

**EDI FLORES REYNA**

**THE PRESCHOOL'S DIRECT AND INDIRECT EFFECTS IN BRAZIL**

Thesis submitted to the Applied Economics Graduate Program of the Universidade Federal de Viçosa in fulfillment of the requirements for the degree of *Doctor Scientiae*.

Adviser: Maria Micheliana da Costa Silva

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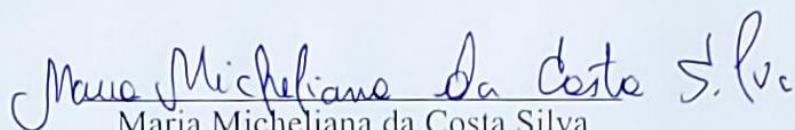
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This doctoral dissertation is dedicated to my  
parents, siblings, and nieces.

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## ABSTRACT

REYNA, Edi Flores, D.Sc., Universidade Federal de Viçosa, February, 2023. **The Preschool's Direct and Indirect Effects in Brazil.** Adviser: Maria Micheliana da Costa Silva.

Interventions in early childhood, like preschool education, have several effects on individuals' outcomes. We can observe preschool's impact on schooling, health outcomes, educational attainment, workforce productivity, and future wages. However, the preschool's effect can also identify in intra-household relationships. For example, in the household, the child's preschool attendance may impact the time allocation of the family members, especially the person who take-care the child. Furthermore, the relationships between the child and her parents may be affected by the learning obtained in preschool. Therefore, in this doctoral dissertation, we sought to identify preschool's effects on intra-household relationships from Brazilian families. This dissertation has been divided into two chapters to understand these effects better. In the first chapter, we aim to identify whether preschool attendance may influence the children's bargaining power in the family decision-making process. To do so, we exploit the educational reform caused by the Brazilian Constitutional Amendment N° 59 of 2009 and the CNE/CEB Resolution N° 2/2016, which makes preschool attendance mandatory from 4 years old onwards. We drew our analysis sample from the POF 2017-2018. Due to the characteristics of the data, the identification strategy we used was a randomization-based RDD approach. We found evidence that preschool frequency can affect the children's bargaining power in family decision-making. Namely, preschool improves the children's bargaining power in the family decision-making process by approximately 0.22 and 0.29 standard deviation in purchasing products of interest to children. We infer, therefore, that preschool attendance affects children's role in family decision-making through improved human capital. Furthermore, we corroborated that children should indeed be considered in household demand analysis. On the other hand, in the second chapter, we focus on identifying the indirect effects of preschool on intra-household variables related to maternal labor supply, the older sibling's domestic, productive work, and the demand for education for older siblings. In this chapter, we also exploit the same preschool educational reform. However, the database comes from the Household Sample Survey (PNAD) for 2011-2015. Using this data, we apply the fuzzy estimation's standard RDD (under the assumption of continuity). Results show that the child's attendance at preschool increases the mother's average weekly working hours by 26 hours but does not affect the hours offered by older siblings in the labor market. In addition, the intervention increases the older siblings'

household chores in low-income families. Concerning older siblings' education attendance, the younger child's preschool attendance showed adverse effects; the preschool reduces the school attendance of the older sibling. This effect is heterogeneous when considering the older siblings' sex: girls are more affected than boys. Finally, the results identify the substitution effect of time allocation between the mother and the older sibling.

Keywords: Preschool. RDD approach. The family decision-making process. Labor market outcomes. Household chores.

## RESUMO

REYNA, Edi Flores, D.Sc., Universidade Federal de Viçosa, fevereiro de 2023. **Efeitos Diretos e Indiretos da Pré-escola no Brasil**. Orientadora: Maria Micheliana da Costa Silva.

As intervenções na primeira infância, como a pré-escola, apresentam diversos efeitos sobre os indivíduos. Estes efeitos são frequentemente observados sobre a escolaridade, estoque da saúde, desempenho escolar, produtividade de trabalho e salários futuros. Entretanto, os efeitos da pré-escola também podem ser identificados nas relações intradomiciliares. Dentro do domicílio, a frequência pré-escolar de uma criança pode gerar uma variação na alocação de tempo das famílias, principalmente da pessoa responsável pelo seu cuidado. Além disso, as relações entre a criança com seus pais ou outro membro do domicílio também pode ser influenciado pelo aprendizado obtido na pré-escola. Portanto, este trabalho tem como fim identificar se a frequência pré-escolar afeta as relações intradomiciliares das famílias brasileiras. Para uma compreensão dos efeitos da pré-escola dentro da família, esta tese foi dividida em dois capítulos. O primeiro buscou identificar se a frequência pré-escolar dos filhos afeta a influência deles nos processos decisórios das famílias, especificamente na compra de produtos de interesse para eles. Para identificar este efeito, foi explorado a reforma educacional proposta pela Emenda Constitucional N° 59 de 2009 e pela Resolução da CNE/CEB n° 2/2016. Esta reforma torna obrigatória a pré-escola para as crianças a partir de 4 anos de idade, considerando o dia e o mês de nascimento. Os dados utilizados para este primeiro ensaio foram obtidos da Pesquisa de Orçamento Familiar (POF) de 2017/2018. Levando em conta as características dos dados e as informações disponíveis, foi utilizado como estratégia de identificação a abordagem de regressões descontínuas (RDD), sob o pressuposto de randomização. Os resultados mostram evidências que a pré-escola também afeta a influência dos filhos nas tomadas de decisões familiares relativas ao consumo. Ou seja, a pré-escola pode afetar o poder de barganha das crianças na tomada de decisões familiares em, aproximadamente, 0,22 e 0,29 desvio-padrão na compra de produtos de interesses para elas. Portanto, os resultados indicam que as crianças desempenham um papel ativo na tomada de decisões domésticas, reforçado pelo investimento em capital humano na primeira infância, evidenciando que as crianças e os adolescentes devem ser considerados na análise da demanda doméstica. Por outro lado, o segundo capítulo buscou identificar os efeitos indiretos da pré-escola sobre a alocação de tempo e recursos dos membros do domicílio. Para esse fim, foram usadas como variáveis resultados: a oferta de trabalho da mãe (participação no mercado de trabalho e horas de trabalho semanais), o trabalho doméstico

e fora de casa dos filhos mais velhos, e demanda por educação dos filhos mais velhos. Neste ensaio também foi explorado a reforma educacional da pré-escola. Os dados utilizados provêm da Pesquisa Nacional de Amostra por Domicílio (PNAD) do período de 2011-2015 e foi aplicado a estratégia baseada na RDD *standard*, sob o pressuposto de continuidade, do tipo fuzzy. Os resultados mostraram que a frequência da criança na pré-escola aumenta em 26 horas semanais a ofertada de horas de trabalho das mães. No entanto, não é observado mudanças na mesma variável para os filhos mais velhos. Além disso, constatou-se que a pré-escola aumenta o trabalho doméstico dos filhos mais velhos em famílias de baixa renda. Por outro lado, para a demanda por educação dos irmãos mais velhos, a frequência pré-escolar da criança mostrou efeito negativo, pois reduz a frequência escolar do irmão mais velho. Ao se considera o sexo do irmão mais velho, foi observado que as meninas são mais afetadas que os meninos. Portanto, este resultado, conjuntamente com o aumento dos afazeres doméstico, permitiu identificar o efeito substituição entre o tempo da mãe e do irmão mais velho.

Palavras-chave: Pré-escola. RDD. Processo decisório familiar. Trabalho fora de casa. Trabalho doméstico.

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## 1 INITIAL REMARKS

The literature has highlighted the effects of early childhood interventions on different individual outcomes. It happens because these interventions in the earliest years of life affect the foundation of children's brain architecture and, thus, directly impact their human capital accumulation process (Center on the Developing Child, 2016). Therefore, early childhood interventions optimize and boost cognitive and noncognitive skills development. As a result, one observes improvement in schooling, school performance on the proficiency test, labor force productivity, wages, and health (Cunha et al., 2010; Cunha & Heckman, 2007; Garces et al., 2002; García et al., 2018; García & Heckman, 2021; Heckman, 2008; Heckman et al., 2013; Heckman & Karapakula, 2019b; Krafft, 2015).

In addition to the direct effects on individual outcomes, early childhood interventions may also have social effects. For example, a society with higher levels of human capital reduces social problems such as crime, teen pregnancy, and school dropout rates, thereby increasing social welfare (Basu, 1999; Center on the Developing Child, 2016; Garces et al., 2002; Heckman, 2008).

The size of the early childhood interventions' effect depends on the type of program implemented (i.e., preschool education, nutritional supplementation, parenting education, or a combination of the programs), the sample characteristics, the groups targeted, the intervention duration, the country, and the socioeconomics environment (Camilli et al., 2010; Nores & Barnett, 2010). Even though all the abovementioned factors determine the size of the interventions' effect, the educational and mixed interventions (early childhood education and nutritional supplementation) showed the most significant impacts on individual outcomes, specifically on cognitive outcomes (Nores & Barnett, 2010). In addition, Nores and Barnett (2010) point out that these types of interventions also affect the child's behavioral dimensions. The Camilli et al. (2010) meta-analysis corroborated that educational interventions, such as early childhood education, have the largest impact on cognitive outcomes and social dimensions.

Some studies have assessed early childhood education's effect on cognitive outcomes in Brazil. Using the Brazilian National System of Evaluation of Basic Education (SAEB) database of 2003 (Curi & Menezes-Filho, 2009; de Felício & Vasconcellos, 2007) and 2005 (Pinto et al., 2017), Brazilian researchers found positive effects of early childhood education attendance on mathematics proficiency scores of fourth-graders in elementary school. It observed that child education positively impacts the likelihood of finishing four school cycles (elementary school

1 and 2, high school, and college) on the future wages of individuals (Curi & Menezes-Filho, 2009). These positive effects are also found in the Portuguese and Mathematics tests of the 2011 Prova Brasil (Brazil Exam) of fifth and ninth-grade students of the Brazilian public elementary school system (Silva Junior & Gonçalves, 2016). A more focused study found positive effects of early childhood education on the literacy scores of second-grade students in a Brazilian municipality called Sertãozinho, located in the countryside of São Paulo (Felicio et al., 2012).

Another factor that explains the size of the early childhood interventions is the characteristics of the target group. Empirical literature emphasizes that disadvantaged children are more beneficial from early childhood interventions. These children live in early adverse environments due to income constraints, low parental education, and lower quality of parenting. Early interventions provide disadvantaged children with an enriching environment to develop their cognitive and noncognitive skills (García et al., 2018; Heckman, 2008; Lehmann et al., 2018; Todd & Wolpin, 2007). It implies that early childhood education must offset the children's family environment (Center on the Developing Child, 2016). For this reason, Heckman (2008) suggests that early interventions should target children who are in disadvantaged environments.

However, beyond the effects mentioned above, early childhood interventions also have indirect effects or externalities within the household (Garces et al., 2002; Heckman & Karapakula, 2019a; Krafft, 2015; Lokshin et al., 2004). These indirect effects can benefit family members differently and cause changes in the household's allocations of both time and resources. For instance, the human capital acquired by the child -given his participation in an early childhood education program affects the younger siblings' process of accumulating human capital and behavior, even if they have not benefited from the program. The effects are observed in the following outcomes of the child's younger siblings who benefited from intervention: academic performance, probability of completing high school, employment, and likely to have been booked (Garces et al., 2002; Heckman & Karapakula, 2019a). The mechanisms that explain the indirect effects of early childhood education are the following: sibling interaction and the role model (Altmejd et al., 2020; Nicoletti & Rabe, 2019; Oettinger, 2000; Qureshi, 2018a, 2018b).

Krafft (2015) and Lokshin et al. (2004) found that access to early childhood education generates siblings spillover effects from younger to older siblings, especially in older sisters. Both papers claim that the participation of the youngest child in child development centers affects the time allocation of older siblings. In disadvantaged families with mothers employed

in the labor market, the older siblings, usually sisters, spend more time caring for the younger siblings and doing other household chores (Dammert, 2010; Lokshin et al., 2004). Thereby, the attendance of the youngest child in early childhood education might reduce the time their older sister spends in his care. As a result, the older sister may increase her time spent on school activities, directly affecting her human capital accumulation (Lokshin et al., 2004).

Likewise, the child's attendance in early childhood education reduces the time spent by the mother on household chores, thus allowing the mother to enter the labor market (Baker et al., 2008; Barros, Olinto, et al., 2011; Berthelon et al., 2020; Fitzpatrick, 2012; Lokshin et al., 2004; Morrissey, 2017; Ryu, 2019). The insertion of the mother in the labor market increases family income. The latter may affect the demand for children's schooling (Bezerra et al., 2009; Lokshin et al., 2004). Therefore, early childhood education may affect older siblings' schooling.

Intra-household changes caused by early childhood education might exceed the abovementioned externalities. Early childhood education affects children's behavior by improving their noncognitive skills. For example, children benefiting from access to early childhood education demonstrate a greater ability to pay attention, motivation to learn, effort, ability to control aggressive impulses and resolve conflicts peacefully, be disciplined, and actively participate in class in elementary school classes (Berlinski et al., 2009; Center on the Developing Child, 2016). Behaviors not only affect the lifelong acquisition of human capital and future outcomes (Almlund et al., 2011; Cunha & Heckman, 2008; Garces et al., 2002; Hanushek, 2013; Heckman et al., 2013); they also may impact intra-household relationships. The children's behavior and communicative abilities impact the individual and shared (parents and children negotiation) decision-making in the household (Lundberg et al., 2009). For this reason, if children are decision-makers like their parents, they can impact the family decision-making process, affecting the household demand (Dauphin et al., 2011).

Therefore, the child's attendance in early childhood education like a preschool may cause several changes in the intra-household context. These changes may increase the mother's participation in the labor market and older siblings' schooling. Additionally, the preschool may influence the household consumption pattern by providing the children with skills to be active decision-makers. To the best of our knowledge, the latter relationship is a gap in the national and international empirical literature. When we consider the lower-income families, where there is the greatest resource constraint (Barros, Mendonça, et al., 2011), the changes caused by preschool can be most significant because preschool may affect the older siblings' child labor -both work inside and out the home- (Basu, 1999; Basu & Van, 1998; Edmonds & Pavcnik, 2005). In this context, the older brother may be the most affected (Dammert, 2010).

In light of all abovementioned, this doctoral dissertation seeks to identify how preschool affects intra-household relationships in Brazilian families. For this purpose, the thesis has been divided into two chapters. This dissertation's division allows us to understand better the relationships of interest to this research. In the first chapter, we assess the preschool's effect on the bargaining power of the children in the family decision-making process related to the consumption of products of interest to them. Our results show that preschool attendance affects children's role in family decision-making due to improving their human capital. It implies that children use a more enhanced negotiation strategy from the accumulated human capital and their knowledge about the products.

The second chapter aims to identify the indirect effect of preschool on intra-household variables relating to maternal labor market supply, older sibling labor (inside and out the home), and demand for education for older siblings. We found that the youngest child's attendance at preschool increases the mother's average weekly working hours but does not affect the hours offered by older siblings in the labor market. In addition, our results show that preschool raises the hours of older siblings' domestic work in lower-income families. The latter is an unexpected result. However, this result allows us to identify the substitution effect of time allocation between the mother and the older sibling.

Analyzing the preschool effect on intra-household relationships is crucial in reducing social inequalities in developing countries. Moreover, our analysis provides evidence about the actual effect (direct and indirect effects) of early childhood education on families and society. This evidence allows us to evaluate the effectiveness of investments in early childhood education more accurately and to support public policies aimed at improving early childhood education and increasing the number of vacancies at this educational level. Finally, given the resource scarcity in society, the information we present here is essential to help policymakers judge which interventions are most beneficial to society.

## 2 PRESCHOOL EDUCATION AND INTRA-HOUSEHOLD BARGAINING POWER

### **Abstract:**

This paper aims to identify the preschool's effect on the children's bargaining power in family decision-making. To do so, we exploit the educational reform caused by the Brazilian Constitutional Amendment N° 59 of 2009 and the CNE/CEB Resolution N° 2/2016, which makes preschool attendance mandatory from 4 years old onwards. We drew our analysis sample from the POF 2017-2018. Due to the characteristics of the data, the identification strategy we used was a randomization-based RDD approach. We found evidence that preschool frequency may affect the children's bargaining power in family decision-making. Results show that preschool improves the children's bargaining power in the family decision-making process by approximately 0.22 and 0.29 standard deviation in purchasing products of interest to children. We infer, therefore, that preschool attendance affects children's role in family decision-making due to improving their human capital. Furthermore, we corroborated that children should indeed be considered in household demand analysis.

**Keywords:** Preschool; human capital; the family decision-making process; bargaining power; Randomization-based RDD approach.

## 2.1 Introduction

Empirical literature that investigates the effects of early childhood education has focused on outcomes related to education, the stock of health, and the future wages of individuals, given that these outcomes are affected directly by boosting the process of accumulating cognitive and noncognitive skills (Berlinski et al., 2009; Borghans et al., 2008; Cunha et al., 2010; Cunha & Heckman, 2008; García & Heckman, 2021; Heckman, 2008; Heckman et al., 2013). However, the improvement of human capital accumulation may affect outcomes beyond those already studied, such as the intra-household behavior of children, especially related to their participation in the household decision-making process.

In economics analyses, children are seldom recognized as economic agents able to actively influence the family consumption decision (Chavda et al., 2005; Dauphin et al., 2011; Lundberg et al., 2009). The traditional theoretical economic models that study intra-household behavior, both the unitary and collective models, treat children as mere passive bystanders or as public goods belonging to parents' utility functions (Becker, 1974; Browning et al., 2013). It means that the child's consumption behavior is modeled only as a reflection of the parents' consumption behavior due to a consumption socialization process, according to Chavda et al. (2005). Therefore, in studies about the family decision process, the children are usually not considered decision-makers.

However, as children grow up, they acquire characteristics of economic agents that allow them to make sole decision-making and shared decision-making with parents about consumption and even become decision-makers in the household decision-making process (Dauphin et al., 2011; Harbaugh et al., 2001, 2003; Lundberg et al., 2009; Sutter et al., 2019; Valkenburg & Cantor, 2001). Under the theoretical framework of the collective model, Dauphin et al. (2011) state that families with children have at least three decision-makers. Even though the authors do not explain how the children influence the family's decision-making process, they provide evidence about the children's active role in this process.

Dauphin et al. (2011) further emphasize that analyzing the family's decision-making process without incorporating the children in this process leads to misunderstanding some intra-household relations between members. The authors underline three reasons for that. First, the theoretical model can fail to explain economic issues concerning the investment in education, labor supply, and resource allocation in a low-income family. As the age of children increases, the decision to invest in their education ceases to be made entirely by the parents and becomes an individual decision (Akresh et al., 2012). Second, we can obtain an inaccurate analysis of family welfare. For example, the time and resources allocation in the family, such as the time

allocation between study and leisure time of children, might be affected by the negotiation abilities of children or adolescents (Lundberg et al., 2009). Finally, analyzing the household demand system that disregards children as decision-makers might obtain biased estimates.

Therefore, when studying family decision-making, it becomes necessary to consider that children can acquire an active role in this process (Dauphin et al., 2011; Lundberg et al., 2009; Valkenburg & Cantor, 2001). Children's participation in family decision-making implies they can decide under rationality assumptions and have bargaining skills. Studies realized by Harbaugh et al. (2001), Harbaugh et al. (2003), and Sutter et al. (2019) showed that as children grow up, they begin to decide in line with the economic assumptions; due to that, their choices exhibit rational behavior close to the adults' behavior.

Harbaugh et al. (2003) further showed, by experimental data, that children between the ages of 7 and 18 exhibit strategy behavior when making decisions in bargaining situations. Beyond of the experimental setting, individuals also came across several bargaining situations with their parents or peers during their childhood and teenage years. The payoffs from this situation are either simple (daily consumption of candy, breakfast products, and snacks) or complex and essential to parents and children (Chavda et al., 2005; Harbaugh et al., 2003; Valkenburg & Cantor, 2001). As for the latter, parents and children can decide where to spend their vacations, which toys to buy, or decide at which university the children will study.

Previous research has established that children's negotiation behavior depends on their age, gender, family income, time parents dedicate to them, and acquired skills (Chavda et al., 2005; Harbaugh et al., 2003; Lundberg et al., 2009; Sutter et al., 2019). Although these factors affect the children's influence on the family decision, in this paper, we focus on understanding how improving skills accumulation can make children active decision-makers in the household.

The children's cognitive and noncognitive skills can influence the family's decision-making process. These skills determine the strategy adopted by the children in the bargaining process. For example, while teenagers use persuasion, argumentation, and emotional strategies, young children usually make direct requests to their parents (Chavda et al., 2005; Palan & Wilkes, 1997; Valkenburg & Cantor, 2001).

