IDB WORKING PAPER SERIES No. IDB-WP-397

Decentralization and Accountability:

The Curse of Local Underdevelopment

Fabiana V.P. Machado

May 2013

Inter-American Development Bank
Department of Research and Chief Economist

Decentralization and Accountability:

The Curse of Local Underdevelopment

Fabiana V.P. Machado

Inter-American Development Bank

Inter-American Development Bank
2013

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Machado, Fabiana V.P.
Decentralization and accountability : the curse of local underdevelopment / Fabiana V.P. Machado.
p. cm. (IDB working paper series ; 397)
Includes bibliographical references.
1. Decentralization in government. 2. Government accountability. 3. Schools—Decentralization—Brazil —Case Studies. I. Inter-American Development Bank. Research Dept. II. Title. III. Series.
IDB-WP-397

http://www.iadb.org

Abstract[*]

Decentralization of provision of public services has been an important item in the agenda of developing countries. While some scholars and practitioners argue that decentralization is associated with improvements in provision due to higher accountability, others note its potential pitfalls. In particular, decentralization to local communities characterized by poverty, low levels of education, and inequality may lead to low accountability and higher susceptibility to political capture. This paper explores these dynamics empirically, taking advantage of the fact that in Brazilian municipalities primary education is provided by schools under municipal as well as under state management. The performance of these two types of school in the same municipalities is compared in terms of their levels of inputs and the efficiency of service delivery using non-parametric data envelopment analysis (DEA). The results suggest that there are indeed drawbacks to decentralization in municipalities where inequality is higher and education and political participation are lower.

JEL classifications: H41, H75
Keywords: Decentralization, Public Education, Accountability

[*] I would like to thank Natasha Falcão for excellent research assistance and my colleagues at the Research Department for fruitful discussions and feedback. All errors and omissions remain my own.

1 Introduction

Political and fiscal decentralization, the devolution of political decision-making power to local level small-scale entities (like villages or municipal governments)—and not just administrative delegation of functions of the central government to their local branches—has been a central issue in the reform agenda of developing countries.[1] The wave of decentralization in the developing world has moved rapidly, producing significant reforms in political and fiscal policymaking.[2] In much of the world a large share of expenditures are now decided at the local level, and some of the most relevant public goods are offered by subnational governments. These changes would have seemed impossible during the previous cycle of reforms, when central planning seemed to be the reigning development paradigm.

Decentralization was expected to provide solutions to many of the ills plaguing the developing world. It was expected create opportunities for citizens to participate in decisions, thus strengthening representation and accountability. It was also expected to increase competition among local governments leading to gains in efficiency.

When it comes to public service provision, the case for decentralization is often that it allows quicker identification of problems and more appropriate solutions to them. It can help clarify lines of accountability and promote the mobilization of resources at the local level through special taxes or community participation that would not be available otherwise. It can also give people the opportunity to be consulted and become more involved in decision-making that concerns them directly.

In the specific case of education, decentralization could lead to more and better quality inputs to schooling, better matching of programs to local interests, and improved learning outcomes.(Welsh and McGinn, 1999) It also has the potential to improve the operation of the educational system by increasing the efficiency of allocation and utilization. Finally, the flexibility afforded by decentralized decision-making can lead to better-targeted spending and therefore improvements in redistribution.

Actual experiences with decentralization and empirical results based on them, however, portray a rather mixed picture. Part of the reason is that substantially different institutional arrangements and conceptual definitions fall under the common heading of "decentralization." There is indeed considerable variation in the extent and scope of decentralization both in theory and practice. In many cases this stems from the nature of the good or service being provided. Certain policies may be associated with particular forms of funding (e.g., user fees, free to the public)

[1] We take the definition by Bardhan and Mookherjee (2005b) Decentralization of Governance and Development.

[2] As Lora (2008) indicates, the percentage of public expenditures executed by subnational governments had grown more than 25 percent since the most recent democratization wave, reaching almost 20 percent of total expenditures on average. Lora (2008) presents a detailed account of the decentralization process in Latin America.

and externalities across jurisdictions (e.g., interstate roads and environmental policies vs. building local clinics and schools) that call for specific levels of centralization in implementation.

More generally, the merits of decentralization, or lack thereof, depend on a number of factors. First, those merits hinge on the characteristics of the population targeted by the policies. How easily people are able to move across jurisdictions, for example, can be crucial in determining the incentives of tax policy decisions. Whether citizens have more or less homogeneous preferences across geographical areas also bears heavily on the incentives decision-makers have to deliver certain goods and services, in particular under different rules of aggregation of those preferences.

Second, institutional capacity at different levels of governments is crucial. Particularly under decentralization, variation across localities can be substantial. Third, the particular rules guiding the delegation of decision-making power may generate good or perverse incentives. For example, providing too much leeway in the management of the fiscal stance by providing spending prerogatives without similar prerogatives on the revenue side could lead to unsustainability of fiscal management (i.e., vertical fiscal imbalances).

With so many modalities of decentralization involving such distinct trade-offs, the primary challenge in studying this topic is to clearly specify appropriate assumptions and mechanisms. The literature offers numerous approaches that fall roughly under two main categories: i) theories of fiscal federalism, generated primarily based on the U.S. case; and ii) those focusing on accountability. The latter emerged from a consensus that in developing countries many of the assumptions on the proper functioning of institutions were not appropriate and that in many cases decentralization in spending is not accompanied by decentralization in taxation. Given that the main emphasis and assumptions differ considerably in these two cases, expectations and empirical implications also differ.

Given our focus on a developing country where public provision of education is only decentralized at the expenditure level (i.e., decisions on the most important taxes remain the prerogative of the central government), our focus is on issues of accountability. The considerable variation in local capacity, coupled with the fact that both state and municipally managed schools co-exist in a given municipality, offers a fertile setting to study the merits of decentralization where political capture may pose a threat.

Previous empirical work has looked at the impact of decentralization in the allocation of public monies (Faguet, 2004),[3] and some evidence exists on the specific case of education (Galiani et al., 2008, Galiani and Schargrodsky, 2001, Faguet and Sanchez, 2008). Still, few have looked

[3] Faguet's work on Bolivia, while a good approximation for measuring impact of the process (the author looks at changes in the allocation of expenditures across goods), does not constitute a full-fledged evaluation of changes in the quality of provision.

directly at the impact of decentralization on efficiency of public goods provision with emphasis on differences in the functioning of local democracy.

In this paper we explore these dynamics empirically, again taking advantage of the fact that primary education is provided by both schools under municipal and under state management. We compare the performance of these two types of school in the same municipalities in terms of their levels of inputs and the efficiency of service delivery using non-parametric data envelopment analysis (DEA). The results suggest that there are indeed drawbacks to decentralization in municipalities where inequality is higher and education and political participation are lower.

The paper proceeds as follows. First, we outline the theoretical underpinnings of the empirical exercise that we borrow from the literature on decentralization and accountability. Next, we provide a brief description of the organization of public provision of primary education in Brazil, which is the case we focus on. We then introduce the empirical strategy used to evaluate the theoretical claims, first with respect to policy provision, measured as levels of inputs to primary education, and then with respect to the efficiency with which these inputs are translated into learning and retention of students.

