

Does Free Childcare Improve Mothers' Careers?

Evidence from São Paulo

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Abstract

Latin America consistently has some of the largest child penalties for female work globally, and, while subsidized childcare is often advanced as a remedy, the literature on its effectiveness is scarce in this context. This paper estimates the impact of a rapid expansion of public childcare on mothers' careers in the city of São Paulo. We leverage the rollout and expansion of childcare facilities, coupled with detailed data on the labor market and household characteristics to identify effects on mothers' labor force participation and earnings. Using a difference-in-differences approach, we compare the child penalty in districts that experienced a large and rapid expansion of childcare with districts with no significant expansion. Our results show that an additional seat per child leads to an increase of 6.7 p.p. (20%) in the mothers' formal employment after the first child's birth. We do not detect any effect of this expansion on mothers-to-be or fathers. Effects are stronger for low-education mothers and in areas with more women as household heads.

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1 Introduction

Recent evidence shows that the contribution of the child penalty to the total gender gap increases with countries' incomes, suggesting that the child penalty will become more relevant as middle income countries develop, and, thus, that policies to address this issue are in particular need (Kleven, Landais, and Leite-Mariante [2023](#)). Despite the growing literature, there is still scant evidence about the effects of childcare in developing countries. Furthermore, Latin America as a whole consistently has some of the largest child penalties in the world, and urban areas tend to have higher penalties. While women in much of the developing world rely on informal family ties for childcare, rapid urbanization separates many households from extended families, denying them this option. The demographic transition to smaller families also drive more demand for institutional childcare options, since childcare from extended family and siblings becomes scarcer. As women increasingly work outside the home in developing countries, there is growing demand for evidence on how best to support families.

Subsidized childcare is often proposed as a way to address gender inequality at work, but the literature has found mixed, often null, results. Research over the last decade has shown that a large part of the earnings gender gap is explained by the dip in female labor-force participation after childbirth – the child penalty (Kleven, Landais, and Søgaaard [2019](#)). This finding suggests cheap childcare provision may have a crucial effect on maternal labor supply. While some studies of childcare provision have shown positive effects, many others have found null results (Kleven, Landais, Posch, et al. [2020](#)).

In this paper, we study the impact of a large expansion of free public childcare in Sao Paulo, Brazil, on the child penalty. This expansion took place from about 2008 to 2018 and increased the number of seats per child from roughly 20% to close to 70%. We estimate the effects using a difference-in-difference design that leverages the expansion

roll-out, accounting for heterogeneous effects. To do so, we use data from three matched administrative datasets that provide information on childcare coverage over time, formal employment and earnings, and household characteristics. We find an additional seat per child increases nearby mothers' formal employment by 6 p.p. (20%) and total earnings by 20% following the birth of a first child. We find null effects for mothers-to-be, a demographically similar group that should not be affected by the policy. We also find no effects on fathers using the same strategy.

Free childcare provision can be life-changing for mothers, especially those from low socioeconomic backgrounds. In our context, the need for this service is reflected in the long wait-lists. Public childcare is a full-time, free service, allowing mothers to work. Without this option, many women may find they cannot count on other forms of childcare and be forced to drop out of the workforce. The human capital loss during time away from work can make it challenging to find a job, even after children are old enough to attend preschool. Often, the viable alternatives are informal arrangements with neighbors or relatives, often in precarious situations. Moreover, public childcare facilities also provide free meals, potentially helping alleviate common issues of malnutrition in Brazilian children.

In response to the high demand, free public childcare coverage in Sao Paulo increased from 20% to 70% between 2006 and 2018. This rapid expansion, following a new city administration, was achieved mainly through partnerships with private-sector childcare providers. This new model increased flexibility in location and hiring regulations, which allowed the rapid opening of new facilities, sometimes in a matter of a few months. A centralized system matches families to facilities, preferentially in the same districts where they live, on a first-come first-served basis.

To measure mothers labor outcomes and access to childcare and their labor out-

comes, we combine three administrative datasets. First, the São Paulo Department of Education provides data with the opening date of each childcare facility, the number of seats and the location. Second, in order to study labor market outcomes, we use data from RAIS, an administrative panel containing information on all formal employer-employee links in the country. Third, we are able to match these two datasets through the Single Registry (Cadastro Único), an administrative dataset with the universe of families receiving any government benefit. The Single Registry allows us to observe families' characteristics, including their address and date of birth of each household member.

Our empirical strategy exploits the timing of roll-out of large expansions in childcare in Sao Paulo across districts, in a dynamic differences-in-differences framework. Although practically every district saw some increase in childcare availability over the period, we can identify periods of discrete increases in particular districts. We define the year when the first facility opened as the expansion year if that happened during our sample period. Otherwise, we use the year with single largest increase in seats in each district, and consider the district treated if the growth is in the top quarter of the distribution. If the largest growth in a district is in the bottom quarter, we consider it a control district. We drop the intermediary districts from the analysis. To address the concerns raised by the recent literature on staggered adoption with heterogeneous treatment¹, we estimate our parameters of interest following Callaway and Sant'Anna (2021). We also obtain similar results with a fixed-effects based strategy, close to that of (Kleven, Landais, Posch, et al. 2020), that does not necessitate the identification of discrete expansion periods and uses all variation in childcare availability.

Our results show that free childcare leads to a significant and persistent reduction on the child penalty. We find that an expansion episode results in an extra 0.33 seat per child, and an average increase of 2 p.p. in the mothers' labor force participation after the

¹See Chaisemartin and D'Haultfoeuille (2019) for a summary.

birth of the first child. These figures imply each additional seat per child is associated with a 6.6 p.p (20%) increase in mothers' employment. Similarly, total annual earnings are increased by 490 BRL (20%). We do not find any evidence that pre-existing differential trends for mothers in the labor market drive our results. As a placebo test, we show that the expansion of childcare did not affect mothers-to-be, a demographically similar population that should not be affected by childcare. We also do not find any effect for fathers. Although we not have sufficient power to detect heterogeneity in effects, but we find suggestive evidence that the effects are stronger for mothers' with lower education and in areas with a higher share of female household heads.

This paper contributes to the literature on childcare on mothers' labor market outcomes. A first wave of studies exploits quasi-experimental variation in the roll-out of public childcare effects on mothers' labor outcomes, finding mixed results (Baker, Gruber, and Milligan 2008; Berlinski and Galiani 2007; Bauernschuster and Schlotter 2015; Bettendorf, Jongen, and Muller 2015; Havnes and Mogstad 2011). A more recent wave of studies uses variation in both the timing of birth and in geographical rollout to compare outcomes between mothers with and without access to subsidized care, before and after childbirth (Kleven, Landais, Posch, et al. 2020). Identification is more credible in this case because the strategy can deal with time-varying unobservables correlated with childcare availability. Despite the methodological improvements, this second wave also finds mixed results. This paper fits in this second strand of literature, to which we add a focus on a large city in a developing country, a context we argue is particularly suitable for this policy.