Cognitive skills linked to reading provide the children with the main element for the negotiation process, communicative skills. Moreover, even though it does not have an obvious mechanism, the skills measured by mathematics scores also affect children's bargaining process (Lundberg et al., 2009). It is worth remembering that scores from proficiency tests capture cognitive and noncognitive skills (Balart et al., 2018; Borghans et al., 2008, 2016; Hanushek, 2013). Thus, the score Lundberg et al. (2009) used to analyze the bargaining process also

captures children's noncognitive skills. These skills relate to children's behavior in and out of the home (Berlinski et al., 2009). It implies that noncognitive skills can influence the negotiation with the parents, given that good behavior is a child's bargaining process strategy (Lundberg et al., 2009).

As mentioned above, beyond the children's age and family characteristics, the stock of skills plays a relevant role in children's ability to influence the family's decision-making. In this sense, in addition to analyzing the children as a decision-maker (Dauphin et al., 2011), we need to study the process by which they acquire power in the household decision, mainly linked to the role of accumulation of human capital in this process, a gap not explored by the literature yet.

The formation and improvement of cognitive and noncognitive skills is a process that happens throughout individuals' lives. However, it is in early childhood that the foundation of brain architecture is established, and the individual is more open to both positive and negative influences for skill development (Castro & Rolleston, 2018; Center on the Developing Child, 2016; Cunha & Heckman, 2008; Heckman et al., 2013). Therefore, any early childhood intervention impacts cognitive and noncognitive skills. The results of early childhood interventions, such as preschool, on skill development, are well documented in several papers (Berlinski et al., 2009; Camilli et al., 2010; Cunha & Heckman, 2008; Felicio et al., 2012; García et al., 2018; Pinto et al., 2017).

By conditioning children's bargaining power on their acquired skill set, it seems reasonable to infer that the degree of intra-household influence of the children can be affected by human capital accumulation. Therefore, this paper focuses on answering the following questions: Do the skills obtained during early childhood through preschool affect the bargaining power of children in the family's decision-making?

Studying the process of children acquiring bargaining power in the household and the role of preschool can help understand the development of individuals' consumption behavior. With that, one might predict the behaviors of these children in the economic environment when they become adults, given that bargaining is a fundamental element of the economic world, especially when considering resource constraints (Harbaugh et al., 2003). Moreover, identifying preschool's effect on households' decision-making process provides policymakers with another indicator of the effectiveness of early childhood interventions. Therefore, the evidence we will find can justify the existing and future interventions (improving the quality of early childhood education) in individuals' lives.

In order to answer our question of interest, this paper suggests two outcomes to measure children's influence or bargaining power over family decision-making. We construct our two outcome measures using the ratio of children's spending on their good interests to family income. Even though children can influence a decision about the consumption of several products such as candy, toys, types of cereal, movies, and types of restaurants that the families frequent (Flurry & Burns, 2005; Labrecque & Ricard, 2001), we analyze the bargaining power only on the consumption of toys, electronic items (technology), and some leisure items. When families buy these products, children are expert individuals and holders of greater information used in the bargaining process (Flurry, 2007; Flurry & Burns, 2005).

The survey conducted by the SPC Brazil through the program called *Meu bolso Feliz* found that children have a greater degree of influence when buying toys, games, and electronic items. The report revealed that the degree of influence of children in the purchase of toy and games are 7.06; the index used to measure the degree of influence varies from 1 to 10. For the electronics category, teenagers have more influence than children when purchasing these items, 6.71 and 4.78, respectively (SPC, 2015). Therefore, we used these product categories to carry out our analysis.

This paper exploits the educational reform caused by the Brazilian Constitutional Amendment N° 59 of 2009 (BRASIL, 2009) and the CNE/CEB Resolution N° 2/2016 to identify the effect of the interest. This reform has become compulsory since 2009 to enroll children who turn years old before March 31 in preschool (BRASIL, 2009, 2018). Therefore, the children's exposure to compulsory preschool is determined by their date of birth. It implies that children born after 2006 were affected by the educational reform; thus, they are a sample of analyses. This characteristic allows applying the RDD approach. The data used in this article come from the Family Budgets Survey (POF) 2017/2018, henceforth POF.

The data limitation does not allow us to identify the preschool effect on children's bargaining power. However, we identify the preschool's intention to treat on-treated (ITT) given the data settings. Our results show early evidence that a child's preschool attendance affects his bargaining power. We find that the preschool improves the children's bargaining power in the family decision-making process by approximately 0.22 S.D. and 0.29 S.D. Given that we identify the ITT, this effect is a minimum effect of the preschool on children's bargaining power intra-household. Therefore, we may infer that preschool attendance can provide an active role for children in the family decision-making process.

We structured the remainder of the article as follows. First, we present the mechanism by which the preschool might affect the children's influence in family decision-making.

Subsection 2.3 outlines the empirical strategy used to identify the intention to treat on-treated. Finally, we present the main results and discussion in subsection 2.4 and the final remarks in subsection 2.5.

## **2.2 Theoretical framework**

Empirical literature generally uses either the collective or unitary model to analyze intra-household behavior. For example, the unitary model assumes that households maximize a single utility function subject to family income. On the other hand, the collective model assumes that household members have an individual utility function. Given a decision-making process, they maximize the weighted sum of the utilities subject to budget constraints and household production. In the latter model, children are considered part of the parents' utility or decision-makers (Browning et al., 2013).

Even if the collective model allows us to know how many decision-makers there are in the household, it is not informative enough about the family decision-making process (Dauphin et al., 2011). The model only assumes that family decision-making leads to the Pareto efficient outcomes without specifying the process (Browning et al., 2013; Dauphin et al., 2011). This assumption does not allow the model to provide information about how the child can influence the family decision-making process and what factors influence this process.

Therefore, to explore and analyze our results, this section will present the mechanism by which early childhood education might affect the process of children's acquisition of bargaining power in the family environment. Studies developed by Cunha and Heckman (2007, 2008), Cunha et al. (2010), and Heckman et al. (2013) explain the technology of human capital production and how it occurs throughout the entire life of individuals. All these papers stated that production technology is composed of stages linked together and that the first stage of the process is relevant for the best accumulation of human capital during the life of individuals. Thus, given that each stage represents a different stage in life, early childhood acquires a leading role in the process of human capital accumulation (Cunha et al., 2010; Cunha & Heckman, 2007). Hence, early childhood interventions, such as preschool, affect cognitive and noncognitive skills accumulation.

The stock of skills determines the children's negotiation strategies in family decision-making (Lundberg et al., 2009). The relationship between these skills and early childhood education has already been documented in the international and national literature, using proficiency test scores as the outcomes variables (Berlinski et al., 2009; Camilli et al., 2010; Curi & Menezes-Filho, 2009; Pinto et al., 2017). Beyond measuring cognitive skills, the

proficiency test score also shows the behavior-related skills that are part of noncognitive skills (Balart et al., 2018; Borghans et al., 2011, 2016; Heckman et al., 2013).

Henceforth, given that early childhood education affects skills accumulation, it can also affect the bargaining power of children in the family decision-making process. First, it allows children and adolescents to develop communicative skills essential in negotiating between parents and children. Second, it can affect their behavior within the household, which can be used as a bargaining element when dealing with their parents (Lundberg et al., 2009). Therefore, it is plausible to think that early childhood education can also influence the decision-making process of children in the household, especially those related to the consumption of products of interest (Chavda et al., 2005; Dauphin et al., 2011; Sutter et al., 2019).

### **2.3 Empirical framework**

This section details the empirical strategy used to study our relationship of interest. In the following subsections, we discuss how we coped with the issue regarding the unavailability of longitudinal data in Brazil. What is more, we describe the strategy adopted to address the endogeneity issue.

#### **2.3.1 Database**

In this investigation, we use microdata from a Brazilian household budget survey, POF, for the biennium 2017-2018, to apply the empirical strategy proposed in the following subsection. This survey is carried out by the Brazilian Institute of Geography and Statistics (IBGE) and contains information regarding consumption, spending, income, and Brazilian families' socioeconomic characteristics. It allows, thus, assessing the profile of household consumption and intra-household resource allocation.

We focus on children born after 2006 because they can be exposed to preschool reform. We detail this reform in the next section. We restrict our sample to children older than nine years because the POF data contains information about individual consumption for individuals aged ten years or older. For these children, we obtained their birth date, the individual consumption of products of interest for them, family income, and other household socioeconomic characteristics. The goods of interest for children are described in Appendix C.

Table 2.1 shows the characteristics and the size of our sample. Note in Table 2.1 that there are 825 children in our sample that were exposed to preschool reform. In the sample, 310 children were born before March 31, and 515 children were born after this date. We observe that, on average, the children in the sample are ten years old, regardless of whether they were born before or after March 31, and 52.3% of individuals are female.

Table 2.1: Summary Statistics

Variable	Whole sample (1)	Children born before March 31 (2)	Children after March 31 (3)	Difference (2-3)
Gender (1=female)	0.523 (0.500)	0.545 (0.498)	0.513 (0.500)	0.032
Age	10.615 (0.735)	10.768 (0.800)	10.546 (0.694)	0.222***
Mother's age	41.669 (12.092)	41.669 (12.581)	41.67 (11.867)	-0.001
Father's age	43.709 (11.372)	43.368 (11.313)	43.866 (11.402)	-0.498
Mother's schooling	9.005 (4.552)	9.031 (4.482)	8.993 (4.585)	0.039
Father's schooling	7.750 (4.616)	7.908 (4.562)	7.678 (4.641)	0.230
Family income	4454.798 (5199.432)	5027.149 (6589.296)	4197.123 (4412.801)	830.798***
Available per capita income	1093.43 (1014.005)	1170.957 (1174.087)	1058.527 (931.437)	112.43**
Household individual consumption expenditure <sup>§</sup>	6457.59 (23795.59)	8392.491 (39088.06)	5585.788 (11462.23)	2806.703**
Children's consumption expenditure	129.932 (257.056)	146.577 (272.297)	122.584 (250.317)	23.993
Leisure	19.256 (21.852)	24.64 (33.047)	16.433 (11.887)	8.206**
Toys	108.752 (197.232)	156.639 (260.382)	93.222 (124.297)	63.417*
TI	201.604 (339.838)	182.524 (260.382)	212.582 (379.363)	-30.058
<b>Outcomes of interest</b>				
Bargaining1	0.006 (0.036)	0.006 (0.034)	0.006 (0.038)	-0.000
Bargaining2	0.024 (0.138)	0.023 (0.122)	0.023 (0.147)	-0.000
Observations	825	310	515	

Note: Standard deviation in parentheses. <sup>§</sup> It is the sum of individual consumption expenditure of all household members. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0,01.

In addition to information about the parents, we show the family income and the consumption expenditure of the household members in Table 2.1. For example, on average, the family income is approximately R\$ 4454.8 for the whole sample. When we stratified by date of birth, it observes that the family income is higher in families of children born before March

31 than those born after this date. The available income per capita variable also exhibited this difference between the groups. The POF defines available income as the sum of monetary and non-monetary family income after deducting taxes, social contributions, and other compulsory or quasi-compulsory deductions (IBGE, 2020).

In order to get an initial overview of family consumption expenditure, we report two variables in Table 2.1. The first one is the household individual consumption expenditure variables. We create this variable by summing the individual consumption expenditure of all household members. The average of this variable is R\$ 6457.59, and the difference between groups is R\$ 2806.7. The second one is the children's consumption expenditure on products of their interest. On average, children born before March 31 spend R\$ 146.58, while children born after this date spend R\$ 122.58. When we detail the expenditure on leisure, toys, and technology-related items, one observes that leisure and toy expenditures are higher in the first group. In contrast, the technology-related expenditure is higher in the second group, but this difference is not statistically significant.

Finally, at the bottom of Table 2.1, we show the average measure of the children's bargaining power in the household. We measure this power of bargaining in two different ways. First, we use the ratio between the expenditure on products of interest to children and the family income, which we are called *bargaining1*. Second, measure 2, called *bargaining2*, is the ratio between the expenditure on products of interest to children and the available per capita income.

Given the information presented, the difference observed in family and children expenditure and bargaining power cannot be attributed to the child attending preschool; household characteristics such as available income may be responsible for this differentiation. Therefore, we present our empirical strategy in the subsequent subsection to identify the effect of interest.

### **2.3.2 Identification strategy**

Identifying the effect of preschool attendance on a child's bargaining power relies on the available data and identification strategy. In Brazil, we do not have information about the profile consumption of individuals and whether an individual attended preschool in the same survey. As a result, we do not allow the identification of the effect of preschool. However, due to the information on consumption and birth data in the POF, we can exploit the educational reform caused by the Constitutional Amendment of 2009 to estimate preschool's intent-to-treat effects (ITT) on bargaining power.

The ITT is a concept commonly used under a randomization setting to deal with non-compliance, missing outcomes, and assignment deviations. In an ideal scenario and a

randomization context, the individual who would be receiving the treatment is receiving it, and the one who should not be receiving it is in the control group. However, we do not always observe this ideal scenario. To overcome these issues, the ITT estimates the effect of the intervention exploits randomization assignment of groups - this creates balanced groups concerning observable characteristics like socioeconomic variables- and ignores the non-compliance and assignment deviation of the individuals. As a result, it obtains a conservative estimate of the effect of the intervention (Gupta, 2011; Mccoy, 2017).

This paper exploits educational reform to define who should be in the treatment or control groups. The educational reform of the Brazilian basic education system caused by the constitutional Amendment of 2009 makes preschool enrollment mandatory starting at age 4 in Brazil. In addition, the enactment of Law N° 12.796 in 2013 reaffirmed the compulsory requirement of preschool enrollment. Together with CNE/CEB Resolution, these legal provisions determine the following eligibility rule that we exploit as exogenous variation: the children who turn four years old by March 31 of the current year must be enrolled in the preschool (BRASIL, 2009, 2013, 2018). This rule allows us to address the preschool variable's endogeneity, which comes from confounders regarding the parents' perception of the importance and return of education (Garces et al., 2002). Therefore, the discontinuity caused by the educational reform allows us to use the Regression Discontinuity Design (RDD). This design is the most rigorous strategy for causal inference in a non-experimental setting (Cattaneo et al., 2017, 2019).

The eligibility rule enforcement over the preschool enrollment is necessary to apply the RDD. It means that children's birth date determines the preschool attendance conditional at the threshold, which is March 31. In order to corroborate the effectiveness of the eligibility rule, we plot the relationship between the date of birth -henceforth score- and the preschool enrollment rate in Figure 2.1<sup>1</sup>. It observes that children born before March 31 are more likely to enroll in preschool than children born after this date. Finally, we present the eligibility rule enforcement before and after the educational reform in Appendix A and B to support the exogenous variation used in this study.

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<sup>1</sup> The data used to elaborate this figure come from to National Household Sample Survey (PNAD) carried out by IBGE. We used this database because allow us to verify the effectiveness of the eligibility rule before and after the educational reform.

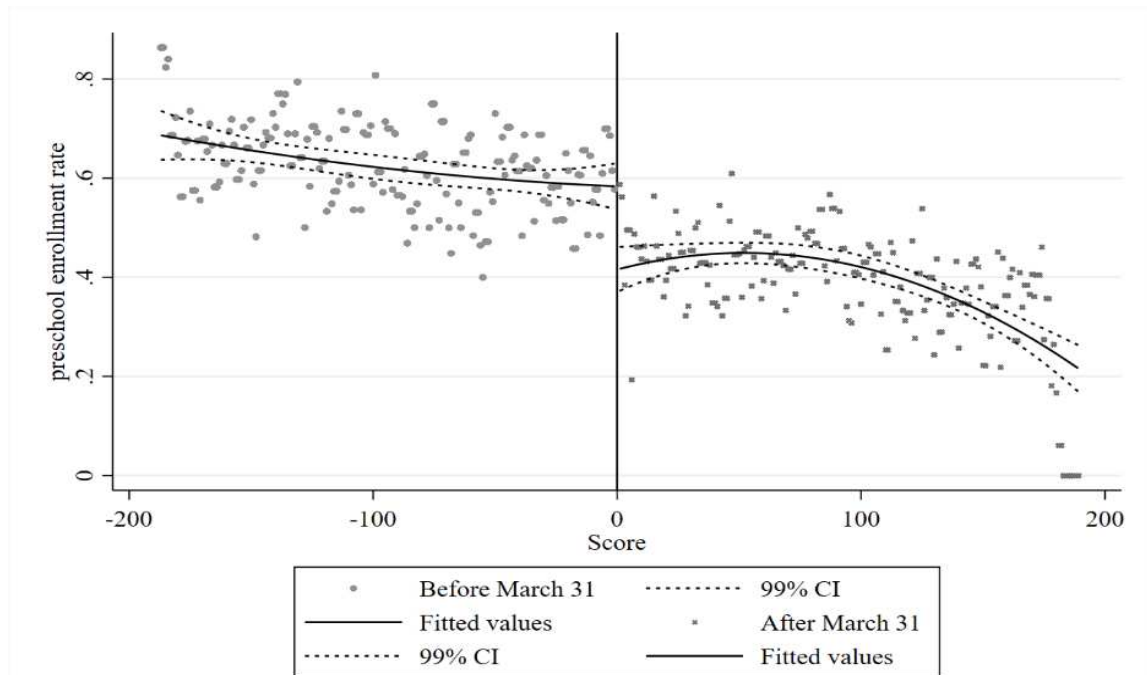


Figure 2.1: Effect of date of birth on the preschool enrollment rate in the period 2011-2015.

Figure 2.1 also shows that compliance with preschool enrollment is imperfect. This setting requires that we use the fuzzy RDD. However, the unavailability of data does not allow the employment of fuzzy RDD. Despite this, due to the effectiveness of the eligibility rule in determining preschool enrollment, we can still investigate the relation of interest under the Sharp RDD. It implies that the likelihood of enrolling the child in the preschool changes from 0 to 1 at the cutoff.

Indeed, we assume that the eligibility rule entirely determined the child's preschool attendance, and applying the RDD approach creates a setting similar to randomization. Therefore, we estimate the intention-to-treat of the preschool on the child's household bargaining power. Likewise, Fitzpatrick (2010) and Guindon (2014) also use the concept of ITT to analyze other outcomes. Fitzpatrick (2010) studied the effect of the universal pre-K program on maternal labor supply. The program provides care to children below the age of five at no cost to parents. Guindon (2014) investigated whether access to health insurance affects health services utilization and health outcomes. Consequently, we will provide evidence of the preschool effect on a child's bargaining power through the ITT parameter and some enlightenment on the role of a child in the family decision-making process.

In this paper, as mentioned above, we use the child's date of birth as the score variable and define the cutoff as March 31. To facilitate the applied the Sharp RDD, we reorganized our data and set March 31 as day zero; thus, the new cutoff value is zero henceforth. Thereby, the estimator to define the preschool effect is:

$$\tau_{W_0} = \frac{1}{N_{W_0}} \sum_{i \in \mathfrak{S}_0} (\tilde{y}_i(1) - \tilde{y}_i(0)) \quad (2.1)$$

In equation 2.1, the difference between the outcomes of children born before ( $\tilde{y}_i(1)$ ) or after ( $\tilde{y}_i(0)$ ) the cutoff date denotes the intention-to-treat effect of preschool. Note that this estimator differs from the standard RDD (see Calonico et al., 2014; Cattaneo et al., 2019; Hahn et al., 2001 and Imbens & Lemieux, 2008 for more details about standard RDD setting); It is because we adopt the framework developed by Cattaneo et al. (2015) called local randomization RDD. Even though the underlying idea is the same, this framework is conceptually different from the continuity-based framework (standard RDD) because its central assumption assumes that the assigned treatment status is random at a given window around the cutoff (Cattaneo et al., 2015, 2017).

We decide to apply the local randomization RDD framework to cope with the unavailability of data. We will analyze the preschool effect only in children exposed to educational reform. It means that our sample is composed of children born after 2006. This setting reduces the number of observations significantly in the sample. According to Cattaneo et al. (2017), the main advantage of this RDD approach is that it does not require a large sample. Thus, unlike the standard RDD, the framework allows us to employ randomization inference in an exact finite sample (Cattaneo et al., 2015, 2017). Therefore, the RDD under the randomization assumption is suited to address the few observations in the sample.

The procedure for implementation of the local randomization RDD framework requires, first of all, identifying a window where the identification assumptions hold. It means the window selected should ensure that preschool status (whether a child attended or not) can be understood as randomly assigned. To do so, we run a data-driven method recommended by Cattaneo et al. (2015), consisting of a balance test of predetermined or placebo covariates. The balance test fails to reject the zero treatment effect for covariates in the optimal window (Cattaneo et al., 2015, 2017).