2 Decentralization and Accountability

There are two main approaches to the study of decentralization. One follows the seminal works of Tiebout (1956) and Oates (1972), placing particular emphasis on the trade-off between tailoring policies to local needs and preferences (decentralization) and applying more uniform policies, but ones that take into account potential externalities that might compromise their optimality at the global level.

The second approach pays particular attention to issues of accountability, or the scope for citizens to monitor political decisions that concern them directly. These studies tend to model the choice between centralization and decentralization using a principal-agent framework of analysis. The idea is that centralized decision-making places a heavier informational burden on citizens than decentralized systems do when it comes to monitoring the performance of representatives. Decentralization brings decisions closer to the people, making it easier for them to assign responsibility for policy choices and to monitor their implementation.

Our focus is on this second approach. As mentioned in the introduction, one of the most highlighted features of decentralization is exactly the proximity it fosters between elected representatives and those they are representing. It has been pointed out by many scholars, however, that the benefits of bringing decisions closer to citizens are not that straightforward. As noted by Bardhan and Mookherjee (2005a), those benefits only obtain under the strong assumption that local democracies are well-functioning democracies. The authors proceed to argue that in the developing world this is not usually the case.

Many communities in the developing countries are characterized by high levels of poverty, low levels of educational attainment and low levels of political participation. All these features have been associated with poor functioning of local democracies (Bardhan and Mookherjee, 2005a). Poverty and education are important factors determining the levels of political information and awareness of citizens. If these are low, the opportunity for inclusion presented by decentralization might not materialize, and monitoring of local representatives might be very low. This means local elites will likely find it easier to capture political power and use it to their advantage. Thus decentralization will generate perverse incentives. Indeed, inequality was found to be associated with higher levels of political capture in local communities, allegedly because it reduces the costs of collective action by a very select elite. Moreover, as pointed out by Sen (1999), in democracies people tend to get what they demand, but typically not to get what they do not ask for. Thus political participation is crucial to translating the opportunity to monitor and hold local representatives accountable into actual accountability by voicing concerns.

In this study we explore the effects of accountability (proxied by the factors just outlined) on the delivery of public provision of education at two levels of proximity of decisions to citizen: a local one, represented by schools under municipal management, and a more distant one, represented by schools under state management. We take advantage of the fact that in Brazil these two modes of delivery coexist in most municipalities.

Our exercise follows closely the framework provided in Bardhan and Mookherjee (2006). Under this framework, and following the experience of most developing countries, including Brazil, the central government is assumed to retain decisions on funding collection and allocation. The difference between centralization and decentralization is on who decides how to allocate the assigned funds to the service or program being implemented. Under centralization, these decisions are delegated to a local bureaucrat, whereas under decentralization they are delegated to a locally elected representative. The key point is that these two forms of organization result in different incentives to the decision-maker.[4]

Under the centralized system, the bureaucrat responds to the central government, and there are problems of communication between the two. Only the bureaucrat knows the actual local need and prices that would allow the most efficient allocation of the central government grant. Given that monitoring is less than perfect, the bureaucrat has the opportunity to manipulate this information in order to maximize his wealth through cost-padding and diversion of the public good.

Under the decentralized system, the elected representative seeks to win elections, and thus to please just enough voters to do so. How many and which voters she will try to please, however, depends on how well informed citizens are and on their levels of political participation. The better

[4] To highlight this difference in incentives, both the elected representative and the bureaucrat are modeled as self-interested individuals (so that differences are not due to one being assumed more altruistic than the other).

informed and participating they are, the higher the incentives of the representative to achieve utilitarian welfare, catering to citizens according to their marginal utility for the good. Thus targeting will be optimal and corruption non-existent. In poorer municipalities, however, where citizens tend to be less informed and participate less in politics, representatives will have an incentive to cater disproportionally to the elite, what is termed "political capture." The reason is that pleasing the elite can lead to higher campaign contributions that can be used to sway "non-informed" voters to vote for the elected representative independent of the utility these voters derive from the policy decisions.

Although the central government also maximizes votes, the electoral incentives are higher and more volatile at the local level. The degree of political capture of the central government is a weighted average of the degree of capture of every community within its boundaries. This means that decentralization can lead to better or worse results relative to centralization, depending on how poor local communities are.

As pointed out by the authors, there are no general or consistent conclusions on the relative vulnerability of different levels of government to political capture by elites. We seek to fill this gap. We investigate these dynamics from two perspectives: policy provision and the efficiency of policy implementation. In the first part of our analysis we focus on levels of inputs to education by each of the two systems (state and municipal). Here we can gain some insight into whether accountability at the local level seems to lead to better policy choices, in this case more investment in education. Conversely, we also investigate whether there is any indication that political capture (proxied by levels of inequality) contributes to lower provision on average, all else equal.

In the second part, we explore the dynamics outlined above with respect to the efficiency of service delivery. That is, given a choice of policy (inputs to education), how well does it translate into desired outcomes (i.e., test scores and student retention)? Efficiency seems pertinent for the analysis in two main respects. First, if bringing decisions closer to people increases the chances of better tailoring policies to local needs and preferences, then we may expect them to yield better results. As the literature on program evaluation shows us, policies and projects that do not take local concerns into account tend to fail to achieve desired objectives, while those that do have better success rates. Second, higher accountability at the local level is expected to curb corruption through better monitoring. Thus the scope for wasteful use of resources is hindered, and higher efficiency is expected.

3 Public Education in Brazil

Before proceeding to the analysis, we briefly outline the main features of the public education system in Brazil to place it in context. Public provision of education in Brazil has undergone important reforms since the inception of the 1988 Federal Constitution. They have been characterized by a

dissonance between its two main aspects, plans for improving the inclusion and quality of services and the availability of funds to enable implementation. The former has evolved at a faster pace than the latter. The initial drive for these reforms was the fulfillment of the constitutional provision of free and accessible basic education to all for grades 1-8. The goal subsequently evolved to include pre-primary education and to seek to integrate and better coordinate all education programs.

The new constitution decentralizes educational responsibilities. In general, the federal government is in charge of financing tertiary education in federal universities and federal technical schools, while supplementing and redistributing funds to states and municipalities. The states are responsible for primary and secondary levels of education, corresponding to grades 1 through 8 and 9 through 11, respectively. Municipalities are mostly in charge of primary and pre-primary education. The respective levels of state and municipal participation in primary education vary by municipality. In some cases municipal schools account for almost all primary enrollment, while in others state schools do. The objective is to gradually transfer responsibility for primary education to municipalities, but variation is still high and the incentives for states to transfer schools to municipal governments are very low (Arretche, 2002).

At the same time that decentralization took place, states went through a process of deconcentration and delegation of authority to the schools. This way, more decision-making power devolved to the municipalities at the same time that schools attained greater administrative, financial and pedagogic autonomy (de A. Parente and Lück, 1999).

So far, the process has reduced inequalities in access and increased teachers' salaries as a minimum level of expenditure per pupil was established. When municipalities find this to be beyond the possibilities offered by their revenue, the central government transfers funds to makes up for the shortfall. In 2001 this was the case in 40 percent of municipalities, where two-thirds of the children enrolled in public basic education were living. Production of course materials for teacher training remains centralized (UNESCO, 2005).

