \theta_3 \alpha_{it}^{bustax} + t_t + \mu_i + \epsilon_{it} \tag{3.9}$$

where X_{it} is per capita local revenue collected by the municipality i in year t, FCM_{it} is the per capita FCM grant received by municipality i in year t, $f(IPPP_{it})$ is a 2nd, 3rd, 4th or 5th order polynomial function of the IPPP used in the distribution formula for municipality i in year t, $\alpha_{it}^{proptax}$ is the proportion of property tax revenue transferred from municipality i to the FCM in year t, α_{it}^{bustax} is the proportion of business tax 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 identification strategy used here is based on the idea behind regression kink design

(RKD), which is summarized in the Appendix B[19]; in principle there is no reason to believe that municipalities located just above the national average are different from municipalities located just below it, except that the latter have positive IPPP grants and municipalities above the kink point receive IPPP grants equal to zero. This discontinuous shift in the slope of the relationship between the IPPP grant and the IPPP arises from the IPPP component formula[20]. Thus, the identification strategy exploits this exogenous variation caused by the kinked scheme.

Moreover, since the IPPP component is updated every triennium, a municipality with IPPP just below the national average could be just above the national average in the next triennium. On average, in every triennium there are 30 municipalities that change position in relation to the national average. We can exploit this variation for every municipality over time. Figure 3.2 shows the frequency with which the municipalities have received an IPPP grant in the 1990-2007 time period. In the period studied, 33 municipalities never received an IPPP grant, 218 municipalities received an IPPP grant in each of the 18 years and the remaining 89 municipalities received IPPP grants in some, but not all, of the years.

The condition for identification of a causal effect is that municipalities cannot deterministically manipulate the value of the IPPP grant (that is, they cannot determine if the IPPP grant equals zero or is positive). If they could, some municipalities might find it optimal to refrain from collecting an extra peso in order to receive IPPP grants. As a result, municipalities would be bunched just to the left of the kink point. However, in this setting this problem would be unlikely. Although municipalities have control of the IPPP given that it corresponds to their revenue collected for the previous two years, they do not know the value of the national average IPPP and thus are unaware if they are just to the left or to the right of the kinked point. Therefore, the IPPP grant is not under the municipalities' full control.

[19]In this setting, IPPP is the assignment variable.

[20]Every year, close to 90 municipalities are within the interval [National average IPPP $\pm$ 0.3$\times$standard deviation's IPPP].

To test this condition, the range of the IPPP[21] was divided into suitable bins[22] and the histogram was plotted across these bins. Figure 3.3 plots the "frequency" of this variable using Th$3 bins, resulting in a graphical analysis with 10 bins on each side of the kink point 0. The histogram shows a drop between the 10^{th} bin (to the left of the kink) and the 11^{th} bin (to the right) which is similar in magnitude to the drops at other points (e.g., between the 5^{th} and 6^{th} bins, the 8^{th} and 9^{th} bins, or the 11^{th} and 12^{th} bins).

According to Card et al. (2009), it is possible to provide an estimate of a potential kink in the density of the assignment variable. Using collapsed data[23], the number of observations in each bin was regressed on polynomials of $(v_{bin} - k)$ and the interaction term $1[v_{bin} \geq k](v_{bin} - k)$, where v_{bin} is the central IPPP that corresponds to the center of each bin and k is the kink point (0). As suggested by Figure 3.3, up to 4^{th} order polynomial the coefficient on the interaction term is statistically insignificant (a t-statistic between 0.27 and 1.66)[24][25].

The IPPP grant is a good instrument for the FCM grant because it satisfies the following two conditions. First, the IPPP grant is partially correlated with the FCM grant because the IPPP grant is a component of the FCM grant. Second, since IPPP grants depend on the IPPP and in turn the IPPP may have a direct effect on current local revenue collection (as IPPP is practically the lagged local revenue), we control for IPPP in the estimations. Because the exact form of this direct effect is unknown, as flexible a functional form as possible is used (specifically, a 2nd order to 5th order polynomial functional form). As long as it is controlled for IPPP, the residual variation in IPPP grants is driven by the shape of the IPPP component formula, which is unrelated to unobserved determinants of

[21] Because the national average IPPP changes every triennium, the IPPP was centralized with respect to the corresponding national average. Thus, the national average IPPP equals zero every year and it is possible to plot and work with all the data together.

[22] Following a procedure presented by Lee and Lemieux (2009), we chose the bin size that passes the test they suggest.

[23] As with Figure 3.3, we collapsed the data into equal-sized bins with a width of Th$ 3. The collapsed data set contains 20 observations because we restricted the sample.

[24] Using Imbens' regression discontinuity estimator with optimal bandwidth, with which the point estimate and standard error for the RD are calculated, the drop between the 10th bin (to the left of the kink) and the 11th bin (to the right) was tested to determine if it is statistically significant. The point estimate for RD was found to be statistically insignificant.

[25] For each triennium, testing was done for kinks in the density of standardized IPPP. There is no robust evidence that the density of the assignment variable is not continuously differentiable at the kink point.

local revenue. This is especially true for municipalities whose IPPP is near the national average.

The main difference between RKD estimation and this identification strategy is that in this setting the regressor of interest (FCM grant) is not determined by a kinked function of an assignment variable. Instead, the instrument proposed is related to an assignment variable through a kinked function. This setting could be referred as a "fuzzy" RKD.

The first stage estimating equation is:

$$FCM_{it} = \gamma_0 + \gamma_1 IPPPg_{it} + \phi f(IPPPd_{it}) + \gamma_2 \alpha_{it}^{proptax} + \gamma_3 \alpha_{it}^{bustax} + t_t + \mu_i + \eta_{it} \quad (3.10)$$

where FCM_{it} is the per capita FCM grant received by municipality i in year t, $IPPPg_{it}$ is the IPPP grant corresponding to the municipality i in year t, $f(IPPP_{it})$ is a 2nd, 3rd, 4th or 5th order polynomial function of the IPPP for municipality i in year t, $\alpha_{it}^{proptax}$ is the proportion of property tax revenue transferred by municipalities to the FCM, α_{it}^{bustax} is the proportion of business tax revenue shifted by municipalities to the FCM, t_t is the year fixed effect, μ_i municipality fixed effects, and η_{it} is a random error term.

The exclusion restriction required for the instrument to be valid is that the functional form of the direct relationship between local revenue and the IPPP is not the same as the relationship between the IPPP and IPPPg, i.e., the IPPP grant formula. If we allow local revenue to be a kinked function of the IPPP as the IPPP grant is, that is, the functional form illustrated in Figure 3.1, it would be impossible to distinguish between changes in local revenue due to a change in IPPP or a change in grant. The relevance of the excluded instrument will be examined with the t value of the coefficient of IPPPg in the first stage estimates and the weak identification will be tested with the Kleibergen-Paap Wald rk F statistic.

3.4.3 Other covariates

Municipality fixed effects are included in the regression because they control for time-invariant, unobserved municipal characteristics which may be correlated with the observed independent variables. Year fixed effects are included in the regression because they control

for common trends such as changes in legislation affecting all municipalities equally or economic growth.

Finally, the proportions of property tax revenue and business tax revenue that are shifted to FCM are included in the regression. Because FCM grants, rather than net grants (i.e., the difference between grants received and shifted resources) are the regressor of interest, these variables can control for shifted resources. Only the proportions for property taxes and business taxes are considered, while the vehicle taxes are excluded, because the proportion of vehicle tax revenue shifted to FCM is the same for all municipalities and only undergoes changes over time that are controlled by year fixed effects. On the other hand, the proportions of property tax and business tax revenue shifted to the FCM are different for the four highest-revenue municipalities and undergo at least one change over the 1990-2007 time period.

3.5 Data

To identify the effect of FCM grants on local revenue, an annual dataset for 340 Chilean municipalities for the 1990-2007 time period was used. The dataset includes all municipalities but some were identified as outliers because in some years they present huge declines or rises in per capita local revenue that did not have an official explanation but they appear to be due to measurement error[26].

Table 3.1 presents descriptive statistics for the variables used in this investigation. The dependent variable[27], per capita collected local revenue (X), and its breakdown into the different kinds of revenue (proptax, bustax, vehtax, orev) exhibit considerable variation and large differences between 5^{th} quintile municipalities and 95^{th} quintile municipalities,

[26]To define an outlier municipality, we use the coefficient of variation of per capita local revenue of each municipality for the 1990-2007 time period. A municipality is an outlier if the variation coefficient of its per capita local revenue is greater than one. Using this definition, five municipalities were categorized as outliers. The per capita local revenue series of these five municipalities and their variation coefficients are reported in Appendix C.

[27] It was not possible to obtain another reliable measure of fiscal effort for the 1990-2007 time period, either a relative measure regarding fiscal capacity or a relative measure of the resources for collection. Covering this period is very important because it enables exploitation of the variation within a municipality.

which is a reflection of the fiscal inequality that exists among Chilean municipalities. The standard deviation of X is almost 1.5 times its mean.

The grants variable FCM[28], IPPP grant (IPPPg) and net grants[29], are measured in per capita terms. FCM grants exhibit considerable variation among municipalities. The standard deviation of FCM grant is almost 2 times its mean. The negative value of the net grants for municipalities in the 5^{th} quintile reflects the fact that the FCM is self-financed.

The Division of Municipalities of the Office of the Undersecretary of Regional Development (Subsecretaría de Desarrollo Regional, or SUBDERE) provided the financial 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 2002-2007[30]. Variables measured per capita use the projected population for the 1990-2007 time period, based on all censuses through 2002. All financial variables are measured in Th$ 2007.

SUBDERE provides official reports of the IPPP used in the distribution formula and in the control functions. Differences between per capita local revenue and the IPPP, besides the temporal element, are due to the definition of local revenue and the way the population is measured. For per capita local revenue, the projected population over the 1990-2007 time period was considered, based on censuses through 2002, whereas the IPPP includes the projected population based on the latest censuses, which changes depending on the year the distribution was made. Therefore, local revenue is considered to be the IPPP definition plus the resources shifted to FCM.

Finally, we use the following variables to control and test robustness: the collected revenue that is not shared with the FCM (X_{net}); the proportions of local revenue

[28]The regressor of interest, FCM_{it}, corresponds to the resources received by the municipalities, that is, the resources that municipalities report to SUBDERE as received. These resources are not necessarily equal to the value given by the distribution formula. This difference could be due to poor accounting by municipalities or to discounts for debt or other agreements. The following section also considers the FCM grant according to the distribution formula as regressor (FCM2).

[29]For estimating net grants, only the corresponding proportion of property tax, business tax and vehicle tax revenue were considered because there is no information for other sources of revenue (vehicle transfer tax and traffic fines). In 2008, both sources of revenue represented only around 4% of the total.

[30]The SINIM, which is administered by SUBDERE, receives financial information from the municipalities.

shifted to the FCM (property taxes and business taxes, all decimalized); poverty rate[31]; population; exempt properties; National Fund for Regional Development (Fondo Nacional de Desarrollo Regional, or FNDR) which is a conditional grant distributed by regional governments[32]; municipal test scores from the System for Measuring Quality of Education (Sistema de Medicin de Calidad de la Educación or SIMCE)[33]; and municipal construction permits[34].

3.6 Results

3.6.1 IV results

This section presents the OLS estimate, the first stage estimates and the IV estimates, following the specifications given in equations (3.9) and (3.10).

Column (1) of Table 3.2 presents the OLS estimate which includes municipality fixed effects, year fixed effects, % revenue shifted to FCM, controls such as FNDR and socioeconomic variables such as population and poverty. The OLS estimate is not statistically significant, that is, there would be no relationship between local revenue collected and FCM grants[35].

Columns (2) to (5) in Table 3.2 show IV estimates. Columns (2) to (5) present the parsimonious model and different orders of the polynomial function, which increase from 2 to 5. Columns (6) to (9) present the model which controls for the per capita

[31]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.

[32]SUBDERE also provides FNDR project-level information for the time period 1990 - 2007. To group this information at the municipal level we just considered the project amounts allocated to each municipality in particular and we did not consider those projects classified as inter-provincial or inter-municipal.

[33]SIMCE data was obtained from the web site of the Ministry of Education

[34]Construction permit data was obtained from the Urban Observatory (Observatorio Urbano) web site of the Ministry of Housing and Urbanism.