In this framework adopted, we need to choose the randomization mechanism and a test statistic. We can adopt two different randomization mechanisms: Bernoulli and fixed margins randomization. However, Cattaneo et al. (2015) recommended the fixed-margin randomization

by default. On the other hand, we use the Bernoulli trial as a validation and robustness check (Cattaneo et al., 2017).

After defining the window optimal and the randomization mechanism, we test whether preschool has no effect on children's bargaining influence inside the windows selected. For that, we can use the following test statistics: the difference-in-means, the Kolmogorov-Smirnov test statistic, and the Wilcoxon rank-sum (Cattaneo et al., 2016, 2017). In this paper, the default test statistic for our estimates will be the difference-in-means. We use the other test statistic as a graphical analysis and a robustness check to improve our estimates.

We choose the following covariates to select the optimal windows: region, gender, age, mother's schooling, father's schooling, family size, years of study, and available per capita income. We use the variable age because it affects the children's say in the household decision. It means that children and teenagers can adopt different strategies to influence parents' purchase of video games, cellphones, toys, and other items. John (1999) and Chavda et al. (2005) show some evidence that children's age defines the strategies children adopt in negotiation with their parents. Consequently, age is a variable that must be included in the balance test.

Family size also affects the bargaining power of children. For instance, a sibling in the household reduces the bargaining power of the children of interest because more family members may reduce the resources available to each member. Additionally, we included as covariates the available per capita incomes. Family income also impacts children's bargaining. Low-income families, for example, prioritize the demand for food, housing, transportation, and health care. According to data from POF 2017/2018, 87 % of the total expenditure of families with an income of up to R\$ 1908 is done on food, housing, transportation, health care, education, clothing, and hygiene. It reduces the recourse available for expenses with the products analyzed in this paper. The opposite scenario can observe in families with higher income levels. These families spend only 59% of their income on food, housing, transportation, health care, education, clothing, and hygiene (IBGE, 2020). Thus, the available family income affects the influence of the children in the household decision.

The geographical location of the families also seems to be a factor that impacts their children's consumption and, consequently, their bargaining power. For example, the POF 2017/2018 shows that children from families living in other regions of Brazil consume more than those in the Northern region. On average, children's consumption expenditure on products of interest in the Northern region is R\$ 153.47, while in other regions, the average varies from R\$ 183.00 to R\$300.00 (IBGE, 2020).

To address the issue of gender bias (Adhvaryu & Nyshadham, 2016; Akresh et al., 2012), we use the gender variable in the balanced test. The parents' schooling is included to avoid issues concerning different levels of investment in children (Adhvaryu & Nyshadham, 2016). Finally, we also use the children's years of study. This variable allows us to cope with school dropouts and failure.

As we explained above, we assume that the parents cannot manipulate the children's date of birth<sup>2</sup> and, consequently, the preschool enrollment. Thus, preschool attendance approximates a randomized experiment in a window closer to the cutoff. It implies that we conduct our analyses only in individuals with a date of birth in the window selected and exposed to education reform. Consequently, we obtain a local intention-treat effect of preschool on bargaining influence, which should be interpreted cautiously.

Finally, to complete this section, we show what the ITT captures in this investigation. Suppose the assumption of the local randomization is satisfied in the windows selected. In that case, we can use the concept of ITT to obtain the lower bound of the preschool effect on our outcomes of interest (Mccoy, 2017). Applying the ITT allows us to improve our estimate over other methods like the ordinary least squares (OLS). Therefore, our estimates become relevant to policymakers because they provide the first evidence of preschool on the active role of the children in the household.

## 2.4 Main results

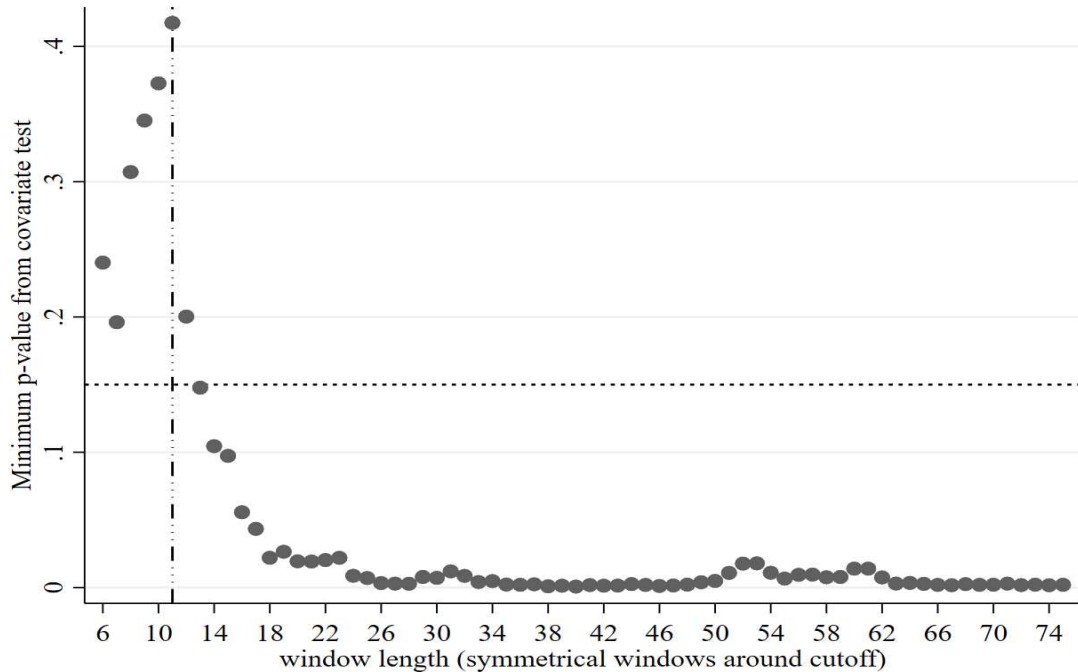
Identification of the ITT depends on the window selected. Thus, we start this section by showing the procedure for choosing the optimal window. It means selecting the window based on covariate balance; therefore, the local randomization assumption is plausible. Consequently, we apply the data-driven procedure developed by Cattaneo et al. (2015) over the entire support of our score variable. In our analysis, the largest window is  $[-90, 275]$ , and the minimum window is  $[-6, 6]$ . We set this minimum window to ensure at least ten observations at either side of the cutoff, as Cattaneo et al. (2015) recommended.

We run the balance test on covariates on different windows for graphical analysis using the Kolmogorov-Smirnov (KS) statistic. Given its low computational demand to perform the graphical analysis, we implement the KS test. After that, we select the minimum  $p$ -value across all tests in each window and plot it in Figure 2.2. The horizontal line in Figure 2.2 represents a significance level of 0.15. We chose this significance level because, in this paper, we are

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<sup>2</sup> We run the manipulation test using data from PNAD and show the results in supporting information Appendix.

concerned with type II error - failing to reject the null hypothesis when it is false (Cattaneo et al., 2015). Figure 2.2 shows that the local randomization assumption holds in windows lower than 14. Therefore, we choose the windows  $[-11.00: 11.00]$ , vertical line, because the minimum p-value exceeds 15% in this window.



Note: The horizontal dotted line correspond to p-value = 0.15 and the vertical dotted line correspond to the window  $[-11.00: 11.00]$

Figure 2.2: Window selector based on covariates

Table 2.2 allows us to understand Figure 2.2 because this table shows the covariates with a minimum p-value for the first ten windows. Table 2.2 shows that window  $[-9.00: 9.00]$  is optimal because it has a minimum p-value equal to 0.265. In this window, we have 60 observations; 30 should be in the treatment group and 30 and the control group. The selection procedure based on the balance test suggests that these observations are statistically identical and thus may be treated as if randomly assigned. The difference in optimal window size between the graphical analysis and Table analyses is due to the statistical test used. While in figure 2.2, we use the KS test; in Table 2.2, we use the difference-in-means test. Therefore, by being cautious, we make our inferences about the preschool effect using the following window:  $[-11.00: 11.00]$ ,  $[-10.00: 10.00]$ , and  $[-9.00: 9.00]$ .

The main results of this paper are presented throughout the remainder of this section. First, we must recall that *bargaining1* is the ratio between the expenditure on products of interest to children and the family income, whereas *bargaining2* is the ratio between the

expenditure on products of interest to children and the available per capita income. Consequently, we expect that the coefficient of interest will always be higher for *bargaining2*.

Table 2.2: Window selector based on covariates: randomization-based p-values from balance tests for different windows.

Window size	Minimum p-value	Covariate with a minimum p-value
[-7.00: 7.00]	0.168	Available per capita income
[-8.00: 8.00]	0.217	Available per capita income
[-9.00: 9.00]	0.265	Available per capita income
[-10.0: 10.0]	0.152	Father's schooling
[-11.0: 11.0]	0.161	Years of study
[-12.0: 12.0]	0.074	Years of study
[-13.0: 13.0]	0.060	Years of study
[-14.0: 14.0]	0.065	Years of study
[-15.0: 15.0]	0.027	Years of study

Note: covariates used in the balance test: region, gender, age, mother's schooling, father's schooling, family size, years of study, and available per capita income.

Table 2.3 shows that preschool attendance positively and significantly affects the children's bargaining power in the family decision-making regarding purchasing products of interest to them. The effect remains stable in the three windows used. Concerning the *bargainng1* variable, we note that the child who attended preschool increases the influence in family decision-making by approximately 0.22 S.D<sup>3</sup>. When we look at the *bargaining2* variable, we observe that the preschool's effect is 0.29 S.D<sup>4</sup>. These results bring the first evidence that children have an active role in family expenditures.

Table 2.3 supports the argument that preschool may be important in producing and improving the necessary skills to enable the negotiation process between parents and children. The preschool creates a foundation that enhances and improves the accumulation of cognitive and noncognitive skills (Cunha et al., 2010; Heckman, 2008; Heckman et al., 2013). Thus, the preschool impacts the bargaining power through the effect called skills begets skills (Cunha & Heckman, 2007; Heckman, 2008). Given that both groups of children have the same years of education, the preschool makes it easier to acquire skills and increases the efficiency of later investments in education, such as primary school.

<sup>3</sup> The standar deviation of *bargaining1* is 0.036

<sup>4</sup> The standar deviation of *bargaining2* is 0,138

Table 2.3: Intention-to-treat of preschool on bargaining power on the household decision in 2017/2018

Randomization-based approach			
		<i>Bargaining1</i>	
Preschool (ITT)	0.008	0.008	0.007
p-value	<b>0.025</b>	<b>0.063</b>	<b>0.071</b>
Window	[-11.00: 11.00]	[-10.00: 10.00]	[-9.00: 9.00]
Sample size treated	37	35	30
Sample size control	36	33	30
		<i>Bargaining2</i>	
Preschool (ITT)	0.037	0.039	0.040
p-value	<b>0.031</b>	<b>0.078</b>	<b>0.085</b>
Window	[-11.00: 11.00]	[-10.00: 10.00]	[-9.00: 9.00]
Sample size treated	37	35	30
Sample size control	36	33	30

Note: Results based on fixed-margins randomization mechanism. The treatment effect is obtained using the difference-in-means test statistic. All  $p$ -values less than or equal to 0.10 are bold.

So far, the results show that a higher level of human capital affects children's bargaining power in the household. To further our analyses, we investigate whether the children's bargaining power varies according to the type of products of interest for them. Table 2.4 presents the estimates for *bargaining1* and *bargaining2* stratified by the following categories: leisure, toys, and technology-related items. Note that the preschool does not affect children's bargaining power on purchasing leisure items [Appendix C. lists all products included in each category]. The non-significance may be attributed to the fact that the average individual's expenditure on leisure items is low, as shown in Table 2.1. The low average amount spent on leisure items can be explained by how the data is collected and the frequency with which these goods are consumed. For example, the data about the consumption of these items refer to the last 30 days before the POF questionnaire was applied, and these items are not consumed every month.

In Table 2.4, we also observe that the preschool variable does not impact children's bargaining power over toy consumption. The characteristic of our sample explains this null effect on the toy category because our sample has information about children older than ten years old. According to SPC (2015), toys are products of interest to younger children. Therefore, given our sample, the results were expected.

The children's bargaining power over purchasing technology-related items provides helpful information. This information confirms the mechanism of how preschool affects family decision-making processes. Table 2.4 reveals that children who attended the preschool

increased their bargaining power by 0.18 S.D<sup>5</sup> and 0.25 S.D<sup>6</sup> over consumption of products listed in the technology category. This significant effect captures the ability to acquire higher levels of human capital due to having attended preschool. We infer that children exposed to preschool use more enhanced bargaining strategies to affect purchasing technology items in the household.

Table 2.4: Intention-to-treat of preschool on bargaining power on the household decision in 2017/2018 stratified by three product categories.

	Leisure		Toys		Technology-related items	
	<i>Bargaining</i> <i>1</i>	<i>Bargaining</i> <i>2</i>	<i>Bargaining</i> <i>1</i>	<i>Bargaining</i> <i>2</i>	<i>Bargaining</i> <i>1</i>	<i>Bargaining</i> <i>2</i>
Preschool (ITT)	0.001	0.002	0.001	0.003	0.006	0.032
p-value	0.243	0.232	0.755	0.694	<b>0.072</b>	<b>0.072</b>
Window	[-11.00: 11.00]		[-11.00: 11.00]		[-11.00: 11.00]	
Sample size treated	37		37		37	
Sample size control	36		36		36	

Note: Results based on fixed-margins randomization mechanism. The treatment effect is obtained using the difference-in-means test statistic. All *p*-values less than or equal to 0.10 are bold. The results in the other windows, 10 and 9, are similar.

The results observed in the technology categories are expected because children older than ten years and adolescents may have more access to product information and a greater understanding of the economic concept (Strauss, 1952). For instance, adolescents may be aware of the possibility of buying using a credit card. Thus, the information about the products and the human capital acquired allows children to increase their influence on purchasing the technology items in the household.

#### 2.4.1 Sensitivity test

In this subsection, we present the sensitivity tests to improve our estimates. First, we run the randomization-based analysis for four different windows. Second, we change the randomization mechanism and analyze the preschool effect on the windows selected above.

<sup>5</sup> The standar deviation of bargaining1 on the technology category is 0.035.

<sup>6</sup> The standar deviation of bargaining2 on the technology category is 0.13

Table 2.5 shows the estimates for four different windows. We consider the following windows to run the sensibility test: [-12.00; 12.00], [-13.00; 13.00], [-14.00; 14.00], and [-34.00; 34.00]. As for the latter, we use this window because it is the optimal bandwidth in the standard RDD approach. The other three windows are larger than those presented in the previous subsection, and they still satisfy assumption 1 according to the KS test shown in Figure 2.2.

The results from table 2.5 show that the ITT of the preschool is stable in windows less than or equal to [-14.00; 14.00]. For these windows, the coefficients are stable in both bargaining measures. However, we observe changes in our estimates when we use the bandwidth size from standard RDD. For example, the coefficient is not significantly different from zero, and its signal is unexpected. The estimates in the window [-34.00; 34.00] do not weaken our analysis because assumption 1 is not satisfied in this window. It means that we do not compare statistically equal individuals under the randomization-based RDD approach.

Table 2.5: Sensitivity of randomization-based RDD results: preschool effects for different windows choices.

	Randomization-based approach			
	<i>Bargaining1</i>			
Preschool (ITT)	0.007	0.007	0.007	-0.003
p-value	<b>0.053</b>	<b>0.022</b>	<b>0.019</b>	0.650
Window	[12.00]	[13.00]	[14.00]	[34.00]
Sample size treated	40	42	45	123
Sample size control	37	41	44	91
	<i>Bargaining2</i>			
Preschool (ITT)	0.034	0.033	0.033	-0.003
p-value	<b>0.075</b>	<b>0.035</b>	<b>0.024</b>	0.858
Window	[12.00]	[13.00]	[14.00]	[34.00]
Sample size treated	40	42	45	123
Sample size control	37	41	44	91

Note: Results based on fixed-margins randomization mechanism. The treatment effect is obtained using the difference-in-means test statistic. All  $p$ -values less than or equal to 0.10 are bold.

We also present the estimates for the selected windows using the Bernoulli randomization mechanism. Table 2.6 shows that even changing the randomization mechanism, the coefficients remain the same as in Table 2.3. As seen in the last column of Table 2.6, when we shift the randomization mechanism, the ITT in the window [-9.00.;9.00] becomes statistically non-significant. However, the randomization mechanism switch does not affect our inferences considerably because it does not generate a significant change in the  $p$ -value.

Table 2.6: Sensitivity of randomization-based RDD results: preschool effects for Bernoulli randomization mechanism.

Randomization-based approach			
		<i>Bargaining1</i>	
Preschool (ITT)	0.008	0.008	0.007
p-value	<b>0.041</b>	<b>0.068</b>	0.103
Window	[-11.00: 11.00]	[-10.00: 10.00]	[-9.00: 9.00]
Sample size treated	37	35	30
Sample size control	36	33	30
		<i>Bargaining2</i>	
Preschool (ITT)	0.037	0.039	0.040
p-value	<b>0.072</b>	<b>0.098</b>	0.132
Window	[-11.00: 11.00]	[-10.00: 10.00]	[-9.00: 9.00]
Sample size treated	37	35	30
Sample size control	36	33	30

Note: Results are based on the Bernoulli randomization mechanism. The treatment effect is obtained using the difference-in-means test statistic. All  $p$ -values less than or equal to 0.10 are bold.

All in all, our sensitivity analysis support that the preschool ITT results are robust. Nevertheless, of course, these results need to be used cautiously. Albeit incipiently, these results indicate that preschool affects the children's role in the household. Our estimates show that investments that improve the children's human capital, such as preschool, may affect the children's bargaining power in the family decision-making process. Therefore, does not include children in the analysis of the household decision-making process generates biased estimates, as stated by Dauphin et al. (2011).

## 2.5 Final Remarks

Being exposed to any interventions during early childhood produces several positive effects on an individual's outcomes. These effects are observed in academic performance, future wages, labor productivity, and health conditions. However, since preschool affects the process of human capital accumulation, it can also affect children's role in intra-household relationships. Although preschool attendance can affect household relations in several dimensions, this paper focused on analyzing the preschool effect on family consumption decision-making. Thus, we sought to identify the intention-to-treat (ITT) of the preschool on the children's bargaining power in purchasing products of interest to them.

To identify the ITT of the preschool on children's bargaining power, we drew our analysis sample from the POF 2017-2018. We used information about children's birth dates, their consumption of products of interest to them, family income, and other household socioeconomic characteristics from this database. Due to the characteristics of the data, the identification strategy we used was a randomization-based RDD approach. Our strategy's

central assumption makes the preschool frequency determination close to a random experiment, allowing the ITT concept to be applied in our setting.

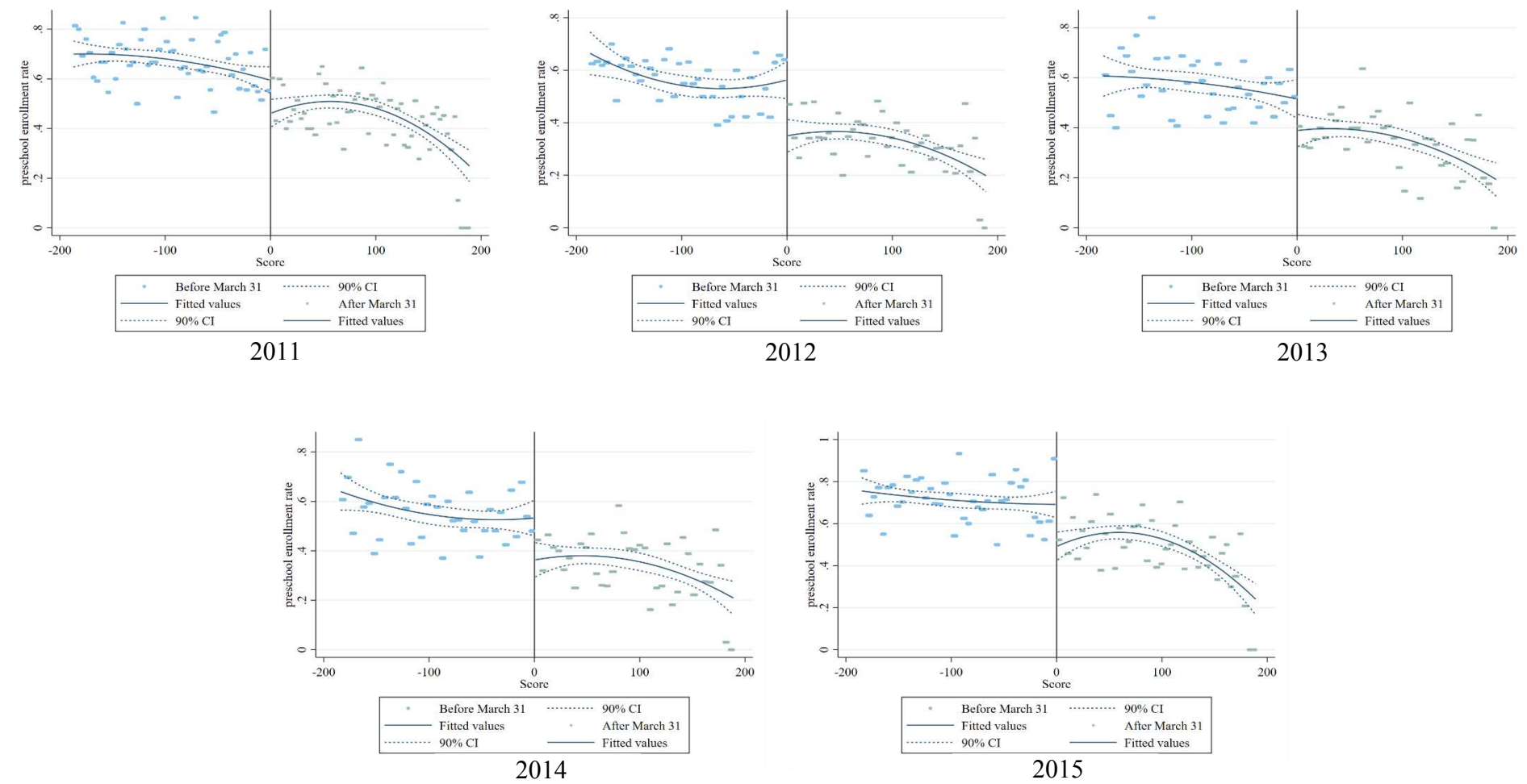
The analysis developed here yields exciting results. They show the novel dimension of the preschool effects. We found evidence that preschool frequency may affect the children's bargaining power in family decision-making. Children who attend preschool have greater bargaining power over the decision-making in purchasing products of interest to them, especially technology items such as cell phones. These results lead us to infer that the accumulation of human capital enhanced by preschool provides the children with different strategic approaches to achieving their goals regarding the consumption of goods.