This way, the main differences between municipal and state schools are not necessarily based on differences in the curricula or on substantial differences in salaries and organization. Instead, they seem to be based on the lines of accountability for those in charge of decision-making at the school level. This fact will be exploited in the empirical analysis.

4 Empirical Analysis

4.1 Policy Provision

As mentioned in the previous sections, there are two competing views regarding the merits of decentralization. The general expectation is that by bringing decisions closer to citizens, decentralization would increase the amount of inputs to schooling and improve their quality. According

to Bardhan and Mookherjee (2006), and following the results of numerous studies of decentralization efforts, however, there is no a priori reason to expect higher accountability to follow from higher proximity between decision-makers and citizens. Whether the change is for the better or worse depends on local communities' poverty levels.

Taking advantage of the fact that the Brazilian system of primary education is characterized by the coexistence of state-managed and municipally-managed schools, we have compiled a broad database to allow us to investigate this issue empirically. In order to measure outcomes we gathered information on the following inputs that characterize the provision of education in each municipality:

- hours students spend at school;
- number of students per teacher;
- average years of education of teachers;[5]
- number of students per classroom;
- school quality composite index.[6]

Each one of these inputs is measured for municipal schools and state schools in each municipality for comparison purposes. Figure 1 shows the levels of inputs allocated by each of the primary education providers.[7]

Many factors influence the policy decisions of representatives: resources from elite members, pressure from international organizations, the ideology of the decision-maker, popular demands, the media, etc. One step at trying to disentangle these effects is the within-country approach, where some of these pressures can be assumed constant. Moreover, the fact that both municipal and state schools are based in the same municipalities makes comparisons much more straightforward.

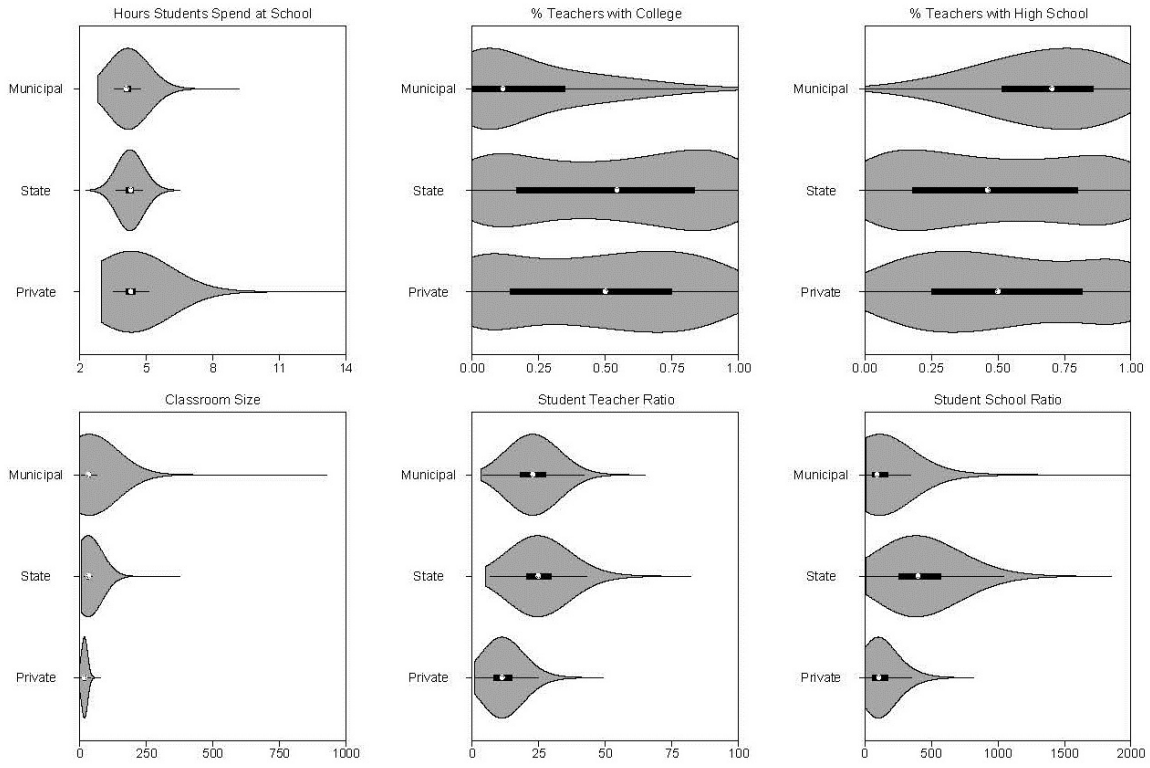
Our interest lies in the effects of the main factors determining levels of accountability in the incentives of decision makers (bureaucrats–agents of governors–for state schools, versus locally

[5] This measure was created based on the composition of teachers according to their education level in each municipality. We multiplied these percentages by the corresponding years of education. For example, if a municipality has 10 percent of its teachers with middle school, 60 percent with high school and 30 percent with college, the average years of education is given by: $.1 \times 8 + .6 \times 11 + .3 \times 15$

[6] We employed Markov Chain Monte Carlo factor analysis to create a scale reflecting the quality of the facilities based on the following items: number of schools with library, computer lab, science lab, sports facilities,television, cable, computers in general, internet access, piped water, electricity and sewage system.

[7] The initial analysis focuses on the first period for which these data are available, which is 1996-99. The idea is to extend this analysis to cover the next electoral cycle 2000-04 (we consider electoral cycles since mayors and governors are the primary decision-makers in this case).

Figure 1. Comparing Education Inputs by Provider



Note: Number of Observations: Municipal = 5,336, State = 5,173, Private = 2,290.

elected representatives for local schools) to provide inputs to the public provision of education. As pointed out in Bardhan and Mookherjee (2005a,b, 2006) the extent to which local democracy works depends on the levels of political participation and awareness of the population. These, in turn, depend on the distribution of literacy and socio-economic conditions in the community. Thus we include in the estimation measures of *educational attainment*, *poverty*, *inequality*, and *voter turnout* at the municipal level.

The educational level of the adult population is deemed important in determining the quality of participation, as illiteracy can limit the capacity of citizens to gather and process information. For our purposes, this means that, all else equal, municipalities with lower levels of education should display lower accountability levels and thus be more prone to capture by elites. Alternatively, however, low levels of education have been associated with lower demand for education (Machado, 2007, Lora, 2008).

The mechanisms linking poverty and adult levels of education to demand for public provision of education have been covered to a great extent by the economic literature. Education is a long-term investment, and developing countries are notorious for lacking credit markets serving the poor population. Thus family income level weighs considerably in the decision of whether to send children to school. The lower a person's income, the higher the utility from current consumption, such as food and shelter. The poor will only start investing in education once they reach an income level where the marginal return from education is above that of current consumption. The poorer the individual, though, the lower the expected return from education, since poorer children face lower chances of succeeding (Lam, 1999) and rates of return are determined mostly by performance rather than actual years spent in school (Curi and Menezes-Filho, 2005, Murphy and Peltzman, 2004, Murnane et al., 1995). Thus at low income levels, demand for education will tend to be low. The role of adult levels of education is directly related to the expected returns from the investment. Children of low-educated parents face more difficulty in succeeding because parents are less likely to be able to help with and to provide higher incentives for learning. Many studies find that adult education level, controlling for the income of the family, is a significant predictor of how much this form of human capital investment is valued.