This paper is closely related to Attanasio et al. (2022), which analyses a similar context to ours, in the city of Rio de Janeiro, through a randomized trial. Our paper evaluates a non-randomized evaluation of a naturally occurring childcare expansion, while they provide RCT evidence in a context where availability was considerably lower and

remained roughly constant over time. They find positive effects for grandparents and older siblings and no effects for parents, possibly highlighting contextual differences to our setting.

This paper is organized as follows. In Section 2, we present the background and describe the childcare program in Sao Paulo. Section 3 details the data used in this paper. We explain the methods in Section 4 and Section 5 presents the results. Finally, Section 6 concludes.

2 Setting

To assess the impact of free childcare on the child penalty, we study the expansion of public childcare in Sao Paulo, a city proper of 12 million people. In this context, female labor force participation is relatively high compared to much of the developing world, including the rest of Brazil, leading to high demand for childcare services. As a response to this high demand, the municipal government prioritized increasing childcare availability, leading to the share of children enrolled in public childcare going from 20% to 70% between 2007 and 2018. This expansion happened while maintaining relatively high-quality of the service, provided preferentially to families within the same district and giving priority to the poorest. One key factor that made the expansion possible was the intense use of public-private partnerships with educational NGOs.

As in other developing countries, women’s labor force participation in Brazil has increased substantially over the last few decades. From 1992 to 2012, the share of 15 – 59 year-old women working rose from 52% to 61% (Barbosa 2014), reaching rates similar to that of developed countries. Although Brazilian women often rely on informal family ties for childcare, in large cities many households are separated from extended families

due to the fast urbanization and migration. Sao Paulo, in particular, is a dynamic labor market, attracting economic migrants from other areas, and where a high proportion of mothers work outside the home (73.3% in 2019). These factors, combined with low stigma against women’s work outside the home (Chioda and Verdú 2016), result in high demand for public childcare.

In response to the large demand for public childcare and motivated by a change in the childcare administration, the city administration started to expand this service. In 2010, about 30% of children were enrolled in publicly funded childcare, and the wait time for a seat could exceed 400 days. Since then, the provision of free public childcare in Sao Paulo increased by a factor of more than 2.6 until 2018, as shown in Figure 1. This rapid expansion was achieved almost exclusively through partnerships with private sector childcare providers. Figure 1 shows that the number of seats provided under the partnership model more than tripled in the period. Meanwhile, provision increased only very slightly in the direct municipal provision. The number of exclusively private providers has also remained flat over the period.

Under the partnership model, the city government contracts with specialized non-profits to provide childcare services. The government guarantees the physical space (usually rented) while the service provider has flexibility to make administrative decisions, including hiring and firing caretakers. The quality standards are the same under direct public provision, and are relatively high. The city stipulates a maximum ratio of children for each provider, depending on age. Public childcare facilities work five days a week, covering 10 hours between 7am and 7pm, except for a reduced schedule during school breaks. Besides daycare activities, like physical play and reading, the facilities also provide free regular meals, helping prevent malnutrition among the poorest children.

The rules for allocation of seats in the childcare system imply that the relevant

geographical unit of analysis is the educational district. To rationalize the enrollment process, in 2006 the city’s administration implemented a centralized online system. In this system, parents request a spot for their child and an algorithm matches them to a facility with available seats in the same educational district where they live. If there is no availability, they may be matched to a neighboring district with excess capacity, or enter a wait-list. Poorer families receive priority in the wait-list.

This centralized system also allowed the municipality to identify places with an excess demand for public childcare, and better direct the expansion efforts. Figure 2 shows the enrollment rates in different districts over time. While almost every district had some increase in enrollment, the largest gains happened in the relatively poorer peripheries. Mothers in these areas are much more likely to be unable to afford childcare services and to depend on wage income, besides being farther from most jobs in the city, and therefore place a high value on public childcare.

3 Data

To study the effect of childcare on mothers’ formal employment we match childcare information from the Sao Paulo Department of Education to employment records in RAIS. The match is possible at the district level, using detailed information on family addresses from Single Registry as an intermediate match. We also observe a family roster and several demographic and social characteristics in the Single Registry.

3.1 Education

Our data on childcare provision comes directly from the Sao Paulo city government, available at the city’s open data portal.² There we observe the contracts and opening dates of all childcare facilities, as well as location and number of seats available. As shown on Section 2, the availability of childcare increased by about 50 percentage points between 2007 and 2018 throughout the city, particularly in the peripheries.

In order to study the effects on the children, we use data from the School Census and the Prova Brasil. Prova Brasil is a standardized exam administered in the fifth grade, covering math and Portuguese language. While it is not possible to link students between datasets to correlate individual performance with childcare enrollment, we are able to use childcare availability at the same district as the school as a proxy for the probability the students used childcare.

To obtain data on population per school district and other demographic data at this level, we do a spatial merge of Census tracts and school districts. Since these areas are not designed to be exactly compatible, where necessary we assign population to different educational sectors proportionally to the area overlap.

3.2 Single Registry

We use data from the Single Registry (*Cadastro Único*) for two main purposes: linking school districts to labor outcomes in the RAIS and observing family characteristics. The Single Registry is a federal registry used for several social programs to verify eligibility and track recipients over time. It started exclusively as Bolsa Família’s administrative database but evolved through the years to be the primary federal dataset on poverty.

²<http://dados.prefeitura.sp.gov.br/>

Currently, more than 20 social programs use it, covering virtually all of Brazil’s poor (Campello, Neri, et al. 2013). Single Registry aims to include all households with income per capita below one-half of the minimum wage (R\$3060 in 2010), which is much higher than the poverty threshold (R\$1680 in 2010).

To be eligible for any government benefit that uses Single Registry, families must have a valid registration (complete and up-to-date), updated at least every two years. They must undergo interviews with local government agents, including a standardized questionnaire on their earnings, living conditions, demographic and occupational characteristics, and personal tax id (CPF). They have to inform authorities of relevant changes to family size or income.

We use a December 2017 extraction from Single Registry to construct the primary analysis dataset in this paper. We start with the 3 million individuals with addresses in São Paulo and identify potential mothers. We classify as mothers all women between 25 and 47 years of age, listed as household heads or spouses to the household head and whose family contains at least one child of 13 years of age or less. Out of the initial 3 million individuals, 549,763 are classified as mothers.

3.3 RAIS

The Annual Account of Social Information (Relação Anual de Informações Sociais, RAIS) is a longitudinal dataset of social security records for employees and employers. It is collected by the Ministry of Labor in a compulsory survey of all firms and their registered workers, covering around 230,000 formally registered firms and over 3.5 million workers annually. RAIS provides information on workers’ demographics (age, gender, schooling, race), job characteristics (occupation, wage, hours worked), hiring and termination dates, and the personal tax id (CPF). It also includes information on many firm-level character-

istics, notably the number of employees, municipality, firm tax id, and industry code.

We built a panel of formal workers from 2011 to 2018, amounting to 159 million worker-year observations in Brazil. We do not restrict our data on workers to São Paulo because some residents may have jobs in other municipalities. We match the sample of mothers in São Paulo obtained in Single Registry to this panel of workers through their tax id. Out of the 156 million worker-year observations, 2.1 million are matched to our Single-Registry-based dataset of mothers in São Paulo. If we find a woman at least once in RAIS, we can re-construct her formal employment history. If we do not see her any year, then we know she has never worked in the formal sector. Our measure of employment is a dummy indicating if the woman appears in the RAIS dataset in that year with at least one job reporting a non-zero amount of hours per week. We also obtain average yearly wages and hours worked from RAIS.