[35]This result holds when we control for polynomial function of IPPP.

vertical conditional grants FNDR, socioeconomic variables, and the different order of the polynomial function.

The first stage estimates from the IV estimation (i.e., estimation of Eq. (10)) are at the bottom of Table 3.2. Examining t-values for the IPPP grant formula and the F statistic's values, we test whether the excluded instrument is relevant. The results show that IPPP grants have a positive and statistically significant effect on FCM grants, regardless of the order of the polynomial function and the inclusion of controls. Increasing the number of the polynomial order increases the point-estimate somewhat and the t-values for the IPPP grant. On the other hand, in all specifications the instruments pass weak instruments test. In conclusion, the IPPP grant is correlated with the FCM grant received by municipalities; hence, the instrument is relevant.

All IV estimates in Table 3.2 are negative and statistically significant at 1% and 5%. Specifically, the IV estimates fall within the interval between -0.153 and -0.193. In other words, an increase of one standard deviation in per capita FCM grants is associated with a decrease between 0.25 and 0.32 standard deviations in per capita local revenue. In terms of elasticity, these results mean that a 10% increase in per capita FCM grant is associated with a 2% decrease in per capita collected revenue. These results imply that the effect of an increase in FCM grants on local revenue is also economically significant. This effect is attributable to the income effect of grants, therefore it is not directly comparable with research that takes the perspective of the flypaper effect. The results are not significantly affected by the order of polynomial function or controls[36]. The IV estimates are larger, in absolute values, than the OLS estimates, suggesting that the net bias is positive.

3.6.2 Interpretation of Results

This estimation is local, which may be interpreted as the expected effect of grants on local revenue for municipalities whose revenue is close to the national average. Table 3.3 presents IV results excluding municipalities if they have the IPPP used in the distribution formula outside a specific range [national average $\pm 0.5 \times$ IPPP's standard deviations], and

[36]Different specifications were estimated, controlling for different orders of polynomial functions and controls which are not presented in this paper.

the IPPP is always below or above the national average. Thus, the sample size and the number of municipalities decrease but we also ensure that the number of observations is sufficiently large, because the estimates are expected to become less precise as the number of observations and municipalities is reduced. The municipalities that have IPPP close to the kink point and whose IPPPs have been above and below the average over time are those for which the estimated effect is identified. Moreover, this group of municipalities is heterogeneous with respect to the region where they are located, the size (population) and level of rurality. If we also exclude municipalities that belong to the most populous regions of the country or municipalities with populations over 100,000 or urban municipalities (with rurality percentages below 30%), the results of Table 3.3 do not change. This way, we rule out the bias that only municipalities representing large urban settlements are able to affect their revenue and therefore show this effect.

Table 3.4 presents the IV estimates with 4th order polynomial [37] but the dependent variable corresponds to different kinds of local revenue that comprise the total local revenue collected, that is, property taxes, business taxes, vehicle taxes and revenue other than tax revenue. When the FCM grant increases by one standard deviation, business tax revenue decreases by almost 0.5 standard deviations and tax property revenue decreases by 0.33 standard deviations. Thus, business taxes are more sensitive than property tax revenue. The greater sensitivity of municipal licenses compared to property taxes could be due to the fact that the municipalities are responsible for collecting the former while for the latter, municipalities only provide updated information on property values and support the SII's efforts, but do not take part in the tax collection process.

On the other hand, vehicle taxes and other revenue are not affected by changes in FCM grants. This result could be due to strategic interaction among governments, which has not been considered in this model[38]. The taxpayer must pay property taxes and business taxes in the municipality where he\ she resides, while vehicle taxes and certain other sources of revenue may be paid in any municipality. Thus, in the latter case, assuming

[37]This order of polynomial is preferred by the Akaike Information Criterion. Appendix D presents the IV results with 2nd, 3th and 5th order polynomial.

[38]According to Brueckner (2003), strategic interaction among governments has recently become a major focus of theoretical work in public economics. In the tax competition literature, governments levy taxes on a mobile base. When the number of jurisdictions is small, these taxes are chosen in strategic fashion, taking into account the inverse relationship between a jurisdiction's tax rate and its base.

a relatively constant tax base, a municipality's revenue collection is affected by collection elsewhere. In other words, if the distribution of tax bases among jurisdictions is affected by the total tax collection by all of them, when a municipality exerts significant effort to collect revenue, this lowers the available tax base for other municipalities. On the contrary, when a municipality exerts little effort to collect revenue, the available tax base for other municipalities is greater. With this kind of strategic interaction among local governments, the income effect of an increase in the FCM grant may be offset. This is because if some municipalities collect lower revenue, even though another municipality has not made a greater effort at collection, the available tax base is more extensive and it can increase its revenue. On the other hand, the income effect of a decrease in the FCM grant could be offset, because if a municipality increases its revenue even though another municipality has made a greater effort, the available tax base is smaller and it may see a decline in revenue. Note that if there is no strategic interaction among local governments, the revenue collected is a good proxy for fiscal effort. Otherwise, if there is strategic interaction, all municipalities could simultaneously make more effort without increasing their collection. Further research on this topic should take into account theoretical and empirical models of strategic interaction among local governments.

Finally, in Table 3.5 we distinguish between municipalities with a low proportion of exempt properties and those with a high proportion and between municipalities with high levels of business equity (the tax basis of business tax) and those with low levels of business equity. In this context we use no exempt properties or business equity as a proxy of fiscal capacity[39]: municipalities with high fiscal capacity should be more sensitive to grants because they have a greater ability to increase or decrease their revenue. When considering municipalities with a low proportion of exempt properties or high levels of business equity, the results remain practically the same. When considering municipalities with a high proportion of exempt properties or low levels of business equity, the FCM grant is not statistically and economically significant, as expected.

[39]To measure fiscal capacity the only information available was the proportion of exempt property and business equity per municipality

3.6.3 Robustness analysis

Table 3.6 presents IV results with 4th order polynomial[40] which consider different regression specifications, regressors of interest, dependent variables and sample definition. Column (1) presents the IV estimates not considering the proportions of revenue shifted to the FCM as covariates. Column (2) presents the IV estimates not considering the proportions of revenue shifted to the FCM as covariates, but the grants variable is represented by net grants[41]. Column (3) uses the FCM grants determined by the distribution formula, rather than the received grant. In column (4), revenue that remains with the municipality[42] is considered the dependent variable and the FCM grant is considered the grant variable. Column (5) considers the method for identifying outliers suggested by Hadi[43][44]. Column (6), following empirical literature on municipal data, excludes information from municipalities founded during the 1990-2007 time period, as well as from the municipalities which they were formerly part of. In all cases, the estimates are slightly different than those presented in Table 3.2, but they should not be statistically different from them[45].

According to Card et al. (2009) the smooth density of IPPP rules out extreme forms of endogenous sorting which might arise when agents can manipulate the IPPP used in the distribution formula and this smooth density condition generates strong predictions for the distribution of covariates that are predetermined prior to the IPPP: their conditional distribution functions should have continuous derivatives with respect to the IPPP at the kink point. In Table 3.7 we test this condition which is analogous to Table 3.2, except that the dependent variables are determined prior to the IPPP used in the distribution formula. The variables that were presumably determined before the IPPP are poverty, SIMCE score and housing construction permits issued by municipalities. All these variables are

[40] Appendix E presents the IV results with 2nd, 3th and 5th order polynomial.

[41] The standard deviation of net grants is very similar to the FCM grants' standard deviation

[42] The standard deviation of this variable is half of the standard deviation of per capita local revenue.

[43] Hadi, 1992; Hadi, 1994.

[44] This method was applied to per capita local revenues series for each municipality, using a different significance level for outlier cutoff. If a municipality has an observation identified as an outlier, then that municipality is considered an outlier. Twenty outlier municipalities fall within this category.

[45] We test the idiosyncratic errors ϵ_{it} for serial correlation, using the test proposed by Wooldridge (2009), and we reject the null hypothesis that the time-demeaned errors are serially correlated. Therefore, we do not present IV estimates allowing clustered standard errors on municipalities.

measured in the same years as the IPPP used in the distribution formula[46] and the point estimates are found to be statistically insignificant.

3.7 Conclusion

This paper analyzes the causal effect of unconditional grants on local revenue collection. Unconditional grants generate incentives for subnational governments that affect the total amount of resources collected, and thus such grants may produce effects other than the desired ones. When subnational governments are responsible for collecting taxes, the total amount of revenue collected depends mainly on their collection effort. However, the revenue collection process is costly for subnational governments. Thus, although grants increase a jurisdiction's total revenue, because of an income effect the jurisdiction may collect less local revenue.

The estimation of the grants' income effect has not been widely studied. Countries like Chile provide the appropriate institutional context for resolving this kind of question because the recipients of the transfers are responsible for collection, and the other determinants of collection are exogenously determined from the municipal perspective. This paper focuses on estimating the income effect of intergovernmental grants (FCM grants) on local governments in Chile. The analysis indicates that an increase of one standard deviation in FCM grants is associated with a decrease between 0.25 and 0.32 standard deviations in per capita local revenue. Our main contribution to this literature is not only to provide an estimate that takes care of the endogeneity of transfer but also to note that there is an income effect that is economically relevant, but that the net effect of an exogenous increase in grants is positive, i.e., the negative effect on the collection of local resources is less than the increase in grants. Thus, the redistributive objective is met.

A possible extension of this work is to exploit "natural experiment" as potential sources of exogenous change in transfers. For instance, in recent years in Chile some municipalities have received substantial transfers of resources resulting from the central government's

[46]These variables are considered contemporary to local revenue and the results did not change.

decisions and its interaction with the private sector that could be considered exogenous from the municipal perspective, such as the establishment of casinos, construction of concession roads and expansion or construction of subway lines.

An important area for future research is the effect of the design of horizontal equalization grants on revenue collected, because it may also generate incentives for subnational governments that affect the total amount of resources collected. Specifically, this occurs when local governments must contribute a portion of their collected revenue to financing these kinds of grants, and the distribution mechanism for these resources depends on the same local revenue that is collected.

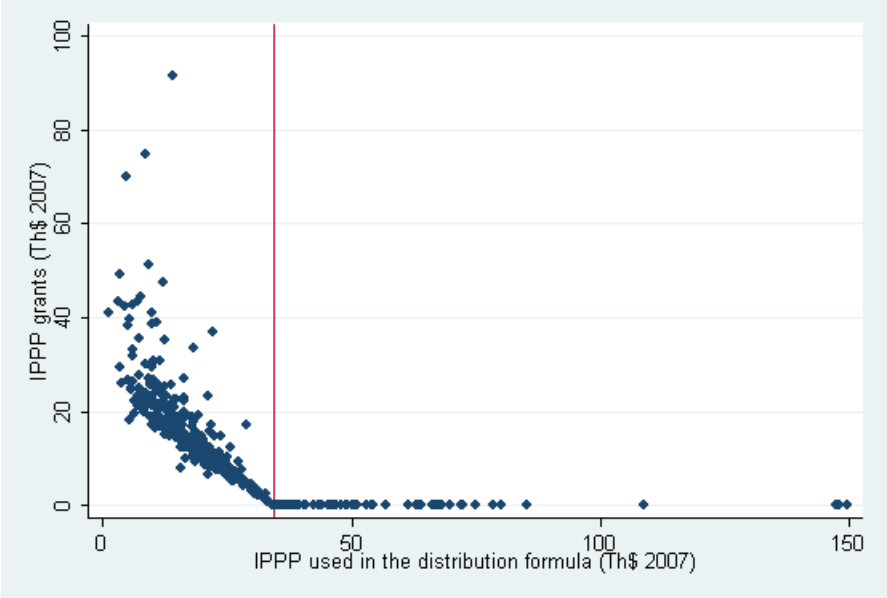

Figure 3.1: IPPP grant against IPPP used in the distribution formula, 2003

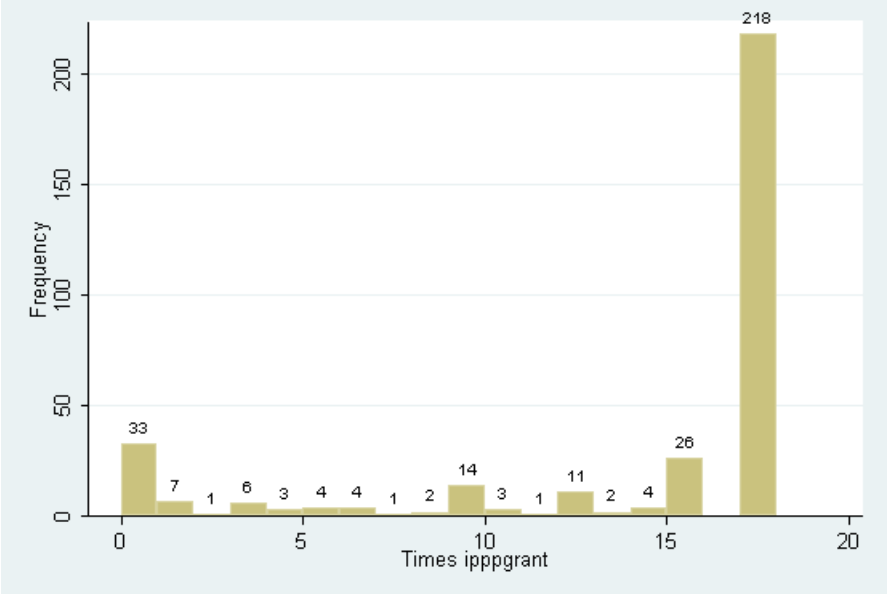

Figure 3.2: Frequency with which municipalities have received IPPP grant over the 1990-2007 time period

