IDB WORKING PAPER SERIES No. IDB-WP-463

Preschool Education in Brazil:

Does Public Supply Crowd Out Private Enrollment?

Paulo Bastos
Odd Rune Straume

November 2013

Inter-American Development Bank
Department of Research and Chief Economist

Preschool Education in Brazil:

Does Public Supply Crowd Out Private Enrollment?

Paulo Bastos*
Odd Rune Straume**

* World Bank
** University of Minho and University of Bergen

Inter-American Development Bank
2013

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

Bastos, Paulo.
Preschool education in Brazil: does public supply crowd out private enrollment? / Paulo Bastos, Odd Rune Straume.
p. cm. (IDB working paper series ; 463)
Includes bibliographical references.
1. Education, Preschool—Brazil. 2. Preschool enrollment—Brazil. I. Straume, Odd Rune. II. Inter-American Development Bank. Research Dept. III. Title. IV. Series.
IDB-WP-463

http://www.iadb.org

Abstract

This paper examines whether an expansion in the supply of public preschool crowds out private enrollment, using rich data for municipalities in Brazil from 2000-2006, where federal transfers to local governments change discontinuously with given population thresholds. Results from a regression-discontinuity design reveal that larger federal transfers lead to a significant expansion of local public preschool services, but show no effects on the quantity or quality of private provision. These findings are consistent with a theory in which households differ in willingness to pay for preschool services, and private suppliers optimally adjust prices in response to an expansion of lower-quality, free-of-charge public supply.

JEL classifications: D12, I21, I28, L21, O15
Keywords: Preschool education, Private and public provision, Crowding out

1 Introduction

Public policies aimed at increasing access to formal preschool education are high on the political agenda in a number of countries. There are probably two main reasons for this. First, a higher supply of formal preschool education is seen as a crucial tool for achieving higher (female) participation rates in the labor market. Second, there is a growing body of evidence indicating that there might be important long-term individual benefits to enrollment in preschool education. Among several recent studies, Berlinski, Galiani and Manacorda (2008) and Berlinski, Galiani and Gertler (2009), using data from Uruguay and Argentina, respectively, present causal evidence of a positive effect of preschool attendance on primary school outcomes. Such effects might also persist in the longer run, as suggested by Havnes and Mogstad (2011a), who find strong positive effects of a large-scale expansion of subsidized child care in Norway on children's educational attainment and later labor force participation.[1]

Access to formal child care is a particularly important policy issue in developing countries, where enrollment rates are generally much lower, and where private institutions constitute a much larger share of the formal preschool sector, than in developed countries.[2] Generally low and uneven access to preschool education is arguably reflected in the observation of large disparities in cognitive development at the start of primary school in many developing countries. For example, Paxson and Schady (2007) document a widening gap in cognitive development between poor and non-poor children under the age of 6 in Ecuador.[3] After this age, the gap remains constant. Why do these gaps emerge and why do they stop growing? In light of the previously cited studies, a possible explanation lies in the differences in opportunities available−in particular, access to formal child care−to poor and non-poor children in their early years.

In order to remedy such problems, an available policy option is to increase the public supply of (free or widely affordable) preschool education. The intended effects of such a policy are two-fold: i) to provide more equitable access and ii) to increase the total supply of formal child care. However, the success of such a policy depends crucially on the extent to which increased public supply crowds out existing private supply, which in turn depends on how private preschool providers respond strategically to increased competition from public providers. Do private providers respond by lowering their prices and competing more aggressively in all market segments? Or do they react by increasingly targeting higher-income households that do not find public providers attractive?

[1]Positive effects of preschool education might even increase over time if human capital investments are characterized by dynamic complementarities, as argued by Carneiro and Heckman (2004).

[2]See UNESCO (2008) for statistics and further information about formal preschool in developed and developing countries. Bastos and Cristia (2012) examine supply and quality choices of private suppliers in the city of São Paulo, Brazil.

[3]Paxson and Schady (2010) show that conditional cash transfers are unlikely to contribute towards narrowing this gap.

If an expansion in free-of-charge public supply simply induces households to switch from high-quality private suppliers to lower-quality public centers, negative impacts on child development cannot be excluded.

In the present paper we analyze these questions empirically by examining the effect of changes in the supply of public child care services on private child care provision in Brazil. We use rich municipal-level panel data covering the period 2000-2006 to analyze the effect of increased availability of public child care centers on the quantity of private supply, as measured by private enrollment rates and number of private centers. We also check whether increased public supply has any impact on the quality of private child care, as measured by group size, teacher qualification and quality of infrastructure. To plausibly identify exogenous variation in public supply, we exploit unique features of the allocation mechanism of federal transfers to municipalities in Brazil, where the transfers received by local governments exhibit a non-linear and non-monotonic relationship with given population estimates. Results from a regression-discontinuity design reveal that larger federal transfers to a given municipality lead to a significant expansion of public preschool services (as measured by the number of municipal centers and enrollment), but show no effects on the quality or quantity of private preschool provision.

To guide the interpretation of our empirical results, we develop a simple theoretical model of vertical differentiation, analyzing the optimal pricing response of a private child care provider to entry of a public competitor. In the model, public preschool education is free of charge (zero price), whereas private providers optimally set prices in a profit-maximizing way and supply higher-quality services. Demand for preschool services comes from two different segments of households, one with higher willingness to pay for preschool education and more homogeneous preferences than the other. The private provider optimally chooses between a high-price strategy, serving consumers with high willingness to pay only, and a low-price strategy, serving consumers from both segments. An expansion of public supply has ambiguous effects on private enrollment, depending on the difference in willingness to pay across consumer segments and on the relative size of each segment. Crowding-out effects of more public provision are less likely when the differences in willingness to pay across consumer segments are relatively large.