Thus a positive estimated effect of adult illiteracy could be capturing two distinct effects: first, the effect of lower accountability and informational asymmetries leading to lower levels of provision of education than desired and, second, the effect of lower demand on supply. In order to gain more insights into this question we rely on a measure of voter turnout. The assumption is that if under higher levels of turnout more inputs are provided, a negative estimated effect of educational attainment could be interpreted as capturing higher levels of capture due to informational asymmetries.

While inequality is not the main focus of our analysis, it is worth noting that the existing literature offers two important insight regarding its relationship to public provision of education. First, under higher inequality the incentives of the elite to supply public education are reduced, especially under high levels of poverty (Levy, 2005, Machado, 2007). This is because for the elite the burden of providing the necessary inputs to the whole population is conceivably higher than acquiring private education individually.[8] Thus we could interpret a negative effect of inequality on levels of input provision as an imbalance in actual representation, granted we assume that it does not affect demand by the poor in the same way.

Second, following Bardhan and Mookherjee (2005a), inequality reduces the costs of collective action by the elite in local communities. The elite's characteristics of being a small and and distinct social group facilitate collusion and coordination of efforts to drive decisions towards their own interest at the expenses of the rest of the population.

In addition to the main variables described above, we also control for city size, captured by the log of the population and the percentage of total primary public school enrollments in municipal schools. In the particular case of levels of inputs, it is also important to control for the level of resources available to the decision-maker to be invested in education. We thus include in the analysis measures of the city's total income[9] in per capita terms and other more specific factors. In the particular case of number of students per teacher and average level of education of teachers, we control for the number of teachers per capita and the average level of education of resident teachers,[10] respectively.

We run two different specifications of the outcome variables. First, we run separate ordinary least squares regressions with state fixed effects on the input levels of municipal schools and then state schools. There we gain some insight into what matters for input levels in each case and draw some comparisons across the two modes of delivery. To facilitate such comparisons, both the measure on class size and student to teacher ratio have been reversed so that higher values mean better provision.

Second we run ordinary least squares regressions on the difference at the municipal level between the average input of municipal schools and the average input of state schools. In this case we can examine under what conditions municipal schools seem to deliver better inputs than state schools and vice versa. Again, for ease of reading, the scales corresponding to class size and student-teacher ratio have been reversed.

[8] We do indeed observe in our sample that poverty is negatively correlated, but inequality positively correlated, with the number of spots being offered in private schools

[9] These include income from all sources, including locally collected taxes, gains from investments and transfers from the federal government.

[10] Following the same calculations done for our variable on average level of education by municipal school teachers.

4.1.1 Results

This initial analysis begins with the first period for which these data are available, which is 1999-2000. We intend to extend this analysis to more recent periods in the near future. Figure 2 depicts the results of our estimations of the effects of the variables described above in each of the input factors we selected with 95 percent confidence intervals. Because both the percentage of people with low levels of education and poverty (and to some extent also inequality) can be affected by the level of provision of education we estimate the models with their lagged values. Since they are calculated based on census data, which is only available every 10 years, they correspond to 1991 values.

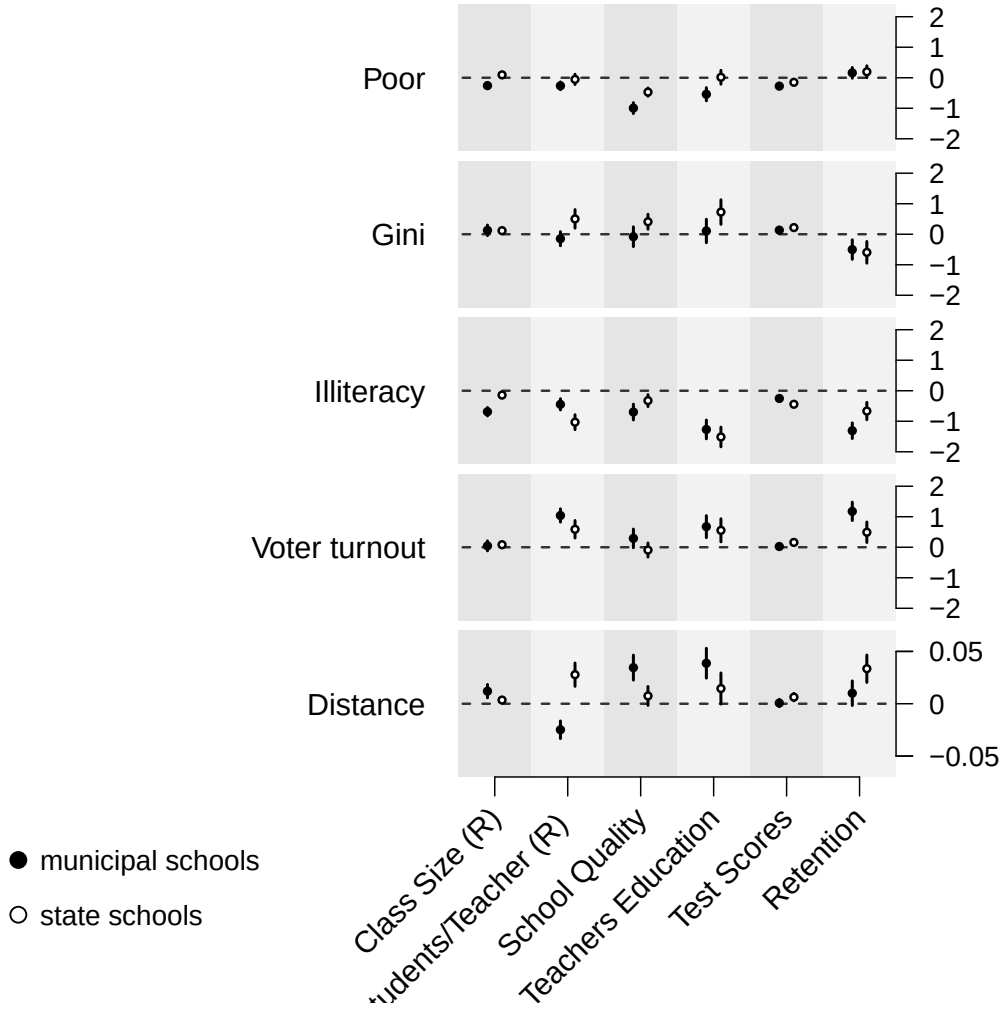
The results suggest that the factors bearing on levels of accountability do indeed matter for the provision of inputs. First, levels of poverty, measured as the percentage of poor living in the municipality, seem to affect the levels of input of municipal schools to a greater extent than those of state schools. In poorer municipalities municipal schools tend to, on average, display more students per class, more students per teacher, lower quality of school facilities, lower educational attainment of teachers and lower test scores, but higher retention rates. State schools do not significantly differ in terms of levels of inputs across municipalities of different poverty levels. To a lesser extent than municipal schools, state schools in poorer places are characterized by, on average, lower quality of facilities and lower test scores.

When it comes to inequality the pattern is reversed. Inequality seems to affect the delivery of inputs in state schools to a higher extent than those of municipal schools. In municipalities where inequality is higher, state schools seem to deliver, on average, better student-teacher ratios, better quality of facilities and higher levels of education in the teacher body than state schools in more equal places. Inequality is only significantly associated with retention rates in the case of municipal schools. In both municipal and state schools, greater equality is associated with higher retention rates.