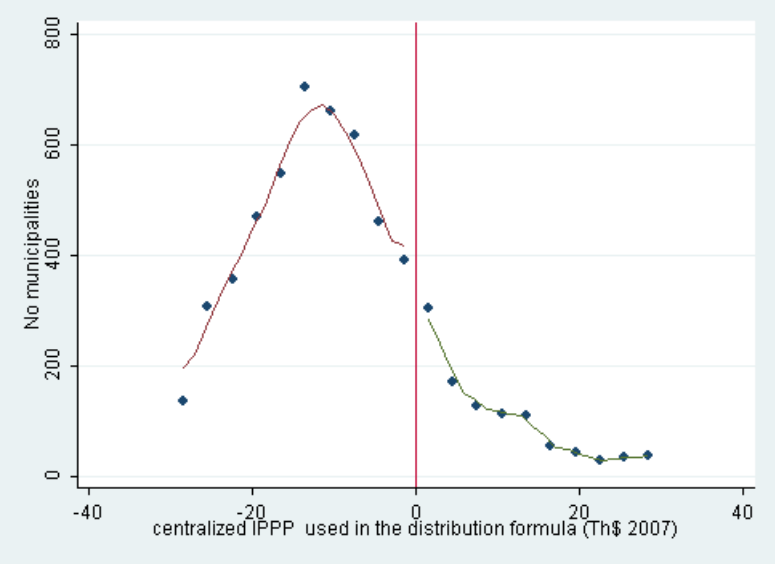

Figure 3.3: Number of observations in each bin of centralized IPPP used in the distribution formula, 1990-2007

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
X	5980	44.005	28.425	61.792	7.966	125.756
fcm	5975	53.298	29.406	104.506	7.417	154.859
ipppg	5974	10.155	8.300	10.696	0	27.437
ipppd	6026	22.621	15.849	27.100	4.351	61.349
proptax	5980	18.710	11.173	33.039	1.357	49.691
munlic	5983	7.120	3.239	17.192	0.635	21.739
vehreg	5984	9.985	5.360	19.202	1.230	34.724
orev	5981	8.338	4.916	12.525	0.821	26.456
$\alpha^{proptax}$	5980	0.6	0.6	0.003	0.6	0.6
α^{vehreg}	5980	0.549	0.5	0.061	0.5	0.625
α^{munlic}	5980	0.007	0	0.064	0	0
netgrant	5974	35.670	18.266	105.656	-17.085	140.207
ippp	5981	26.375	17.446	32.428	5.025	80.515
fcm2	5958	53.667	29.932	105.682	7.706	153.236
fndrpc	6005	21.874	6.674	56.432	0	85.252
pop	6024	44837	16896	69179	2197	187000
poverty	6024	27.823	28.950	11.837	8.890	47.065
exprop	6029	8173.192	3593.000	12642.592	522	32781
simce	5422	161.292	221.500	88.062	47.855	251.191
permcons	3617	676.023	274	1175.103	28	2626

Table 3.1: Descriptive Statistics

Dependent Variable	Per capita local revenue								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation	OLS	IV	IV	IV	IV	IV	IV	IV	IV
Polynomial order		2nd	3rd	4th	5th	2nd	3rd	4th	5th
FCM grant	0.007333	-0.153***	-0.166***	-0.159***	-0.156***	-.181**	-0.193***	-0.185***	-0.182***
	(0.00601)	(0.0589)	(0.0506)	(0.0455)	(0.0471)	(0.069)	(0.0589)	(0.0535)	(0.0556)
Fndrpc	Yes					Yes	Yes	Yes	Yes
Poverty	Yes					Yes	Yes	Yes	Yes
Population	Yes					Yes	Yes	Yes	Yes
Exempt properties	Yes					Yes	Yes	Yes	Yes
Observations	5,953	5,966	5,966	5,966	5,966	5,953	5,953	5,953	5,953
No comuna	340	340	340	340	340	340	340	340	340
					First stage				
IPPP grant		1.665***	2.057***	2.162***	2.068***	1.504***	1.866***	1.952***	1.871***
t		5.45	8.69	9.23	8.09	5.05	7.90	8.30	7.35
F		29.72	62.87	539.19	535.14	25.46	62.43	68.81	54.07

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

All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.2: Effects of FCM grants on local revenue

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.0968***	-0.102***	-0.104***	-0.103***
	(0.0366)	(0.0377)	(0.0379)	(0.0376)
Observations	3,568	3,568	3,568	3,568
No of comuna	256	256	256	256
	First stage			
IPPP grant	2.514***	2.500***	2.510***	2.518**
t	8.55	8.42	8.49	8.52
F	73.11	70.93	69.17	294.35

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.3: Effects of FCM grants on local revenue. Municipalities close to kink point.

Dependent Variable	Tax property	Business Tax	Vehicle Tax	Other revenue
	(1)	(2)	(3)	(4)
Polynomial order	4th	4th	4th	4th
FCM grant	-0.104***	-0.075***	0.037*	-0.011
	(0.0223)	(0.0207)	(0.0203)	(0.0105)
Observations	5,966	5,966	5,966	5,966
No comuna	340	340	340	340
	First stage			
IPPP grant	2.163***	2.163***	2.163***	2.163***
t	9.23	9.23	9.23	9.23
F	539.19	539.19	539.19	539.19

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.4: Effects of FCM grants on different kind of local revenue

Dependent Variable	Tax property	Tax property	Business Tax	Business Tax
Municipalities	Low % Exempt Prop.	High % Exempt Prop.	High Business Eq.	Low Business Eq.
	(1)	(2)	(3)	(4)
Polynomial order	4th	4th	4th	4th
FCM grant	-0.15***	-0.01	-0.20**	-0.05**
	(0.042)	(0.023)	(0.088)	(0.02)
Observations	2,970	2,996	2,896	2,927
No munic.	168	172	168	172
	First stage			
IPPP grant	2.42***	2.08***	1.36***	2.69***
t	5.27	7.07	15.15	11.13
F	27.82	50.02	229.6	123.89

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.5: Effects of FCM. Municipalities with high and low fiscal capacity

Dep. Variable	Per capita local revenue			IPPP	Per capita local revenue	
Grant	FCM_{it}	$NetFCM_{it}$	FCM determined by formula	FCM_{it}	FCM_{it}	FCM_{it}
	(1)	(2)	(3)	(4)	(5)	(6)
Polynomial order	4th	4th	4th	4th	4th	4th
Grant	-0.279***	-0.245***	-0.433**	-0.119***	-0.186***	-0.177***
	(0.0665)	(0.0515)	(0.0275)	(0.0305)	(0.0565)	(0.0529)
% revenue shifted to FCM	No	No	Yes	No	Yes	Yes
Observations	5,963	5,962	5,947	5,962	5,713	5,648
No comuna	340	340	340	340	326	317
First stage						
IPPP grant	1.963***	2.239***	1.258***	1.960***	1.969***	1.985***
t	7.89	9.07	3.70	7.88	7.91	8.03
F	539.39	502.55	491.54	540.09	488.97	526.29

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects and Time Dummies

Table 3.6: Robustness Analysis

Dependent Variable	Poverty	SIMCE	Construction Permits
	(1)	(2)	(3)
Polynomial order	4th	4th	4th
FCM grant	0.004	-0.004	-1.217
	(0.00919)	(0.0105)	(2.709)
Observations	5,966	5,292	3,597
No of comuna	340	338	224
First stage			
IPPP grant	2.162***	1.931***	1.360***
t	9.23	7.97	31.18

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.7: Effects of grants on predetermined covariates.

Appendix A

Currently 65 municipalities have an OCM. Figure 3.4 shows the evolution of per capita property tax collected on average by these 65 municipalities compared to the evolution of 65 municipalities that have not signed such an agreement with SII. The selection of these municipalities was based upon the propensity score matching method with treatment defined as having OCM (one-to-one matching). Municipalities with OCM have been able to almost double the average raised by municipalities without OCM.

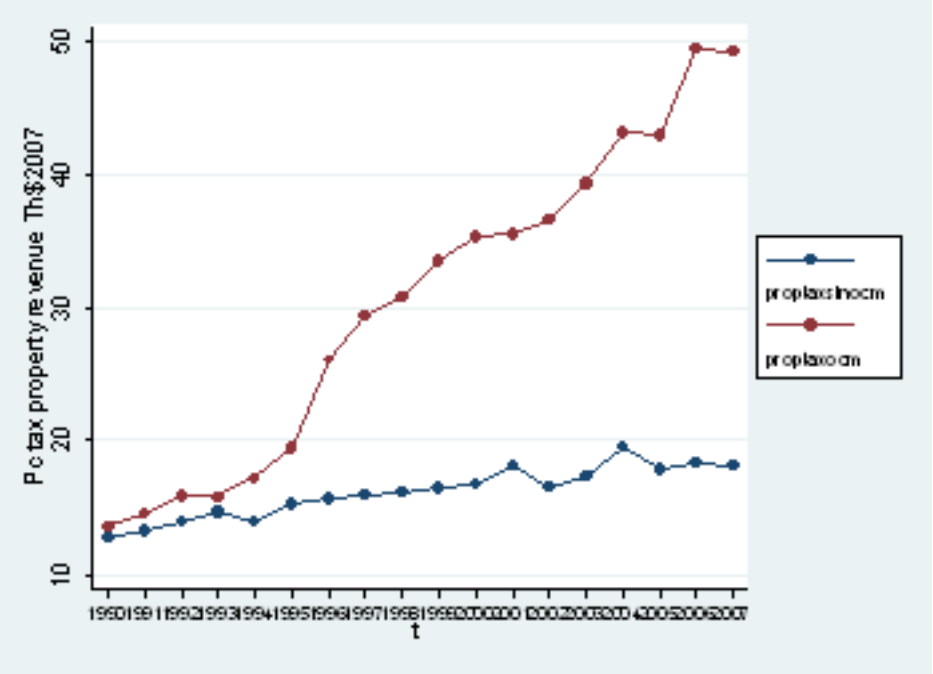

Figure 3.4: Revenue Collection. Municipalities with OCM versus Municipalities without OCM

Appendix B

The regression kink provides nonparametric identification of the average marginal effect of a continuous endogenous regressor which is a known, deterministic, but kinked function (policy rule) of an observed continuous assignment variable. It is similar to a regression discontinuity design (RDD) except that instead of exploiting a shift in levels, the regression kink design exploits a shift in slopes (Simonsen et al., 2010). The identification strategy used is based on the same condition for identification which is behind RKD, the main characteristics of which are described below. This appendix is based on Card, Lee and Pei (2009).