Our paper clearly relates to the more general literature on crowding-out effects of government funding, in particular the strand of the literature dealing with crowding-out effects of public provision of private goods. However, the existing empirical research has mainly been devoted to health care markets. Cutler and Gruber (1996) and Gruber and Simon (2008) analyze the extent to which public health insurance crowds out private insurance, while Cohen, Freeborn and McManus (2013) study crowding-out effects of public providers in the US market for outpatient substance abuse treatment. In each case, sizeable crowding-out effects are identified. The only empirical study on child care markets that we are aware of in this particular strand of the literature is Bassok, Fitzpatrick and Loeb (2012), who find no evidence of any substantial crowding-out of private providers as a result of increased public provision in the child care markets in Oklahoma and Georgia. In this respect, the results from their study are reminiscent of ours.[4]

While there is very little empirical literature on the response of private providers to increased public supply of child care, there exists a considerable literature on the effect of public (or subsidized) child care provision on maternal labor supply, which is a related but still quite different issue. Although the reported results from this strand of the literature are quite heterogeneous, most recent studies (applying quasi-experimental approaches) find that increased public financing of child care tends to crowd out existing child care provision, quantitatively ranging from moderate crowding-out effects (e.g., Baker, Gruber and Milligan, 2008) to almost complete crowding out with practically no effect on maternal labor supply (e.g., Cascio, 2009, and Havnes and Mogstad, 2011b). However, this literature is generally not able to distinguish whether public child care provision crowds out private provision of *formal* or *informal* child care. While this distinction is irrelevant for the question of maternal labor supply, it is of course crucial if the policy aim is to increase the total supply of formal child care in order to reap the long-term benefits of increased preschool attendance.

The rest of the paper is organized as follows. In the next section we present a simple theoretical model of a market for formal preschool education. We use the model to analyze optimal pricing responses of a private preschool provider to entry of a public competitor and identify the circumstances under which public provision is likely (or not) to crowd out private provision. In Section 3 we give some information about the institutional characteristics that are important for the implementation of our empirical analysis. A detailed description of the data is presented in Section 4, while the empirical method and results are presented and discussed in Sections 5 and 6, respectively. Finally, some concluding remarks are given in Section 7.

2 Theoretical Model

Consider a market for institutional preschool education with potentially two providers: one private and one public. The private provider offers preschool services at quality q and price p. For simplicity, we take a short-term perspective by assuming that the quality level is fixed, making price the only choice variable of the private provider. The public provider offers preschool education for free (zero price). However, we assume that the quality of preschool is lower in the public provider. By normalizing the quality level in the public provider to zero, we can interpret p and q as the price

[4]There is also a related recent study by Owens and Rennhoff (2012), who examine competition between for-profit and nonprofit child care providers in four Tennessee counties and find no evidence that nonprofit providers crowd out for-profit ones.

and quality differences, respectively, between private and public preschool.

Demand for preschool services comes from two different segments, henceforth referred to as Segment A and Segment B. Both segments are characterized by unit demand, where each consumer demands either one unit of child care from the most preferred provider, or zero units if that is the utility-maximizing choice. Consumers in Segment A have homogeneous preferences and are characterized by relatively high willingness to pay for preschool education. For a consumer in this segment, the net utility of buying one unit of preschool education is given by

$$u_A = \begin{cases} v_A + q - p & \text{if} \quad \text{buying from the private provider} \\ v_A & \text{if} \quad \text{buying from the public provider} \end{cases} . \tag{1}$$

Consumers in Segment B, on the other hand, are characterized by a lower willingness to pay for preschool services, and we also assume that these consumers are heterogeneous with respect to the marginal valuation of quality. For a consumer in this segment, the net utility of buying one unit of preschool is given by

$$u_B = \begin{cases} v_B + \theta q - p & \text{if} \quad \text{buying from the private provider} \\ v_B & \text{if} \quad \text{buying from the public provider} \end{cases} , \tag{2}$$

where $v_B < v_A$ and θ is uniformly distributed on the interval $[0, 1]$. Although not explicitly modelled, a reasonable interpretation of the two demand segments would be that Segment A and Segment B consist of high-income and low-income consumers, respectively. We assume that there are n consumers in Segment A, while the total consumer mass in Segment B is normalized to 1.

In order to analyze the effect of public preschool supply on private enrollment, we will compare the equilibria under two different scenarios: i) a private monopoly and ii) a mixed duopoly with a private and a public provider. Public price and quality are exogenously given while we let the private provider optimally choose its price in order to maximize profits, which is given by

$$\pi = (p - cq)\, D, \tag{3}$$

where $c \in (0, 1)$ is a cost parameter and $D := D_A + D_B$ is total demand for the private provider, which is the sum of demand from Segment A (D_A) and Segment B (D_B). Notice that, since consumers in Segment A are perfectly homogeneous, demand from Segment A is either n or 0 (i.e., $D_A = \{0, n\}$), while demand from Segment B is a continuous function of the price charged by the private provider. Notice also that the cost of meeting higher demand increases with the quality of preschool services offered.[5,6] Finally, we assume that it is not possible for the private

[5]The restriction $c < 1$ is made to ensure the existence of equilibrium in the mixed duopoly case.

[6]In reality there might also be fixed quality costs. However, as long as quality is exogenously given such costs are

provider to price discriminate among different types of consumers.

2.1 Private Monopoly

The profit-maximization problem of the private provider involves choosing between a high-price strategy, which induces demand only from Segment A, and a low-price strategy which induces demand from both segments.

The optimal *high-price strategy* is to set the highest possible price that still makes consumers in Segment A willing to buy preschool services from the private provider. This price is given by

$$p_M^{high} = v_A + q. \tag{4}$$

At this price, no consumer in Segment B is willing to buy preschool services from the private provider. The corresponding demand and profits are

$$D_M^{high} = n \tag{5}$$

and

$$\pi_M^{high} = (v_A + q\,(1-c))\,n. \tag{6}$$

If the provider chooses a *low-price strategy*, demand from Segment B is given by $D_B = 1 - \widehat{\theta}_M$, where $\widehat{\theta}_M = \frac{p-v_B}{q}$ is the marginal utility of quality for the consumer in Segment B who is indifferent between buying preschool services or not from the private provider. Notice that consumers in Segment A are always willing to buy preschool from the private provider for any price that makes as least one consumer in Segment B willing to buy (i.e., any price which yields $\widehat{\theta}_M \in (0,1)$). Thus, the optimal price under a low-price strategy is given by

$$p_M^{low} = \arg\max\left\{\pi = (p-cq)\left(n+1-\left(\frac{p-v_B}{q}\right)\right)\right\} = \frac{q\,(1+c+n)+v_B}{2}. \tag{7}$$

The corresponding demand and profits are

$$D_M^{low} = \frac{q\,(1+n-c)+v_B}{2q} \tag{8}$$

and

$$\pi_M^{low} = \frac{\left(q\,(1+n-c)+v_B\right)^2}{4q}. \tag{9}$$

irrelevant for optimal pricing decisions and are therefore dropped.