Figure 3 shows the share of women working in the formal sector relative to the birth of their first child. At the year of the child’s birth, there is a drop of about 13 p.p. on the share of women employed in the labor market (from 55% to 42%), increasing to 45% three years after birth, and it remains constant the following years.

3.4 Descriptive statistics

Table 1 shows descriptive statistics for mothers-to-be (panel 1), mothers (panel 2), fathers-to-be (panel 3), fathers (panel 4) and average district characteristics (panel 5).

The data show a large child penalty for women, accompanied by a small reduction in hours. Comparing mothers 1 year after childbirth to 1 year before, the dip in labor force participation is of 11 p.p., with total earnings falling by a third. The fall in earnings is mostly explained by lower employment, together with a reduction in the average number

of hours conditional on working. There is no reduction in hourly wages conditional on work.

Unsurprisingly, men in the sample work and earn considerably more than women. Fathers-to-be have a higher participation in the formal sector (57%) compared to mothers-to-be (44%), and they see only a very small dip after childbirth, that could be explained by overall labor market trends. All measures of labor market participation and wages are higher than those of women. As a result, women earn 54% as much as men before childbirth and 34% after childbirth. Our sample includes substantially fewer fathers than mothers, due to a large fraction of single mothers, leading to lower precision in those estimates.

4 Empirical Strategy

We analyse the effect of childcare provision on mothers’ labor market outcome using two complementary strategies. First, we follow Callaway and Sant’Anna (2021) in estimating treatment effects in a dynamic differences-in-differences context. To do so, we define a “time of treatment” for each district based on large expansions in childcare availability. While this approach deals robustly with concerns over heterogeneous treatment effects, choosing a specific time of treatment can be somewhat arbitrary in our context and does not make full use of the variation in the data. Therefore, we also present results in a fixed-effects framework that takes advantage of the full variation in the data.

4.1 Differences in Differences

To study the effect of childcare on mothers’ labor market outcomes, we employ a dynamic difference-in-differences strategy. The treatment is a large increase in availability of child-

care during one period, defined as the number of seats per child in the 2010 Census. We compare the evolution of outcomes in treated districts with districts where there was only small or no expansion between any two consecutive years. This approach lets us deal with some of the main challenges to identification. It allows for targeting of e.g. districts where women are more likely to want to work outside the home, as long as districts labor markets follow parallel trends, absent childcare availability.

We define the treatment as happening in the year of the largest expansion for each district. For each district, we compute the largest annual growth in seats available the sample. If this largest growth was small relative to other districts (bottom 40%), we consider it never treated, while those with large increases (above top 40%) are treated. For the districts where the first facility was opened in a given year, we attribute that year as the year of the expansion and consider them treated. All other districts are dropped from the sample, i.e. those between percentiles 40 and 60.

Recent evidence suggests that “staggered access” estimations might be biased by heterogeneous effects over time (Callaway and Sant’Anna 2021; Chaisemartin and D’Haultfoeuille 2019). To address this concern, we estimate the parameter of interest following Callaway and Sant’Anna (2021). Formally, adopting their notation, denote by C the group of districts that did not had a large expansion between any two consecutive years, and by G_g the group of districts that had a large expansion at some point in the study period. Let g indicate in which period each district expanded childcare. Let e denote event-time, i.e., $e = t - g$ denotes the time elapsed since treatment was adopted. Our parameter of interest is given by

$$\theta(e) = \sum_{g \in \mathcal{G}} \mathbf{1}\{g + e \leq \mathcal{J}\} P(G = g | G + e \leq \mathcal{J}) ATT(g, g + e) \quad (1)$$

where

$$ATT(g, t) = E[Y_t - Y_{g-1} | G_g = 1] - E[Y_t - Y_{g-1} | C = 1]$$

and $P(G = g | G + e \leq \mathcal{J})$ indicates the probability of being treated for the first time at time g .

Thus $\theta(e)$ is the average effect of expanding childcare e time periods after the treatment was adopted across all districts that are observed to have ever participated in the treatment for exactly e time periods. The key identification assumption is parallel trends. We cluster the standard errors at the district level, and weight the observations by the district's population.

This procedure seems to capture a real feature of the expansion process, a somewhat lumpy growth concentrated in a few places each year. Figure 4 shows the evolution on childcare availability over time for the control group, and for groups treated each year. It is clear that each group shows a marked increase in the period we designate as the treatment period, substantially larger than any other in most cases. Meanwhile, the control group shows only a very modest increase in available seats throughout the period. However, there is also a general upward trend in all groups, and several show considerable increases during other years, particularly for the later years.

To deal with this complication and to allow a natural interpretation of the results, we estimate the effects of an expansion on the number of seats per child over time. We interpret this parameter as a first stage and use it to re-scale the labor market effects. The resulting estimates are interpreted as effects of childcare availability on labor market outcomes.

One potential challenge to our strategy is endogenous migration. If families that place a higher value in access decide to move to areas with higher availability of childcare,

that could be driving our results. To deal with this issue, we record families in their location in the Single Registry in the year 2017 and keep it constant over time. This choice rules out any effects through endogenous migration, at the cost of potentially adding error to families' location, and thus biasing the effects towards zero.

4.2 Alternative Strategy

Our main strategy has some important limitations. One issue is that we do not make full use of available data, in two main ways. First, because we drop districts that had a median increase in childcare availability, and thus are not included neither in the treatment nor in the control groups. Second, because identification does not take into account smaller increases in childcare availability that are also informative. Another issue is that the definition of an expansion is somewhat arbitrary. Finally, when we analyse outcomes for mothers it is possible that the effects are, at least in part, driven by shocks to the local labor market that affect all workers and are correlated with childcare expansion.

In this session we provide an alternative strategy that deals with these concerns. In this alternative approach the identification of the effect of childcare availability is coming from a comparison between mothers and mothers-to-be in the same district. Intuitively, we look at how the child penalty evolves as childcare availability increases in a given district. Under the hypothesis that mothers-to-be labor market outcomes are not affected by the presence of childcare, we can identify effects even if childcare investments are correlated with arbitrary labor market trends, as long as these trends affect women irrespective of motherhood status. We do not rely on identifying particular periods as expansions and treat all changes in childcare availability equally.

To fix ideas, let us consider a single district, where childcare availability increased over time. Supposing we observe employment for mothers and mothers-to-be. In this

context we can identify the effect of childcare availability using a continuous dif-in-dif strategy, with periods before and after, mothers as the treated group, and mothers-to-be as the comparison group. Let us denote mothers by $m = 1$ and mothers-to-be as $m = 0$. Then:

$$Y_{m,t} = \alpha + \beta \cdot Availability_t \cdot 1_{m=1} + \gamma_{m=1} + \delta_t + u_{m,t}$$

In this case, β identifies the effect of childcare under the usual dif-in-dif assumption of parallel trends. The SUTVA assumption implies that mothers-to-be cannot be affected by childcare availability, either by anticipation or general equilibrium effects.