To understand this particular design, consider the model Y = y(B, V, W) where Y is an outcome, B is a continuous regressor of interest, V is another covariate that enters the model, and W is an unobservable, nonadditive error term. B is mechanically determined as a function of the assignment variable V which has a kink at $v = v_0$ (B= b(V)). There are observed random variables X which are determined prior to V, which in turn is determined prior to B. The idea is that if B exerts a causal effect on Y, and there is a kink in the deterministic relationship between B and V at $v = v_0$, then we should expect to see an induced kink in the relationship between Y and V at $v = v_0$. That is, it exploits the exogenous variation in the regressor of interest caused by kinked schemes. This corresponds to a sharp regression kink design.

Card et al. (2009) establish the conditions under which the RKD estimator identifies the "local average response" or, equivalently, the "treatment on the treated" parameter that is identified in an ideal, randomized experiment. Thus, the parameter estimated using RKD is local.

Card et al. (2009) describe the assumptions and mechanics behind this strategy. The key condition for identification is the smoothness of the first derivative of the density of the assignment variable V conditional on W, which implies that agents must not have full control of the assignment variable, i.e., they cannot deterministically manipulate the value of the assignment variable used in the policy formula. If there is imprecise control over the assignment variable, every agent will have approximately the same probability of being just above or below the kink point, so the variation that this design isolates is

randomized.

Another consequence of this smoothness condition is that the conditional distribution functions of observed covariates which are determined prior to the policy variable (X) should have continuous derivatives with respect to the assignment variable at the kink point. Thus, the validity of the RKD can be tested.

Appendix C

Municipality	1402	6309	8415	10404	11303
Per capita local revenue 1990	2.3	14.9	4.93	9.26	4.22
Per capita local revenue 1991	2.65	13.01	4.55	9.88	5.89
Per capita local revenue 1992	3.59	12.42	4.13	22.61	6.21
Per capita local revenue 1993	6.96	14.03	12.54	17.94	3.11
Per capita local revenue 1994	7.34	13.62	4.02	11.91	3.29
Per capita local revenue 1995	6.7	17.77	7.75	13.16	3.17
Per capita local revenue 1996	5.08	21.07	7.73	18.52	3.70
Per capita local revenue 1997	4.07	22.87	14.61	17.13	9.42
Per capita local revenue 1998	19.87	26.92	7.27	16.89	5.19
Per capita local revenue 1999	25.77	29.00	8.7	21.76	5.33
Per capita local revenue 2000	123.64	23.15	7.33	20.71	3.91
Per capita local revenue 2001	1.14	25.82	11.18	16.99	4.29
Per capita local revenue 2002		299.39	6.46	22.02	116.83
Per capita local revenue 2003	5.77	29.04	3.77	921.31	131.90
Per capita local revenue 2004	11.6	30.25	7.85	23.61	180.29
Per capita local revenue 2005	5.93	27.03	28.85	29.34	179.02
Per capita local revenue 2006	13.51	29.42	37.42	28.89	274.14
Per capita local revenue 2007	6.72	29.66	82.57	24.7	211.82
Coefficient of Variation	1.935	1.739	1.32	3.071	1.43

Table 3.8: Per capita local revenue series of outlier municipalities

Appendix D

Dependent Variable	Tax property	Business Tax	Vehicle Tax	Other revenue	Tax property	Business Tax	Vehicle Tax	Other revenue
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polynomial order	2nd	2nd	2nd	2nd	3rd	3rd	3rd	3rd
FCM grant	-0.10***	-0.078***	0.034	-0.007	-0.096***	-0.086***	0.026	-0.0044
	(0.0297)	(0.0274)	(0.0244)	(0.0125)	(0.0219)	(0.0237)	(0.0278)	(0.0113)
Observations	5,966	5,966	5,966	5,966	5,966	5,966	5,966	5,966
No comuna	340	340	340	340	340	340	340	340
				First stage				
IPPP grant	1.665***	1.665***	1.665***	1.665***	2.057***	2.057***	2.057***	2.057***
t	5.45	5.45	5.45	5.45	8.69	8.69	8.69	8.69
F	29.72	29.72	29.72	29.72	62.87	62.87	62.87	62.87

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.9: Effects of FCM grants on different kind of local revenue

Dependent Variable	Tax property	Business Tax	Vehicle Tax	Other revenue
	(1)	(2)	(3)	(4)
Polynomial order	5th	5th	5th	5th
FCM grant	-0.118***	-0.082***	0.048**	-0.001
	(0.0254)	(0.0203)	(0.0200)	(0.0106)
Observations	5,966	5,966	5,966	5,966
No comuna	340	340	340	340
		First stage		
IPPP grant	2.069***	2.069***	2.069***	2.069***
t	8.09	8.09	8.09	8.09
F	535.14	535.14	535.14	535.14

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.10: Effects of FCM grants on different kind of local revenue (cont.)

Appendix E

Dependent Variable	Per capita local revenue		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
FCM grant	-0.174***	-0.271***	-0.238***
	(0.0658)	(0.0646)	(0.0632)
Observations	5,966	5,966	5,966
No of comuna	340	340	340
First stage			
IPPP grant	1.663***	1.981***	2.023***
t	5.40	7.93	7.52
F	29.15	62.90	535.33

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects and Time Dummies

Table 3.11: Effects of grants on local revenue, without proportions of revenue shifted to the FCM. Robustness analysis

Dependent Variable	Per capita local revenue		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
Net grant	-0.164***	-0.239***	-0.213***
	(0.0578)	(0.0504)	(0.0508)
Observations	5,965	5,965	5,965
No of comuna	340	340	340
First stage			
IPPP grant	1.764***	2.250***	2.263**
t	5.83	9.14	8.59
F	33.99	83.54	503.67

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects and Time Dummies

Table 3.12: Effects of net grants on local revenue. Robustness analysis

Dependent Variable	Per capita local revenue		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
FCM grant determined by formula	-0.411	-0.364**	-0.409**
	(0.275)	(0.148)	(0.199)
Observations	5,950	5,950	5,950
No of comuna	340	340	340
First stage			
IPPP grant	.848***	1.381***	1.225**
t	1.95	4.26	3.05
F	3.78	13.82	480.64

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

All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.13: Effects of FCM grants determined by distribution formula on local revenue. Robustness analysis

Dependent Variable	IPPP		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
FCM grant	-0.112***	-0.133***	-0.118***
	(0.0385)	(0.0340)	(0.0336)
Observations	5,967	5,967	5,967
No of comuna	340	340	340
First stage			
IPPP grant	1.662***	1.977***	2.019***
t	5.40	7.93	7.52
F	29.19	62.87	536.02

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

All specifications include municipality fixed effects and Time Dummies

Table 3.14: Effects of FCM grants on IPPP. Robustness analysis

Dependent Variable	Per capita local revenue		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
FCM grant	-0.166***	-0.174***	-0.164***
	(0.0622)	(0.0532)	(0.0499)
Observations	5,716	5,716	5,716
No of comuna	326	326	326
First stage			
IPPP grant	1.654***	2.034***	2.038***
t	5.34	8.37	7.76
F	28.52	58.30	484.05

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.15: Effects of FCM grants on local revenue. Definition outlier according to Hadi.

Dependent Variable	Per capita local revenue		
	(1)	(2)	(3)
Polynomial order	2nd	3rd	5th
FCM grant	-0.156***	-0.167***	-0.152***
	(0.0603)	(0.0516)	(0.0480)
Observations	5,651	5,651	5,651
No of comuna	317	317	317
First stage			
IPPP grant	1.654***	2.045***	2.054***
t	5.35	8.46	7.89
F	28.60	59.53	523.81

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All specifications include municipality fixed effects, Time Dummies and % revenue shifted to FCM

Table 3.16: Effects of FCM grants on local revenue. Without new municipalities.

Chapter 4

The Incentive Effect of Equalization Grants on Tax Collection

4.1 Introduction

Equalization grants intended to enhance horizontal equity require definition of a mechanism that distributes the resources based on the fiscal need and fiscal capacity of each jurisdiction. When fiscal capacity is measured using collected jurisdictional revenue, equalization grants are inversely related to this amount. Thus, if a jurisdiction increases its collected revenue, the grant received will be lower. This kind of transfer discourages jurisdictions from revenue collection because it levies a tax on collecting revenue that we refer to as an implicit tax[1].

In this paper, we study how Chilean equalization grants affect the revenue collected by municipalities. Studying a panel of 340 Chilean municipalities during the 1990-2006 period, we find that an increase in the equalization grant's implicit tax is associated with a decrease in local per capita revenue. To identify the incentive effect we exploit the characteristics of the Chilean distribution formula and the reforms made to it from 1990

[1]If fiscal capacity were measured accurately, such transfers would not create a disincentive for local governments to raise revenues, because at the margin local governments still bear full fiscal responsibility for expenditure and tax decisions, essentially because transfers are lump sum in nature (Smart, 2007).

to 2006, which could be considered exogenous from the viewpoint of a municipality.

The Common Municipal Fund (*Fondo Común Municipal*, or FCM)is the Chilean grant system used to redistribute revenue among municipalities and constitutes one of the main sources of revenue for Chilean municipalities[2]. The FCM grant received by each municipality is determined by a formula that depends on, among other components, the so-called Permanent Own Revenues (*Ingresos Propios Permanentes*, or IPP), a proxy of municipal collected annual revenue, using the IPP from at least two years earlier. In this way, today's collected revenue affects the grant received two, three or four years later. That is, municipalities "pay" the implicit tax two, three or four years after they collect the revenue on which it is based. Furthermore, this component only affects municipalities with per capita IPP less than the national average. As a consequence, the implicit tax is zero if the municipality has per capita IPP below the national average. Otherwise, the implicit tax depends negatively on the difference between the municipality's IPP and the national average and positively on the relative importance of the part of the FCM grant associated with the IPP component with respect to municipal revenue. Thus, the Chilean implicit tax could depend on unobservable local characteristics that partly explain municipal collected revenue.

To identify the effect of the implicit tax on revenue collected by Chilean municipalities, we control for municipal fixed effects and exploit the dynamic feature of FCM. In particular, we exploit the fact that the period of time in which to pay implicit taxes is exogenously determined and is changed by law. We distinguish the incentive effect that occurs when the year in which municipalities must pay taxes is closer (two years later) from the incentive effect that exists when the year in which municipalities must pay taxes is three or four years later. Moreover, we adjust the implicit tax for the likelihood that the political coalition to which the incumbent mayor belongs will win the next election and, in fact, pay the implicit tax in the coming years.

We find that the incentive effect is greater when the period to pay the implicit tax is shorter and when the likelihood that the political coalition to which the incumbent mayor belongs will pay this tax in the future is higher. We study robustness checks such as the

[2]The FCM, in turn, is self-financing: municipalities must contribute a share of their main sources of local revenue to the FCM every year.

introduction of socioeconomic controls and distinguish between municipalities with high and low fiscal capacity, and carry out a falsification check using as the dependent variable municipal revenue that is not subject to the implicit tax.

There are many reasons why Chilean municipalities offer a good case for study. Chilean municipalities do not have tax autonomy; that is, Chilean municipalities do not choose the tax rate or define the tax base, but they collect most local taxes and can improve their collection rate by making a greater effort to collect or by gathering information to update property assessment surveys carried out by a central government agency, among other activities that might affect assessed value. Second, the design of the distribution formula is the responsibility of the central government, which has implemented reforms to the formula that affect the years remaining to "pay" the implicit tax that the municipalities did not expect. In addition, there are available data for a large panel of municipalities which allows for exploiting the aforementioned reforms.

The incentive effect of equalization transfers on tax policy has been studied extensively in the context of federal countries with local taxing autonomy such as Germany, Australia and Canada. In this context, equalization grants are negatively related to the tax base and the theoretical prediction is that equalization grants induce governments to raise tax rates[3]. Dahlby and Warren (2003) find relatively weak evidence in support of this hypothesis. However, the estimated model does not consider the potential endogeneity of the incentive effect. Buettner (2006) summarizes German municipalities' total revenue from intergovernmental transfers with a linear function relating grants to the tax base. The slope of the function measuring an incentive effect is called the "marginal contribution rate," i.e., the extent to which an increase in the tax base results in lower grants. He exploits the fact that the "marginal contribution rate" is a discontinuous function of relative fiscal capacity, which permits the use of regression discontinuity (RD) estimation techniques to determine the effect of the "marginal contribution rate" on the tax rate chosen by municipalities. Alternatively, he exploits this variable's variation due to changes in the law over time. He finds that an increase in the marginal contribution rate of one

[3]The theoretical literature on the impact of equalization grants takes into account that consumer and producer mobility in response to fiscal incentives is a distinctive characteristic, especially when jurisdictions have fiscal autonomy and the tax rate varies among them; hence, this literature is closely related to tax competition literature (Wilson, 1999; Kothenburger, 2002; and Smart, 1998)

percentage point is associated with an increase in the tax rate of .121 -.142 percentage points. Finally, Egger et al. (2010) empirically analyze the incentive effect 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 in 1999. Their results confirm the theoretical prediction.