Political participation, as proxied by voter turnout, seems to affect both municipal and state schools in a similar way. Higher participation is significantly associated with fewer students per teacher, better school quality (in municipal schools only), better-educated teachers, and higher retention rates. As the theory would predict, the effect seems more pronounced in the case of municipal schools.

Levels of illiteracy among the adult population (15 years or more) are associated with lower provision of inputs and worse outcomes in every case analyzed, for both municipal and state schools. Even controlling for the pool of teachers in the municipality, lower literacy rates are significantly associated with lower education of teachers. Given that political participation seems to bring benefits, it is possible that the effect of low educational attainment of the population on

Figure 2. What Matters for Input Levels? Municipal vs. State Schools.



Note: All results are based on ordinary least square regressions with state-level fixed effects. The bars around the estimates represent the 95 percent confidence intervals. In the specific case of students per teacher we control for number of resident teachers per capita, and in the case of average years of schooling of teachers we control for average years of schooling of all resident teachers. These estimates are not shown.

provision of schooling inputs is due to lower awareness and accountability as opposed to low demand alone.

The resources at the disposal of the municipality, however, seem to matter primarily for the average educational level of teachers and the quality of schools. Interestingly, in municipalities with greater resources at their disposal, state schools fare rather poorly, on average, in terms of the educational attainment of its teachers. The higher the local government income, the lower, on average, the educational attainment of state school teachers and the higher, on average, the educational attainment of municipal teachers.

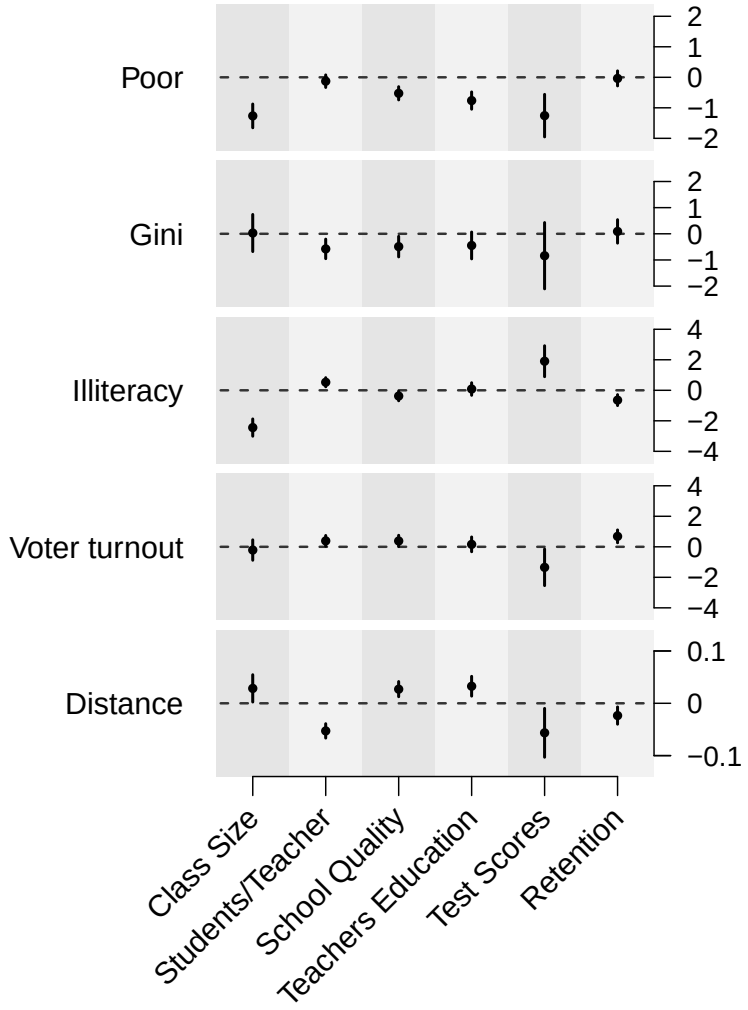
Turning now to a more straightforward comparison between the performance of state schools and that of municipal schools, some of the results hinted above are reinforced. Municipal schools seem to perform better than state schools in municipalities where poverty and illiteracy rates are lower and voter turnout is higher. This is consistent with theories of accountability arguing that these measures tend to be associated with a better informed and more politically engaged citizenry that is better able to monitor and hold elected representatives accountable.

4.2 Efficiency of Provision

The literature on efficiency analysis, especially that geared towards the study of firms, is rich. Different approaches have been devised to estimate the unobservable level of efficiency of different production units both in terms of outputs produced given a level of inputs and in terms of inputs utilized to produce a given output quantity. The first major distinction between these methods is whether they rely on parametric or non-parametric estimation procedures. Parametric estimations are usually based on Cobb-Douglas production functions, where efficiency is estimated based on the residuals. That is, all that cannot be explained by input quantities alone is attributed to efficiency or productivity.

The other class of approaches relies on some form of constrained optimization problem where a production frontier is estimated based on the observations and efficiency measures are computed relative to this frontier. The most common are the Free Disposal Hull (FDH) and the Data Envelopment Analysis (DEA). Each one has its strengths and limitations, depending on the aim of the study. At a very general level, we can say that parametric estimation is problematic because it requires the researcher to specify a particular production function that is unknown a priori. Non-parametric approaches provide freedom in this respct, but at the cost of results being highly contingent on the sample available (not to mention the "curse of dimensionality" innate to non-parametric estimation). While there is still much debate around the right production function for firms, even less is known in the case of public provision of education. Given that we have data for almost all municipalities in Brazil, adding up to around 4,000 observations, we opted to start this project by implementing the non-parametric approach.

Figure 3. What Matters for Input Levels? Differences between Municipal and State Schools.



Note: All results are based on ordinary least square regressions with state-level fixed effects. Positive values of the dependent variable mean municipal schools are delivering more of the input. The bars around the estimates represent the 95 percent confidence intervals. In the specific case of students per teacher we control for number of resident teachers per capita, and in the case of average years of schooling of teachers we control for average years of schooling of all resident teachers. These estimates are not shown.

Our interest here, though, is not so much in the efficiency estimates themselves but in how a group of covariates affect them. Recent advances in the techniques of efficiency analysis allow us to retrieve the effects of what are commonly termed "environmental variables." Attempting to explain efficiency scores is not a new enterprise, and there are many studies that have done so. However, as pointed out by Simar and Wilson (2007), most of them fail to take into account some basic and important issues, such as the heavy reliance of non-parametric estimates on the particular sample used, introducing bias into the estimation of these indices, and that efficiency scores are truncated measures (either below or above one). These authors propose a data generating process (DGP) that incorporates the role of covariates in efficiency and suggest a double-bootstrap procedure that allows us to retrieve both bias-corrected efficiency scores and unbiased and consistent estimates of the effects of the environmental variables. The model assumes the following DGP:

$$f(x_i, y_i, \delta_i, z_i) = f(x_i, y_i|\delta_i, z_i) f(\delta_i|z_i) f(z_i)^{11},$$

where x denotes a vector of input measures, y denotes a vector of output measures, z corresponds to the vector of environmental variables and δ corresponds to the efficiency scores and $i = 1, ..., n$ denotes each individual unit. Moreover, while no particular functional form is assumed on the relationship between inputs and outputs and efficiency levels (estimated non-parametrically using DEA), a specific functional form linking the environmental variables to the efficiency scores is assumed:

$$\delta_i = z_i\beta + \epsilon_i \geq 1^{12}$$

where β is the true population parameter and ϵ_i $N(0, \sigma^2)$ and truncated to the left at $1 - z_i\beta$.