Comparing (6) and (9) yields

$$\pi_M^{high} - \pi_M^{low} = \frac{2nq\left(2v_A - v_B\right) - q^2\left(1-c-n\right)^2 - 2qv_B\left(1-c\right) - v_B^2}{4q}. \tag{10}$$

From (10) it is easy to verify that the profit difference is monotonically increasing in v_A, and that $\pi_M^{high} - \pi_M^{low} < 0$ if $v_A \to v_B$. The following result follows straightforwardly:

Proposition 1. *A private monopoly provider will optimally choose a high-price strategy, serving consumers from Segment A only, if the difference in willingness to pay between the two demand segments is sufficiently high. Otherwise, the provider will choose a low-price strategy and serve consumers from both segments.*

This result is quite intuitive. If willingness to pay for preschool is sufficiently higher in Segment A than in Segment B, profits are maximized by setting a price so high that all consumer surplus is extracted from Segment A, at the cost of having no demand from Segment B. Otherwise, if the difference in willingness to pay is sufficiently small between the two demand segments, it is more profitable to adopt a low-price strategy and have demand from both segments. Formally, a high-price strategy is the equilibrium outcome for the parameter space defined by

$$v_A > \widehat{v}_A := \frac{v_B^2 + q^2\left(1-c-n\right)^2 + 2qv_B\left(n+1-c\right)}{4nq}. \tag{11}$$

2.2 Mixed Duopoly

In a mixed duopoly, the private provider still has a choice between a high-price and a low-price strategy, but under each strategy the optimal price differs from the corresponding optimal monopoly price. With a public provider in the market offering preschool at zero price, it is no longer feasible for the private provider to follow the same high-price strategy as under monopoly. If the private provider charges a price $p = v_A + q$, all consumers in Segment A would be strictly better off switching to the public provider (which would give these consumers a positive net utility of v_A) and this would leave the private provider with no demand.

In the presence of a public competitor, the optimal *high-price strategy* for the private provider would now be to set the price equal to the quality difference between private and public preschool:

$$p_D^{high} = q. \tag{12}$$

This would make all consumers in Segment A (weakly) prefer the private provider while the consumers in Segment B would choose the public provider.[7] Thus, the corresponding demand and

[7]Notice that, when public child care is offered at zero price, all consumers (in both demand segments) will buy

profits for the private center are

$$D_D^{high} = n \tag{13}$$

and

$$\pi_D^{high} = (1 - c)\, qn. \tag{14}$$

If the private provider chooses a *low-price strategy*, the consumer in Segment B who is indifferent between private and public child care is characterized by $\widehat{\theta}_D = \frac{p}{q}$. At this price, all consumers from Segment A prefer the private provider, so total demand for this provider is $n + 1 - \widehat{\theta}_D$. The profit-maximizing price under a low-price strategy is therefore

$$p_D^{low} = \arg\max \left\{ \pi = (p - cq) \left(n + 1 - \frac{p}{q} \right) \right\} = \frac{q\,(c + n + 1)}{2}. \tag{15}$$

At the optimal price, the indifferent consumer in Segment B is characterized by $\widehat{\theta}\left(p_D^{low}\right) = \frac{1}{2}\,(c + n + 1)$. Thus, an interior solution (i.e., $\widehat{\theta}_D \in (0, 1)$) requires that $n < 1 - c$. Otherwise, if $n > 1 - c$, profits are maximized by choosing the high-price strategy $p_D^{high} = q$, targeting consumers in Segment A only. Intuitively, a low-price strategy that targets consumers in both segments is optimal only if the segment with lower willingness to pay (Segment B) is sufficiently large relative to the other demand segment. The condition $n < 1 - c$ reveals that a necessary (but not sufficient) condition for a low-price strategy to be optimal is that Segment B is strictly larger than Segment A.

If the private center chooses the low-price strategy given by (15), demand and profits are given by

$$D_D^{low} = \frac{1}{2}\,(1 + n - c) \tag{16}$$

and

$$\pi_D^{low} = \frac{q\,(1 + n - c)^2}{4}. \tag{17}$$

We have already confirmed that a high-price strategy is always optimal if $n > 1 - c$. It remains to check whether a low-price strategy is always optimal for $n < 1 - c$. A comparison of (14) and (17) reveals that this is indeed the case, as

$$\pi_D^{low} - \pi_D^{high} = \frac{q\,(c + n - 1)^2}{4} > 0. \tag{18}$$

Thus, the mixed duopoly equilibrium can be characterized as follows:

Proposition 2. *In a mixed duopoly, the private provider will choose a high-price strategy, serving consumers from Segment A only, if $n > 1 - c$. Otherwise, if $n < 1 - c$, the private provider will choose a low-price strategy and serve consumers from both demand segments.*

child care from one of the providers.

2.3 Does Public Supply Crowd Out Private Enrollment?

Propositions 1 and 2, when seen in conjunction, reveal that we must distinguish among four different regimes when comparing private demand under monopoly and mixed duopoly.

Regime (i): $n < 1 - c$ and $v_A < \widehat{v}_A$.

In this regime, there is a relatively small difference in willingness to pay between the two demand segments, and Segment A is also relatively small compared with Segment B. The private provider will therefore choose a low-price strategy, targeting consumers in both demand segments, regardless of whether it faces a public competitor or not. The presence of a public provider will reduce the price of private preschool and also lead to lower demand for the private provider.[8] Thus, in this regime public preschool supply crowds out private enrollment.

Regime (ii): $n > 1 - c$ and $v_A < \widehat{v}_A$.

In this regime, the difference in willingness to pay is still small but the size of Segment A is relatively large. The private provider will now respond to public competition by switching from a low-price strategy to a high-price strategy. Sticking to a low-price strategy also in the presence of a public provider would push the optimal price down and lead to lower profits. If Segment A is sufficiently large ($n > 1 - c$), it is more profitable for the private provider to meet public competition by adopting a high-price strategy and only target consumers with relatively high willingness to pay. As in Regime (i), public child care supply crowds out private enrollment.

Regime (iii): $n > 1 - c$ and $v_A > \widehat{v}_A$.

If the number of consumers with high willingness-to-pay is relatively large, and if the difference in willingness-to-pay between the demand segments is also relatively large, the private provider will always adopt a high-price strategy, targeting consumers from Segment A only. The presence of a public provider will force the price of private preschool downwards, but demand for the private provider will remain constant, consisting of all consumers from Segment A. In this case, public preschool supply has no effect on private enrollment.

Regime (iv): $n < 1 - c$ and $v_A > \widehat{v}_A$.