On the other hand, Baretti et al. (2002) study the effects of equalizing transfers on German state tax revenue. Germany's states administer tax collection but do not choose their own tax rates and bases. To measure the incentive effect, they define and calculate a marginal tax rate (MTR); that is, the fraction of 1 deutsche mark of a state's additional income tax revenue that flows out of the region. Since MTR depends on the state's tax revenue, they exploit the fact that the MTR tends to be higher in states with low population and they use the population size instead of the MTR as the explanatory variable. They find that a 1% increase in the MTR 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 the authors did not analyze the validity of population as an instrumental variable. Our paper adds to this literature by providing an empirical investigation of the incentive effect on local collected revenue in a dataset of Chilean municipalities. Moreover, in the Chilean case where the FCM is self-financing, the incentive effect is not only important in terms of the design of equalization grants but also in terms of its effect on total fund size (the size of the pie depends on how it is distributed).

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 19902006 period. Section 4 describes the identification strategy. Section 5 describes and presents the data. Section 6 reports the results. Finally, Section 7 concludes.

4.2 A motivating theoretical model

We present a very simple dynamic model that considers the individual decision of a local government regarding tax collection when it must provide a share of its collected revenue

for redistribution and future grants are inversely related to today's collected revenue. We will analyze the potential incentive effect of this transfer design on collected local revenue.

4.2.1 Representative household utility

Assume that a representative household has the following utility function[4]:

$$U_t = f(Z_t) \tag{4.1}$$

where Z_t denotes the public good spending in period t. The function $f(\cdot)$ is increasing and concave ($f'(\cdot) > 0$ and $f''(\cdot) < 0$). That is, decreasing marginal utility is assumed.

4.2.2 Collection cost

The collection cost in period t depends on the local revenue collected in that period (X_t):

$$C_t = c(X_t) \tag{4.2}$$

$c(\cdot)$ is the cost function (or disutility function) and is increasing and convex ($c'(\cdot) > 0$ and $c''(\cdot) > 0$). That is, increasing marginal cost is assumed. We also assume that the local government's collection effort is the only determinant of tax collection.

4.2.3 Local government net utility

AAt the local government level, the decision-maker maximizes representative household utility minus cost effort:

$$U_t = f(Z_t) - e(X_t) \tag{4.3}$$

[4]If we assume an additively separable utility function for private and public goods, the results do not change.

Net utility is assumed to be separable; that is, the marginal utility of spending today depends on today's spending only and marginal cost of collecting today depends on today's collection only. When a local government evaluates net utility in the future, it is discounted by a constant factor $\delta < 1$, assuming spending in the future is not valued as much as spending today. The objective is to maximize the present discounted value of future net utility:

$$\sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t) \right) \tag{4.4}$$

4.2.4 Local government budget constraint

Local governments have two sources of revenue for financing local public good spending in each period t: local revenue (X_t) of which a proportion α_t is shifted by local government to the common fund in t and equalization grants (G_t)[5].

$$Z_t = (1 - \alpha_t) X_t + G_t \tag{4.5}$$

The equalization grants received have two components: first, the component that depends on exogenous variables (fixed component K_{t-1} determined in t-1) and, second, the component $\beta(\cdot)$ that depends negatively on past local revenue X_{t-1}:

$$G_t = K_{t-1} + \beta_t(X_{t-1}) \tag{4.6}$$

We 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.

Since $f(\cdot)$ is increasing, the local government maximizes Equation 4.4 subject to this budget constraint.

[5]We assume that the budget constraint is satisfied with equality because in Chile municipalities may not take on debt, although some Chilean municipalities run large deficits. Even if we include debt as a third source of revenue, the incentive effect still exists.

4.2.5 Optimal local revenue

A local government decision-maker must decide how much to collect, X_t, and how much to spend on public goods, Z_t, in each period t = 0,1,2,...,∞. The local government decision-maker's problem may be written thus:

$$\underset{\{X_t,Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t)\right) \tag{4.7}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + β_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,...,∞.

We use the dynamic programming approach to solve this problem. Then, for each period, the Bellman equation is:

$$v(X_{t-1}) = \underset{\{X_t,Z_t\}}{Max} \left(f(Z_t) - e(X_t)\right) + \delta v_{t+1}(X_t) \tag{4.8}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + β_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.

We incorporate the constraint into the objective function, thereby eliminating local public spending as a variable to be chosen. So the first order condition (FOC) becomes:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta)\frac{\partial v_{t+1}}{\partial X_t} \tag{4.9}$$

This equates the marginal net utility of collecting current revenue to the lost marginal utility of receiving reduced grant funds in the next period. The Beveniste-Shienkman

condition is:

$$\frac{\partial v_t}{\partial X_{t-1}} = \frac{\partial f}{\partial Z_t}\frac{\partial \beta_t}{\partial X_{t-1}} \tag{4.10}$$

Then, the FOC can be written as:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) = \frac{\partial e}{\partial X_t} - \delta\frac{\partial f}{\partial Z_{t+1}}\frac{\partial \beta_{t+1}}{\partial X_t}(X_t) \tag{4.11}$$

This condition states that the local government decision-maker will raise collection until the point where if collection were increased by one more peso today, the gain in utility would equal the cost (disutility) of collecting that peso today plus the loss in utility tomorrow (because the grant will be lower tomorrow) $\frac{\partial \beta_{t+1}}{\partial X_t(X_t)}$ represents the rate at which the grants decrease in t+1 due to an increase in local revenue in t. The size of the implicit tax[6] $\delta\frac{\partial f}{\partial Z_{t+1}}\frac{\partial \beta_{t+1}}{\partial X_t(X_t)}$) depends not only on the rate at which the grants decrease in t+1 due to an increase in local revenue in t, but also on the discount factor 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 implicit tax is paid), the lower the implicit tax (Appendix B shows the case where equalization grants depends on X_{t-2}).

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

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) = \frac{\partial e}{\partial X_t} \tag{4.12}$$

Equalization grants that depend negatively on collected local revenue will discourage the collection of local revenue. To see this, compare Equation 4.11 and Equation 4.12. In the former, the cost of collecting revenue is greater than it is in the latter because municipalities must pay the implicit tax.

[6]Note that due to the dynamic structure of the model, it is possible to separate the implicit tax, which must be anticipated by the local government, from the contribution rate (α_t) which is contemporaneous, unlike what has been done previously. In a static model, this is not possible (see Appendix A).

4.3 Equalization grants in Chile

The Common Municipal Fund (FCM) is the Chilean grant system used to redistribute revenue among municipalities. The FCM, in turn, is self-financing: municipalities must contribute a share of their main sources of local revenue to the FCM every year. Collected revenue corresponds to the sum of the three most important local taxes (property tax, business tax and vehicle tax) and municipal rights. Chilean municipalities do not choose their tax rate and define their tax base, but they collect most local taxes and can improve their collection by making a greater effort to collect or by gathering information to update property assessment surveys carried out by a central government agency, among other activities that might affect assessed value.

The FCM grant received by each municipality is determined by a formula that depends, among others components, on the so-called permanent own revenues (IPP). The IPP definition, which corresponds to those revenue items generated by local sources and that remain with the municipality (i.e., they are not shifted to the FCM) is used by the FCM to measure revenue. The IPP is therefore a proxy of municipal collected revenue.

The IPP component of the distribution formula works only for municipalities that have per capita IPP lower than the national average. In this case, the grants they will receive in the future depend positively on the difference between the national average and their per capita IPP. In addition, FCM has two dynamic considerations: (1) the IPP per capita figure used in the distribution formula corresponds to that of at least two years prior and (2) information is updated every three years; that is, the same information has been used for more than one year to distribute FCM resources.

More formally, let the per capita IPP of municipality i in period t be Y_{it}, and $\overline{Y}_{Nt}$ is the national average IPP per capita in period t. If $Y_{it} < \overline{Y}_{Nt}$, municipality i receives grant G_{it+1} in period t+1 according to the following formula:

$$G_{it+1} = K_{it} + \frac{b_{t+1}(\overline{Y}_{Nt} - Y_{it})}{\sum_{j=1}^{M_t}(\overline{Y}_{Nt} - Y_{jt})} = K_{it} + \frac{b_{t+1}}{M_t}\frac{(\overline{Y}_{Nt} - Y_{it})}{(\overline{Y}_{Nt} - \overline{Y}_{Mt})} \tag{4.13}$$

where j=1, ..., M_t is the number of municipalities that have an IPP per capita that

is lower than the national average in period t, $\overline{Y}_{Mt}$ is the average IPP per capita of the municipalities that have IPP per capita below the national average in period t, K_{it} represents the FCM components other than IPP and b_{t+1} is the weight of the IPP component.

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

When $Y_{it} < \overline{Y}_{Nt}$, the rate at which grants decrease in t+1 due to an increase in local revenue in t is:

$$\frac{\partial G_{it+1}}{\partial Y_{it}} = -b_{t+1}[\frac{(1-\frac{1}{N_t})(\overline{Y}_{Nt}-\overline{Y}_{Mt})-(\frac{1}{M_t}-\frac{1}{N_t})(\overline{Y}_{Nt}-Y_{it})}{M_t(\overline{Y}_{Nt}-\overline{Y}_{M})^2}] \tag{4.14}$$

According to Equation 4.14, 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 19902006 period, the distribution mechanism underwent two major reforms that affected the information used in the distribution formula, the weight of the components and the formula itself.

Until 1995, the information used in the distribution formula was updated every three years and the IPP component considered IPP per capita measured two years before the updating year. In other words, if the updating year is t, the grant in the years t, t+1 and t+2 used the IPP per capita of the year t-2. Then, because the updating years were 1990 and 1993, only the revenue collected in 1991 and 1994 were relevant figures for the distribution of resources. 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 also, but in this period the IPP component considered the average IPP per capita of the three years starting from two years before the updating year. Thus, if the updating year is t, the grant in the years t, t+1 and t+2 used 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 periods before and after 1995 (let's call them Period 1 and Period 2) is that in the latter, the revenue collected each year is relevant for the distribution formula, although there are differences among the periods with respect to the number of years between revenue collection and the update of information. For instance,

revenue collection in 1995, 1996 and 1997 is used to determine grants distribution in the 1999-2002 period, so in 1995 municipalities were aware that their tax collection would affect future grants after the next four years (or, in other words, municipalities were aware that the implicit tax would be paid after four years); in 1996, the implicit tax would be paid after three years and in 1997 after just two years[7]. During this period, the weight of the equalizing component was 31.5%[8].

Figure 4.1 shows the main aspects characterizing these two periods. In this diagram each dotted line is associated with an arrow, which represents the relationship between the years when revenue is collected (dotted line) and the year when information is updated or the implicit tax is paid by municipalities (arrow). In addition, each dotted line shows the number of years until the transfer is affected. This relationship is defined by considering the available information for municipalities in the respective year[9]. The years in which information was updated are indicated by the letter A, while the years when municipal elections were held are indicated by the letter E. The letters P, S and D indicate the years when presidential, senatorial and parliamentary (Chamber of Deputies) elections were held, respectively.

In summary, during the 1990-2006 period five kinds of years can be distinguished: (1) years when revenue collection is not relevant for future grants and thus for all municipalities, the implicit tax equals zero (1990, 1992 and 1993); (2) years that belong to Period 1 when revenue collection affects grants distribution after two years (1991, 1994); (3) years that

[7]Moreover, in 2002 and 2006 the update was delayed by one year. The municipalities were only informed of this decision at the end of 2001 and 2005, respectively. This kind of reform changes the number of years between revenue collection and the update of information for the remaining years.