Our paper underlines the effectiveness of preschool on family decision-making, even if only incipiently. The characteristics in our analysis do not allow us to identify a causal relationship; therefore, we need to be cautious when using the results because the ITT shows the minimum preschool's effect on our relationship of interest. However, our findings indicate that children play an active role in household decision-making. This role can be enhanced by investment in human capital in early childhood. Thus, policies directed at financial education or consumer awareness may be more effective when directed at children. Furthermore, we corroborated that children should indeed be considered in household demand analysis, especially if they are teenagers.

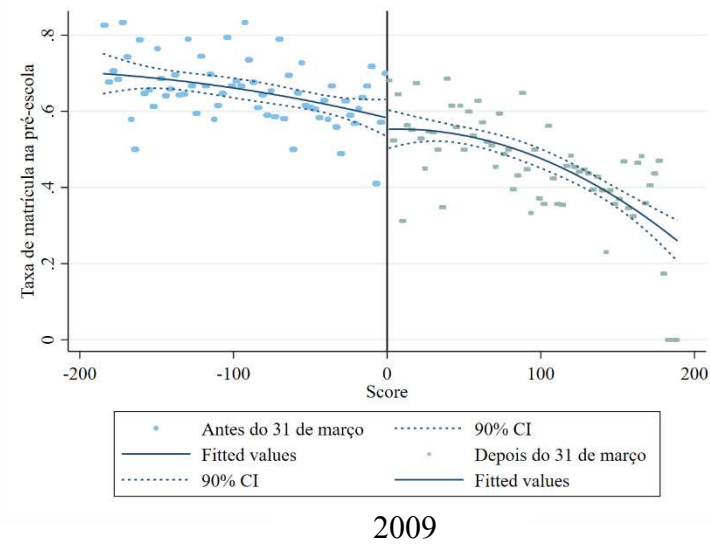
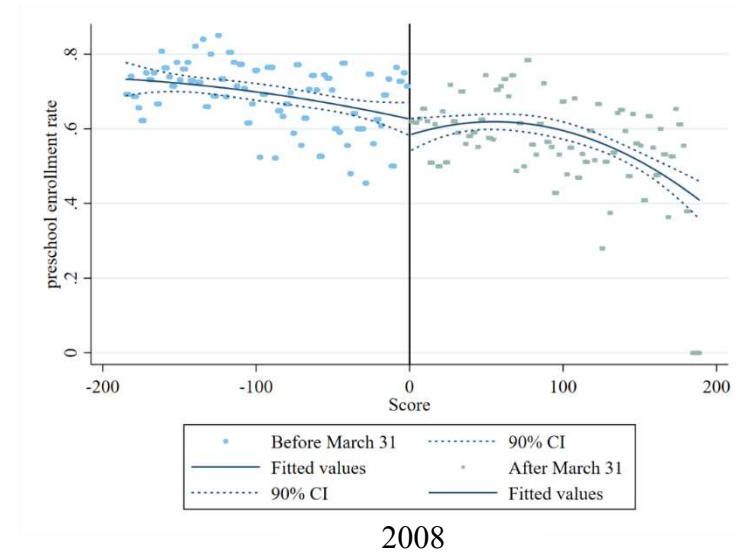
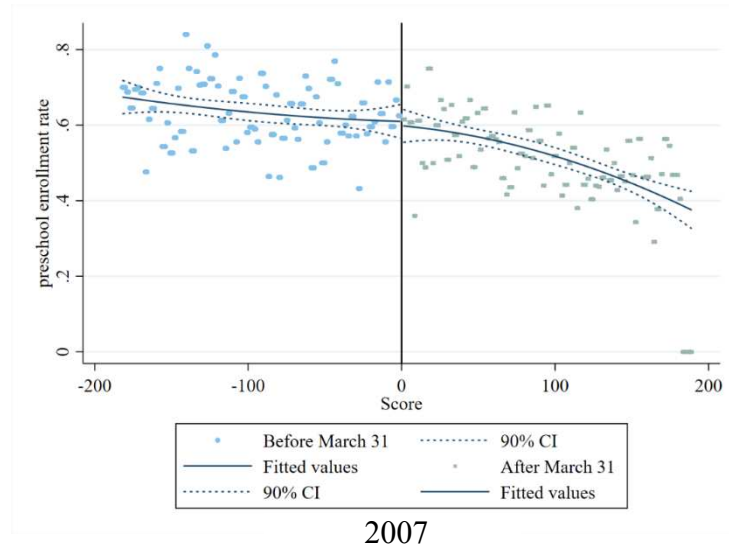
The main limitation of this paper was the data availability. Without longitudinal data on the individuals of interest, we resort to identifying the ITT estimator. In addition, the scarcity of data did not allow for a heterogeneous effects study considering the location of the rural or urban households.

## Supplemental Appendix

### Appendix A - Effect of data birth on preschool enrollment after 2009



## Appendix B - Effect of data birth on preschool enrollment before 2010



## Appendix C - List of the products used to define the consumption of the individuals of interest

Category	POF Table	Description
Leisure items	28	Cinema (tickets) Circus (tickets) Amusement park (tickets) Shows (tickets) Parties (tickets) Soccer (tickets) Volleyball (tickets) F1 (tickets) Eletronic games (token) Video game (token) Eletronic games (internet) CD, DVD, or Game Cartridge Game CD Game DVD Game cartridge CD, DVD, or Game Cartridge rental Game CD rental Game DVD rental Game cartridge rental Playstation NOW Steam Gameflix Netflix game Nintendo Twitch
Toys	43	All items listed in table 43 were included
Technology items	44	Cell phone Mobile phone applications Mobile phone accessories Mobile phone case Snap projector

Source: IBGE (2020)

### 3 PRESCHOOL ATTENDANCE AND INTRA-HOUSEHOLD TIME ALLOCATION: EVIDENCE FROM BRAZIL

#### **Abstract**

This paper aims to identify the indirect effects of preschool on intra-household variables related to maternal labor supply, the older sibling's domestic, productive work, and the demand for education for older siblings. We used the Constitutional Amendment that makes mandatory preschool attendance from 4 years old onwards as the identification strategy, and we used this discontinuity to perform an RDD fuzzy estimation. Results show that the child's attendance at preschool increases the mother's average weekly working hours by 25.5 hours but does not affect the hours offered by older siblings in the labor market. In addition, the intervention increases the older siblings' household chores in low-income families. Concerning older siblings' education attendance, the younger child's preschool attendance showed adverse effects; the preschool reduces the school attendance of the older sibling. This effect is heterogeneous when considering the older siblings' sex: girls are more affected than boys. Finally, the results identify the substitution effect of time allocation between the mother and the older sibling.

**Keywords:** Preschool; labor market outcomes; Household chores; RDD.

### 3.1 Introduction

Preschool attendance has effects that extend beyond the accumulation of children's human capital. Recent literature shows that early childhood education affects individual outcomes, such as schooling, test scores, workforce productivity, wages, and health (Cunha et al., 2010; Curi & Menezes-Filho, 2009; Garces et al., 2002; García et al., 2018; García & Heckman, 2020; Heckman, 2008; Heckman et al., 2013; Heckman & Karapakula, 2019b; Krafft, 2015; Pinto et al., 2017). Furthermore, these effects on human capital can spill over to society by reducing the crime rate, rate of teenage pregnancy, and school dropout rate, consequently increasing social welfare (Basu, 1999; Garces et al., 2002; Heckman, 2008).

Early childhood education also exhibited effects within households (Garces et al., 2002; Heckman & Karapakula, 2019a; Krafft, 2015; Lokshin et al., 2004). A child's attendance at an early childhood education center can change the mother's time allocation due to reducing the mother's household chores related to childcare. Thus, this alteration in time allocation can foster the mother's participation in the labor market (Baker et al., 2008; Barros, Olinto, et al., 2011; Berthelon et al., 2020; Fitzpatrick, 2010, 2012; Lokshin et al., 2004; Morrissey, 2017; Ryu, 2019).

Several studies have realized to identify the effects of daycare, preschool, and elementary school on maternal labor market outcomes. The effects found are mixed, and rely on the labor market conditions, cultural factors, availability of childcare alternatives, sample characteristics, country, and the public policy analyzed (Baker et al., 2008; Berthelon et al., 2020; Fitzpatrick, 2010; Morrissey, 2017; Ryu, 2019; Schlosser, 2018).

For example, the positive effect of preschool on the maternal labor supply is conditional on the mother's schooling. In traditional societies, the children's attendance in preschool increases the labor supply of mothers who are more educated because they are likely to overcome the cultural norms regarding the role of women in households (Schlosser, 2018). When considering the particularities of the labor market's demand, the mother's schooling also determines the positive effects of preschool on maternal labor market outcomes (Berthelon et al., 2020; Brewer et al., 2015). Likewise, the labor market characteristics and the availability of formal and informal childcare also explain whether the effect of interest is small (Baker et al., 2008) or not significant (Fitzpatrick, 2010).

On the other hand, previous studies have reported that family composition is relevant to these analyses. For example, positive effects have been observed on maternal labor market outcomes in mothers without any additional younger children, whether they are single (Cascio, 2009; Fitzpatrick, 2012) or not (Berlinski et al., 2011; Ryu, 2019).

Beyond affecting the mother's work participation and hours offered on the labor market, preschool affects the quality of jobs that mothers can get (Berthelon et al., 2020; Ryu, 2019). Other studies also found positive effects when analyzing the same relationship of interest (Barros, Olinto, et al., 2011; Berlinski & Galiani, 2007; Brewer et al., 2015; Carta & Rizzica, 2018; Du & Dong, 2013).

Discussing this relationship between preschool and mother labor supply is important due to overall improvements in family well-being. This improvement is a result of the increased household income (Carta & Rizzica, 2018) promotion of gender equality, female empowerment, and income security, all of which are products of female insertion into the labor market (Berthelon et al., 2020; Du & Dong, 2013; Schlosser, 2018)

The mechanism that explains the effect observed on the relationships described above is the reduction of unpaid domestic work done by the mothers (Berlinski et al., 2011; Lokshin et al., 2004; Ryu, 2019). Domestic activities produce an economic phenomenon called a double workday, which women predominantly carry out. In Brazil, for example, women have a double workday and spend 24.6 average hours per week performing domestic work. This average is more than double the hours men spend, 10.9 hours per week (IBGE, 2017a). This phenomenon explains the occupation rate when we analyze gender. According to the National Household Sample Survey (PNAD), in 2015, 70.2% of men over 15 years old were in paid work, while for women, the percentage was 48.2% (IBGE, 2017a).

The time spent on household chores increases when there is a child under the age of 4 in the family. Data from PNAD revealed that, in 2015, 83.8% of those responsible for children's care were female. In addition, 74.5% of these children did not use the childcare center, formal or informal, out of the household, and their care is under the responsibility of some household member. However, the unequal household time distribution devoted to childcare activity accentuates the gap between men and women in the employment rate. Men, who declare themselves as caregivers, had an employment rate of 89%, while for caregivers women, the rate was 45% in 2015 (IBGE, 2017b).

In this context, Ryu (2019) and Barros et al. (2011) investigated how children's preschool or daycare attendance affects the maternal labor supply in Brazil. Both studies found positive effects in different subsamples, such as low-income mothers from Rio de Janeiro (Barros et al., 2011) and mothers with no additional younger children or no other relatives (Ryu, 2019). However, both Ryu (2019) and Barros et al. (2011) do not consider the presence of an older daughter in the household, who may affect the mother's participation in the paid work market (Barbosa & Costa, 2017). Older daughters affect the mother's time allocation because

there is a substitution effect between the time spent by the mother and the older daughter on household chores (Lokshin et al., 2004; Skoufias, 1994). Older sisters play a significant role in taking care of their younger siblings. Thus, in this type of study, we need to consider the presence of the older siblings in the household. In Brazil, for example, 78% of a teenager between 10 of 17 years old perform domestic chores (IBGE, 2017a).

Lokshin et al. (2004) used the substitution effect between mothers and older offspring to assess the effect of the cost of childcare centers on the older sibling's schooling in the household. The authors stated that childcare centers' cost influences the mother's employment rate and the enrollment rate of older siblings. Studies by Lokshin et al. (2004) and Jain (2018) reported that the younger child's attendance at childcare centers impacts the schooling of the older siblings. The sign and magnitude of this impact depend on the older siblings' gender because, beyond the substitution effects, there is an income effect. The income effect improves the family's socioeconomic status and increases the family's demand for education.

Although the research by Lokshin et al. (2004) and Jain (Jain, 2018) consider the work of older siblings in the home, they do not include the work outside the home of these children in their analyses. The gender of the older sibling also affects the type of activities they perform. While girls are more likely to perform household chores, boys, especially in low-income families, are more likely to perform paid work outside the home. The longitudinal data from Brazil between 2011 and 2015 reported that girls aged 10 to 17 spend 13.5 hours per week on housework, while boys in the same age group spend 8 hours per week. When we examine the work outside the home, we observe a more significant insertion of boys in paid work, 13.8%, than girls, 7.5% (IBGE, 2017a). Therefore, the income effect may affect the siblings' work outside the home.

Activities carried out by the children in the home (domestic and family production activities such as farming) or outside the home can be understood as child labor. The International Labour Organization (ILO) defines child labor as harmful work that affects children's physical and mental development and schooling achievement (Hilowitz et al., 2004). In developing countries, older siblings carry out activities relatives to child labor. These activities reduce the time children, and adolescents devote to school, consequently harming their performance on school tests (Akresh et al., 2012; Bezerra et al., 2009; Dammert, 2010; Edmonds, 2006). Bezerra et al. (2009) reported that child labor affects Brazilian children's school performance and educational attainment.

Changes in the allocation of intra-household time and resources resulting from preschool can affect older siblings and mothers. For example, the attendance of the family's

youngest children in an early childhood program could increase the family income by increasing the mothers' participation rate in work paid and reducing the time spent by siblings in activities both inside and outside the home. Therefore, in this study, we estimate the effects of preschool on maternal labor supply, older siblings' schooling, and labor supply outside (paid work) and inside (household chores) the home of older siblings in Brazilian families. To identify the effects of the interest, we exploit the Brazilian Constitutional Amendment N° 59 of 2009 (BRASIL, 2009). This Constitutional Amendment and the CNE/CEB Resolution N° 2/2018 make it compulsory to enroll children who turn four years old before March 31 in preschool (BRASIL, 2009, 2018). Thus, this educational reform allows us to address the non-randomization of preschool attendance by using the Regression Discontinuity Design (RDD).

Empirical literature closely related to this study used educational reforms and date of birth as the main elements of the identification strategy (Bauernschuster & Schlotter, 2015; Berlinski et al., 2011; Brewer et al., 2015; Carta & Rizzica, 2018; Fitzpatrick, 2010, 2012; Ryu, 2019). We also use these elements to exploit the eligibility rule for preschool enrollment in Brazil. To the best of our knowledge, only one study, Ryu (Ryu, 2019), has been done using a Brazilian database (PNAD) and exploring the same exogenous sources of variation we use here. However, this study differs from Ryu (Ryu, 2019) because we analyze the effect of preschool on other household members' outcomes, especially the outcomes of older siblings. Furthermore, the current paper estimated the heterogeneous treatment effects of preschool in different subsamples considering family and older siblings' characteristics. As such, we contribute to the debate and enhance the current state of knowledge about the real effects of preschool education on intra-household decisions in a developing country.

Our results indicate that preschool attendance positively affects a mother's average working hours per week; the impact is 25.5 hours per week. When we perform heterogeneous effects analyses, we find that mothers from families formed by couples benefit the most from their child's preschool attendance. Moreover, concerning older siblings' outcomes, we find preschool increases participation and the hours older siblings spend on household chores in low-income families. We also observe that younger child preschool attendance harms older sibling's school attendance; this effect is more significant for older siblings in low-income families. Finally, we run a placebo and predetermined covariates model, and we do not find significant effects of preschool, which gives robustness and supports our results.

In sum, our results, along with the reduction in mother household chores produced by preschool attendance, provide evidence of the substitution effect of time allocation between mother and older siblings in producing non-caregiving household chores. Therefore, public

policies that seek to affect mother time allocation must consider these effects for they will be more effective, especially in low-income families.

The article sections are organized as follows. In subsection 3.2, we explain how the mechanism of preschool attendance affects the outcome variables of interest. Subsection 3.3 outlines the empirical strategy used to identify the causal effects of the relationship of interest and describes the data source. Subsections 3.4 and 3.5 present the main results and the final remarks, respectively.

### **3.2 Preschool and the intra-household time and resource allocation**

The availability of preschool centers produces changes in the members' household relations through two different mechanisms: time and income. Through the time mechanisms, we understand how preschool affects the hours devoted by mothers to household chores (Ryu, 2019). The youngest child's preschool attendance reduces the hours spent by the mother in activities regarding caring for the child. When these activities are minimal, the mothers' supply in the labor market may increase because there is a reduction in mothers' reservation wage (Carta & Rizzica, 2018) and an increase in the hours available in a job outside the households (Berthelon et al., 2020; Ryu, 2019).

Furthermore, the time mechanism may affect the older siblings' time allocation in the household. For instance, if there is an older daughter in the household, the mother is more likely to enter the labor market (Barbosa & Costa, 2017; Lokshin et al., 2004). Due to the substitution effects, the older daughter can substitute the mother in household chores and caring for younger siblings (Dammert, 2010; Jain, 2018; Lokshin et al., 2004; Skoufias, 1994). Thus, the younger sibling's access to preschool decreases the time spent on household chores by an older sister and increases her time dedicated to academic activities, directly impacting her human capital (Jain, 2018; Lokshin et al., 2004).

Similarly, the income mechanism also improves the older sister's human capital. Shifts in the mother's time allocation resulting from preschool increase her entering the labor market, thus improving her economic status. When the family's level of economic status increases, the demand for education for offspring increases, too (Bezerra et al., 2009; Lokshin et al., 2004). It is important to note that the gender of older children determines the magnitude of the effects of income mechanisms on their schooling (Lokshin et al., 2004).

The two mechanisms we mentioned above determine the sign and the magnitude of the effects of preschool on older siblings' outcomes of interest. Therefore, the magnitude of the income and substitution effects determine the impact on the older siblings' schooling. For

example, if the income effect is more significant than the substitution effect, we expect older children's education to increase. On the other hand, if the substitution effect is more significant than the income effect, we expect an increase in the hours spent on household chores performed by the older siblings while at the same time, there is a reduction in the hours spent by their in academic activities (Lokshin et al., 2004)

In low-income families, the impact of preschool may be more pronounced. In these families, the investment in human capital is lower than desired due to their restricted resources (Barros et al., 2011). In this context, the allocation of family resources in children's education considers the children's abilities and the higher return on that investment. Thus, some children will benefit more than others (Adhvaryu & Nyshadham, 2016; Akresh et al., 2012). In families with resource restrictions, there exists a phenomenon called sibling rivalry. It explains the different levels of investment in education among the siblings. In traditional society, which has a pro-male bias, girls' returns on education are lower than boys (Akresh et al., 2012). All these factors and the greater participation of the girls in household chores result in the sacrifice of the older sister's education in families with limited resources (Lokshin et al., 2004).