The final regime to consider is the case where the difference in willingness to pay is relatively large, but consumers with high willingness to pay are relatively few. Because of the large difference in willingness to pay, the optimal pricing strategy for the private provider is a high-price strategy

[8]From (7)-(8) and (15)-(16), it is easily confirmed that $p_M^{low} > p_D^{low}$ and $D_M^{low} > D_D^{low}$.

in the absence of public competition. However, since the presence of a public provider pushes the price of private child care downwards, sticking to a high-price strategy is optimal only if the size of Segment A is sufficiently large. Otherwise, if $n < 1-c$, the private provider will optimally respond to public preschool supply by switching from a high-price strategy to a low-price strategy. This regime produces perhaps the most counterintuitive result, where public preschool supply *crowds in* private enrollment. The presence of a public provider forces the private provider to compete for consumers (in Segment B) who would otherwise not be profitable for the private provider to target. As a result, the demand for private child care increases.

The main results are summarized in Table 1 (tables and figures appear at the end of this paper) and in the final proposition of this theoretical section:

Proposition 3. *(i) If $n < 1 - c$ and $v_A < \widehat{v}_A$, public supply implies that the private provider maintains a low-price strategy and private enrollment decreases;*

(ii) If $n > 1 - c$ and $v_A < \widehat{v}_A$, public supply implies that the private provider switches from a low-price strategy to a high-price strategy and private enrollment decreases;

(iii) If $n > 1 - c$ and $v_A > \widehat{v}_A$, public supply implies that the private provider maintains a high-price strategy and private enrollment is unaffected;

(iv) If $n < 1 - c$ and $v_A > \widehat{v}_A$, public supply implies that the private provider switches from a high-price strategy to a low-price strategy and private enrollment increases.

3 Institutional Background

This section describes the institutional setting underlying the empirical analysis. We first outline the rules determining the allocation of federal transfers across Brazilian municipalities, then move on to describing the system governing the provision of formal preschool services.

3.1 Federal Transfers to Municipal Governments

Brazil has a highly decentralized system of government. Local governments receive large sums of public funds in the form of intergovernmental transfers, and they are responsible for an important share of public goods provision, notably in the domain of education and culture, health and sanitation, social assistance and local infrastructure.

A single federal fund−*Fundo de Participação dos Municípios* (FPM)−accounts for about 75 percent of all federal transfers and 40 percent of total municipal revenue. Established by the federal constitution, this fund consists of automatic federal transfers to municipal governments. At least 15 percent of total FPM transfers received by each municipality must be spent on education, and another 15 percent must be spent on health care, while the rest is unrestricted.

The rules governing the allocation of FPM transfers across municipalities provide unique features for our empirical analysis. In particular, the amount of FPM funds transferred to each municipality in a given year depends on population size in a discontinuous way. As discussed in detail below, these discontinuities provide a useful source of exogenous variation in municipal funds available to local governments, part of which must be spent on municipal education.[9]

The FPM allocation mechanism groups municipalities into population intervals. These intervals determine the coefficients employed to share total state resources earmarked for the FPM. Municipalities in higher population brackets have higher coefficients, and hence receive larger transfers. Each of the 26 federal states receives a different share of the total resources earmarked for FPM.[10] Thus, in a given year, two municipalities from the same state will receive identical transfers if they are in the same interval. Specifically, let FPM_{ikt} be the total FPM transfers received by municipality i in state k in year t. The revenue-sharing rule is:

$$FPM_{ikt} = \frac{FPM_{kt}\theta_i}{\sum_{i\in k}\theta_i} \tag{19}$$

where FPM_{ikt} is the amount of resources allocated to state k in year t, and θ_i is the FPM coefficient of municipality i based on its population size.

Due to sample size restrictions, we restrict our attention to municipalities with less than 50,940 inhabitants. These municipalities account for about 90 percent of Brazilian municipalities and 1/3 of the population. The provision of public goods and services in these locations is primarily financed by intergovernmental transfers from federal and state governments−local taxes represent only about 6 percent of fiscal revenue. Table 2 displays the FPM coefficients applied to each population interval. We focus our attention on the initial seven thresholds: 10,189; 13,585; 16,981; 23,773; 30,564; 37,356; and 44,148. The intervals between the initial three thresholds are equal to 3,396, whereas the intervals between the subsequent thresholds amount to twice as much (6,792). For symmetry, we exclude municipalities with less than 6,793 inhabitants.

The coefficient θ_i is assigned to a given municipality by *Tribunal de Contas União* (TCU) on the basis of population estimates for the previous year. These population estimates are calculated yearly by *Instituto Brasileiro de Geografia e Estatística* (IBGE), the national statistical institute. IBGE is independent from the government and employs a top-down approach in producing these estimates: municipal-level estimates must be consistent with state-level estimates; the latter must in turn be consistent with population estimates of the whole country (which draw on birth and

[9]The allocation mechanism described below does not apply to municipalities that are state capitals, which are therefore excluded from the analysis. See Mendes, Miranda and Cosio (2008) for a more detailed review of the institutional features governing the allocation of intergovernmental transfers in Brazil.

[10]The federal district (Brasilia) is excluded from the analysis because it contains only one municipality.

mortality rates, and net immigration between Censuses).

However, IBGE population estimates for a given year do not perfectly predict the FPM transfers that each municipality effectively receives in the subsequent year. As noted by Brollo et al. (2013), reasons for such discrepancies may include: i) imperfect adjustments of the coefficients assigned to municipalities that split during the period of analysis; and ii) other distortions in the application of the FPM allocation procedure, which is not audited.

3.2 Preschool Provision

According to Brazilian law, in the period of analysis preschool services were provided to children aged between 4 and 6. There are two types of preschool providers:

(i) Public preschool centers which are run either by the municipality or the state.

(ii) Private preschool centers which are run independently.

Public centers are financed by the public budget, predominantly at the municipal level, though a number of states have some state public preschool centers as well. Legal provisions mandate that parents seeking to enroll their children in public preschool must do so in a center that is located near their home. Enrollment in public centers is not subject to tuition fees, and these centers cannot reject children unless demand exceeds capacity. Private preschool providers are generally for-profit and have full discretion over tuition fees (INEP, 2002). The child care market remains highly unregulated. Although education authorities set minimum recommended standards on teacher qualifications and group size, centers were not bound by strict legal constraints on these variables.

4 Data

We use data for the period 2000-2006. The key variables of interest are federal transfers to municipal governments, and indicators on the supply and quality of municipal and private preschool. We describe each of these variables in detail below.