[8]Since 2007, the information used in the distribution formula has been updated every year and the revenue component considers the IPP per capita measured two years before the updating year. So if the updating year is t, the grant in year t considers the IPP per capita of the year t-2. Thus, since 2007 every year has been relevant for the distribution formula and the number of years between revenue collection and the update of information is always two years. Finally, the weight of the equalizing component is 35%. We do not consider 2007 because a sophisticated compensation mechanism was established that year for the municipalities that received a lower grant than in the previous year.

[9]For instance, during most of 2001, municipalities were aware that the information would be updated in 2002 and that therefore, collected revenue in 2001 would have an 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, the collected revenue in 2002 also affected the grant distribution after four years. The collected revenue in 2001 ultimately affected the grant distribution in 2003, which was known ex-post, and that is why it is not considered in the diagram.

belong to Period 2 when revenue collection affects grant distribution after two years (1997, 2000 and 2004); (4) years when revenue collection affect grant distribution after three years (1996, 1999 and 2003); and (5) years when revenue collection affect grant distribution after four years (1995, 1998, 2001, 2002, 2005 and 2006).

4.4 Empirical Strategy

To analyze the incentive effect of the FCM, we estimate the effect of implicit tax on collected revenue. Although the implicit tax is unobservable by the researcher, we assume that it is determined by the rate at which the future grant decreases due to an increase in present local revenue (see Equation 4.14), the municipalities' discount factor and the relative importance of the part of FCM grant associated with the IPP component with respect to municipal revenue (see Equation 4.12).

Each year, the IPP component is applied only to a group of municipalities, specifically, for those municipalities with IPP per capita below the national average. In other words, these municipalities pay positive equalization tax, while municipalities with IPP per capita above the national average pay implicit taxes equal to zero. We assume that municipalities cannot deterministically manipulate their per capita IPP in relation to the national average because they do not know the value of the national average IPP. However, since municipalities that pay positive equalization tax could have unobservable local characteristics which would explain in part why the revenue is lower than the average, endogeneity problems could arise.

When the implicit tax is positive, it depends negatively on the difference between the per capita IPP and the national average IPP and positively on the relative importance of the part of the FCM grant associated with the IPP component in relation to municipal revenue (collected revenue plus FCM grant)[10] [11]. Although collected revenue and IPP are highly

[10] For instance, for municipalities with IPP per capita closer to the national average, the part of the FCM grant associated with the IPP component is quite small in comparison to municipal revenue. However, because the per capita IPP of those municipalities is near the national average, the rate at which their future grants decrease due to increased collection is also high.

[11] To calculate the relative importance of the part of the FCM grant associated with the IPP component with respect to municipal revenue, we use the average data for the 1990-2006 period.

correlated, the implicit tax is not simultaneously determined by revenue collection[12].

To identify the effect of the FCM's implicit tax on collected revenue, we use the following identification strategy. First, we use municipal fixed effects to control for unobservable variables that affect the implicit tax and collected revenue and that are time invariant.

Second, we exploit the implemented reforms in the distribution formula in the 1990-2006 period which could be considered exogenous from the viewpoint of a municipality. On the one hand, we compare revenue collection between years when revenue collection affects future grants and years when it does not. On the other hand, since we assume that municipalities have a discount factor that is less than 1, we exploit the fact that the period of time to pay implicit taxes changes and is exogenously affected by law. In this way, it is possible to distinguish the incentive effect when municipalities must pay implicit tax closer in time (two years later) from the incentive effect when municipalities must pay the implicit tax three or four years later. To do this, we define the following dummy variables: (1) $tt1$, which equals 1 if the year is in Period 1 and when revenue collection affects grant distribution after two years (1991 and 1994); (2)$tt2$, which equals 1 if the year belongs to Period 2 and when revenue collection affects grant distribution after two years (1997, 2000 and 2004); (3) $tt3$, which equals 1 when revenue collection affects grant distribution after three years (1996, 1999 and 2003); and (4) $tt4$, which equals 1 when revenue collection affects grant distribution after four years (1995, 1998, 2001, 2002, 2005 and 2006). We distinguish between $tt1$ and $tt2$ because we consider the former a special regime, as not all years in Period 1 were relevant.

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

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

[12]For instance, for 1996, we consider the collected revenue that year and the implicit tax is calculated with the average IPP per capita of 1992, 1993 and 1994. There is another difference between per capita 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 period was considered, based on censuses through 2002, whereas the IPPP per capita includes the projected population based on the latest censuses, which changes depending on the updating year.

(4.15)

Where x_{it} iis per capita local revenue collected by municipality i in year t; $IPPPd_{it}$ refers to the IPP per capita used in the distribution formula, tax_{it} is the amount of implicit tax owed by municipality i in year t, tt_j for $j = 1, ..., 4$ corresponds to dummies defined previously, $\alpha_{it}^{proptax}$ 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 payment will take place in two years and the municipalities are in Period 1; β_2 which corresponds to the incentive effect when the update or tax payment 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 payment will take place in three years an β_4 corresponds to the incentive effect when the update or tax payment will take place in four years. I would expect these coefficients to be negative and decreasing, that is, a major disincentive to collecting revenue as the year of tax payment nears.

Year fixed effects are included in the regression because they control for shocks that affect all municipalities equally or economic growth. $IPPPd_{it}$ is considered because it is correlated with the dependent variable and the regressor of interest. Finally, the proportions of property tax revenue and municipal license revenue that are shifted to FCM are included in the regression in order to control for the contribution mechanism.

Finally, as an alternative specification, we adjust the amount of the implicit tax for the likelihood that the political coalition to which the incumbent mayor belongs will actually pay the implicit tax. If there is no municipal election before the year of updating, the likelihood that the coalition to which the mayor belongs will pay the tax will be one. If there is a municipal election before the year of updating, the likelihood that the coalition to which the incumbent mayor belongs will pay the tax depends on the likelihood of reelection of that 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 influence the collection decision).

In this case, we consider the following specification:

$$x_{it} = \gamma + \beta_0 * IPPPd_{it} + \beta_1 * tt1 * tax_{it} + \beta_2 * tt2 * tax_{it} + \beta_3 * tt3 * tax_{it} + \beta_4 * tt4 * tax_{it} + \lambda_0 * paytax + \lambda_1 * tax * paytax_{it} + \theta_0 \alpha_{it}^{proptax} + \theta_1 \alpha_{it}^{munlic} + t_t + \mu_i + \epsilon_{it} \quad (4.16)$$

Where $paytax_{it}$ is the likelihood that the political coalition to which the incumbent mayor belongs will pay pay a future implicit tax in year t.

4.5 Data

In this study, data for 340 Chilean municipalities in the 1990-2006 period was used[13]. Table 4.1 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}), the relevant year dummies ($tt1$, $tt2$, $tt3$, and $tt4$), the likelihood of paying future tax ($paytax_{it}$) and the dummy for municipalities with a high likelihood of paying the future tax ($dhigh_{it}$), the proportions of local revenue shifted to the FCM (property taxes and business taxes, all decimalized), and variables used to control and test robustness (poverty rate, population, exempt properties, FNDR[14], the dummy for municipalities with a low proportion of exempt properties and the dummy for municipalities with high own capital and municipal school enrollment).

Table 4.2 presents the same information presented in Table 4.1 but only considering those municipalities that pay positive implicit tax. Close to 80% of the municipalities pay positive implicit tax, and on average these have lower collected revenue, higher implicit

[13]Five municipalities were not considered in the panel because their data present serious measurement errors.

[14]FNDR is an important vertical grant source used to finance investment projects

tax and lower revenue dispersion. In these municipalities, the standard deviations of revenue and taxes are lower than their respective means. On the other hand, there are no large differences between all municipalities and municipalities that pay positive tax, on average, with respect to the likelihood of paying future implicit tax, poverty rate, population, exempt properties, and municipal school enrollment. The magnitude of these differences increases slightly if we compare municipalities that pay positive implicit tax with municipalities whose implicit tax is equal to zero. Appendix C presents descriptive statistics for these municipalities.

The Division of Municipalities of the Office of the Undersecretary for Regional and Administrative Development (*Subsecretaría de Desarrollo Regional y Administrativo*, or SUBDERE) provided the revenue data for the 1990-2001 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 2007 ThCh$. In addition, SUBDERE provides official reports of the IPP used in the distribution formula used to calculate the implicit tax. SUBDERE also provides the FNDR data.

Poverty data is provided by the Socioeconomic Identification Survey (*Encuesta de Caracterización Socioeconómica*, known as CASEN)[15]. Population data was obtained from the National Institute of Statistics (*Instituto Nacional de Estadísticas*, or INE), exempt properties and business equity (the tax base for municipal taxes) data were obtained from the Internal Revenue Service (*Servicio de Impuestos Internos*, or SII) and municipal school enrollment data were obtained from the Ministry of Education's web page.

Information related to elections (municipal, presidential and parliamentary) was obtained from the web page www.elecciones.gov.cl. In Appendix D we explain how we calculated the likelihood of paying tax for every municipality and the data we use. The definition of the dummy that equals one if the likelihood of paying tax is high ($dhigh_{it}$) considers a threshold of 70% [16].

[15]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.

[16]This threshold was defined on the basis of the average proportion of municipalities in which the political coalition to which the mayor belongs was reelected and the distribution of the predicted likelihood

Finally, the dummy for municipalities with a low proportion of exempt properties considers a threshold of 78%, which corresponds to the median of the average proportion of exempt properties between 2001 and 2006. Similarly, I use the median business equity to define the dummy for municipalities with high business equity.

4.6 Results

4.6.1 Main results

Table 4.3 presents the main findings. Column 1 shows the estimates of the parsimonious model which only includes implicit tax (and the controls specified below the table), which is statistically and negatively related to collected revenue. This result means that an increase in the implicit tax discourages local collection. Column 2 presents the results of the estimation of Equation 4.15, that is, when we differentiate the implicit tax according to the period of time to pay the implicit tax. In this case the coefficients β_2, β_3 and β_4 are negative, statistically significant and decreasing in absolute value with respect to the period of time to pay the implicit tax. An increase in the implicit tax of one standard deviation is associated with a decrease in local per capita revenue of 0.29 standard deviations if there are two years to pay the implicit tax, 0.21 if there are three years and 0.18 if there are four years[17]. That is, municipalities collect less when there are two years to pay the implicit tax compared to when there are three or four years, which is due to the discount rate. In addition, I test the hypothesis: $\beta_2 = \beta_3 = \beta_4$, which is rejected using a Wald test. This means that the differences among these coefficients are statistically significant and that the implicit tax to be paid in the distant future is not valued as much as that which must be paid today (near future). To contextualize this result, consider that during 1990 and 2006 the IPP component's weight was 0.38, on average. The average implicit tax would increase by one standard deviation if this weight were 0.6 (or implicit tax inbrease

of paying tax in every year. That is, on average, the proportion of municipalities in which the political coalition to which the incumbent mayor belongs was reelected is close to 60%. Therefore then I set the threshold at the predicted likelihood that corresponds to the centile 40 which is, on average, close to 70%.

[17]The effect measured in standard deviations is calculated using the descriptive statistics of Table 4.2, i.e., considering municipalities that pay a positive implicit tax.

by 100%). The exception of these results is the case of β_1: the implicit tax did not affect collected decision in the Period 1 (1990-1995). One possible explanation is that in Period 1 not all years were relevant and thus municipalities were not concerned about the effect on future transfers.

Column 3 presents a specification similar to those in Column 1, but in this case we control for the likelihood of paying tax and its interaction with the implicit tax: the incentive effect is greater when the political coalition to which the incumbent mayor belongs has a high likelihood of actually paying tax.

Column 4 presents the result of the estimation of Equation 4.16, that is, when we not only differentiate the implicit tax according to the period of time to pay the tax but also for the likelihood of paying tax and its interaction with the implicit tax. The previous results are maintained; that is, the incentive effect decreases with the length of time to pay the implicit tax and increases with the likelihood of paying the tax in the future. To improve the interpretation of this last result, in Column 5 we use a dummy for municipalities with a high likelihood of paying the future tax instead of using the variable of the likelihood of paying the implicit tax. The municipalities with a high likelihood of paying future tax show a greater incentive effect than those with a low probability. Specifically, the effect of an increase of one standard deviation in the implicit tax is that the former group decreases per capita collected revenue by 0.06 standard deviations more than the latter.