The same resource constraint faced by lower-income families generates child labor by the older siblings inside and outside the household (Basu, 1999; Basu & Van, 1998; Edmonds & Pavcnik, 2005). Older siblings are encouraged to help with the family income (Dammert, 2010). Consequently, the time spent working reduces the time used on school activities. As a result, child labor causes school dropouts or undermines classes' effectiveness for those children still attending school (Dammert, 2010; Edmonds & Pavcnik, 2005). Therefore, the mothers entering the labor market increase the resources available in the household and reduce the time the older children spend on paid work, especially for the boys.

The mechanism we showed in the current section will allow us to analyze the results obtained after applying the identification strategy. Finally, the upcoming section describes the identification strategy and the data used.

### **3.3 Methodology**

#### **3.3.1 Identification strategy**

Due its nature feature, preschool attendance is not randomly assigned because it carries endogeneity caused by omitted variables. Unobservable household characteristics determine the parent's decision to enroll the children in an early childhood center. For example, the parent's perception of the importance and the returns of the education may raise the likelihood of enrolling the children in the preschool. This perception also affects the demand for education

of all the children that live in the household. In addition, another source of endogeneity resulting from the simultaneity exists between the decision to enroll the child in preschool and the mother's participation in the labor market (Ryu, 2019).

To address all sources of endogeneity that we describe above, we exploit the variation obtained from the Brazilian educational reform, which resulted from the enactment of Constitutional Amendment N° 59 in 2009, Law N° 12.796 in 2013, and CNE/CEB Resolution N° 2/2018 (BRASIL, 2009, 2013, 2018). These legal provisions made basic education compulsory from age four until age 17. The CNE/CEB N° 2/2018 reaffirmed that the age cutoff for the child's enrollment in preschool is four years, meaning that upon turning four years old by March 31 of the current year, the child must be enrolled in the second stage of early childhood education (preschool). This scenario allows us to exploit the discontinuity of the enrollment age, and thus we address the non-randomization of preschool attendance by using the Regression Discontinuity Design, henceforth RDD.

Therefore, we use RDD to identify the treatment effect of preschool attendance on labor maternal and older siblings' labor child and domestic work. The RDD is one of the most reliable quasi-experimental methods in empirical research to identify the causal effects of the project, policies, and program (Calonico et al., 2019). The critical element of this method is the existence of a covariate that partially or fully determines the treatment status of the individual regarding a cutoff (Calonico et al., 2014a, 2014b, 2019; Hahn et al., 2001; Imbens & Lemieux, 2008). This covariate is called a score, running variable, or forcing variable. Observation units whose score is higher than the cutoff value receive the treatment; otherwise, they do not receive it.

In this paper, we use the child's date of birth as the score variable; henceforth, we refer to this variable as score. Therefore, according to the Amendment, we set the cutoff value to March 31. Thus, children born before March 31 must be enrolled in preschool; contrarily, those born after this date do not have to be enrolled. The database shows us that the treatment status, the preschool attendance, is not entirely determined by the score; hence we use the RDD fuzzy approach. As there is no perfect compliance, we estimate the treatment effects in the two-stage estimation process. In the first stage, we estimate the score's effect on the probability of the child's preschool attendance conditional on the cutoff value. For that, we use equation 3.1.

$$\lim_{x \uparrow c} [Pre_i | D_i = c] - \lim_{x \downarrow c} [Pre_i | D_i = c] = E[Pre_i(1) - Pre_i(0) | D_i = c] \quad (3.1)$$

where the variable  $Pre_i$  is an indicator that shows whether the children are enrolled in preschool.  $D_i$  is the score variable, and the constant  $c$  is the cutoff value. To simplify RDD implementation, we reorganized the data and set March 31 as day zero, so the cutoff value is zero ( $c=0$ ). In this way, children born before the cutoff date have values smaller than zero in  $D_i$ ; and children born after March 31 have values of  $D_i$  higher than zero.

Finally, the treatment effects of preschool on the outcomes of interest of this study will be obtained by estimation of equation 3.2,  $\tau_{RDF}$ . In this equation  $Y_i$  represents the following variables: the mother's labor market status, the hours offered by the mothers in the labor market per week, the older siblings' school attendance, the older siblings' status of household chores, and how many hours they spend per week in these activities, and their labor market status and how many hours they spend in work outside the household.

$$\tau_{RDF} = \frac{\lim_{x \uparrow c} [Y_i | D_i = c] - \lim_{x \downarrow c} [Y_i | D_i = c]}{\lim_{x \uparrow c} [Pre_i | D_i = c] - \lim_{x \downarrow c} [Pre_i | D_i = c]} \quad (3.2)$$

First, the probability of preschool attendance conditional on the score must jump discontinuously at the cutoff equal to zero to identify the effects of interest. Under the continuity-based approach, the identification strategy relies on the assumption that the conditional expectation of potential outcomes is continuous at the threshold ( $c=0$ ). Furthermore, the assumptions of exclusion and monotonicity must be satisfied (Hahn et al., 2001; Imbens & Lemieux, 2008). We can estimate equation 3.2 by including other explanatory covariates. The latter may improve the efficiency of the estimator (Calonico et al., 2019).

For the implementation of RDD, we choose the bandwidth by data-driven procedures. By doing so, we avoid issues concerning choosing an ad hoc bandwidth, such as a lack of transparency and specification searching. Cattaneo and Vazquez-Bare (Cattaneo & Vazquez-Bare, 2016) and Cattaneo et al. (Cattaneo et al., 2019; Cattaneo & Vazquez-Bare, 2016) discussed these issues and recommended selecting the bandwidth based on data-driven because it gives objectivity and robustness to the RDD estimator. Hence, we select the bandwidth by the Mean Squared Error (MSE) optimal bandwidth choice and the Coverage Error (CER) optimal bandwidth choice.

The MSE optimal approach selects the bandwidth to minimize the MSE of the local polynomial used to identify the RDD estimator. Consequently, it optimizes the bias-variance trade-off. However, the MSE optimal bandwidth does not have suitable properties for conducting inference. To address this concern, we use CER optimal bandwidth choice. The

MSE optimal is used to identify the RDD estimator and CER optimal to construct optimal confidence intervals (Cattaneo & Vazquez-Bare, 2016).

Another two main elements necessary for RDD implementation are the kernel function and the order of the local polynomial. As for the latter, we employ a low-order local polynomial, specifically a local linear polynomial. According to Cattaneo et al. (Cattaneo et al., 2019) and Gelman and Imbens (2019), using a high-order local polynomial leads to unreliable results and poor approximation at the boundary, at cutoff; because it is more sensitive to outliers at these points. Therefore, using a lower-order local polynomial provides a more robust approximation and less sensitivity to boundary problems (Cattaneo et al., 2019; Gelman & Imbens, 2019).

The kernels frequently used by researchers are the triangular and uniform kernels. The triangular kernel function assigns larger weights to observations closer to the cutoff and zeroes to all observations outside the selected bandwidth. The uniform kernel, in turn, assigns the same weights to all observations within the bandwidth. Following the recommendation of Cattaneo et al. (2019), we use the triangular kernel function in all our estimations.

We perform the manipulation test developed by McCrary (2008) to validate and improve the estimates. The test allows us to verify any score manipulation by the families around the birth date of March 31. Moreover, we also performed placebo and predetermined covariates tests, as well as we used placebo cutoff analysis.

### **3.3.2 Database**

We used data from the PNAD from 2011 to 2015. The Brazilian Institute of Geography and Statistics (IBGE) made the survey available annually. It contains information on education, household characteristics, employment status, income, migration, and other socioeconomic characteristics of the population. We use the PNAD for two main reasons: this survey contains information on the date of birth of individuals detailed in the day, month, and year; it is the complete database available from before the implementation of the compulsory law until 2015. It is a year before the deadline for municipalities and states to adapt to the law of compulsory preschool education.

For this paper, we selected the children who were or would turn four years old when the PNADs were applied. We kept, for our analysis, the children declared as sons or daughters in the family status variable because there were children within the age group of interest that declared them as other relatives. We used in the analysis information from families with mothers older than 17 and younger than 50 years. The data provide information about whether the mothers worked during the reference week that the questionnaire was applied and the average number of hours weekly they spent working in their primary job. In addition, we

identified the average number of hours spent on chores each week by mothers. Thus, the sample that we used to assess the effect of preschool on mothers' labor market outcomes contains 14784 units of observations (families or households).

For the sample that contained information about the older siblings, we restricted the sample to households with children between 10 and 17 years old. We chose this age group because the data contains detailed information about the supply of work for these children. Additionally, children younger than 17 are more likely to attend basic Brazilian education. Thus, in this sample, we obtained details about the older siblings' school attendance, whether they performed household chores, and the average number of hours spent on chores each week. We also identified the older siblings' labor status during the week of reference, whether they worked, and their average number of working hours.

We extracted other variables from PNAD to identify heterogeneous effects and validate the empirical strategies. We identified the heterogeneous effects using the following variables: family composition, household location, gender of the older children, and income bracket. Our methods for validation and falsification of RDD are based on a test with predetermined variables, placebo outcomes, a manipulation test around the cutoff, and a placebo cutoff analysis. In the placebo outcomes test, we use the fathers' labor market outcomes because the mechanism by which the preschool affects the maternal variables is the reduction of the double workday, a phenomenon less observed in fathers. The predetermined variables that we used are mothers' education and age.

### **3.4 Main Results**

In this subsection, we first show the characteristics of the samples that we use in the analysis. After that, we display a discontinuous jump in the probability of the children enrolled in preschool at the cutoff. Finally, in the subsections 3.4.2 and 3.4.3, we point out the main results of this investigation and the validation and falsification test to improve the robustness of our estimates.

#### ***3.4.1 Descriptive statistics and graphical analysis***

Table 3.1 presents the summary statistic of the current samples used in this paper. Column 1 shows information about the whole sample, and columns 2 and 3 present information based on whether the children attended the preschool. It can be seen in Table 3.1 that 79.1% of the families analyzed live in areas classified as urban by PNAD. This percentage increased to 86.5% when we considered only the sample of families with children who attended the preschool. We note that in families where the child did not attend preschool, the size of the

family and the number of children are larger than in the subsample of families where the child attended preschool. The presence of more people in the families increases the probability of someone substituting the mothers' time for caring for the young children and consequently reduces the demand for preschool; we can understand this as the availability of informal childcare (Aquino & Pazello, 2011; Lokshin et al., 2004).

In panel A (Table 3.1), we note that the mothers' schooling of children who attended preschool is higher than the mothers' schooling of other children. We observe the same difference in variables such as mothers' age, the mothers' employment rate, and the average number of hours working outside the home during the reference week. In column (4), we also observe that all differences are significant at level 1% and that the mother's time on chores is more significant in families with a child who did not attend preschool.

Panel B presents details about the sample of older siblings. The data reports statistically significant differences in the older siblings' variables, such as: whether they perform chores, the average number of hours dedicated by them to chores per week, work outside the home in the reference week, and their school attendance. What is interesting about the data is that all differences seem to favor the older siblings of the child who attended the preschool. However, we cannot say that preschool causes these differences.

Table 3.1: Summary Statistics

	Whole sample (1)	The child attends preschool (2)	The child does not attend preschool (3)	Difference (4)
Family size	4.213 (1.458)	3.936 (1.231)	4.423 (1.577)	-0.487***
Number of children	2.297 (1.345)	2.008 (1.104)	2.486 (1.471)	-0.479***
Urban	0.791 (0.406)	0.865 (0.341)	0.735 (0.441)	0.130***
<b>A. Mothers' time allocation characteristic</b>				
Mothers' schooling	8.491 (3.951)	9.822 (3.85)	7.477 (3.719)	2.333***
Mothers' ages	30.652 (6.852)	31.464 (6.636)	30.033 (6.949)	1.461***
Work outside the home	0.468 (0.499)	0.547 (0.498)	0.408 (0.492)	0.139***
Average of working hours per week	33.672 (14.645)	34.774 (13.659)	32.6 (15.471)	2.144***
Average of hours on chores per week	31.175 (17.389)	30.395 (17.74)	31.759 (17.102)	-1.364***
<b>B. Older siblings' characteristic</b>				
Gender	0.479 (0.499)	0.488 (0.500)	0.474 (0.499)	0.014 <sup>NS</sup>
Age	12.719 (2.172)	12.756 (2.196)	12.789 (2.159)	-0.033 <sup>NS</sup>
Work outside the home	0.095 (0.294)	0.079 (0.261)	0.104 (0.31)	-0.096***
Average of working hours per week	24.263 (13.866)	23.715 (14.472)	24.037 (13.653)	-0.322 <sup>NS</sup>
Work on chores	0.583 (0.493)	0.576 (0.007)	0.604 (0.010)	0.027**
Average of hours on chores per week	11.235 (8.558)	10.675 (0.232)	11.68 (0.169)	-0.937***
Attends school	0.948 (0.223)	0.973 (0.003)	0.937 (0.003)	0.035***

Notes: This table presents the means and standard deviation of the main variables of this study—the standard deviation is in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.

We implemented our identification strategy to further investigate these differences in Table 3.1. For that, we first present visual evidence supporting of RDD fuzzy approach. In Figure 3.1, we plot the relationships between the score and the preschool enrollment rate. Zero in the score variable represents March 31 of the year in which the child turned four years old. We observe that the figure displays a discontinuity in the preschool enrollment rate at the cutoff. Thus, children born before March 31 are more likely to be enrolled in preschool than children after that date. Around the cutoff, the difference in enrollment rate is 12 percentage points (p.p). This result indicates that basic education reform is validated to explain children’s preschool attendance. Because of this, we exploit this discontinuity to assess the effect of preschool on outcomes of interest. Appendix E shows the same discontinuity for the older siblings’ sample.

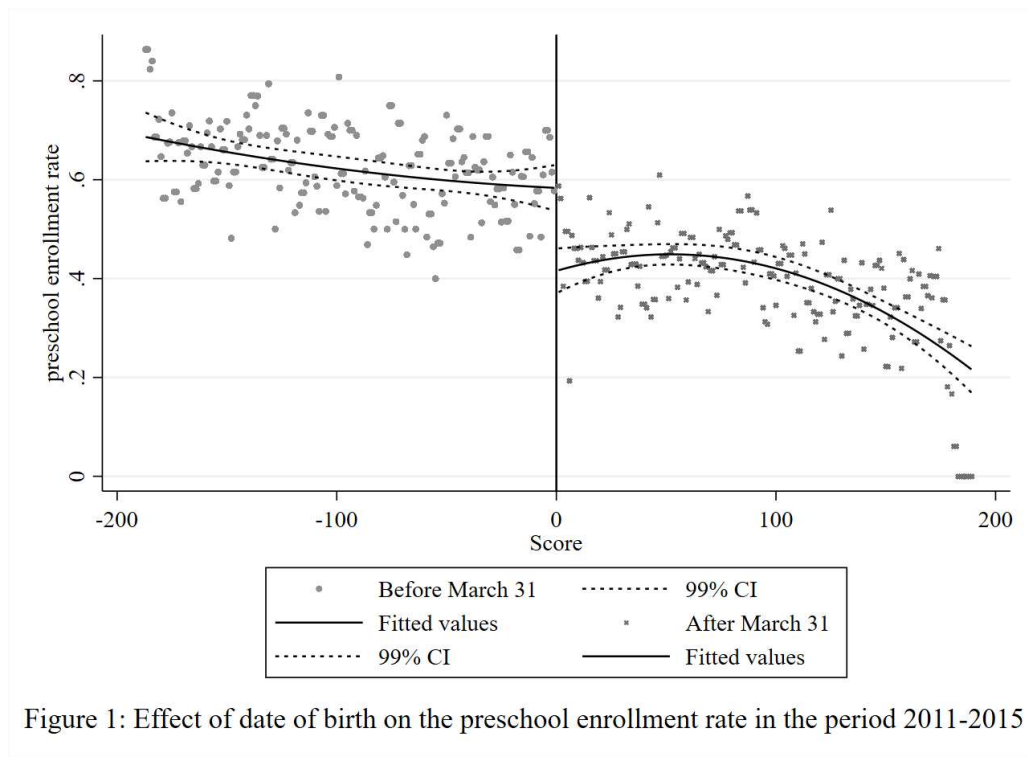


Figure 1: Effect of date of birth on the preschool enrollment rate in the period 2011-2015

Next, we illustrate the relationship between these outcomes and the score variable to show the first evidence that a child’s preschool attendance affects our outcomes of interest. Appendix A plots the effect of the score on maternal labor market outcomes. We observe discontinuity at the cutoff in the variables regarding the average number of hours offered by the mother. In turn, for the older siblings’ whole sample, Appendix B, C, and D show the relationship between score value and the older siblings’ outcomes. Only the school attendance variable shows a discontinuity at the cutoff.

### 3.4.2 Main results and heterogeneous effects

After supporting the validity of RDD fuzzy throughout the graphical analysis, we report the main results in this subsection. In every estimation present in this subsection, we include the following control variables: mother's years of education, mother's age, mother's race, state, and survey fixed effects, the number of family members, and the older sibling's age. First, we report the estimates assessing whether preschool attendance impacts maternal labor market outcomes in Table 3.2. The first-stage regressions show that the eligibility rule used in this paper increase the preschool enrollment rate for children who have a value of score variable less than zero. Children who turn four years old before the cutoff have approximately 11-12 p.p. more probability of being enrolled than those who turn four years old after the cutoff.

Table 3.2 shows that preschool does not seem to have a statistically significant impact on mothers entering the labor market. The non-significance of this parameter of interest might be explained by the high reservation wage of the women in Brazil, which is almost double compared to the reservation wage of the men. The women's reservation wage is R\$ 10,45 per hour, while the men's is R\$ 5,45 per hour (Monte et al., 2011). Therefore, this finding suggests that preschool attendance variation does not modify the mother's reservation wage.

Table 3.2: Effects of preschool attendance on mothers' labor market outcomes between 2011-2015

	Worked in the reference week		Working hours per week	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 52.387</i>		<i>Bandwidth = 49.010</i>	
Cut-Off	0.11*** (0.034)	0.486 <sup>NS</sup> (0.379)	0.11*** (0.036)	25.863* (15.032)
Controls	Yes	Yes	Yes	Yes
Observations	3732	3732	3547	3547
<i>CER-Optimal</i>	<i>Bandwidth = 32.432</i>		<i>Bandwidth = 36.470</i>	
Cut-Off	0.119*** (0.039)	0.552 <sup>NS</sup> (0.409)	0.117*** (0.037)	25.128* (14.989)
Controls	Yes	Yes	Yes	Yes
Observations	2349	2349	2663	2663

Note: Standard errors<sup>7</sup> are reported in parentheses, and we used the Robust Bias Correction. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the "RDF estimate" we defined in equation 3.2.

To further analyze the relationship between preschool attendance and mothers entering the labor market, we explore the impact of preschool on different subsamples to identify possible heterogeneous effects. Panel A in Table 3.3 reports the heterogeneous effects of

<sup>7</sup> We used the nearest-neighbor method along this study to compute the variance-covariance matrix estimator. The number of neighbors was defined by default of rdrobust package (3 nearest neighbor).

preschool attendance on subsamples based on family compositions (couples and mothers who are singles), household location (rural and urban), and household income. Appendix F and G present the first and second stages of regression of the analysis of the heterogeneous effects on the mother's sample. We find no significant effects on all the subsamples. These results accord with Ryu (Ryu, 2019), who found the same results for the whole sample and the subsamples.

Concerning the average number of hours offered by the mother on paid work, estimates from Table 3.2 show evidence that preschool attendance has a positive and significant impact. For instance, we find that enrolling the child at a preschool increases the mother's average working hours per week by 25.5 hours, which is in line with the school day provided by a preschool in Brazil for the regular period (BRAZIL, 2013). These results indicate that preschool only affects mothers who were already working. Moreover, this impact is larger in families formed by couples, regardless of the older child's age. According to Panel B in Table 3.3, preschool attendance increases the mother's average weekly working hours by approximately 30 hours in these families.