In our alternative strategy, we build upon this simplified model in two ways. First, instead of the binary mothers or mothers-to-be, we use time since childbirth (τ), allowing childcare to have different effects depending on the age of the child. Second, we stack the all the different districts, with all fixed effects being fully flexible between districts. With i denoting an individual and t a year, let:

$$Y_{d,t,\tau} = E[y_{i,t} | \text{district} = d, \text{time since childbirth} = \tau]$$

Then, the estimating equation is:

$$Y_{d,t,\tau} = \alpha_{d,\tau} + \sum_{\substack{k=-4 \\ n \neq -2}}^6 \beta_k Availability_{d,t} \cdot 1_{\tau=k} + \gamma_{d,t} + \varepsilon_{d,t,\tau}$$

In this regression, any stable, pre-existing local patterns in the child penalty that are not related to childcare availability are captured in $\alpha_{d,\tau}$, e.g., areas where mothers are particularly unlikely to work because of lack of access to jobs. Any local labor market shocks or trends that are common to all women irrespective of motherhood status are

captured in $\gamma_{d,t}$. Availability of childcare increases the proportion of women working at a rate that depends on the age of the child, β_τ : we expect a coefficient of zero for $\tau < 0$ and a positive coefficient for $\tau \geq 0$.

Since childcare availability varies only with (d, t) but not τ , we need to choose a comparison group, against which the effects of availability are defined, just as we did in the simplified example above. We use $\tau = -2$ as the reference, and therefore, assume childcare availability has no effect on women two years before having their first child.

5 Results

5.1 Main effects

Using a dynamic difference-in-difference strategy, we find that an additional seat per child leads to an increase of 6.7 p.p. in mothers' labor force participation after the birth of the first child, or a 20% increase, with a corresponding increase in mothers' yearly total earnings of the same magnitude. We do not find any evidence that pre-existing differential trends in the labor market drive our results. As placebo tests, we show that the expansion of childcare did not affect mothers-to-be or fathers, two populations that should not be affected by childcare. Heterogeneity analysis is somewhat underpowered to detect meaningful differences in treatment effects, but we find suggestive evidence that effects are larger for less educated households and in districts with a higher share of female household heads.

First, we find that, as expected, a childcare expansion strongly increases availability. Figure 5 shows the effect of childcare facilities opening on the number of seats per child over time. We observe a very small but statistically significant difference in the

years before the expansion, indicating a small degree of pre-trends in childcare availability. However, the expansion results in a large immediate increase in childcare, with continuing subsequent growth. Right at the time of opening, there is an increase of about 0.26 seats per child, that increases gradually to about 0.75 after 10 years. Averaging across years 0 to 10 after treatment, the effect is 0.45 seats per child, statistically significant at 1%.

Figure 6 shows the effects of childcare expansion on formal employment and earnings for mothers of children from 0 to 3 years relative to the time of expansion of childcare. Before the treatment, the treated and control groups have no statistically significant difference, and the parallel trends assumption seems to hold. One year after the expansion, there is a statistically significant increase in the share of working mothers of close to 1 p.p., that increases over time to about 3 p.p. in 10 years, with an average effect of 1.7% in the post period. Re-scaling this effect by the effect on seats implies that each additional seat available increases maternal employment by 0.038. The effects on earnings show a similar pattern, with modest gains at first increasing over time. The magnitudes are fairly modest, consistent with effects begin driven by the extensive margin in a population earning the Brazilian minimum wage.

As a placebo test, we estimate the same model using the labor market outcomes among women who are not mothers, but will have have a child in 1-5 years. If our results are driven by a correlation between general labor market trends and childcare expansions, we would expect to see a similar pattern for women who are not mothers. Since these women will become mothers within a few years and are drawn from the same population, they are demographically very similar, other than being younger. Figure 7 shows the results. In contrast with the results for mothers, we see no increase in employment or earnings for mothers-to-be. We cannot reject equality of effects year-by-year due to fairly large errors.

Finally, we estimate the effect on fathers. There are theoretical reasons for fathers' labor market choices to be affected by changes in the overall labor supply in the household. However, in this context, the employment rate for fathers tend to be very high, and it is unlikely that childcare will have an appreciable effect. Figure 8 shows that estimated effects are not statistically significant either in employment or earnings, although precision is very low in this case.

In order to obtain more precisely estimated effects, we collect and average the effects over time into a “Pre” and a “Post” effects. Table 2 presents the estimates. On average, over the first 10 years, the effect of an expansion is an increase of 20 p.p. in the probability that mothers' work, corresponding to an extra 200 BRL per year. Re-scaling by the 0.41 effect on seats per child means that one additional seat corresponds to 0.49 mothers employed, earning an extra 487 BRL per year.

As expected from the period-by-period figures, the average effects for mothers-to-be and for fathers are not statistically significant. The estimated effects on mothers-to-be are indeed much smaller and outside the confidence interval of the estimates for mothers. Effects for fathers, however, still have very wide confidence intervals, and effects on earnings are of a similar magnitude as the ones for mothers.

5.2 Heterogeneity

In this session we investigate potential mechanisms by splitting our sample of mothers by migration status and educational attainment. We expect migrants to be more sensitive to increased public childcare availability due to being likely separated from extended family and neighbors. We also expect lower education mothers to be more strongly affected. We do find a larger effect on migrants, but education heterogeneity is inconclusive.

Figure 9 and Table 3 Panel A show estimated effects for migrants and natives. We define migrant mothers as women who were not born in Sao Paulo, no matter how long they lived there. These people are less likely to have extended family networks they can use for informal childcare, and so may be more sensitive to public childcare availability. The results give only weak support to this hypothesis. While estimated effects are indeed higher for migrants, both in employment and earnings, the differences are relatively small and not statistically significant.

Similarly, Figure 10 and Table 3 Panel B presents the estimates for mothers with high and low levels of education. High education is defined as having completed high school. Overall, the results are very similar in magnitude and do not support significant differences by education.

5.3 Fixed Effects Estimation

As an alternative strategy, we estimate the effect of childcare availability directly in a fixed-effects regression. Figure 11 shows the results. Each bar shows the estimate of an increase of 1 seat per child on mothers (in orange) and mothers-to-be (in blue) by time relative to childbirth. The coefficient one year before childbirth is zero by assumption.

Consistent with previous findings, we find null effects for each of the years before childbirth, indicating no effects on mothers-to-be. We also find positive effects for all years after childbirth. The effects do not seem to fade over time for either employment or earnings. The magnitude of the effects on employment is larger than what we find using differences-in-differences. This may be explained by the fact that this strategy takes any changes in childcare availability into account, not only changes during expansion years. Since some places do see substantial increases in subsequent years, those are also important for identification.

6 Conclusion

This paper explores the impact of a significant expansion of free public childcare on the child penalty and maternal labor market outcomes in Sao Paulo, Brazil. We contribute to the growing literature on the effectiveness of free or subsidized childcare as a remedy for the motherhood penalty at work. Employing a dynamic differences-in-differences framework and leveraging administrative datasets, we add to the literature by shedding light on the effects of childcare provision in a developing country context.