4.6.2 Robustness analysis

In Table 4.4 we control for variables such as FNDR, poverty, population, municipal school enrollment and number of exempt properties. Controlling for FNDR per capita is a way to incorporate other kind of transfers, but because of the lack of information, not all vertical transfers are considered in this research. FNDR is the most important vertical transfer, and distribution decisions regarding these funds are made at the regional level. Municipal school enrollment is considered a proxy for municipal education revenue, which is another important conditional vertical transfer[18]. The results are maintained when we control for

[18]If I consider that this kind of revenue does not depend on fiscal effort because it is determined by subsidy amount per pupil (defined at the national level) and the average attendance of students

all these variables.

Tables 4.5 and 4.6 show the results of the estimation of Equation 4.15 and Equation 4.16, respectively, but we distinguish between municipalities with a low proportion of exempt properties and those with a high proportion and between municipalities with high business equity and those with low business equity. We assume that a municipality with a low proportion of exempt properties or with high business equity obtains a greater benefit from exerting more effort than those with a high proportion of exempt properties or with low business equity. That is, we use the lack of exempt properties or business equity as a proxy for fiscal capacity[19]: municipalities with a high fiscal capacity should be more sensitive to implicit tax because they have a greater ability to increase or decrease their revenue. When we consider municipalities with a low proportion of exempt properties or those with high business equity, the results are practically the same. The main difference with Table 4.3 is the significance of β_3 and β_4 i in Column 4. That is, the differences between the β's are greater. In the other case, the implicit tax is not statistically and economically significant, as expected.

Table 4.7 presents a falsification test in which the dependent variable is a proxy for revenue received by municipalities that is not subject to implicit tax. These resources correspond to voucher subsidies that municipalities receive for management of public schools. Since there are no available education transfer data for the 1990-2006 period, I use the natural logarithm of municipal school enrollment. As expected, the implicit tax in this case is not relevant, indicating that the results are measuring the incentive effect and not a correlation. The implicit tax only affects taxable revenue[20].

enrolled in municipal schools (although lately municipal authorities have made efforts to encourage student attendance and thus increase education resources), the estimated coefficients will represent the compensated (Marshallian) incentive effect.

[19]Since there are different sources of revenue (property tax, business tax, vehicle tax) we could use different measures of fiscal capacity, but the only data available was the proportion of exempt properties and business equity for each municipality.

[20]However, there could be a substitution effect between collected revenue and education resources when the cost of efforts to collect in relation to the effort to increase attendance is higher.

4.7 Conclusions

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

In Chile, not all municipalities "pay" this implicit tax; rather, only those with per capita IPP lower than the national average do so. Since endogeneity problems could arise, the identification strategy exploits reforms in the distribution formula during the 1990-2006 period to identify the effect of interest. The main finding is evidence for Chilean municipalities that the FCM has an incentive effect on local revenue which decreases with respect to the time to pay the implicit tax and increases in respect to the probability of paying the implicit tax in the future.

One of the recommendations arising from these results is that the distribution formula should consider a better proxy for fiscal capacity that is not in any way controlled by the recipient governments. A mechanism to compensate for the disincentive to tax collection and to reward tax efforts (another variable difficult to measure) should be created.

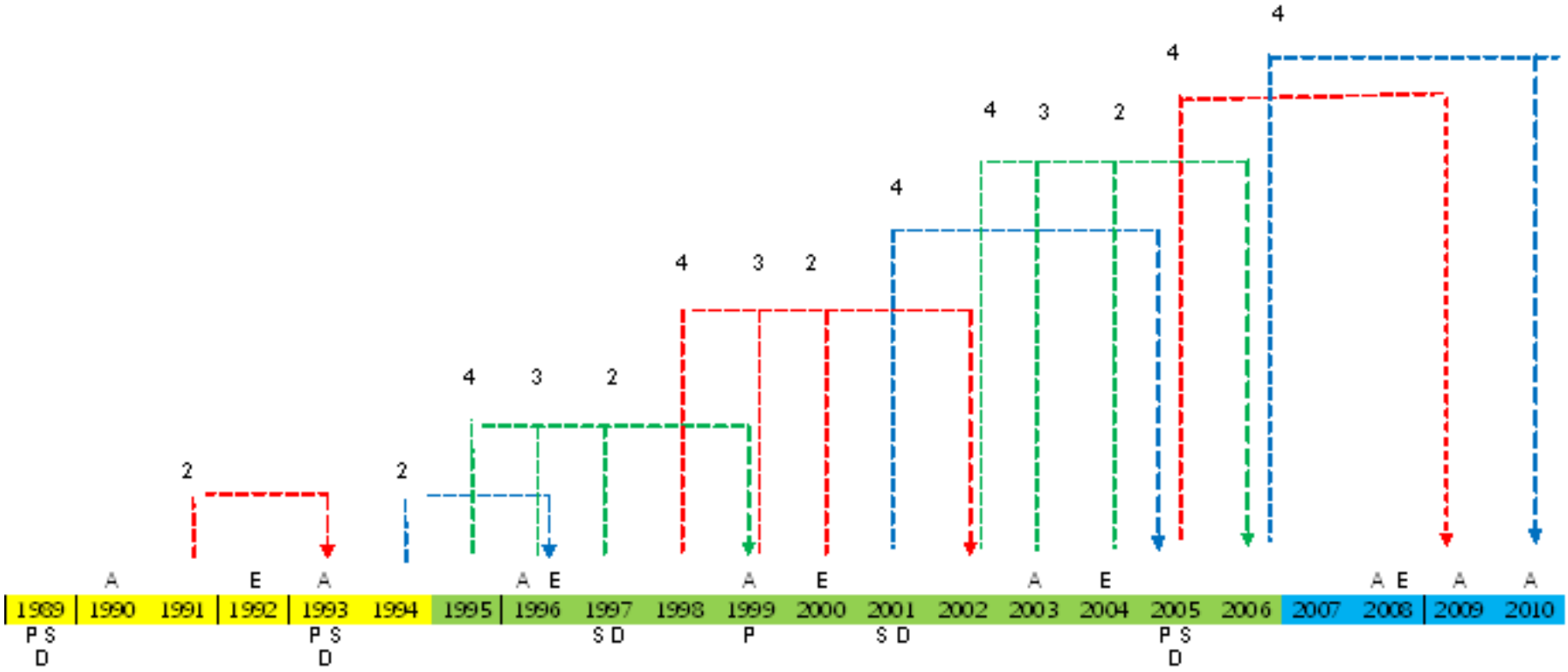

Figure 4.1: Effects of Revenue Collection on Grant Distribution

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
x	5980	44.005	28.425	61.792	7.966	125.756
ipppd	6026	22.621	15.849	27.100	4.351	61.349
tax	6120	0.000015	0.000011	0.000017	0.000000	0.000049
tt1	6120	0.167	0.000	0.373	0.000	1.000
tt2	6120	0.167	0.000	0.373	0.000	1.000
tt3	6120	0.167	0.000	0.373	0.000	1.000
tt4	6120	0.333	0.000	0.471	0.000	1.000
taxpay	6029	0.527	0.619	0.423	0.000	1.000
dhigh	6120	0.472	0.000	0.499	0.000	1.000
aproptax	5980	0.600	0.600	0.003	0.600	0.600
avehreg	5980	0.549	0.500	0.061	0.500	0.625
amunlic	5980	0.007	0.000	0.064	0.000	0.000
poverty	6024	27.823	28.950	11.837	8.890	47.065
pop	6024	44837	16896	69179	2197	1.87e+05
exprop	6029	8173	3593	12642	522	32781
lowexprop	6120	0.494	0.000	0.500	0.000	1.000
highbok	5958	0.508	1.000	0.500	0.000	1.000
munenroll	5977	5581	2689	7492	349	22786
proptax	5980	18.710	11.173	33.039	1.357	49.691
munlic	5983	7.120	3.239	17.192	0.635	21.739
vehreg	5984	9.985	5.360	19.202	1.230	34.724
orev	5981	8.338	4.916	12.525	0.821	26.456

Table 4.1: Descriptive Statistics. All Municipalities

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
x	4664	26.942	23.670	17.828	7.117	56.383
ipppd	4699	14.030	12.933	7.356	3.859	28.412
tax	4699	0.000020	0.000017	0.000017	0.000000	0.000052
tt1	4699	0.163	0.000	0.370	0.000	1.000
tt2	4699	0.171	0.000	0.376	0.000	1.000
tt3	4699	0.171	0.000	0.376	0.000	1.000
tt4	4699	0.340	0.000	0.474	0.000	1.000
paytax	4660	0.525	0.597	0.419	0.000	1.000
dhigh	4699	0.458	0.000	0.498	0.000	1.000
aproptax	4664	0.600	0.600	0.000	0.600	0.600
avehreg	4664	0.551	0.500	0.061	0.500	0.625
amunlic	4664	0.000	0.000	0.000	0.000	0.000
poverty	4695	29.578	30.100	11.250	11.510	47.460
pop	4695	40915	17050	65820	3704	1.72e+05
exprop	4688	8053	3771	12641	865	30642
lowexprop	4699	0.423	0.000	0.494	0.000	1.000
highbok	4640	0.462	0.000	0.499	0.000	1.000
munenroll	4667	5205	2727	6499	611	20980
proptax	4664	10.918	9.381	8.432	1.308	26.092
munlic	4667	4.266	2.789	4.816	0.600	11.964
vehreg	4668	6.166	4.582	7.704	1.082	15.392
orev	4665	5.656	4.179	6.057	0.774	14.235

Table 4.2: Descriptive Statistics. Municipalities that pay positive equalization tax

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-156,081***		-55,971		
	(47,123)		(58,471)		
	[-0.14]		[-0.04]		
tax*tt1		14,513		84,957	63,687
		(58,959)		(64,221)	(59,685)
		[0.01]		[0.06	0.05]
tax*tt2		-394,884***		-312,602***	-325,768***
		(70,448)		(84,354)	(82,270)
		[-0.29]		[-0.23]	[-0.24]
tax*tt3		-341,240***		-266,351***	-283,764***
		(69,638)		(79,550)	(77,468)
		[-0.21]		[-0.20]	[-0.21]
tax*tt4		-243,513***		-172,750***	-188,435***
		(52,600)		(65,810)	(62,560)
		[-0.18]		[-0.13]	[-0.14]
tax*taxpay			-141,334***	-102,092**	
			(46,581)	(46,985)	
			[-0.11taxpay]	[-0.08taxpay]	
tax*dhigh					-82,500**
					(1.368)
					[-0.06]
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	5,639	5,639	5,607	5,607	5,639
No of comuna	340	340	340	340	340

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

Effect in Standard Deviations in square brackets

All specifications include municipality fixed effects, Time Dummies, % revenue shifted to FCM and IPPPd

Table 4.3: Incentive Effect of FCM on local revenue

Dependent Variable	Per capita local revenue				
	(1)	(2)	(3)	(4)	(5)
tax	-148,788***		-51,744		
	(46,431)		(57,661)		
	[-0.11]		[-0.04]		
tax*tt1		13,307		81,495	61,580
		(58,712)		(63,580)	(59,171)
		[0.01]		[0.06]	[0.05]
tax*tt2		-388,953***		-305,788***	-321,247***
		(70,392)		(84,355)	(82,313)
		[-0.29]		[-0.23]	[-0.24]
tax*tt3		-331,225***		-263,969***	-275,046***
		(69,356)		(79,301)	(77,169)
		[-0.25]		[-0.20]	[-0.20]
tax*tt4		-229,746***		-161,391**	-175,924***
		(51,729)		(65,126)	(61,955)
		[-0.17]		[-0.12]	[-0.13]
tax*taxpay			-136,346***	-97,787**	
			(46,015)	(46,560)	
			[-0.10taxpay]	[-0.07taxpay]	
tax*dhigh					-80,927**
					(39,736)
					[-0.06]
paytax	No	No	Yes	Yes	No
dhigh	No	No	No	No	Yes
Observations	5,614	5,614	5,597	5,597	5,614
No of comuna	340	340	340	340	340

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

Effect in Standard Deviations in square brackets

All specifications include municipality fixed effects, Time Dummies, % revenue shifted to FCM IPPPd, poverty, population, exempt properties, FNDR per capita and municipal school enrollment

Table 4.4: Incentive Effect of FCM on local revenue controlling for socioeconomic variables

Dependent Variable	Per capita local revenue			
Municipalities	Low % Exempt Prop.	High % Exempt Prop.	High Business Eq.	Low Business Eq.
	(1)	(2)	(3)	(4)
tax*tt1	-83,144	4,947	-31652	-79,924
	(104,257)	(58,634)	(74,098)	(108,922
	[-0.06]	[-0.00]	[-0.02]	[-0.06]
tax*tt2	-504,908***	-103,989	-423,542***	-81,277
	(124,912)	(69,987)	(93,868)	(111,299)
	[-0.38]	[-0.08]	[-0.32]	[-0.06]
tax*tt3	-373,781***	-144,830*	-206,336***	-161,215
	(121,545)	(78,640)	(97,357)	(101,908)
	[-0.28]	[-0.11]	[-0.19]	[-0.12]
tax*tt4	-252,116***	-117,102*	-211,904***	-130,685
	(89,908)	(54,466)	(71,672)	(84,737)
	[-0.19]	[-0.09]	[-0.16]	[-0.10]
Observations	2,976	2,984	2,914	2,899
No of comuna	168	163	168	163

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

Effect in Standard Deviations in square brackets

All specifications include municipality fixed effects, Time Dummies, % revenue shifted to FCM and IPPPd

Table 4.5: Incentive Effect of FCM on local revenue.