In the context of this particular analysis we are thus assuming that the decision-maker faces a set of conditions over which she has no control (z_i) and that will constrain her choices of inputs in two ways: both directly (poverty means less money can be spent on the public good) and through the expected level of efficiency (if, given these conditions the decision maker believes citizens will not value or not take full advantage of a given service, she might decide not to "waste" inputs and thus not provide the service).

The objective of the double bootstrap procedure is to consistently estimate the effect of variables in z on efficiency levels, but not their direct effect on input levels. We run this analysis separately in the section on inputs. The double bootstrap procedure proposed by Simar and Wilson (2007) that we employ in this study can be summarized as follows:

[11] From Simar and Wilson (2007, pg. 35)

[12] From Simar and Wilson (2007, pg. 38)

1. Estimate efficiency scores, $\hat{\delta}_i$[13], using DEA based on the observed inputs and outputs in the sample.
2. Estimate $\hat{\beta}$ and $\hat{\sigma}$, by running a truncated normal regression of $\hat{\delta}_i$ on z_i on the subset of observations satisfying $\hat{\delta}_i > 1$.
3. Generate a set of b_1 bootstrap estimates of $\hat{\delta}_i^*$ by repeating the following steps:
   (a) Draw ϵ_i from $N(0, \hat{\sigma}^2)$ left-truncated at $1 - z_i\hat{\beta}$ for each i.
   (b) Compute $\delta_i^* = z_i\hat{\beta} + \epsilon_i$
   (c) Define $x_i^* = x_i$ and $y_i^* = y_i\frac{\hat{\delta}}{\delta^*}$.
   (d) Estimate efficiency scores $\hat{\delta}^*$ using DEA and replacing the actual observations with x^* and y^* as the bounds of the constraints, but maintaining the original observations otherwise.[14]
4. Compute bias-corrected estimates $\hat{\hat{\delta}}_i$ where $\widehat{bias} = \hat{\delta} - \hat{\delta}^*$
5. Estimate $\hat{\hat{\beta}}$ and $\hat{\hat{\sigma}}$, by running a truncated normal regression of $\hat{\hat{\delta}}_i$ on z_i.
6. Generate a set of b_2 bootstrap estimates of $(\hat{\beta}^*, \hat{\sigma}^*)$ by repeating the following steps:
   (a) Draw ϵ_i from $N(0, \hat{\hat{\sigma}}^2)$ left-truncated at $1 - z_i\hat{\hat{\beta}}$ for each i.
   (b) Compute $\delta_i^{**} = z_i\hat{\hat{\beta}} + \epsilon_i$
   (c) Estimate $\hat{\hat{\beta}}^*$ and $\hat{\hat{\sigma}}^*$, by running a truncated normal regression of δ_i^{**} on z_i.
7. Build confidence intervals based on the distribution of the estimates $(\hat{\hat{\beta}}^*, \hat{\hat{\sigma}}^*)$

Appendix B contains the actual coding for the algorithm, which was run using R statistical software. We employ the package FEAR (Wilson, 2006) to calculate the efficiency scores, and we wrote the maximum likelihood function for a truncated normal regression.

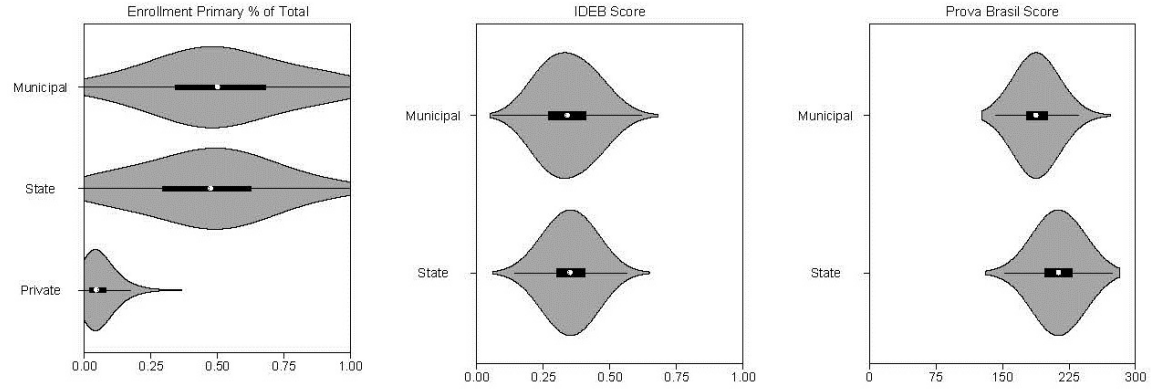
4.2.1 Results

The efficiency of a given policy can only be evaluated relative to some stated objective. In the case of education, two come quickly to mind. One is the educational system's capacity to serve and retain the totality or at least the majority of the school-age population. The enrollment rate is actually one of the most common outputs used in efficiency analysis of educational systems

[13] Parameters with a hat denote an estimate of the true unknown parameter.

[14] The objective of this first loop is to get a sense of the bias in the estimation of the efficiency scores. As the sample size increases this bias should be reduced because changing one observation will have less of an impact on the estimation of the efficiency of neighbor observations. Remember that efficiency is calculated based on an estimated frontier, so if we have two samples where different units lie at the frontier (while the other observations remain the same), the estimated frontier will likely differ and thus the efficiency estimates of the other units would differ too (because we would be comparing them to a different benchmark in each case). Repeating the operation described above gives us a sense of the uncertainty in the estimation of the efficiency scores and thus a way of estimating the bias that results from relying on one sample.