4.1 FPM Transfers

We use data on FPM transfers received by each municipality and IBGE population estimates (the key variables of the FPM revenue-sharing mechanism). Data on FPM transfers are made available online by *Tesouro Nacional*, while population estimates can be obtained on the IBGE website. Using these data, we apply the allocation rule described above to construct the "theoretical transfers" that each municipality should receive in each year. The amount of federal transfers that each municipality receives should be computed according to the IBGE population estimates sent to TCU in the previous year. Hence we use yearly population estimates for the period 1999-2005.

Table 3 reports summary statistics by population interval on actual and theoretical FPM transfers. We see that average actual transfers within intervals are closely aligned with theoretical transfers. We also see that municipalities in the proximity of the first four thresholds account for about 87 percent of the observations. Figure 1 plots actual and theoretical FPM transfers over the period 2000-2006 against the corresponding population estimates. The upper-left (lower-left) figure in this figure depicts effectively received (theoretical) transfers, while the seven vertical lines mark the position of the FPM population thresholds. The right panel displays similar associations, but where FPM transfers (actual or theoretical) are averaged over cells of 100 inhabitants, as well as the smoothed average of transfers (represented by the solid line) computed independently within each interval. All figures show clear discontinuities at the FPM thresholds. These are somewhat more noisy in the case of actual transfers, suggesting that there exist some cases where FPM transfers are imperfectly assigned to municipalities.[11]

4.2 Private and Municipal Preschool Centers

We use administrative data from *Censo Escolar* on municipal and private preschool centers and their inputs for the years 2000 to 2006. Censo Escolar is a compulsory yearly census conducted by the Ministry of Education, in conjunction with state-level education departments. This data set gathers information on the universe of public and private preschool centers in Brazil. In each year, it comprises data on enrollment, group size, and teacher qualifications. In addition, it collects information on the infrastructure and equipment of each center, such as whether it has adequate sanitation for preschool, a playground, and a refrigerator. To ensure that the information is reported accurately, inspections are conducted every year on a random sample of centers.

Table 4 shows descriptive statistics on municipal and private preschool centers in different population intervals. We see that, in the set of municipalities considered, municipal supply accounts for about 86 percent of enrollment and 88 percent of the number of centers. We also see that the proportion of enrollment accounted for by private providers tends to be higher in larger municipalities, reaching almost 20 percent of the total in the largest population intervals.

Table 5 reports summary statistics on the aforementioned quality indicators of municipal and private providers. Consistently with the theoretical model presented in Section 2, we see that private centers tend to have systematically higher quality indicators: group sizes are considerably smaller, the share of teachers with higher education is slightly higher, and they are more likely to

[11] Theoretical transfers exibit some heterogeneity within intervals due to the different share received by each state.

have a playground, adequate sanitation for preschool, and a refrigerator. We also see that quality indicators are fairly homogeneous across municipalities of different size.

4.3 Additional Data

To perform validity tests to our empirical strategy, we use additional data from IPEA on a number of time-invariant attributes of municipalities. These include the area of the municipality (in square Km), its altitude, latitude, and longitude, as well as the distances to the state and federal union capitals.

5 Empirical Method

Here we present the econometric strategy for examining the impact of FPM transfers on the supply of municipal and private preschool in Brazilian municipalities. As shown by Brollo et al. (2013), the allocation system of FPM transfers makes it possible to apply a (fuzzy) Regression Discontinuity (RD) design. A municipality will receive high versus low federal transfers (the treatment) depending on its population size (the running variable) in a stochastic manner, but the likelihood of being treated conditional on the running variable is known to have sizable discontinuities at multiple thresholds.

In the neighborhood of a given population threshold separating two population intervals of the FPM revenue-sharing mechanism, "theoretical" transfers sharply increase from a lower to a higher level. Theoretical transfers are therefore a step function of population (the running variable). Due to imperfect compliance or measurement error, transfers effectively received by municipalities may differ from theoretical transfers. Theoretical transfers can therefore be thought of as the treatment assignment and actual transfers as the observed treatment. In the neighborhood of the population thresholds, treatment assignment is exogenous, though the observed treatment may also be influenced by additional factors, such as the ability of local governments to sidestep the exogenous assignment rule. As long as actual transfers depend on theoretical transfers, however, we can use the latter as an instrument in a (fuzzy) regression discontinuity setup.

We estimate an equation of the form:

$$y_{it} = g(P_{it-1}) + T_{it} + \gamma_s + \delta_t + \mu_{it} \tag{20}$$

where y_{it} is the outcome of interest, $g(Pi)$ is a high-order polynomial in the population of the municipality in the previous year, T_{it} is the amount of FPM transfers received by municipality i in year t (instrumented by theoretical transfer), γ_s are state fixed-effects, δ_t are year effects, and μ_{it} the error term (clustered at the municipality level).

6 Empirical Results

6.1 Validity Tests

One potential concern about the validity of the fuzzy RD design we adopt is potential manipulation of the running variable−for example, if local governments were able to attract more inhabitants to obtain larger transfers, or manipulate the IBGE population estimates sent to the TCU. As we noted above, the way in which IBGE population estimates are constructed makes these sources of potential manipulation unlikely. Even if the official population figures released to obtain the transfers were subject to manipulation, the use of IBGE estimates (rather than TCU data) as an instrument would remove this problem.

We nevertheless inspect for manipulative sorting by performing balance tests (reported in Table 6) on several time-invariant municipal characteristics. In the presence of nonrandom sorting, some of these characteristics would likely differ systematically between treated and untreated municipalities around each threshold. The attributes we examine are the area of the municipality (measured in square Km) and its geographical location (altitude, latitude, longitude, and distances to the state and federal capitals). The balance tests are performed by testing for the presence of discontinuities in these attributes at the pooled thresholds. We consider all seven thresholds pooled, and also separately examine the four initial ones (for which we have a larger number of observations in the vicinity of each threshold). Reassuringly, we do not observe any significant discontinuity along time-invariant characteristics of municipalities. We can therefore use a fuzzy RD design as a (local) source of exogenous variation in the neighborhoods of the seven FPM thresholds considered.

6.2 FPM Transfers and the Provision of Preschool Services

In this section, we implement (20) to examine the impact of transfers on the provision of municipal and private preschool services. The first column of Table 7 reports the estimated first-stage coefficient on the relationship between theoretical transfers and actual FPM transfers. The point estimate is positive, smaller than one, and estimated with a great degree of precision. The fact that the coefficient is smaller than one might reflect measurement error, e.g., due to differences between IBGE population estimates and those used by TCU. In the second column, we see that theoretical transfers further exhibit a strong positive relationship with total federal transfers (not just FPM transfers) received by municipal governments. This evidence reassures us that the discontinuities of FPM transfers at the thresholds of interest are not offset by systematic changes in other federal transfers−as would be expected in the absence of other relevant policy discontinuities affecting the allocation of transfers around these thresholds.