Dependent Variable	Per capita local revenue			
Municipalities	Low % Exempt Prop.	High % Exempt Prop.	High Business Eq.	Low Business Eq.
	(1)	(2)	(3)	(4)
tax*tt1	34,642	-11,045	51,500	26,976
	(107,913)	(78,500)	(86,399)	(113,967)
	[0.03]	[-0.01]	[0.04]	[0.02]
tax*tt2	-365,369***	-124,239	-331,608***	55,495
	(139,691)	(104,493)	(106,827)	(148,704)
	[-0.27]	[-0.09]	[-0.25]	[0.04]
tax*tt3	-243,815*	-172,084	-174,589*	-50,190
	(128,875)	(106,833)	(103,933)	(137,870)
	[-0.18]	[-0.13]	[-0.13]	[-0.04]
tax*tt4	-134,184	-135,293	-126,336	-20,809
	(103,093)	(85,259)	(84,375)	(117,584)
	[-0.10]	[-0.10]	[-0.09]	[-0.02]
tax*taxpay	-184,085**	22,290	-116,667**	-158,391*
	(81,772)	(66,839)	(57,527)	(85,703)
	[-0.14taxpay]	[0.02taxpay]	[-0.9taxpay]	[-0.12taxpay]
Observations	2,976	2,984	2,914	2,899
No of comuna	168	163	168	163

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

Effect in Standard Deviations in square brackets

All specifications include municipality fixed effects, Time Dummies, % revenue shifted to FCM, IPPPd and paytax

Table 4.6: Incentive Effect of FCM on local revenue.

Dependent Variable	Ln Municipal Shool Enrollment	
	(1)	(2)
tax	-0.597	
	(305.0)	
	[-0.00]	
tax*tt1		246.8
		(349.2)
		[-0.003]
tax*tt2		-342.9
		(445.1)
		[- 0.005]
tax*tt3		103.0
		(466.6)
		[0.001]
tax*tt4		-187.4
		(345.4)
		[0.003]
Observations	5,617	5,617
No of comuna	340	340

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

Effect in Standard Deviations in square brackets

All specifications include municipality fixed effects, Time Dummies, % revenue shifted to FCM and IPPPd

Table 4.7: Incentive Effect of FCM on proxy of Education Transfer

Appendix A: Static Model

We 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:

$$\underset{X}{Max} f(Z) - e(X) \tag{4.17}$$

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

The FOC of this problem is:

$$\frac{\partial f}{\partial X}(1 - \alpha - \frac{\partial \beta}{\partial X}) = \frac{\partial e}{\partial X} \tag{4.18}$$

In this context, both the implicit tax and the contribution rate 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: $G_t = f(X_{t-1}, X_{t-2})$

$$\underset{\{X_t, Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t)\right) \tag{4.19}$$

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

The Bellman equation is:

$$v(X_{t-1}, X_{t-2}) = \underset{\{X_t, Z_t\}}{Max}\ (f(Z_t) - e(X_t)) + \delta v_{t+1}(X_t, X_{t-1}) \tag{4.20}$$

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

The first order condition becomes:

$$\frac{\partial f}{\partial Z_t}(1 - \alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta)\frac{\partial v_{t+1}}{\partial X_t} \tag{4.21}$$

The Beveniste-Shienkman conditions are:

$$\frac{\partial v_t}{\partial X_{t-1}} = \frac{\partial f}{\partial Z_t}\frac{\partial \beta_t}{\partial X_{t-1}} + \delta\frac{\partial v_{t+1}}{\partial X_{t-1}} \tag{4.22}$$

$$\frac{\partial v_t}{\partial X_{t-2}} = \frac{\partial f}{\partial Z_t}\frac{\partial \beta_t}{\partial X_{t-2}} \tag{4.23}$$

Then, the FOC can be written:

$$\frac{\partial f}{\partial Z_t}(1 - \alpha_t) - \frac{\partial e}{\partial X_t} = -\delta\frac{\partial f}{\partial Z_{t+1}}\frac{\partial \beta_{t+1}}{\partial X_t} - \delta^2\frac{\partial f}{\partial Z_{t+2}}\frac{\partial \beta_{t+2}}{\partial X_t} \tag{4.24}$$

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

$$\underset{\{X_t,Z_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \delta^t \left(f(Z_t) - e(X_t)\right) \tag{4.25}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + β_t (X_{t-2})

The Bellman equation is:

$$v(X_{t-2}) = \underset{\{X_t,Z_t\}}{Max} \left(f(Z_t) - e(X_t)\right) + \delta v_{t+1}(X_t - 1) + \delta^2 v_{t+2}(X_t) \tag{4.26}$$

s.t. Z_t = (1-α_t)X_t + K_{t-1} + β_t (X_{t-2})

The first order condition becomes:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -(\delta^2)\frac{\partial v_{t+2}}{\partial X_t} \tag{4.27}$$

The Beveniste-Shienkman condition is:

$$\frac{\partial v_t}{\partial X_{t-2}} = \frac{\partial f}{\partial Z_t}\frac{\partial \beta_t}{\partial X_{t-2}} \tag{4.28}$$

Then, the FOC can be written:

$$\frac{\partial f}{\partial Z_t}(1-\alpha_t) - \frac{\partial e}{\partial X_t} = -\delta^2\frac{\partial f}{\partial Z_{t+2}}\frac{\partial \beta_{t+2}}{\partial X_t} \tag{4.29}$$

Appendix C: Descriptive Statistics

variable	Obs.	Mean	Median	Standard Deviation	5th percentile	95th percentile
x	1315	104.540	65.384	107.447	25.693	343.595
ipppd	1327	53.043	39.630	44.244	18.832	147.876
tax	1327	0.000	0.000	0.000	0.000	0.000
tt1	1327	0.174	0.000	0.379	0.000	1.000
tt2	1327	0.157	0.000	0.364	0.000	1.000
tt3	1327	0.157	0.000	0.364	0.000	1.000
tt4	1327	0.316	0.000	0.465	0.000	1.000
taxpay	1321	0.544	0.712	0.433	0.000	1.000
dhigh	1327	0.509	1.000	0.500	0.000	1.000
aproptax	1315	0.601	0.600	0.007	0.600	0.600
avehreg	1315	0.544	0.500	0.060	0.500	0.625
amunlic	1315	0.031	0.000	0.135	0.000	0.450
poverty	1327	21.597	20.200	11.766	3.740	41.140
pop	1327	58712	15852	78451	782	2.37e+05
exprop	1327	8630	2580	12696	90	37057
lowerprop	1327	0.762	1.000	0.426	0.000	1.000
highbok	1237	0.669	1.000	0.471	0.000	1.000
munenroll	1310	6921	2596	10169	71	30268
proptax	1315	46.351	24.312	61.111	2.115	200.788
munlic	1315	17.251	6.691	33.639	0.781	73.762
vehreg	1315	23.549	11.482	35.101	3.893	82.336
orev	1315	17.858	11.646	21.620	1.225	60.936

Table 4.8: Descriptive Statistics. Municipalities that pay equalization tax equals zero

Appendix D: The likelihood of paying tax

To calculate the likelihood of paying tax, I use Figure 4.1, which easily identifies the relationship between the updating year and election year. To calculate the likelihood of paying tax we need to consider that the information update occurs every three years. For instance, in 1991 the likelihood of paying the tax equals the probability (estimated in 1991) of the reelection in 1992 of the political coalition to which the incumbent mayor belongs, because the implicit tax must be "paid" in 1993, 1994 and 1995 and the nearest municipal election is in 1992. Whereas, in 1994 the likelihood of paying tax equals the average of one and two times the likelihood (estimated in 1994) of reelection in 1996 of the political coalition to which the incumbent mayor belongs, 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); thus, the first payment of the implicit tax has a probability equal to one. Table 4.9 presents the probabilities considered in each year to calculate the likelihood of paying tax.

To determine the probability of reelection of the political coalition to which the incumbent mayor belongs, we assume that mayors have rational expectations and we estimate a probit regression where the dependent variable is a dummy that equals one if the political coalition to which the mayor belongs is reelected in the nearest future election. The explicative variables change every year because we consider all the available information that a mayor could have. For instance, for 1999 we estimate a probit regression for the likelihood of being reelected in 2000 and consider the following explicative variables: the percentage that the coalition obtained in the municipal elections of 1992 and 1996, the percentage that the coalition obtained in the parliamentary elections of 1989, 1993 and 1997, the percentage that the coalition obtained in the presidential elections of 1989 and 1993, the percentage that the coalition obtained in the 1988 plebiscite, the change in the proportion of municipal school enrollment with respect to the last election year (in this case between 1996 and 1999), the change in municipal poverty considering the available information (in this case between 1996 and 1998), and the relevant change in the SIMCE scores of municipal schools, which represent a quality measure (in this case between 1995 and 1997). For 2000 we estimate a probit regression for the likelihood of being reelected in 2000 and consider the same explicative variables that we consider in 1999 with the exception of: change in the proportion of municipal school enrollment between 1996 and

Year when likelihood was estimated	**Likelihood of reelection considered**
1991	likelihood of wining 1992 municipal election
1994	1 and likelihood of wining 1996 municipal election (twice)
1995	likelihood of wining 1996 municipal election (twice) and likelihood of wining 2000 municipal election
1996	likelihood of wining 1996 municipal election (twice) and likelihood of wining 2000 municipal election
1997	1, 1 and likelihood of wining 2000 municipal election
1998	likelihood of wining 2000 municipal election
1999	likelihood of wining 2000 municipal election
2000	likelihood of wining 2000 municipal election
2001	likelihood of wining 2004 municipal election
2002	likelihood of wining 2004 municipal election
2003	likelihood of wining 2004 municipal election
2004	likelihood of wining 2004 municipal election
2005	likelihood of wining 2008 municipal election
2006	likelihood of wining 2008 municipal election

Table 4.9: Probabilities considered in each year to calculate the likelihood of paying tax.

1999 (in this case we use the change between 1996 and 2000) and the change in the SIMCE scores of municipal schools between 1995 and 1997 (in this case we use the change from 1999 to 1996). For 2001 we estimate a probit regression for the likelihood of being reelected in 2004 and consider the same explicative variables that we consider in 2000 plus the percentage that the coalition obtained in the municipal election of 2000 and with the exception of: change in municipal poverty between 1996 and 1998 (in this case we use the change between 1998 and 2000); the change in the proportion of municipal school enrollment between 1996 and 2000 (in this case we use the change between 2000 and 2001), and the change in the SIMCE scores of municipal schools between 1996 and 1999 (in this case I use the change from 2000 to 1997), and so on.

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