Table 3.3: Heterogeneous effects of preschool on maternal labor market outcomes

Sub-samples	Bandwidth	RDF estimate	Standard error	Observations
<b>Panel A</b>				
<b>Work in the reference week</b>				
Singles mothers	48.625	-0.078 <sup>NS</sup>	0.649	575
Couples	36.304	0.664 <sup>NS</sup>	0.462	2217
Couple with children under 14 years old	49.659	0.498 <sup>NS</sup>	0.353	2525
Urbano	36.693	0.391 <sup>NS</sup>	0.362	2136
Rural	44,700	0.836 <sup>NS</sup>	1.652	630
Per capita family income < ½ minimum wage	37.064	-0.003 <sup>NS</sup>	0.335	1251
<b>Panel B</b>				
<b>Working hours per week</b>				
Singles mothers	49.000	-5.642 <sup>NS</sup>	27.234	586
Couples	35.166	32.633*	19.633	2161
Couple with children under 14 years old	47.442	27.031*	15.063	2419
Urbano	36.755	20.113 <sup>NS</sup>	15.136	2136
Rural	44.737	43.892 <sup>NS</sup>	56.396	630
Per capita family income < ½ minimum wage	34.256	-2.201 <sup>NS</sup>	12.472	1148

Note: We used the Robust Bias Correction. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01. The bandwidth was selected using the MSE-Optimal data-driven method.

In contrast, preschool does not affect the average number of hours weekly working of mothers who are singles (Panel B in Table 3.3). In single-parent families, mothers are the head of households and the main source of home income. In the sample used, we observed that 61.1% of single mothers were working during the reference week, while the percentage of mothers in families formed by couples was 48%. In addition, single mothers worked an average of 36.4 hours per week in paid work, a value larger than the sample mean presented in Table 3.1. From this data, we infer that the non-significance of preschool is due to the mothers' need to be working because they are the main family's source of income.

Table 3.4 reports the estimates for the effects of young child's preschool attendance on the older siblings' labor market outcomes. It observes that even though the cutoff is statistically significant to explain the preschool enrollment, the preschool attendance does not impact the older siblings' entry into the labor market nor the average number of weekly working hours. The income mechanism explains this non-significance. Child labor outside the home depends on the family income variation (Basu, 1999; Basu & Van, 1998; Edmonds & Pavcnik, 2005). Therefore, because preschool does not generate a significant variation in the family's income through the mother's insertion in the labor market, in Tables 3.2 and 3.3, the result observed in Table 3.4 was expected.

Table 3.4: Effect of preschool on older siblings' labor market outcomes.

	Worked in the reference week		Working hours per week	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth=41.772</i>		<i>Bandwidth=62.484</i>	
Cut-Off	0.060** (0.034)	0.173 <sup>NS</sup> (0.221)	0.072** (0.033)	-6.071 <sup>NS</sup> (5.051)
Controls	Yes	Yes	Yes	Yes
Observations	1349	1349	1945	1945
<i>CER-Optimal</i>	<i>Bandwidth=41.000</i>		<i>Bandwidth=40.220</i>	
Cut-Off	0.060** (0.033)	0.174 <sup>NS</sup> (0.222)	-0.056** (0.027)	-5.938 <sup>NS</sup> (7.143)
Controls	Yes	Yes	Yes	Yes
Observations	1345	1345	1308	1308

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The value for the cutoff effect in the second stage is the "RDF estimate" we defined in equation 3.2.

Likewise, we observe that the effects are also not significant when we assess heterogeneous effects based on the gender of the older siblings and household income. Table 3.5 reports that preschool does not impact the labor market outcomes of the older sister and older brother. Similar results it observes when analyzing this relationship in low-income

families. We present the first and second-stage regression of the estimates in Table 3.5 in Appendix H.

Table 3.5: Heterogeneous effects of preschool on the older siblings' labor market outcomes.

Sub-samples	Bandwidth	RDF estimate	Standard error	Observations
<b>Work in the reference week</b>				
Sister	51.258	-0.318 <sup>NS</sup>	0.288	819
Brother	59.880	0.302 <sup>NS</sup>	0.195	942
Per capita family income < ½ minimum wage	41.149	0.151 <sup>NS</sup>	0.21	836
<b>Working hours per week</b>				
Sister	48.708	-11.491 <sup>NS</sup>	8.945	776
Brother	50.290	-0.486 <sup>NS</sup>	6.499	804
Per capita family income < ½ minimum wage	35.387	-4.296 <sup>NS</sup>	6.318	727

Note: We use the Robust Bias Correction. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01. The bandwidth was selected using the MSE-Optimal data-driven method.

In turn, Table 3.6 presents the estimate of the effect on older siblings' household chores. When we use the whole sample of older siblings, we find no effects on the variables concerning older siblings' household chores. However, we observe a significant effect when analyzing a subsample of low-income families. In these families, in Table 3.7, the variation in preschool enrollment increases by 37.6 p.p., the probability the older siblings perform household chores. This result is somewhat unexpected.

Table 3.6: Effect of preschool on older siblings' housework outcomes

	Did household chores		Hours on household chores	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth=66.410</i>		<i>Bandwidth=50.370</i>	
Cut-Off	0.076** (0.031)	-0.33 <sup>NS</sup> (0.274)	0.069** (0.034)	4.156 <sup>NS</sup> (5.767)
Controls	Yes	Yes	Yes	Yes
Observations	2095	2095	1610	1610
<i>CER-Optimal</i>	<i>Bandwidth=42.747</i>		<i>Bandwidth=41.714</i>	
Cut-Off	0.064** (0.032)	-0.367 <sup>NS</sup> (0.376)	0.062* (0.034)	6.385 <sup>NS</sup> (7.035)
Controls	Yes	Yes	Yes	Yes
Observation	1366	1366	1349	1349

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the "RDF estimate" we defined in equation 3.2

Given that the PNAD does not draw a distinction between care and other chores activities, we can infer that the positive and significant impact on low-income families may result from the substitution effect discussed by Lokshin et al. (2004) and Skoufias (Skoufias, 1994). That is, when the child is in preschool attendance, the time allocated by the mothers for chores such as cleaning the home and cooking meals is replaced by the older siblings' time. According to Table 3.7, the substitution effect in low-income families is approximately 13.3 hours per week in Brazil. The result at the bottom of Table 3.7 supports the substitution mechanism idea because preschool reduces mothers' household chores by 22.5 p.p. in low-income families. Appendix I shows information about the first-stage regression of the estimates that we report in Table 3.7.

Table 3.7: Heterogeneous effects of preschool on the older siblings' household chores outcomes.

Sub-samples	Bandwidth	RDF estimate	Standard error	Observations
<b>Did household chores</b>				
Sister	48.407	0.565 <sup>NS</sup>	0.571	776
Brother	56.682	-0.033 <sup>NS</sup>	0.332	921
Per capita family income < ½ minimum wage	52.720	0.376*	0.221	1050
<b>Hours on household chores</b>				
Sister	48.876	15.893 <sup>NS</sup>	16.267	776
Brother	46.186	-3.744 <sup>NS</sup>	5.047	751
Per capita family income < ½ minimum wage	50.576	13.299**	6.428	1011
<b>Mothers' housework</b>				
Per capita family income < ½ minimum wage	52.420	-0.225**	0.093	998

Note: We use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The bandwidth was selected using the MSE-Optimal data-driven method. First-stage regression for mothers' housework is the same that we report in Appendix F and G for low-income families.

Finally, Table 3.8 shows the effects of the preschool variable on demand for the older siblings' education. This finding indicates that a child's attendance at preschool reduces the older siblings' school attendance. Although this is an unexpected result, some factors may explain this result. For instance, the insignificant of preschool attendance on mothers' entry into the labor market is a factor that may partly explain the relationship observed in Table 3.8. Even though this factor does not explicate the negative impact that we find, with this non-significance, it is plausible to expect that the income mechanism does not affect the demand for

education for the older children because there is no significant shift in the economic status of the families.

Table 3.8: Effect of preschool on older siblings' school attendance.

	School attendance	
	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>		
	<i>Bandwidth=73.151</i>	
Cut-Off	0.072** (0.030)	-0.377*** (0.106)
Controls	Yes	Yes
Observations	2332	2332
<i>CER-Optimal</i>		
	<i>Bandwidth=47.087</i>	
Cut-Off	0.07** (0.032)	-0.439*** (0.164)
Controls	Yes	Yes
Observations	1534	1534

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \*  $p < 0.1$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . The value for the cutoff effect in the second stage is the "RDF estimate" we defined in equation 3.2.

In developing countries, the scarcity of economic resources is another factor that may explain the negative effect found in the relationship of interest presented in Table 3.8. In our sample of the older siblings, 69% of the families earn less than  $\frac{1}{2}$  minimum wage per capita. This percentage increases to 74.3% for families where the older child does not attend school. Therefore, we infer that the available family income seems to be a factor that explains why preschool negatively impacts the demand for education of the older siblings. In a resource-competitive environment, the older child's education is sacrificed to help with household chores or provide resources for the families (Dammert, 2010). This argument is endorsed by the similarity between estimates in Tables 3.8 and 3.9 when considering low-income families.

Table 3.9: Heterogeneous effects of preschool on the older siblings' school attendance.

Sub-samples	Bandwidth	RDF estimate	Standard error	Observations
<b>School attendance</b>				
Sister	59.803	-0.355*	0.201	933
Brother	50.126	-0.316**	0.154	804
Per capita family income $< \frac{1}{2}$ minimum wage	51.201	-0.426***	0.139	1032

Note: We use the Robust Bias Correction. \*  $p < 0.1$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . The bandwidth was selected using the MSE-Optimal data-driven method. Appendix J reports the first-stage regression

The allocation of family resources in children's education considers their abilities, gender, and the returns of the investment in education (Adhvaryu & Nyshadham, 2016; Akresh et al., 2012; Kaul, 2018). Thereby, in a resources-competitive environment, someone would

tend to be less favored in demand for education. Tables 3.8 and 3.9 show that the families sacrifice the older siblings' education to favor the younger siblings' education. In low-income families, older children leave school to perform household chores, Table 3.7. In addition, social norms with pro-male bias - cause girls' returns to be lower than boys (Akresh et al., 2012) and become the women net transferors of unpaid housework time to other household members (de Jesus et al., 2018) - generate a scenario in which the demand for education to daughters are low. It explains why the older sisters have a significant and negative impact, -35.5 p.p., than the older brothers, -31.6 p.p.

### 3.4.3 Robustness checks: validation and falsifications tests

This subsection provides the robustness checks that aim to ensure and improve the consistency of the results exposed in the previous subsection. We begin by plotting Figure 3.2, which is analogous to Figure 3.1. Figure 3.2 presents the relationship between the preschool enrollment rates and the score for the period prior to 2009. It observes that there is no discontinuity around the cutoff, March 31. Thus, we may state that the eligibility criterion did not affect the preschool enrollment rates prior to the Constitutional Amendment N° 50 of 2009. This result improves the robustness of the first stage of the empirical strategy we proposed.

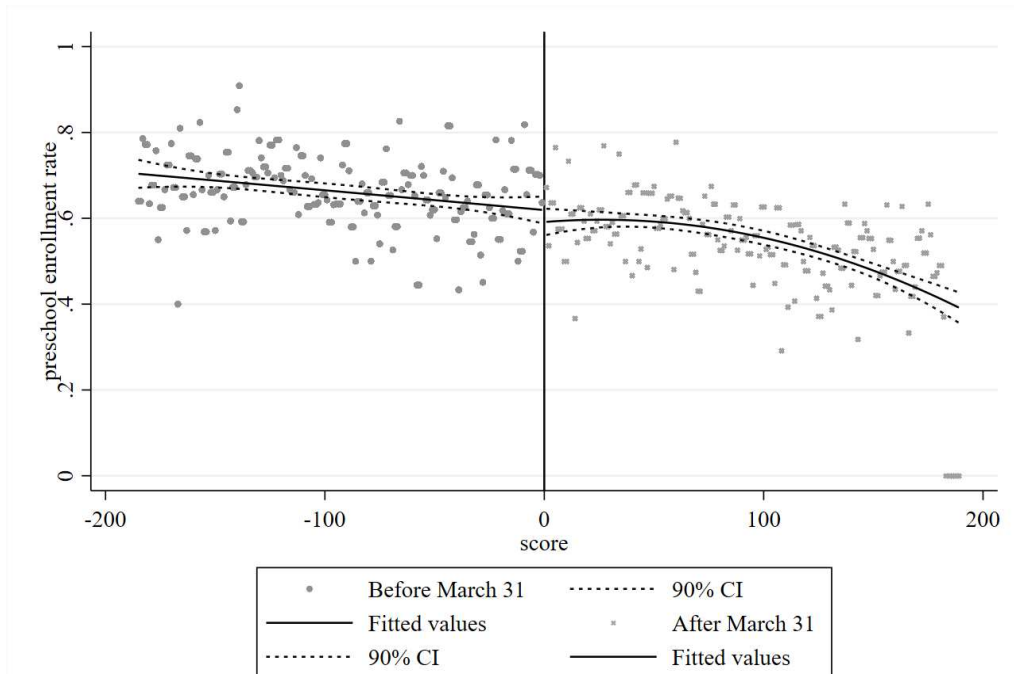


Figure 2: Effect of date of birth on the preschool enrollment rate in the period 2007-2008

To further validate the eligibility criterion we used to estimate the RDD, we performed the density test proposed by Cattaneo et al. (2018) based on McCrary (2008). We use this test to check if there was manipulation in the value of the score around the cutoff. Figure 3.3 shows

the result of the density test. We note that the density is statistically equal on both sides of the cutoff. It implies that there is no manipulation of the score; therefore, we cannot reject the hypothesis null of the test. This result ensures robustness to the eligibility criterion.

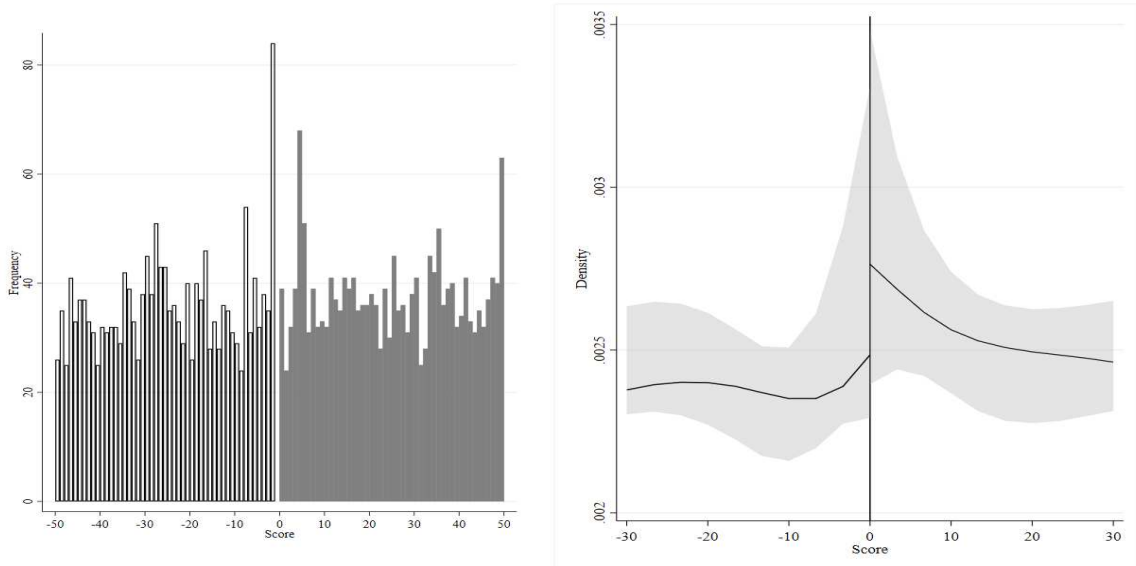


Figure 3: Manipulation test

We also conducted the RDD falsifications test to verify if other mechanisms explain the abovementioned results. For this aim, we used predetermined variables from mothers and older siblings and placebo outcomes: fathers' labor market outcomes. We applied the same empirical strategy to these variables, presenting the results in Table 3.10. We expected that there would be no statistical differences between these observable characteristics when considering the treatment status. Table 3.10 shows that preschool attendance is insignificant in all variables. Additionally, Appendix K, L, and M show these non-significances effects using graphical analysis. Hence, another mechanism does not exist that explains the result presented in the previous subsection except the ones we mentioned in section 3.2.

Table 3.10: Effect of preschool on predetermined and placebo variables.

Variables	Bandwidth	RDF estimate	Standard error	Observations
Mother's schooling	63.508	0.169 <sup>NS</sup>	2.396	4447
Mother's age	71.482	1.767 <sup>NS</sup>	3.8012	5063
Father was working in the reference week	54.980	0.004 <sup>NS</sup>	0.231	3239
Father's working hours per week	49.383	10.097 <sup>NS</sup>	14.636	3586
<b>Type of families</b>				
<b>Couples</b>				
Mother's schooling	59.002	0.232 <sup>NS</sup>	3.138	3504
Mother's age	62.124	2.519 <sup>NS</sup>	5.043	3670
<b>Couples with children under 14</b>				
Mother's schooling	62.038	0.807 <sup>NS</sup>	2.573	3099
Mother's age	62.811	7.150 <sup>NS</sup>	4.365	3114
Father was working in the reference week	55.456	0.016 <sup>NS</sup>	0.187	2800
Father's working hours per week	58.050	7.893 <sup>NS</sup>	10.845	2945

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. The bandwidth was selected using the MSE-Optimal data-driven method.

Furthermore, we examined whether changing the cutoff value changes the child's probability of enrolling in preschool. For that, we used the placebo cutoff. Figure 3.4 shows that only the cutoff equal to March 31 is significantly different from zero. Recall that the negative coefficient is due to the data's organization and the score variable's characteristics. For example, children who turn four years after March 31 are expected to be less likely to be enrolled in preschool

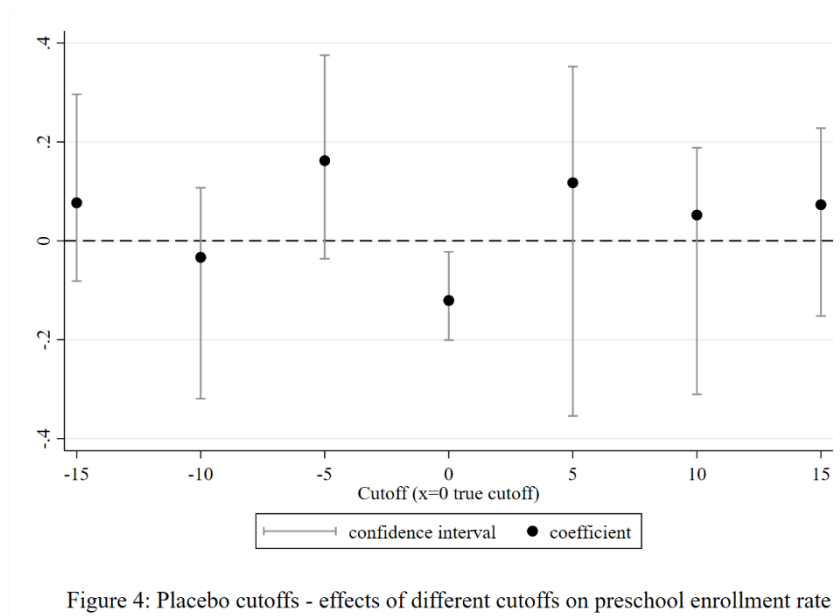


Figure 4: Placebo cutoffs - effects of different cutoffs on preschool enrollment rate

We observe similar results when performing the placebo cutoff validation in the outcomes of interest impacted by the child's preschool attendance. Figure 3.5 presents the analysis for the variable of the mother's average number of hours working per week. We note that only the main cutoff is significant. Therefore, it is crucial to emphasize that in some estimations, specifically when we use the cutoff = 5, the first stage of the RDD is not significant.