In Table 8 we examine the effects of larger transfers on the quantity of municipal and private preschool, as measured by enrollment and the number of private centers. Panel A reports the effects on municipal supply. The first two columns report reduced-form regressions relating theoretical transfers to municipal enrollment, whereas the last two columns report results from IV specifications where theoretical transfers serve as instruments for actual transfers. We see that larger transfers increase significantly the number of and enrollment in municipal preschool centers. On average, a one-standard deviation increase in the amount of FPM transfers (8.84 hundred thousand reais) increases municipal enrollment by about 41 pupils (8.5 percent of average enrollment), and raises the number of centers by 2.56 (20 percent of the number of centers, on average). Taken together, these estimates suggest that the marginal municipal centers constructed with the extra FPM revenues tend to be smaller than the average center.

We now turn to the effects of larger transfers on the supply of private preschool (reported in Panel B). Since private suppliers operate independently, the amount of FPM transfers would not be expected to affect private supply other than via the observed expansion in public supply. We see that there is no robust evidence that an expansion of public supply crowds out private supply. If anything, there is some weak evidence that private enrollment increases: when looking only at the first four thresholds, we see a positive and weakly significant (at the 10 percent level) effect on private enrollment in preschool. If interpreted in the context of the theoretical model presented above, this evidence suggests that the difference in willingness-to-pay for preschool services between the demand segments is relatively large.

The results in Table 9 show the reduced-form and IV effects of larger transfers on quality indicators of municipal and private supply. We see that larger transfers—and the resulting expansion in public supply—have no significant impacts on the quality of private supply. This evidence is therefore consistent with the theoretical assumption we adopt that the quality level of private supply is fixed. In general, we also see no robust evidence that the expansion in municipal supply leads to systematic changes in quality indicators.

For robustness, in Table 10 we examine more directly the relationship between municipal and private supply, using theoretical transfers as instrument for municipal enrollment (Panel A) and municipal centers (Panel B). Once again, the estimates in this table do not show evidence that an expansion in public supply crowds out private supply.

7 Concluding Remarks

We have examined if and how an expansion in the supply of public preschool affects private provision. Using rich data for municipalities in Brazil from 2000-2006, we have used an RD design to exploit the fact that federal transfers received by local governments exhibit a non-linear and non-monotonic relationship with given population estimates. The results reveal that larger federal transfers lead to a significant expansion of municipal preschool, as measured by the number of centers and enrollment, but show no impacts on the quality or quantity of local private providers. These findings are consistent with a theoretical model in which households differ in willingness to pay for preschool services, and private suppliers optimally adjust prices in response to an expansion of lower-quality, free-of-charge public supply. In the context of the model, the absence of crowding-out effects of more municipal preschool providers can be rationalized by the existence of relatively large differences in willingness to pay for preschool services across different demand segments.

References

Baker, M., J. Gruber and K. Milligan. 2008. ”Universal Child Care, Maternal Labor Supply, and Family Well-Being.” *Journal of Political Economy* 116: 709–745.

Bassok, D., M. Fitzpatrick and S. Loeb. 2012. ”Does State Preschool Crowd-Out Private Provision? The Impact of Universal Preschool on the Childcare Sector in Oklahoma and Georgia.” NBER Working Paper 18605. Cambridge, United States: National Bureau of Economic Research.

Bastos, P., and J. Cristia. 2012. ”Supply and Quality Choices in Private Child Care Markets: Evidence from São Paulo.” *Journal of Development Economics* 98(2): 149-286.

Berlinski, S., S. Galiani and M. Manacorda. 2008. ”Giving Children a Better Start: Preschool Attendance and School-Age Profiles.” *Journal of Public Economics* 92: 1416–1440.

Berlinski, S., S. Galiani and P. Gertler. 2009. ”The Effect of Pre-Primary Education on Primary School Performance.” *Journal of Public Economics* 93: 219–234.

Brollo, F. et al. 2013. ”The Political Resource Curse.” *American Economic Review* 103(5): 1759-96.

Carneiro, P., and J.J. Heckman. 2004. ”Inequality in America: What Role for Human Capital Policies?” In: J.J. Heckman and A.B. Krueger, editors. *Human Capital Policy*. Cambridge, United States: MIT Press.

Cascio, E.U. 2009. ”Maternal Labor Supply and the Introduction of Kindergartens into American Public Schools.” *Journal of Human Resources* 44: 140–170.

Cohen, A., B. Freeborn and B. McManus. 2013. ”Competition and Crowding Out in the Market for Outpatient Substance Abuse Treatment.” *International Economic Review* 54(1): 159–184.

Cutler, D., and J. Gruber. 1996. ”Does Public Health Insurance Crowd Out Private Insurance?” *Quarterly Journal of Economics* 111: 391–430.

Gruber, J., and K. Simon. 2008. ”Crowd-Out 10 Years Later: Have Recent Public Insurance Expansions Crowded Out Private Health Insurance?” *Journal of Health Economics* 27: 201–217.

Havnes, T., and M. Mogstad. 2011a. ”No Child Left Behind: Subsidized Child Care and Children’s Long-Run Outcomes.” *American Economic Journal: Economic Policy* 3: 97–129.

Havnes, T., and M. Mogstad. 2011b. ”Money for Nothing? Universal Child Care and Maternal Employment.” *Journal of Public Economics* 95: 1455–1465.

INEP. 2002. ”A Educação Infantil no Brasil: 1994–2001.” Brasilia, Brazil: Instituto Nacional de Estudos e Pesquisas Educacionais, Ministerio da Educação.

Mendes, M., R.B. Miranda and F.B. Cosio. 2008. ”Transferencias Intergovernamentais no Brasil: Diagnostico e Proposta de Reforma.” Texto para Discussão 40. Brasilia, Brazil: Consultoria Legislativa do Senado Federal, Coordenação de Estudos.

Owens, M.F., and A.D. Rennhoff. 2012. ”Provision and Price of Child Care Services:

For-Profits and Nonprofits." Available at SSRN: http://ssrn.com/abstract=2149831 or http://dx.doi.org/10.2139/ssrn.2149831.

Paxson, C., and N. Schady. 2007. "Cognitive Development among Young Children in Ecuador: The Roles of Wealth, Health, and Parenting." *Journal of Human Resources* 42: 49–84.