Figure 4. Comparing Education Outputs by Provider



Note: Number of Observations for test scores: Municipal = 4,431, State = 4,554

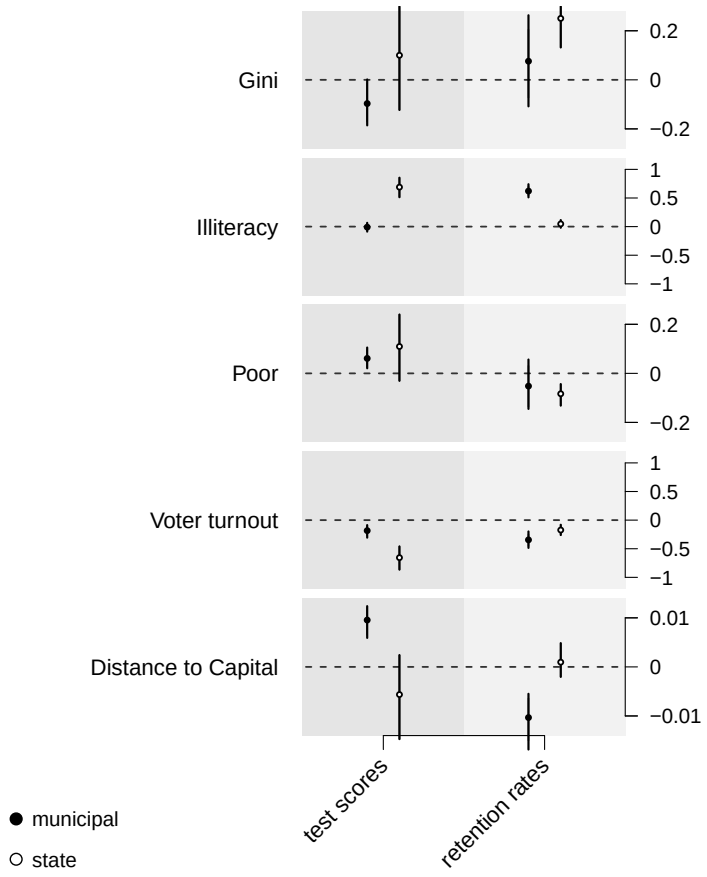
(Afonso and Aubyn, 2005, Gupta and Verhoeven, 2001). Another sensible output to consider is test scores, or how well the inputs are being translated into actual learning. Theories on the determinants of returns to education suggest that there might be a trade-off between these two. The idea is simply that children from less educated caregivers need to put more effort into learning than those coming from wealthier and more educated families. Thus by emphasizing learning, children from whom more effort is required to achieve the same scores in a test can become discouraged and decide to give up studies. This is a particularly perverse effect on children of less well-off families, precisely those who need this investment the most to break the cycle of poverty. For this reason in some cases, for example, no repetition is allowed in schools. This helps build a constituency for school attendance, at the cost of rigorous concurrent learning.

We calculate efficiency taking these two outputs in turn. First we consider test scores and then the rate of retention of students by public schools, that is the percentage of students who decide to continue, rather than abandon, their studies in each kind of public system (municipal and state).

In Figure 4 we show the performance of each public provider on test scores along with the percentage of total enrollments each one is responsible for. The IDEB scores correspond to an index built by a governmental education research foundation, the Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP). The index takes both the scores on the mathematics and Portuguese tests of the Prova Brasil and the rate of grade repetition into account. The third graph in Figure 4 represents the distribution of the average score obtained by all students of grades 4 and 8 by municipality in the mathematics and Portuguese tests. These tests were given in 2005.

Efficiency scores can be computed in two ways: in terms of output efficiency or input efficiency. The former compares the outputs of units with the same bundle of inputs. The latter

Figure 5. What Matters for Inefficiency Levels?



Note: Bars represent 95 percent confidence intervals around coefficient estimates. Results refer to the sample of municipalities where the share of municipal enrollments was similar to those of state enrollments (between 40 percent and 60 percent).

compares the inputs of units producing the same output levels. Our focus in this section is on output efficiency. Moreover, efficiency is computed as the ratio between the estimated frontier output (in other words the maximum output one can achieve given a bundle of inputs) and the actual output of a given unit. Therefore it can take values that are equal to or greater than 1, with a value of one meaning the unit is on the frontier and thus fully efficient. This means covariates that are negatively associated with the efficiency measures are in fact contributing to more efficiency.

The figure displays the results of our estimation using the double bootstrap procedure described above with $b_1 = 100$ and $b_2 = 100$. Each column corresponds to one of the two outputs. The first model takes only municipal schools' test scores as the output. The second model is based on drop out-rates. The bars in the picture correspond to the estimated 95 percent confidence intervals.

The variables entered as z are the same used in the previous section, with the exception of the specific controls used in the estimation of inputs. These were not included in the efficiency estimation.

As shown in Figure 5, the results are mixed. First, levels of inequality seem to matter for state schools only. In more unequal municipalities state schools tend to be less efficient in retaining students than their counterparts in more equal places. Inequality does not appear to be significantly associated with the efficiency of municipal schools in either case—retention and test scores—and with state schools when the output of interest is test scores.

Illiteracy, however, is significantly associated with lower efficiency in both cases and in particular with respect to municipal schools. Both efficiency in terms of test scores and retention rates are negatively associated with adult illiteracy in the case of municipal schools. While local adult illiteracy does not seem to matter for the efficiency with which state schools curb drop-out rates, it is significantly associated with lower efficiency in terms of test scores.

Voter turnout, or political participation, tends to work towards higher efficiency in the case of retention rates in both municipal and state school, with a more pronounced effect on municipal schools. Higher efficiency in learning is only associated with political participation in the case of state schools.

Finally, poverty levels appear to be positively associated with efficiency in retaining students in the state educational system. Given the incentives of bureaucrats to divert resources to the black market, this result can be interpreted as more poor people, meaning a smaller market for the diverted goods, and thus higher allocation towards the poor. In the case of municipal schools, however, poverty levels do not seem to matter for efficiency. This somewhat contradicts the results obtained with respect to inputs and expectations, both general and those from theories of accountability.

The next step is to extend the analysis using data collected at the school level, where more controls and years are available.

5 Conclusion

While decentralization figures prominently in the discourse of scholars and practioners as the solution to many ills that plague the delivery of public services in the developing world, no consistent and uniform assessment exists on its merits. The heterogeneity of experiences and of results from studies of these experiences suggest that whether the potential virtuous effects of decentralization materialize depends on the specific ways in which the various experiments that share the heading of "decentralization" are undertaken, in particular how they fit within various institutional and social conditions. Any study attempting to analyze these experiences and draw lessons from them needs to be able to articulate and operationalize these concepts in a clear and organized manner, so that the numerous trade-offs involved in the decision can be captured.

In many instances such studies have been carried out comparing countries and without a clear theoretical framework. They have for the most part focused on the relation between decentralization (measured as the share of subnational government spending, proportion of directly elected officials at subnational government, number of subnational tiers, land area, etc.), corruption (measured as subjective perceptions of businesspeople and investors), and government performance (measured in terms of delivery of infrastructure or social services). These studies relied on panel data for a small number of countries, and the different specifications chosen in each case yielded very different results.

As argued in the International Handbook on the Economics of Corruption:

"*Given the methodological problems with this research methodology—involving the difficulty of controlling for unobserved cross-section heterogeneity, for other sources of endogeneity bias, for measurement errors and limited and biased selection of samples owing to the questionable quality and comparability of the data—it is hard in any case to make any firm inferences based on such studies. It is more instructive to seek empirical evidence on a more disaggregated and localized set of contexts*."

We have thus sought to help fill in this gap by combining advances in theories of decentralization with empirical analysis at the local level. In particular, we do so by taking advantage of the coexistence in Brazilian municipalities of delivery of public education in both the decentralized and more centralized models. Given the particular characteristics of decentralization in that case, where responsibility for public provision was devolved to the local level without accompanying freedom in fiscal matters, we based our analysis on theories of accountability rather than on accounts of fiscal decentralization.

While the analysis is still preliminary, we found evidence suggesting that decentralization might not necessarily increase accountability just because it brings decisions closer to the people. Municipalities where citizens tend to display higher levels of poverty, and lower levels of education and political participation, might find it harder to monitor and hold local representatives accountable than their more educated and engaged counterparts. Moreover, as monitoring is hindered, the opportunity for political capture by an elite increases, threatening gains in efficiency and targeting of public service delivery. A healthy democratic environment seems to be a prerequisite for the expected gains from decentralization to materialize.