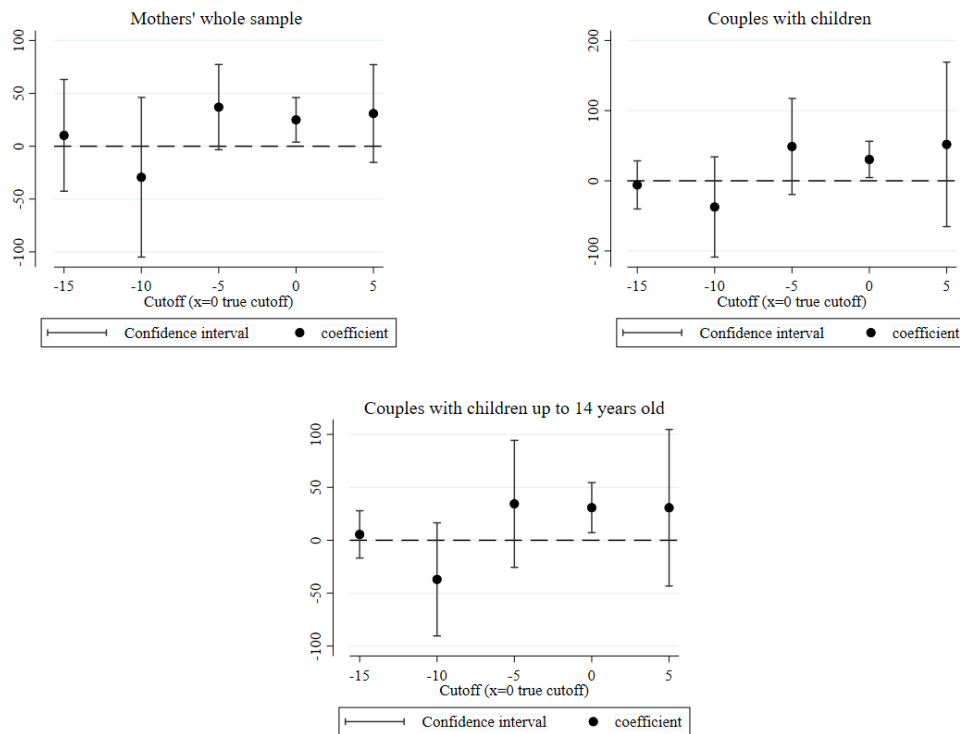


Figure 5: Placebo cutoffs - effect of preschool on mothers' weekly hours for working

Finally, Figure 3.6 presents the result of the same placebo cutoff test for older siblings' housework in low-income families. The upper left graph is related to whether housework was performed by the older sibling, while the upper right graph is regarding the hours spent by the older sibling on chores. The upper graph shows that the effect of preschool is significant only at a cutoff equal to zero. We note that the cutoff equal to -10 is not consistent with the data, the first-stage regression is not significant, and the coefficient shows the larger confidence interval. In other words, the score does not affect the probability of the child being enrolled at preschool. The bottom graph shows the results for the older siblings' school attendance. Again, disregarding the cutoff equal to 20, only the eligibility criterion cutoff is statistically significant.

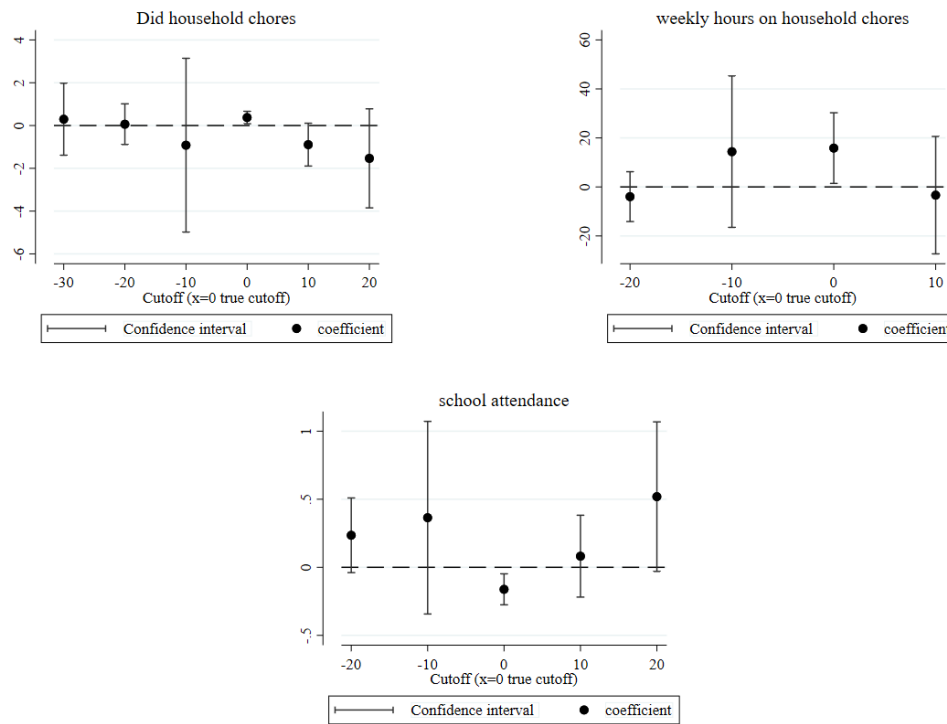


Figure 6: Placebo cutoffs - effect of preschool on older siblings' outcomes

After performing all robustness tests, we state that the effects presented in subsection 3.4.2 are close to a causal relationship. Hence, a child's attendance at preschool generates an intra-household effect on the household's allocation of time and resources. These effects should be considered in formulating public policies and social programs.

### 3.5 Final remarks

The literature has shown that access to early childhood education programs such as preschool is relevant in explaining improvements in human capital accumulation. However, the effects of preschool go beyond the outcomes of the beneficiaries themselves. The child's attendance at preschool has potential effects on different intra-household outcomes. In this way, this current study analyzes the effects of preschool on intrahousehold variables such as mothers' labor market outcomes, older siblings' labor market outcomes, older siblings' housework outcomes, and the demand for education for older siblings. Thus, we investigated the indirect effects of preschool on Brazilian households.

We used an identification strategy that exploited the Constitutional Amendment N° 59, which makes preschool education compulsory for children up to 4. This Constitutional Amendment and the CNE/CEB Resolution N° 2/2018 generate an age cutoff for enrollment of the children at preschool. Therefore, if the child turns four years old by March 31 of the current year, the child must be enrolled in the second stage of early childhood education (preschool).

Therefore, we used this discontinuity to perform an RDD fuzzy. This empirical strategy allows us to identify the indirect effects of preschool on the outcomes of interest.

We found that the child's attendance at preschool increases the mothers' average number of hours working per week by 25.5 hours. This impact is larger for mothers from families formed by couples, 30 hours per week approximately. We also found that preschool increases older siblings' household chores in low-income families. In these families, a child's preschool attendance increases the probability of the older siblings performing chores by 37.6 p.p. Regarding the hours spent by the older siblings on these activities, the impact of preschool is an increase of 13 hours per week. From these data, we found a substitution effect between mother time and older child time in Brazilian low-income families to perform chores in non-care activities. To support this argument, we observe that preschool reduces the mothers' housework by 22.5 p.p. in low-income families.

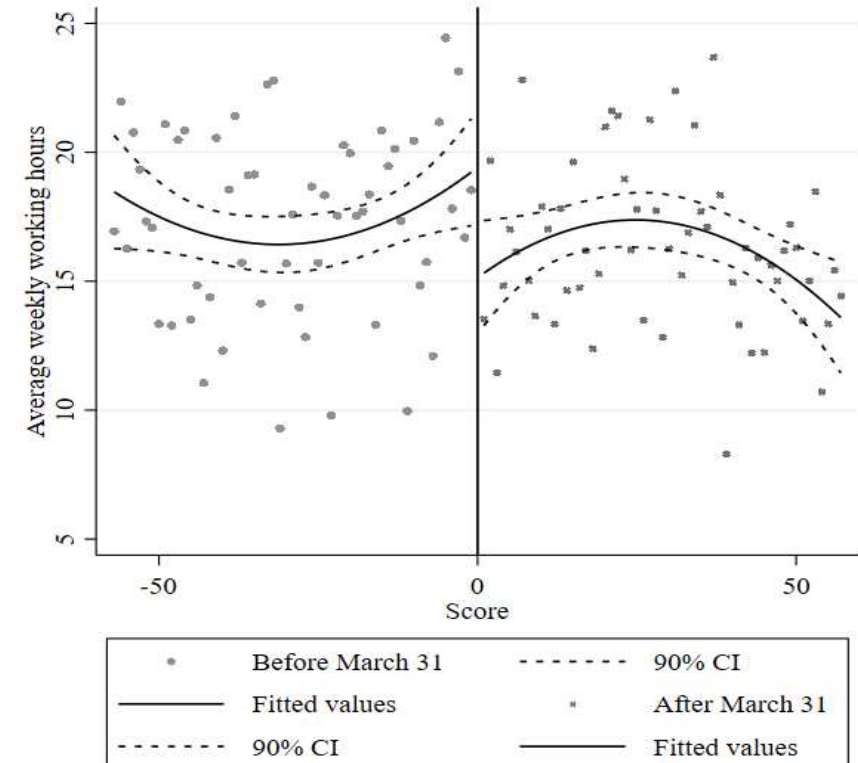
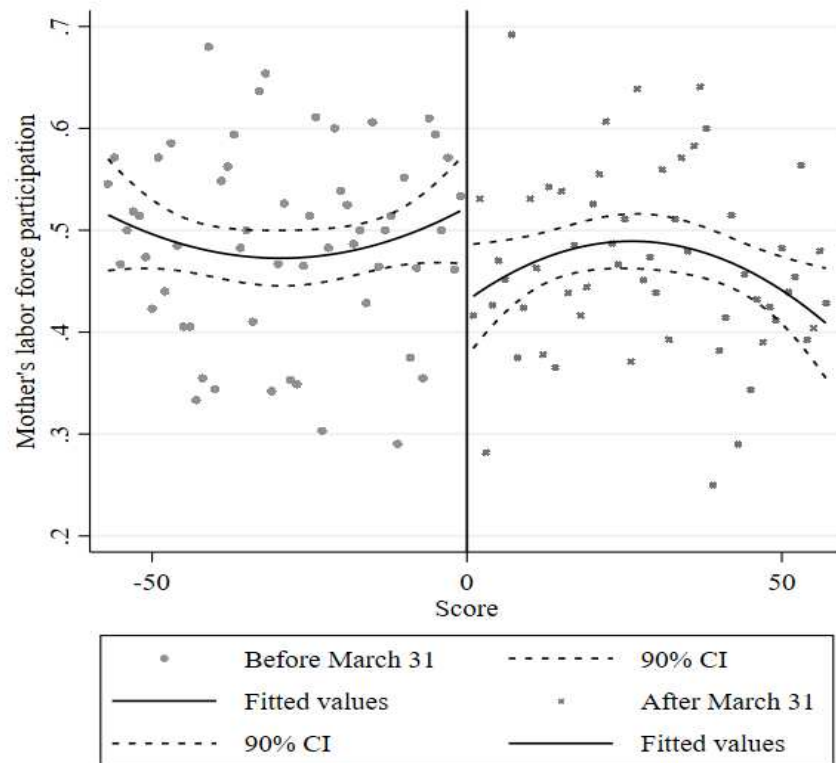
Concerning the demand for education of older siblings, a child's attendance at preschool harms older siblings' school attendance. We point out some factors that can explain the effects in the Brazilian context: household resource constraints, how the parents allocate the available resources among the siblings, and the social norms related to the siblings' gender. When we consider the sex of the older siblings, we find that girls are more harmed than boys.

Given these results, we conclude that a child's attendance at preschool does not cause significant household allocation time changes that motivate the mother to enter the labor market or affect their reservation wage. Therefore, labor market policies may be more effective in increasing the mothers' labor supply. Thus, we suggest public policies that significantly reduce women's double workday and consider local market characteristics. Additionally, given the substitution effect that we identified in this study, we recommended that these policies be conditional to avoid sacrificing the older siblings' schooling.

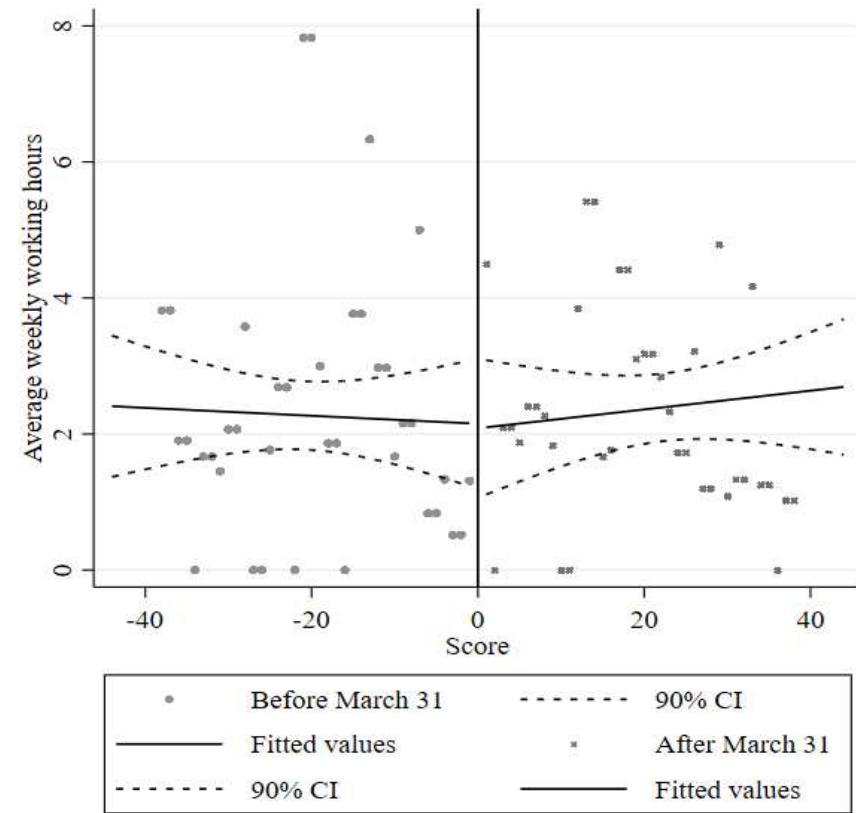
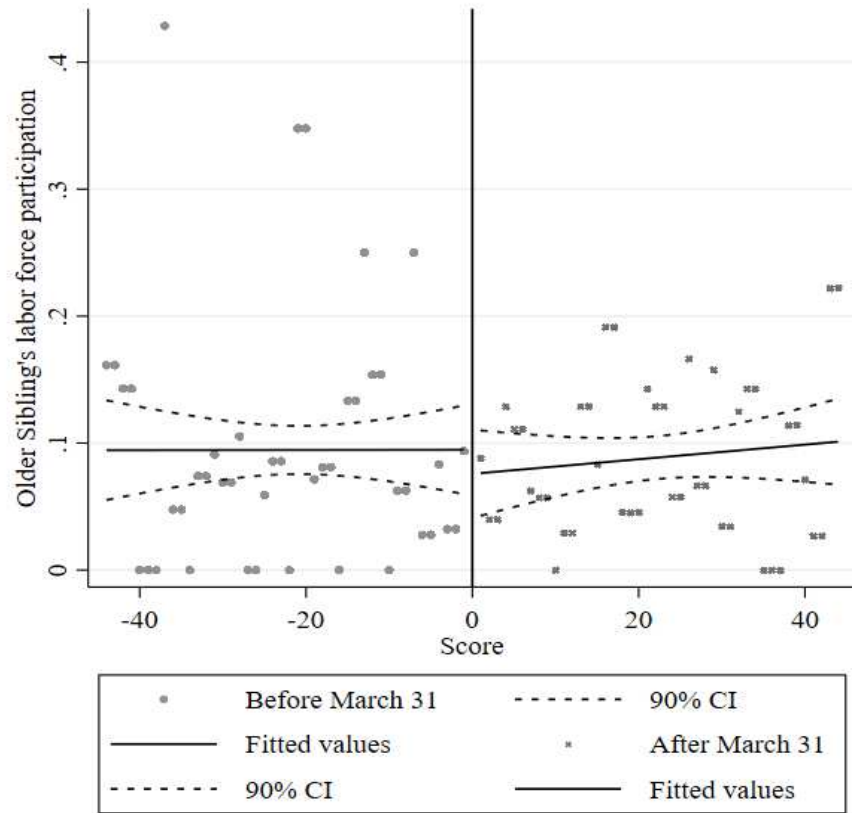
The limitations of this paper are mainly data limitations. The PNADs that we use failed to provide details about the time spent on each household chore. This information could provide more understanding about the impact of preschool on older siblings' allocation of time. Moreover, because we used a sample survey, the scarcity of data does not allow us to conduct heterogeneous effects analyses on older siblings' samples based on household location and siblings' age group.

## Supplemental Appendix

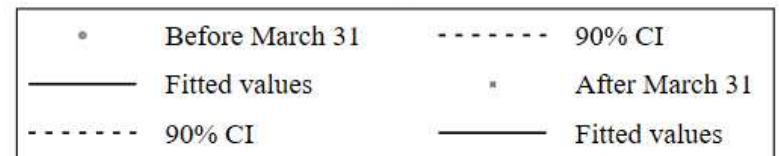
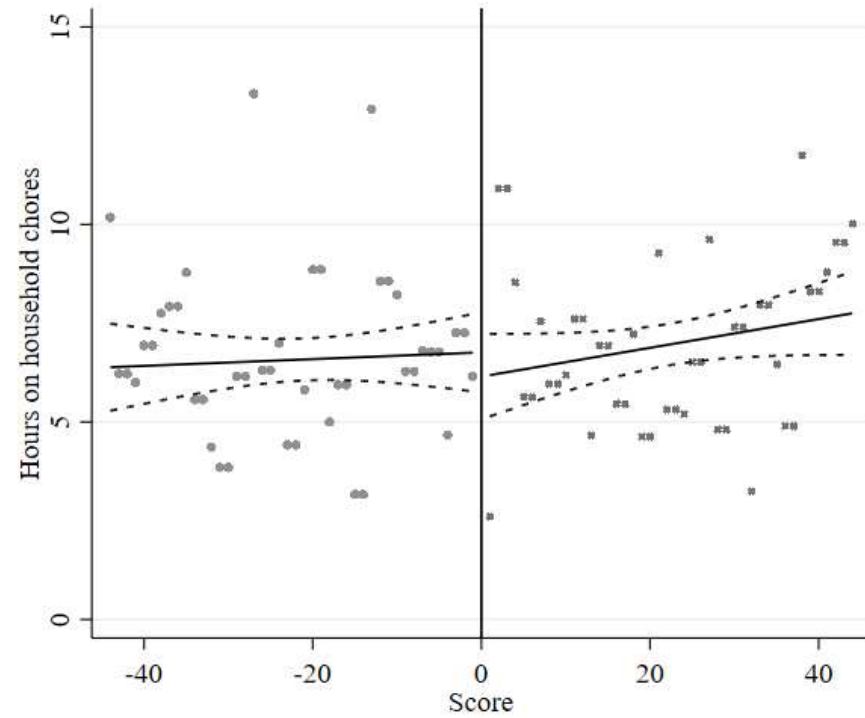
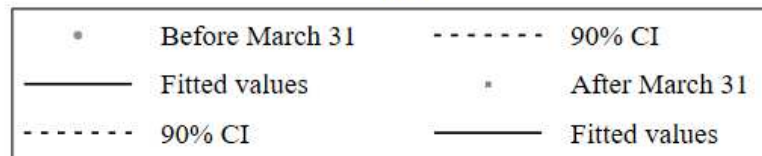
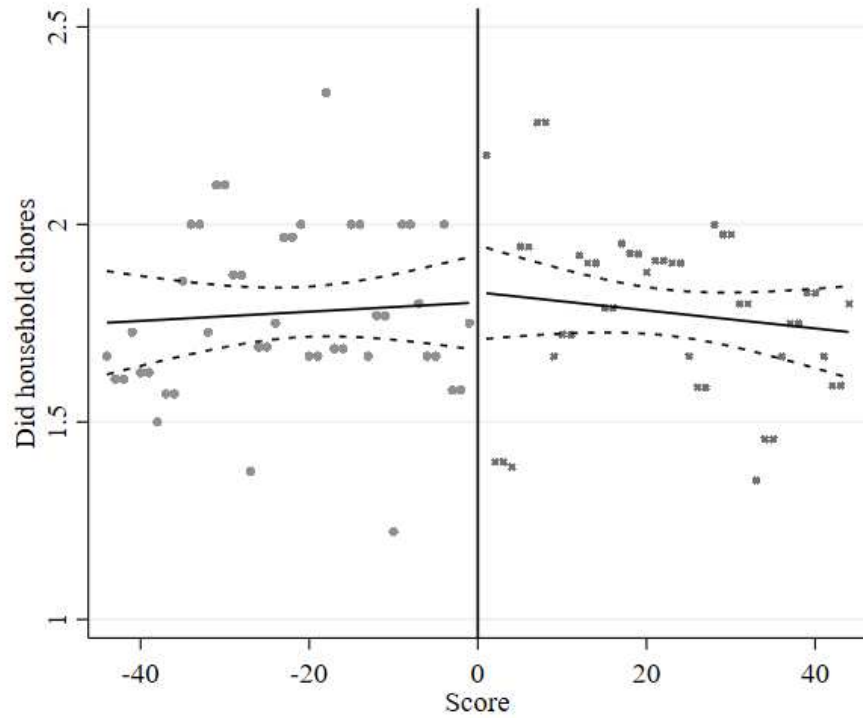
### Appendix A - Effect of score value on mothers' labor market outcomes