Paxson, C., and N. Schady. 2010. "Does Money Matter? The Effects of Cash Transfers on Child Development in Rural Ecuador." *Economic Development and Cultural Change* 59: 187–229.

UNESCO. 2008. "The Six Goals: How Far Have We Come?" Chapter 2 in *Education for All Global Monitoring Report*. Paris, France: United Nations Educational, Scientific and Cultural Organization.

Table 1. Effect of Public Supply on Private Enrollment

	$n < 1 - c$	$n > 1 - c$
$v_A < \hat{v}_A$	$-$	$-$
$v_A > \hat{v}_A$	$+$	0

Table 2. FPM Coefficients

Population	FPM coefficient
Below 10,189	0.6
10,189-13,584	0.8
13,585-16,980	1
16,981-23,772	1.2
23,773-30,564	1.4
30,565-37,356	1.6
37,357-44,148	1.8
44,149-50,940	2
Above 50,940	2-4

Table 3. Actual and Theoretical FPM Transfers

Population	Actual transfers	Theoretical transfers	Obs.
6,793-10,188	13.91	13.11	5211
10,189-13,584	18.20	17.65	3982
13,585-16,980	22.48	22.28	2931
16,981-23,772	26.77	26.78	3931
23,773-30,564	31.12	31.17	2312
30,565-37,356	35.35	35.60	1412
37,357-44,148	39.55	39.80	907
44,149-50,940	43.81	44.43	542
Total	23.42	23.13	21168

Notes: Actual and theoretical FPM transfers are in hundred thousand Brazilian *reais* at 2000 prices.

Table 4. Preschool Supply

Population	Enrollment	# centers	Obs.
Panel A: Municipal supply			
6,793-10,188	240.09	7.14	5211
10,189-13,584	320.84	9.85	3982
13,585-16,980	409.75	12.21	2931
16,981-23,772	519.85	14.85	3931
23,773-30,564	691.08	17.52	2312
30,565-37,356	863.46	21.44	1412
37,357-44,148	1042.58	22.85	907
44,149-50,940	1245.77	25.60	542
Total	480.05	12.98	21168
Panel B: Private supply			
6,793-10,188	16.35	0.50	5211
10,189-13,584	32.65	0.87	3982
13,585-16,980	50.71	1.28	2931
16,981-23,772	78.35	1.88	3931
23,773-30,564	135.38	2.88	2312
30,565-37,356	192.72	3.90	1412
37,357-44,148	226.60	4.55	907
44,149-50,940	264.46	5.24	542
Total	75.54	1.71	21168

Table 5. Quality Indicators of Preschool Providers

Population	Group size	% teachers with higher education	Playground	Adequate sanitation	Fridge	Obs.
Panel A: Municipal supply						
6,793-10,188	23.64	0.22	0.24	0.25	0.62	5170
10,189-13,584	24.17	0.20	0.22	0.21	0.59	3936
13,585-16,980	24.34	0.20	0.21	0.21	0.56	2899
16,981-23,772	24.36	0.21	0.20	0.21	0.57	3901
23,773-30,564	25.18	0.20	0.21	0.20	0.57	2301
30,565-37,356	24.74	0.25	0.23	0.23	0.59	1397
37,357-44,148	24.67	0.25	0.26	0.24	0.64	903
44,149-50,940	24.75	0.27	0.26	0.25	0.66	540
Total	24.28	0.21	0.22	0.22	0.59	20982
Panel B: Private supply						
6,793-10,188	14.04	0.22	0.62	0.49	0.68	1874
10,189-13,584	14.53	0.23	0.67	0.56	0.71	2153
13,585-16,980	14.65	0.24	0.68	0.57	0.70	1834
16,981-23,772	15.51	0.24	0.69	0.60	0.72	3009
23,773-30,564	16.20	0.25	0.69	0.62	0.75	1970
30,565-37,356	16.33	0.27	0.71	0.64	0.75	1287
37,357-44,148	16.17	0.28	0.76	0.69	0.78	873
44,149-50,940	15.57	0.31	0.77	0.68	0.77	515
Total	15.26	0.25	0.68	0.59	0.72	13471

Table 6. Balance Tests of Invariant Municipal Attributes

	Area	Elevation	Latitude	Longitude	Distance to federal capital	Distance to state capital	Obs.
Thresholds 1-7	-47.643	0.737	0.001	0.000	0.334	-0.326	21,124
	[32.080]	[1.460]	[0.009]	[0.010]	[1.006]	[0.950]	
Thresholds 1-4	-21.432	0.516	-0.001	0.007	1.664	-0.357	18,321
	[24.250]	[1.790]	[0.011]	[0.013]	[1.198]	[1.150]	

Notes: Estimates from reduced-form regressions relating time-invariant municipal attributes to theoretical transfers. All regressions include a three order population polynomial, state and year fixed effects. Robust standard errors clustered at the municipal level in brackets. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 7. Actual and Theoretical Transfers

	FPM transfers	All Transfers	Obs.
Thresholds 1-7	0.804***	0.989***	21,168
	[0.010]	[0.040]	
Thresholds 1-4	0.753***	0.853***	18,365
	[0.012]	[0.037]	

Notes: Estimates from reduced-form regressions relating FPM transfers and all federal transfers to theoretical transfers. All regressions include a three order population polynomial, state and year fixed effects. Robust standard errors clustered at the municipal level in brackets. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 8. FPM Transfers and Preschool Supply

	Reduced form		IV		Obs.
	Enrollment	# centers	Enrollment	# centers	
Panel A: Municipal supply					
Thresholds 1-7	3.750**	0.232***	4.666**	0.289***	21,168
	[1.551]	[0.082]	[1.926]	[0.101]	
Thresholds 1-4	4.016***	0.187**	5.333***	0.249**	18,365
	[1.415]	[0.084]	[1.879]	[0.111]	
Panel B: Private supply					
Thresholds 1-7	0.831	0.000	1.035	0.000	21,168
	[0.702]	[0.011]	[0.874]	[0.014]	
Thresholds 1-4	1.045*	-0.002	1.387*	-0.003	18,365
	[0.559]	[0.011]	[0.743]	[0.015]	

Notes: Reduced form regressions relate the relevant outcome to theoretical transfers. In the IV regressions, theoretical transfers serve as instrument for actual transfers. All regressions include a three order population polynomial, state and year fixed effects. Robust standard errors clustered at the municipal level in brackets. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 9. FPM Transfers and the Quality of Preschool Supply