The findings reveal moderate and persistent reductions in the child penalty following the expansion of public childcare. An additional seat per child leads to an increase of 6.6 p.p. in mothers' labor force participation after the birth of their first child, corresponding to a 20% increment. Moreover, the study demonstrates an associated rise of 20% in mothers' annual earnings.

The observed effects are particularly strong for migrant families. This suggests that women from backgrounds that are more likely to face challenges in securing alternative childcare arrangements may benefit significantly from the availability of public childcare services. However, the results also indicate that fathers' labor market outcomes are not influenced by the expansion of childcare, reinforcing the notion that this policy primarily affects maternal employment decisions.

The paper underscores the transformative potential of accessible and high-quality public childcare in mitigating the negative impact of the child penalty and promoting gender equality in the labor market. By providing mothers with the opportunity to participate in the formal workforce, free public childcare becomes a vital tool in alleviating financial constraints, reducing dependence on informal childcare networks, and contributing to a more equitable distribution of labor market opportunities.

In conclusion, this study underscores the importance of public childcare provision as a catalyst for positive change in the labor market landscape, particularly in developing countries. The robust evidence of reduced child penalties and improved labor market outcomes for mothers reflects the potential for policy interventions to reduce gender disparities and facilitate inclusive and equitable societies.

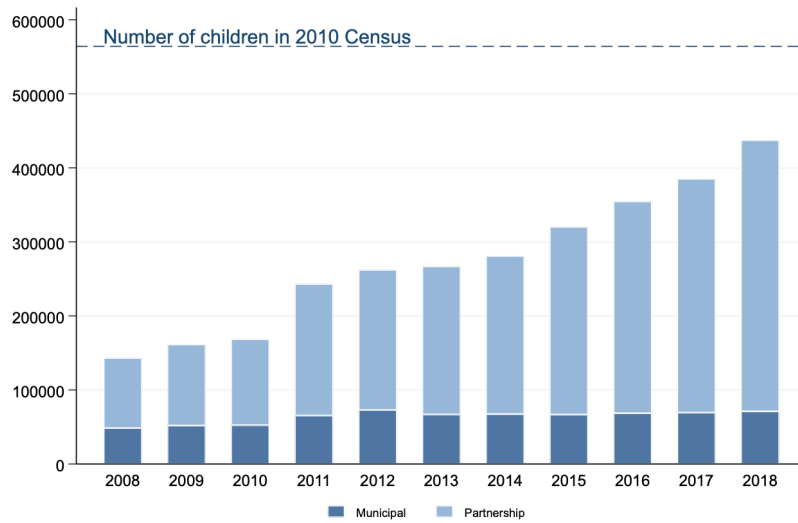
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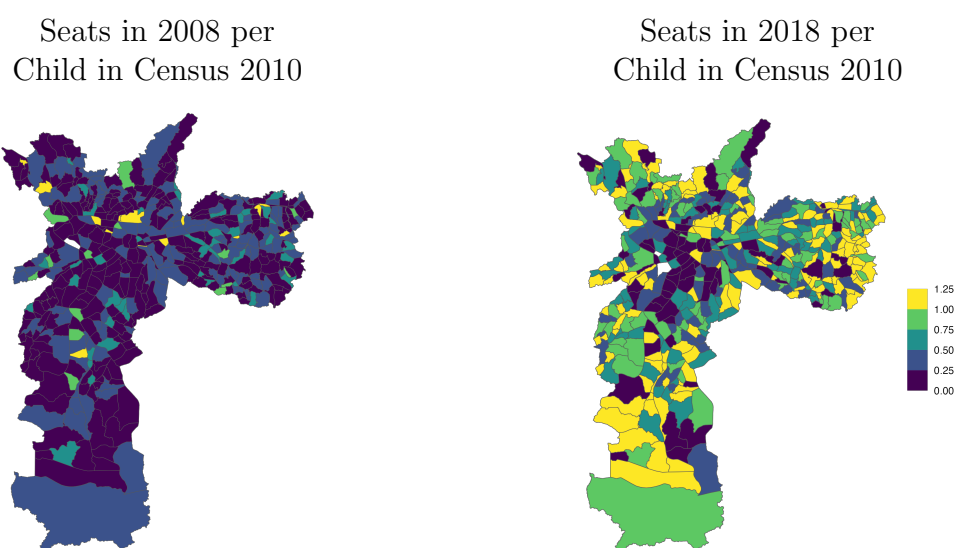
Figures and Tables

Figure 1: Children Attending Childcare by Type of Provider



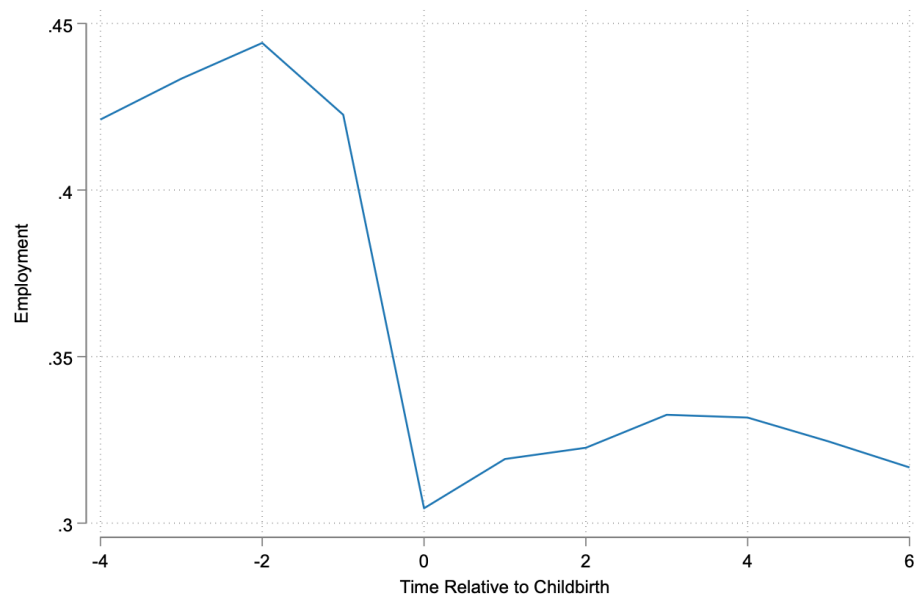
Notes: This figure shows total enrollment the childcare system in a) facilities funded by the municipal government and operated by non-profit partners, b) facilities funded and operated by the municipal government.

Figure 2: Childcare Enrollment per Educational District



Notes: This figure shows childcare enrollment rates by educational districts in 2008 and 2018. The rate is defined as the ratio between the number of childcare seats in a given district divided by the population between 0 and 3 years of age residing in that district in the 2010 Census.