References

Afonso, A. and Aubyn, M. S. (2005). Cross-country efficiency of secondary education provision: a semi-parametric analysis with non-discretionary inputs. European Central Bank: working paper 494.

Arretche, M. (2002). Federalismo e relações intergovernamentais no brasil: A reforma de programas sociais. *Revista de Ciências Sociais*, 45(3):431–458.

Bardhan, P. and Mookherjee, D. (2005a). 6 decentralization, corruption and government accountability. *International handbook on the economics of corruption*, page 161.

Bardhan, P. and Mookherjee, D. (2005b). Decentralizing delivery of anti-poverty programs in developing countries. *Journal of Public Economics*, 89(4):675–704.

Bardhan, P. and Mookherjee, D. (2006). Decentralization and accountability in infrastructure delivery in developing countries. *The Economic Journal*, 116(1):101–27.

Curi, A. Z. and Menezes-Filho, N. A. (2005). A relação entre o desempenho escolar e os salários no Brasil. Associação Nacional dos Centros de Pósgraduação em Economia.

de A. Parente, M. M. and Lück, H. (1999). Mapeamento da descentralização da educação brasileira nas redes estaduais do ensino fundamental. Texto para discussão no. 675 IPEA.

Faguet, J. (2004). Does decentralization increase government responsiveness to local needs?:: Evidence from bolivia. *Journal of Public Economics*, 88(3-4):867–893.

Faguet, J.-P. and Sanchez, F. (2008). Decentralization's effects on educational outcomes in bolivia and colombia. *World Development,*, 36(7):1294–1316.

Galiani, S., Gertler, P., and Schargrodsky, E. (2008). School decentralization: Helping the good get better, but leaving the poor behind. *Journal of Public Economics*, 92(10-11):2106–2120.

Galiani, S. and Schargrodsky, E. (2001). Evaluating the impact of school decentralization on education quality. Available at SSRN: http://ssrn.com/abstract=297829.

Gupta, S. and Verhoeven, M. (2001). The efficiency of government expenditure: Experiences from Africa. *Jounral of Policy Modeling*, 23(433-467).

Lam, D. (1999). Generating extreme inequality: Schooling, earnings, and intergenerational transmission of human capital in South Africa and Brazil. Population Studies Center, University of Michigan, Report 99-439.

Levy, G. (2005). The politics of public provision of education. *The Quarterly Journal of Economics*, 120(4):1507–1534.

Lora, E., editor (2008). *Beyond Facts. Understanding Quality of Life*. Inter-American Development Bank/DRCLAS, Harvard University.

Machado, F. (2007). Poverty, inequality and citizens' preferences over social spending: the case of Brazil. Working paper.

Murnane, R. J., Willett, J. B., and Levy, F. (1995). The growing importance of cognitive skills in wage determination. *The Review of Economics and Statistics*, 77(2):251–266.

Murphy, K. M. and Peltzman, S. (2004). School performance and the youth labor market. *Journal of Labor Economics*, 22(2):299–325.

Oates, W. (1972). *Fiscal federalism*. Harcourt Brace Jovanovich New York.

Sen, A. (1999). *Development as Freedom*. Anchor Books.

Simar, L. and Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, 136:31–64.

Tiebout, C. (1956). A pure theory of local expenditures. *The journal of political economy*, 64(5):416–424.

UNESCO (2005). Decentralization in education: National policies and practices. Education Policies and Strategies.

Welsh, T. and McGinn, N. (1999). *Decentralization of education: why, when, what and how*. Unesco.

Wilson, P. W. (2006). Fear: A software package forfrontier efficiency analysis with r.

6 Appendix A

6.1 Variables and Descriptive Statistics

Poverty (*poor*): Percentage of poor in the municipality in 1991.

Inequality (*gini91*): Gini coefficient in 1991.

Voter turnout (*votertout*): Percentage of voting age population who turned out to vote.

Illiteracy (*HDI*): Percentage of adult population that are illiterate.

Municipal share (*matfunM99*): Share of public provision of primary education under municipal responsibility.

City Income (*receitapc*): Log of municipalities' income (including transfers from federal and state governments) measured in per capita terms, averaged over the period 1996 to 2000.

Population (*poptotal00*): Log of number of inhabitants.

7 Appendix B

Code for running algorithm using the R statistical software.

```
library(FEAR)
library(foreign)
library(msm)


algor2 <- function(inputs,outputs,indep,L1,L2,id){
#1.DEA estimation
dhat <- 1/(dea(XOBS=inputs,YOBS=outputs,ORIENTATION=2))
dhatm <- cbind(id,dhat)

#2.Estimates of bhat with MLE of dhat>1 on environmental vars (indepvars)

g1 <- which(dhat>1)
source("truncreg.R")
mle1 <- trunc.mle(dhat[g1],indep[g1,],1)
bhat1 <- matrix(mle1$par[1:ncol(indep)])
sigma1 <- exp(mle1$par[ncol(indep)+1])


#3. Bootstrap to get bias-corrected efficiency estimates
n.obs <- nrow(indep)
zb <- as.matrix(indep)%*%bhat1
t1 <- matrix(1-zb)

dstar.hat <- matrix(NA,ncol=L1,nrow=n.obs)#matrix to collect results

for (i in 1:L1){
#3.1 draw error for each obs independently
    eps <- rtnorm(n.obs,sd=sigma1,lower=t1)

#3.2 estimate delta star with zb
    dstar <- zb + eps

#3.3 change inputs by weighing each by dhat/dstar and re-estimate DEA
    outputs.star <- t(t(outputs)*c(dhat/dstar))
    dstar.hat[,i] <- 1/(dea(XOBS=inputs,YOBS=outputs,XREF=inputs,
    YREF=outputs.star,ORIENTATION=2))
}


## 4. Compute bias corrected efficiency estimates using boot estimates
dhat.bc <- (2*dhat)-apply(dstar.hat,1,mean)
dhat.bcm <- cbind(id,dhat.bc)

## 5. Compute MLE on bias-corrected estimates and get estimates of beta and sigma
mle2 <- trunc.mle(dhat.bc,indep,1)
bhat2 <- matrix(mle2$par[1:ncol(indep)])
sigma2 <- exp(mle2$par[ncol(indep)+1])
```

```
## 6. Loop again, this time the last step is the MLE to get estimates of beta
#with boot confidence intervals
n.est <- (3*ncol(indep))+1
boot.bhat <- matrix(NA,ncol=n.est,nrow=L2)#matrix to collect beta estimates



for (i in 1:L2){
#6.1 draw error for each observation independently
    eps <- rtnorm(n.obs,sd=sigma2,lower=t1)

#6.2 estimate delta star with zb
    dstar2 <- zb + eps

#6.3 estimate MLE and collect coefficients
    mle3 <- trunc.mle(dstar2,indep,1)
    m <- ncol(indep)+1
    std.error <- sqrt(diag(solve(-1*mle3$hessian))[-m])
    tstat <- mle3$par[-m]/std.error
    boot.bhat[i,] <- c(mle3$par[1:ncol(indep)],exp(mle3$par[m]),std.error,tstat)
}

mean.bhat <- apply(boot.bhat,2,mean)
list(dhatm,dhat.bcm,boot.bhat,mean.bhat)

}
```