	Reduced form					IV					
	Group size	% teachers with higher education	Playground	Adequate sanitation	Fridge	Group size	% teachers with higher education	Playground	Adequate sanitation	Fridge	Obs.
Panel A: Municipal supply											
Thresholds 1-7	0.061	-0.001	0.002	-0.000	0.001	0.075	-0.001	0.003	-0.000	0.001	20,990
	[0.041]	[0.001]	[0.001]	[0.001]	[0.002]	[0.051]	[0.001]	[0.002]	[0.002]	[0.002]	
Thresholds 1-4	0.108**	-0.002*	0.003	-0.001	0.001	0.144**	-0.003*	0.003	-0.001	0.002	18,207
	[0.050]	[0.001]	[0.002]	[0.002]	[0.002]	[0.066]	[0.002]	[0.002]	[0.002]	[0.002]	
Panel B: Private supply											
Thresholds 1-7	0.010	0.000	-0.001	0.002	0.000	0.012	0.001	-0.002	0.003	0.000	13,471
	[0.036]	[0.002]	[0.002]	[0.002]	[0.002]	[0.045]	[0.002]	[0.003]	[0.003]	[0.003]	
Thresholds 1-4	0.043	-0.001	-0.003	0.004	0.001	0.058	-0.001	-0.005	0.006	0.001	10,840
	[0.049]	[0.002]	[0.003]	[0.003]	[0.003]	[0.066]	[0.003]	[0.004]	[0.005]	[0.004]	

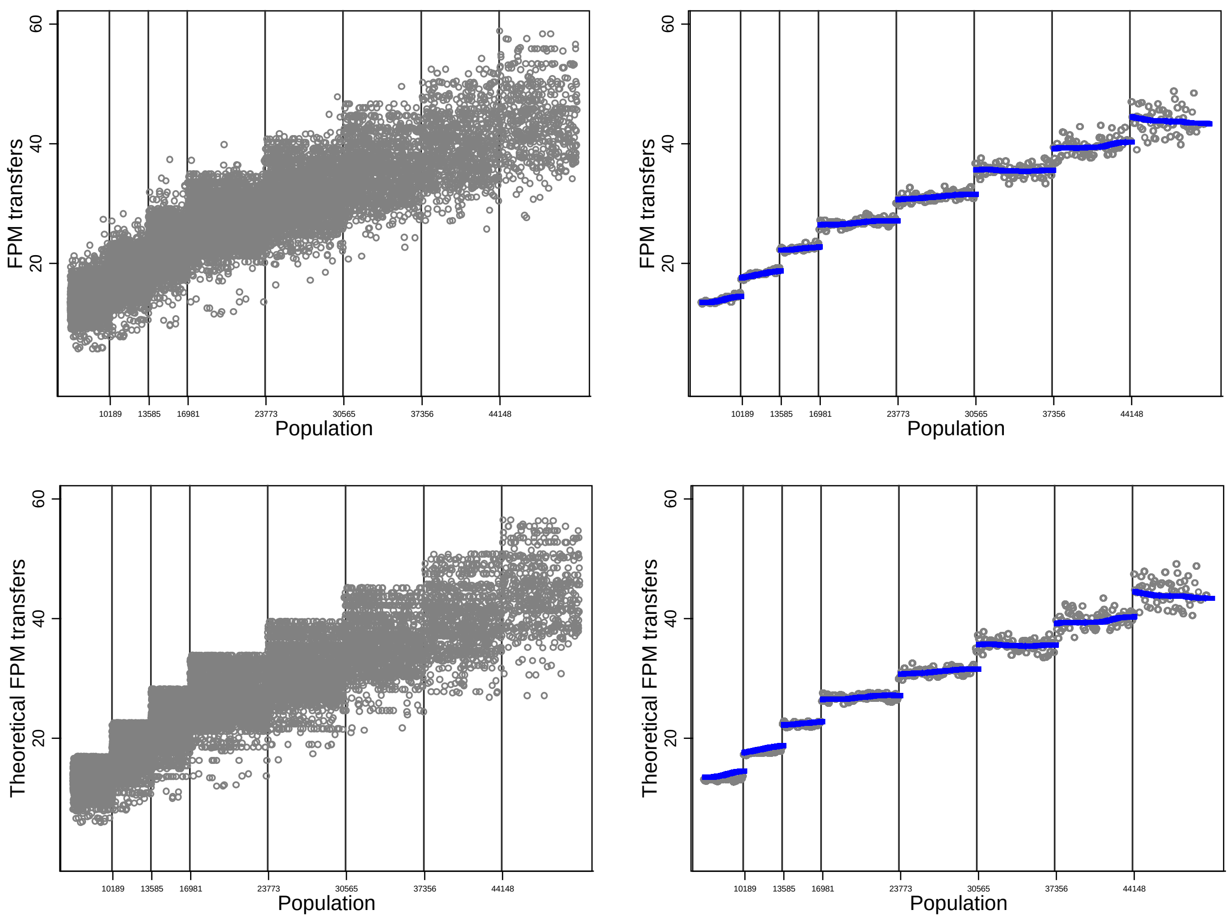
Reduced form regressions relate the relevant outcome to theoretical transfers. In the IV regressions, theoretical transfers serve as instrument for actual transfers. All regressions include a three order population polynomial, state and year fixed effects. Robust standard errors clustered at the municipal level in brackets. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Table 10. IV Estimates: Private and Public Preschool Supply

	Private enrollment	# Private centers	Obs.
Panel A: Municipal enrollment			
Thresholds 1-7	0.222	0.000	21,168
	[0.207]	[0.003]	
Thresholds 1-4	0.260	-0.001	18,365
	[0.167]	[0.003]	
Panel B: Municipal centers			
Thresholds 1-7	3.582	0.002	21,168
	[3.356]	[0.049]	
Thresholds 1-4	5.582	-0.012	18,365
	[3.961]	[0.061]	

Notes: Theoretical transfers serve as instrument for the measure of the size of public supply. All regressions include a three order population polynomial, state and year fixed effects. Robust standard errors clustered at the municipal level in brackets. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

Figure 1. Actual and Theoretical FPM Transfers



Notes: The upper left panel plots actual FPM transfers versus population size; the upper right scatterplot is averaged over 100-inhabitant bins plus running-mean smoothing performed separately in each interval between two thresholds. The lower left panel plots theoretical FPM transfers versus population size; the lower right scatterplot is averaged over 100-inhabitant bins plus running-mean smoothing performed separately in each interval between two thresholds.