Figure 3: Child Penalty



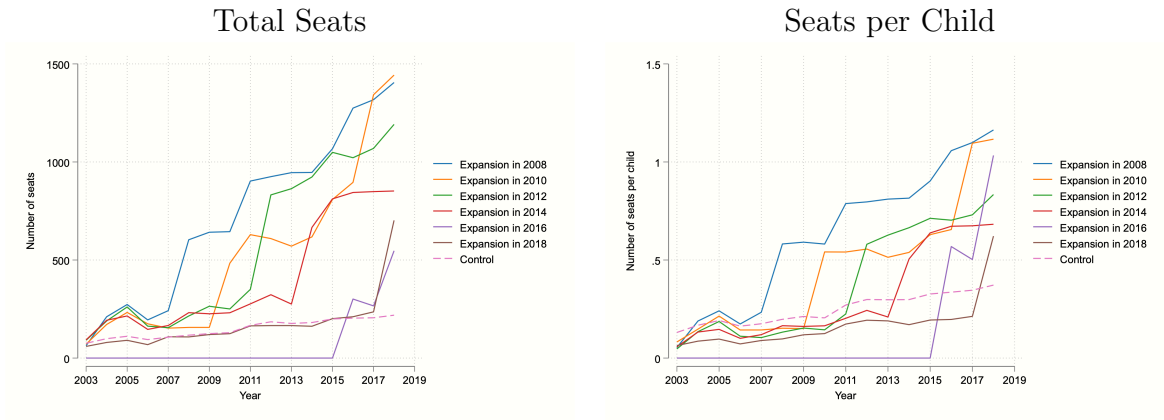
Notes: This figure shows the average employment rate in the formal sector for women in Sao Paulo around the year of first childbirth, denoted as 0. Data includes years 2007 to 2018.

Table 1: Summary Statistics

Variable	Mean	SD	Obs	Weight
Sample: Mothers-to-be 1 year before childbirth				
Share formally employed	0.44	0.11	4,145	2,203,288
Total earnings (Yearly)	3465.11	1161.92	4,145	2,203,288
Earnings if employed (Yearly)	7749.01	1566.95	3,992	2,197,594
Work hours if employed (Weekly)	29.04	3.44	3,992	2,197,594
Wage if employed (Hourly)	4.95	0.78	3,992	2,197,594
Sample: Mothers 1 year after childbirth				
Share formally employed	0.33	0.09	5,076	2,581,852
Total earnings (Yearly)	2217.08	852.48	5,076	2,581,852
Earnings if employed (Yearly)	6606.77	1656.01	4,843	2,573,597
Work hours if employed (Weekly)	24.36	3.63	4,843	2,573,597
Wage if employed (Hourly)	5.07	1.44	4,843	2,573,597
Sample: Fathers-to-be 1 year before childbirth				
Share formally employed	0.57	0.17	3,875	904,030
Total earnings (Yearly)	6444.92	2897.08	3,875	904,030
Earnings if employed (Yearly)	11313.87	3713.83	3,575	885,704
Work hours if employed (Weekly)	33.16	7.15	3,575	885,704
Wage if employed (Hourly)	6.35	1.70	3,575	885,704
Sample: Fathers 1 year after childbirth				
Share formally employed	0.55	0.16	4,764	1,107,490
Total earnings (Yearly)	6448.60	2849.54	4,764	1,107,490
Earnings if employed (Yearly)	11740.74	3973.22	4,390	1,085,336
Work hours if employed (Weekly)	33.23	5.84	4,390	1,085,336
Wage if employed (Hourly)	6.65	2.37	4,390	1,085,336
Sample: Districts, 2010 Census				
Household income (Yearly)	38649	30734	4,710	4,710
Number of households	7575	5777	4,710	4,710
Population	23758	16892	4,710	4,710
Share of households with female head	0.44	0.05	4,710	4,710

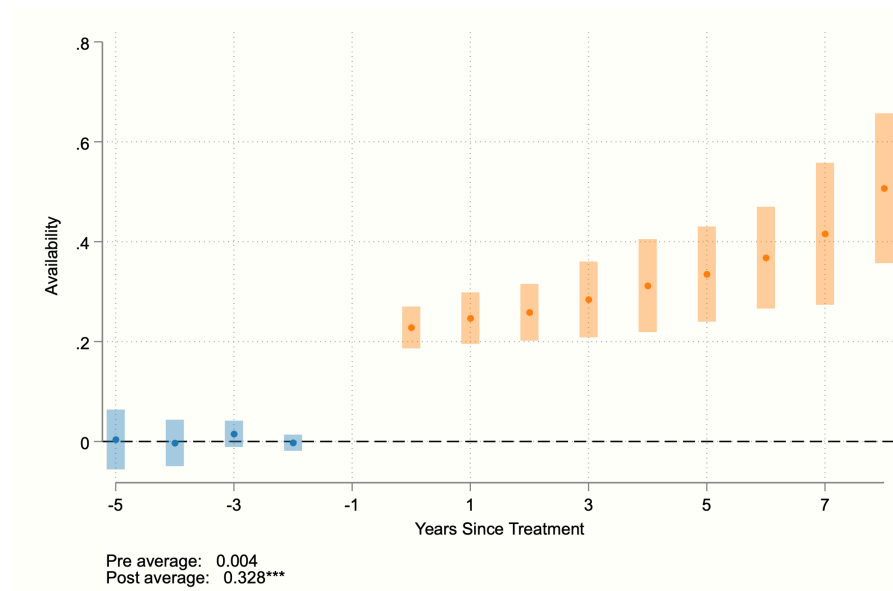
Notes: This table shows summary statistics for the main sample. The included periods are 2013 to 2018, and the included districts are the ones that had either a large increase in childcare availability (above third quintile), or no year with an increase above the second quintile. Observations are year by districts, weighted by the total mothers/fathers in each district. Each panel corresponds to, respectively, mothers-to-be 1 year before childbirth, mothers 1 year after childbirth, fathers-to-be 1 year before childbirth, fathers 1 year after childbirth and the general population by districts in the 2010 Census. All monetary values are BRL.

Figure 4:
Childcare Availability by Treatment Year



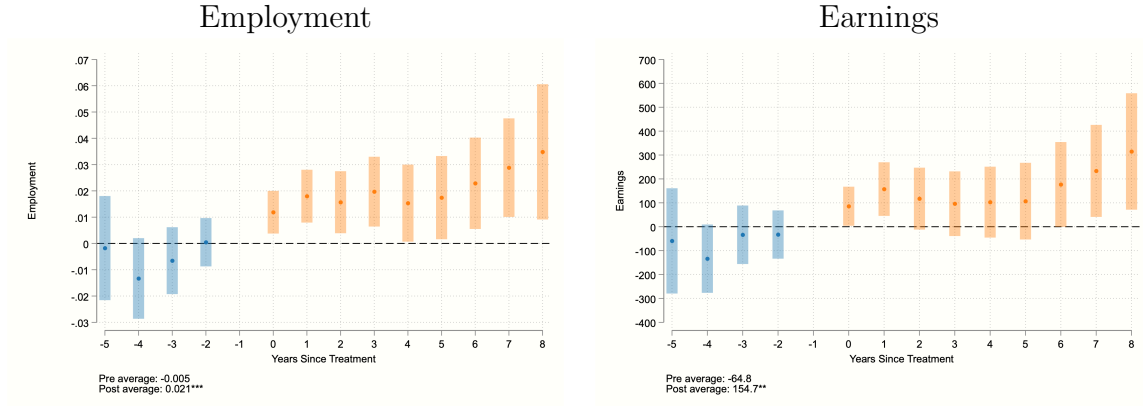
Notes: This figure shows the evolution of the number of total childcare seats (left) and total seats per child in the 2010 Census (right). Data are grouped by the year of expansion, defined as the year of largest increase or the year the first childcare facility opened in the district. The control group includes districts where the largest increase in availability was in the bottom 40% of the distribution. Only even years are shown in the plot, to improve visualization.

Figure 5: First stage: Childcare seats per child



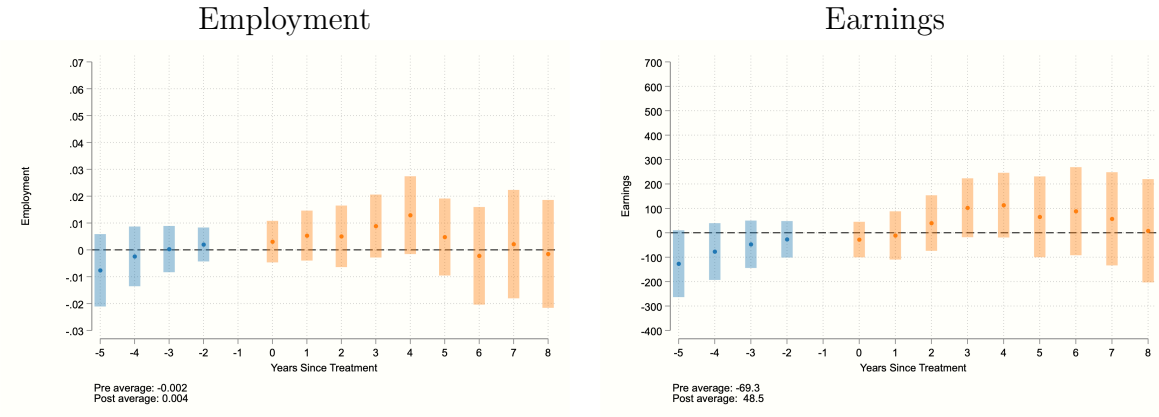
Notes: This figure shows the estimated effect of an expansion on childcare availability, defined as seats per child in the 2010 Census. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 6:
Effect of Expansion on Mothers



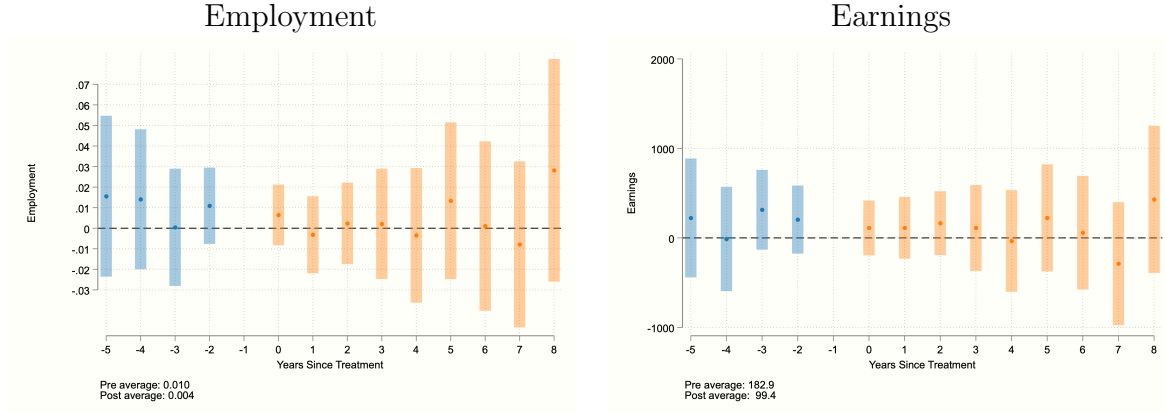
Notes: This figure shows the estimated effect of an expansion on mother's employment (left) and earnings (right). The sample includes mothers of children from 0 to 5 years of age. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 7:
Placebo - Effect of Expansion on Mothers-to-be



Notes: This figure shows the estimated effect of an expansion on mother's employment (left) and earnings (right). The sample includes mothers-to-be 4 years before childbirth to 1 year before childbirth. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 8:
Effect of Expansion on Fathers



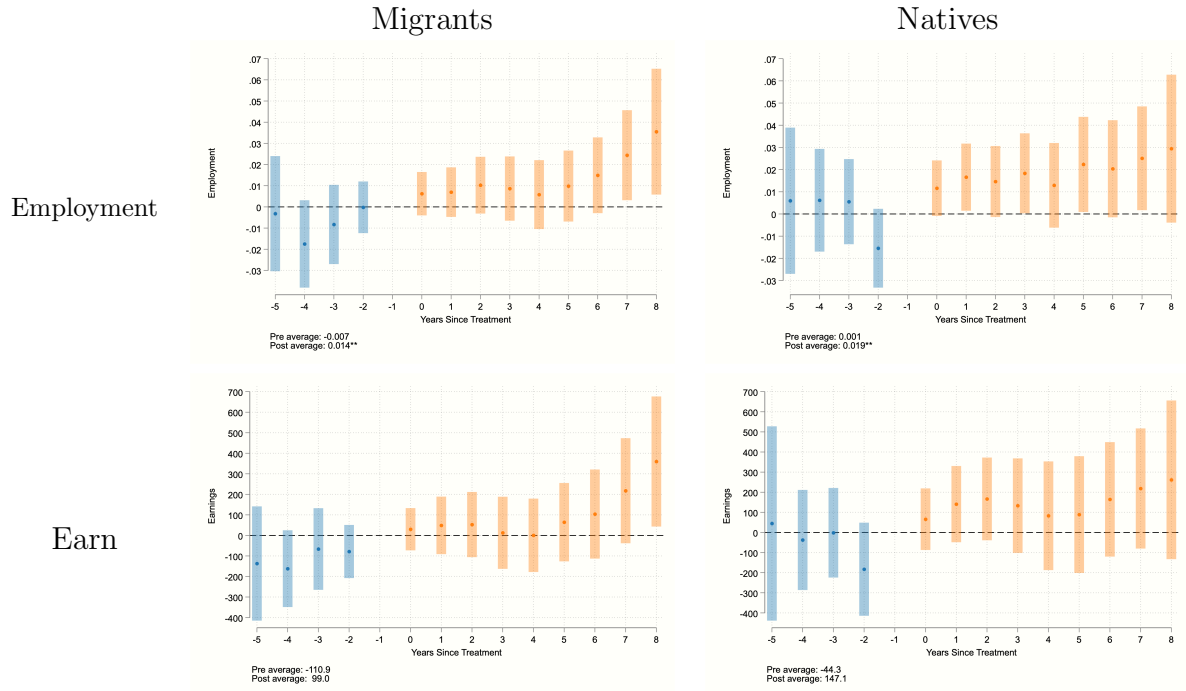
Notes: This figure shows the estimated effect of an expansion on father's employment (left) and earnings (right). The sample includes mothers of children from 0 to 5 years of age. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Effects of Childcare Expansion

	Employment		Earnings	
	Pre	Post	Pre	Post
Mothers	-0.005 (0.006)	0.021*** (0.007)	-64.8 (63.1)	154.7** (65.9)
Mothers-to-be	-0.002 (0.004)	0.004 (0.006)	-69.3 (47.3)	48.5 (59.5)
Fathers	0.010 (0.012)	0.004 (0.014)	182.9 (219.0)	99.4 (221.5)

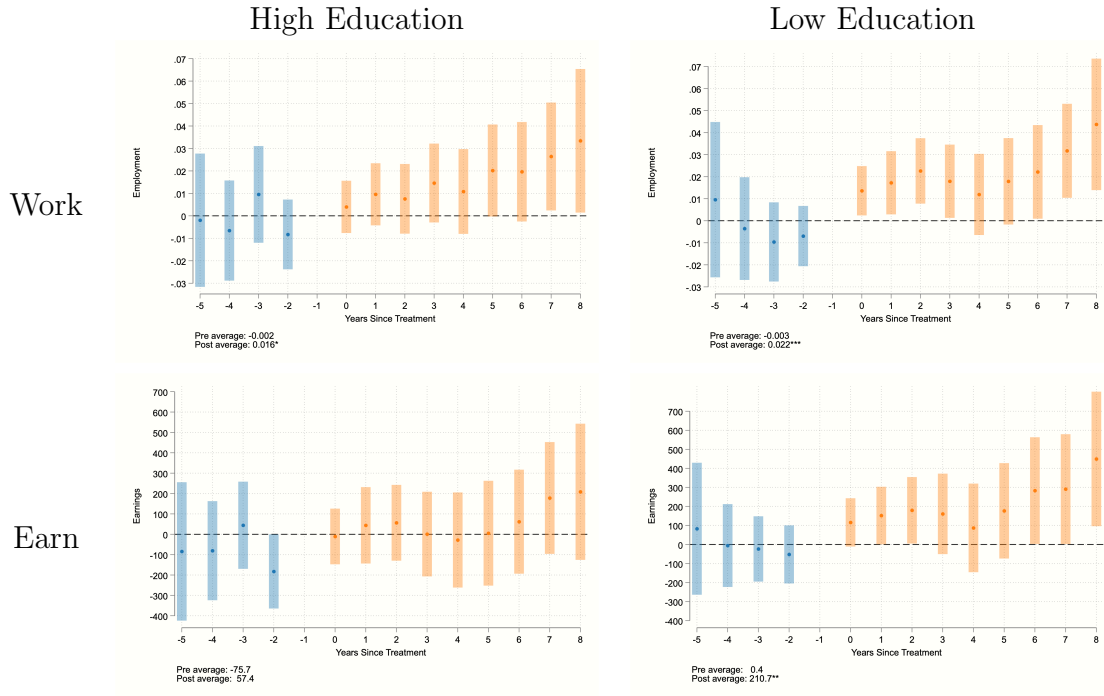
Notes: This table shows the average estimated effects for the Pre- and Post-expansion periods, for mothers, mothers-to-be and fathers. The mother and father samples include parents from 0 to 5 years after childbirth. The mothers-to-be sample includes 4 to 1 year before childbirth. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 9: Heterogeneity: Migration



Notes: This figure shows the estimated effect of an expansion on mother's employment (top) and earnings (bottom), for mothers who are migrants (left) and natives (right). Natives are defined as people who were born in São Paulo, while migrants are people who were born anywhere else. The sample includes mothers of children from 0 to 5 years of age. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 10: Heterogeneity: Education



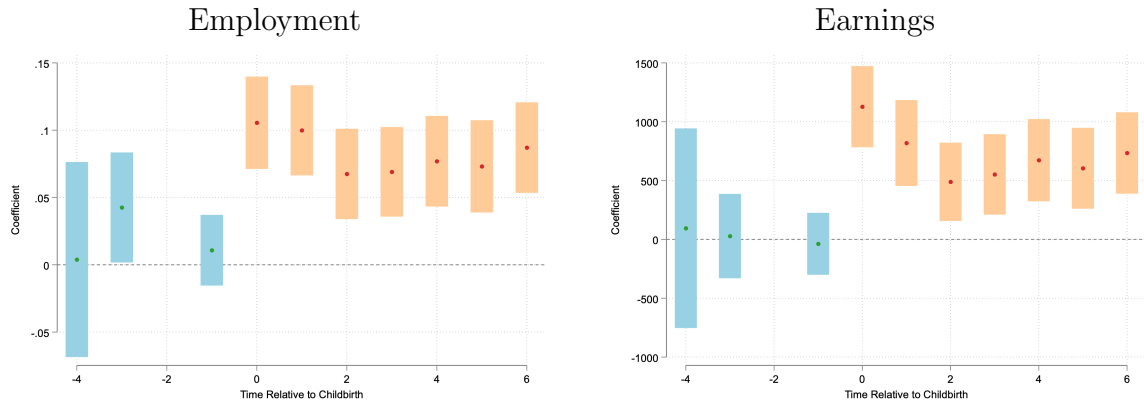
Notes: This figure shows the estimated effect of an expansion on mother's employment (top) and earnings (bottom), for mothers with low education (left) and high education (right). Low-education mothers are those that completed high school or less. The sample includes mothers of children from 0 to 5 years of age. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Effects of Childcare Expansion - Heterogeneity

	Employment		Earnings	
	Pre	Post	Pre	Post
Migration				
Immigrants	-0.007 (0.009)	0.014** (0.007)	-110.9 (85.1)	99.0 (77.8)
Natives	0.001 (0.009)	0.019** (0.009)	-44.3 (126.8)	147.1 (114.0)
Education				
Low	-0.003 (0.010)	0.022*** (0.008)	0.4 (97.9)	210.7** (97.6)
High	-0.002 (0.009)	0.016* (0.009)	-75.7 (100.4)	57.4 (99.1)
Share of Pentecostals				
Low	0.004 (0.010)	0.017** (0.008)	49.2 (90.1)	204.1* (108.5)
High	-0.011 (0.008)	0.024*** (0.008)	-132.3 (81.1)	142.7* (78.7)
Share of Female Household Heads				
Low	-0.016* (0.009)	0.006 (0.008)	-139.6* (83.1)	40.7 (82.6)
High	0.009 (0.009)	0.038*** (0.009)	-4.5 (87.1)	266.9*** (93.3)

Notes: This table shows the average estimated effects for the Pre- and Post-expansion periods, according to mothers migration status and educational attainment. Natives are defined as people who were born in São Paulo, while migrants are people who were born anywhere else. Low-education mothers are those that completed high school or less. The sample includes mothers of children from 0 to 5 years of age. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 11: Effects of School Availability by Time from Childbirth



Notes: This figure shows the estimated effect of one additional seat per child on mothers' employment and earnings, by time relative to childbirth. The statistics in the bottom show the average value of the Pre- and Post-treatment estimates. Earnings in 2010 BRL. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$