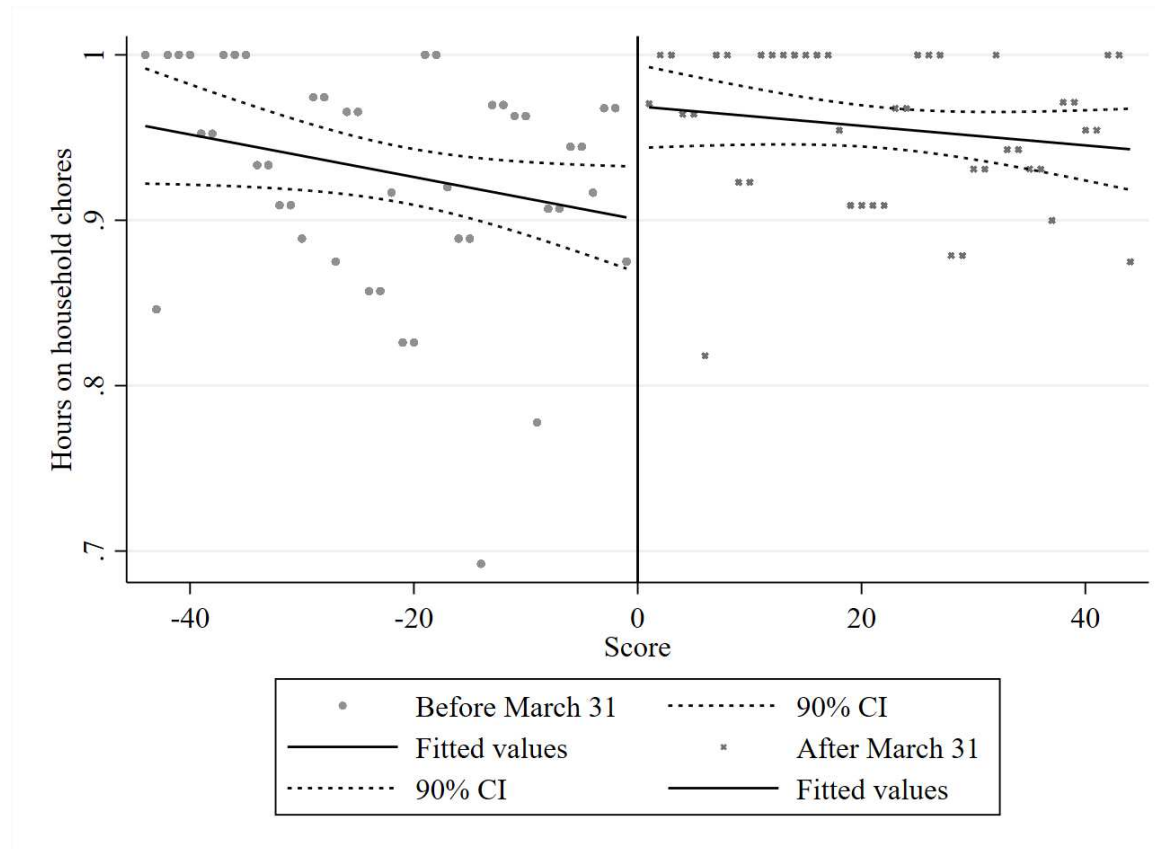
Appendix B - Effect of score value on older siblings' labor market outcomes



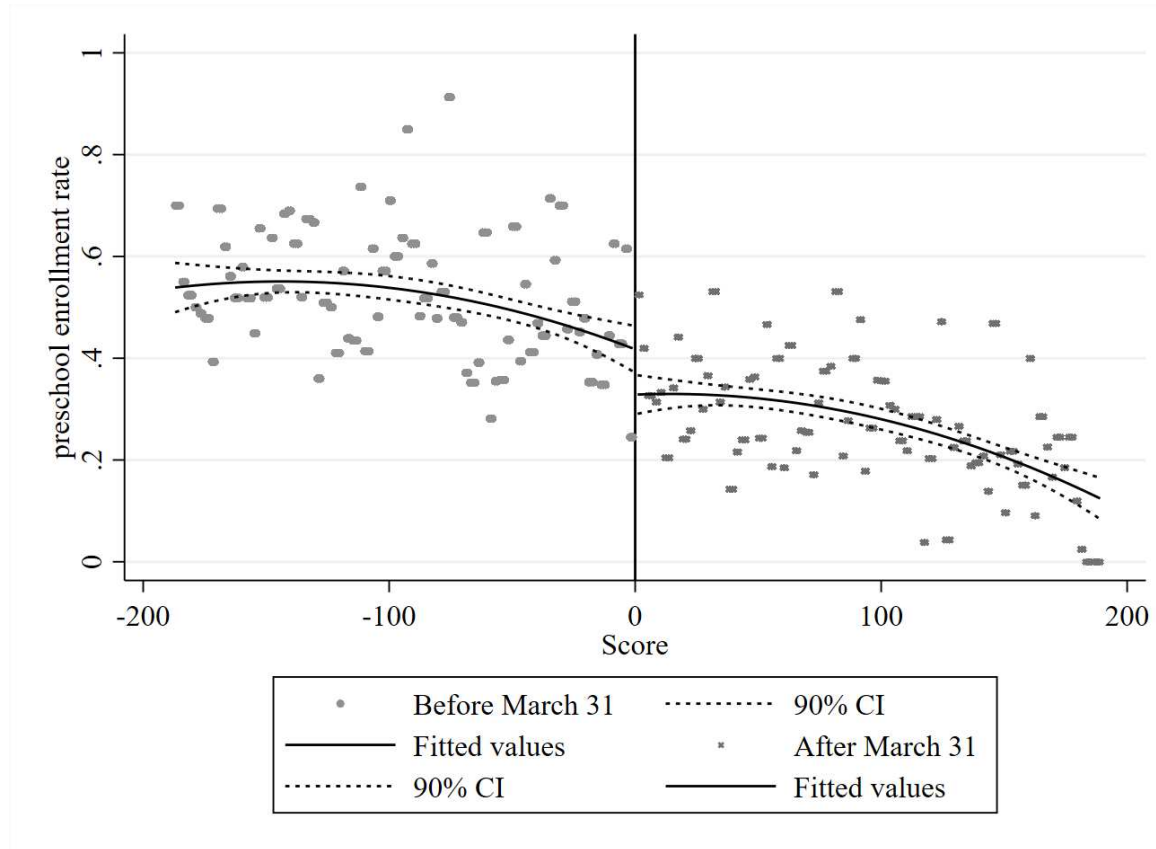
## Appendix C - Effect of score value on performing older siblings' household chores



## Appendix D - Effect of score value on older siblings' school attendance



## Appendix E - Effect of date birth on the preschool enrollment rate in the period 2011-2015 (older siblings sample)



## Appendix F - Heterogeneous effects of preschool on maternal labor market outcomes (first-stage and second-stage)

Work in the reference week				
Panel A				
	Single mothers		Couples with children	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 48.625</i>		<i>Bandwidth = 36.304</i>	
Cut-Off	0.132** (0.071)	-0.078 <sup>NS</sup> (0.649)	0.112*** (0.040)	0.664 <sup>NS</sup> (0.462)
Controls	Yes	Yes	Yes	Yes
Observations	575	575	2217	2217
	Couple with children under 14 years old		Urban	
<i>MSE-Optimal</i>	<i>Bandwidth = 49.659</i>		<i>Bandwidth = 36.693</i>	
Cut-Off	0.132*** (0.038)	0.498 <sup>NS</sup> (0.353)	0.135*** (0.041)	0.391 <sup>NS</sup> (0.362)
Controls	Yes	Yes	Yes	Yes
Observations	2525	2525	2136	2136
	Rural		Per capita family income < ½ minimum wage	
<i>MSE-Optimal</i>	<i>Bandwidth = 66.721</i>		<i>Bandwidth = 37.064</i>	
Cut-Off	0.081 <sup>NS</sup> (0.075)	0.836 <sup>NS</sup> (1.652)	0.173*** (0.049)	-0.003 <sup>NS</sup> (0.335)
Controls	Yes	Yes	Yes	Yes
Observations	630	630	1251	1251

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the “RDF estimate” we defined in equation 3.2.

## Appendix G - Heterogeneous effects of preschool on maternal labor market outcomes (first-stage and second-stage)

Working hours per week				
Panel B				
	Singles Mothers		Couples with children	
	First stage	Second-stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 49.000</i>		<i>Bandwidth = 35.166</i>	
Cut-Off	0.132* (0.076)	-5.642 <sup>NS</sup> (27.234)	0.112*** (0.041)	32.63* (19.633)
Controls	Yes	Yes	Yes	Yes
Observations	586	586	2161	2161
	Couple with children under 14 years old		Urban	
<i>MSE-Optimal</i>	<i>Bandwidth = 47.442</i>		<i>Bandwidth = 36.755</i>	
Cut-Off	0.132*** (0.039)	27.031** (15.063)	0.135*** (0.041)	20.113 <sup>NS</sup> (15.136)
Controls	Yes	Yes	Yes	Yes
Observations	2419	2419	2136	2136
	Rural		Per capita family income < ½ minimum wage	
<i>MSE-Optimal</i>	<i>Bandwidth = 44.737</i>		<i>Bandwidth = 34.256</i>	
Cut-Off	0.079 <sup>NS</sup> (0.075)	43.892 <sup>NS</sup> (56.396)	0.17*** (0.057)	-2.201 <sup>NS</sup> (12.472)
Controls	Yes	Yes	Yes	Yes
Observations	630	630	1148	1148

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the “RDF estimate” we defined in equation 3.2.

## Appendix H - Heterogeneous effects of preschool on the older siblings' outcomes (first-stage and second-stage)

<b>Panel A</b>						
Worked in the reference week						
	Sister		Brother		Per capita family income < ½ minimum wage	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 51.258</i>		<i>Bandwidth = 59.880</i>		<i>Bandwidth = 41.149</i>	
Cut-Off	0.069*	-0.318 <sup>NS</sup>	0.10**	0.302 <sup>NS</sup>	0.10***	0.151 <sup>NS</sup>
	(0.038)	(0.288)	(0.043)	(0.195)	(0.038)	(0.21)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	819	819	942	942	836	836
Working hours per week						
	Sister		Brother		Per capita family income < ½ minimum wage	
<i>MSE-Optimal</i>	<i>Bandwidth = 48.708</i>		<i>Bandwidth = 50.290</i>		<i>Bandwidth = 35.387</i>	
Cut-Off	0.068*	-11.491 <sup>NS</sup>	0.096**	-0.486 <sup>NS</sup>	0.094**	-4.296 <sup>NS</sup>
	(0.039)	(8.945)	(0.043)	(6.499)	(0.040)	(6.318)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	776	776	804	804	727	727

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the “RDF estimate” we defined in equation 3.2.

## Appendix I - Heterogeneous effects of preschool on the older siblings' outcomes (first-stage and second-stage)

<b>Panel B</b>						
Did household chores						
	Sister		Brother		Per capita family income < ½ minimum wage	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 48.407</i>		<i>Bandwidth = 56.636</i>		<i>Bandwidth = 52.720</i>	
Cut-Off	0.069* (0.039)	0.565 <sup>NS</sup> (0.571)	0.097* (0.044)	-0.033 <sup>NS</sup> (0.332)	0.165*** (0.035)	0.376* (0.221)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	776	776	921	921	1050	1050
Hours on household chores						
	Sister		Brother		Per capita family income < ½ minimum wage	
<i>MSE-Optimal</i>	<i>Bandwidth = 48.982</i>		<i>Bandwidth = 46.186</i>		<i>Bandwidth = 50.576</i>	
Cut-Off	0.068* (0.038)	14.543 <sup>NS</sup> (12.57)	0.079* (0.046)	-3.047 <sup>NS</sup> (5.047)	0.108*** (0.038)	13.299** (6.428)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	776	776	751	751	1011	1011

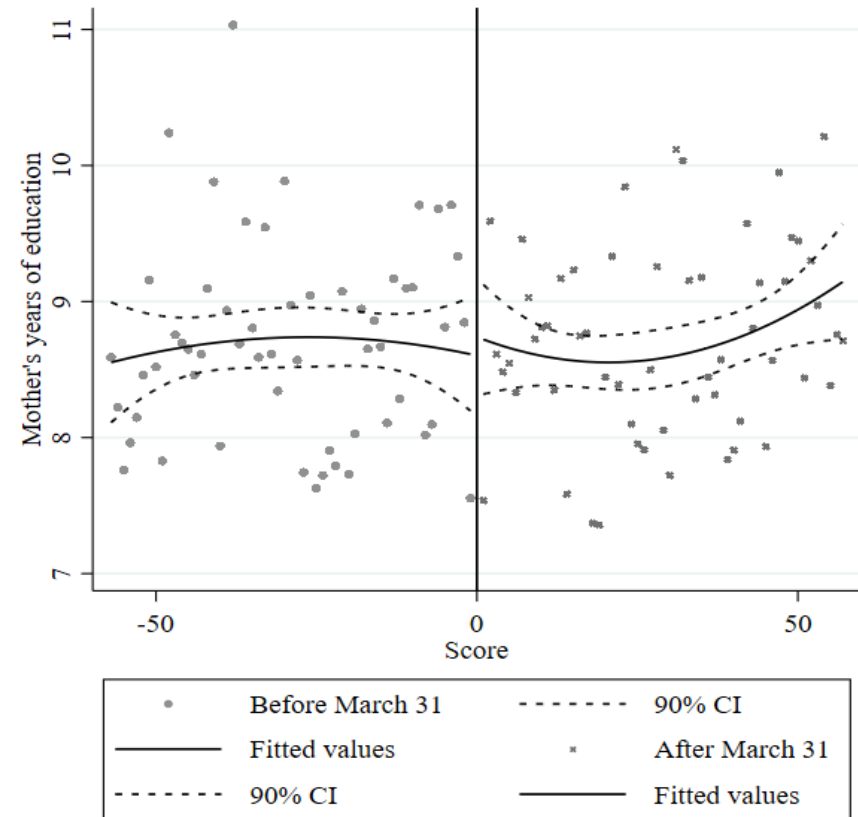
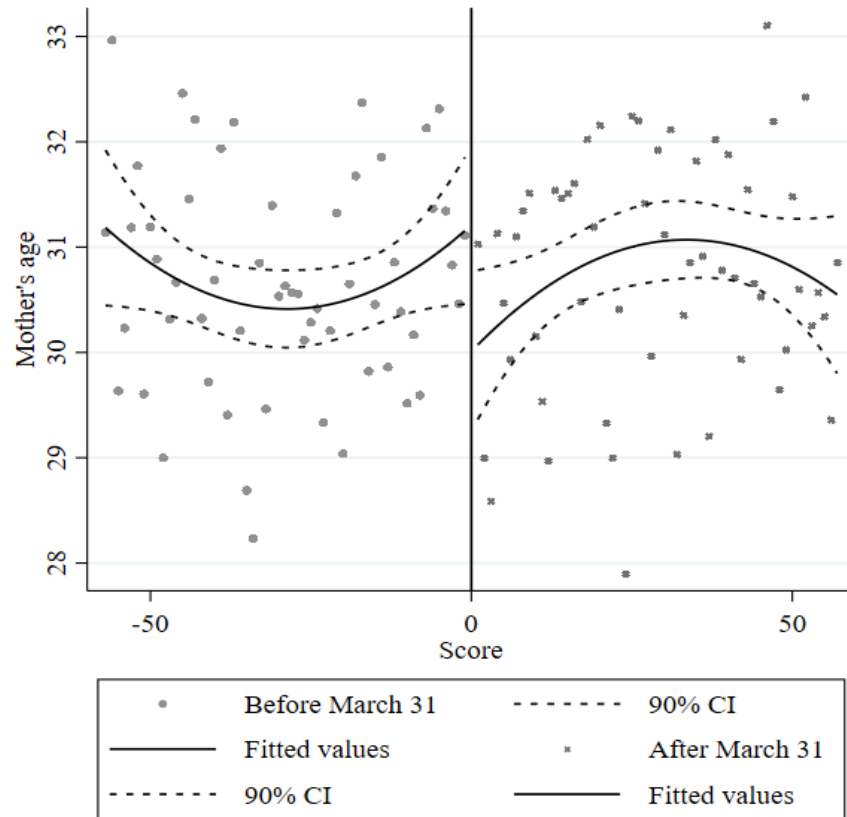
Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the “RDF estimate” we defined in equation 3.2.

## Appendix J - Heterogeneous effects of preschool on the older siblings' outcomes (first-stage and second-stage)

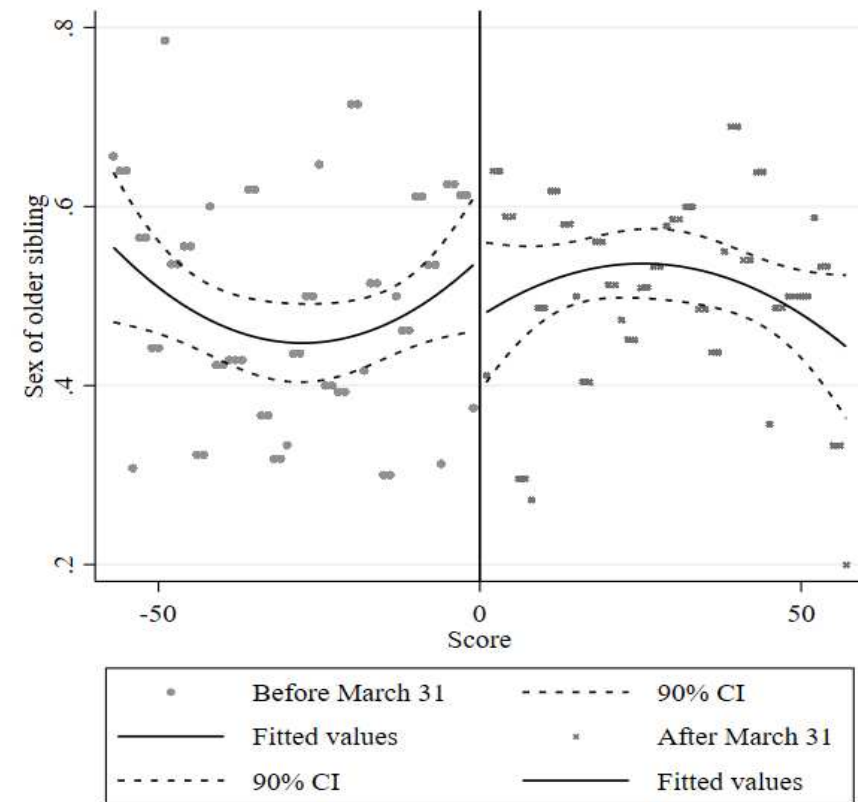
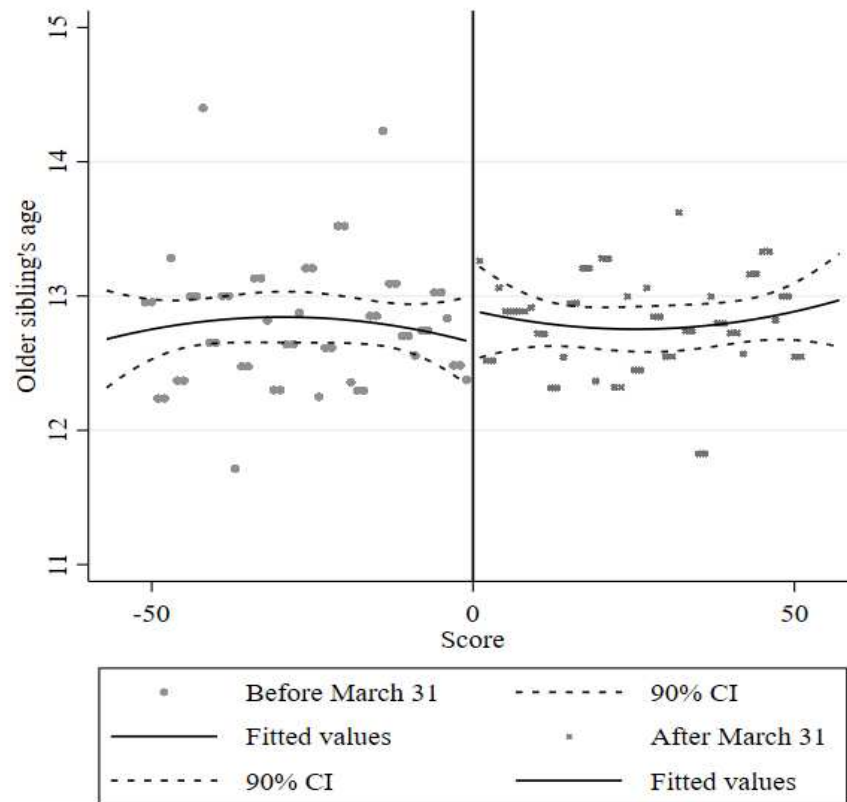
<b>Panel C</b>						
School attendance						
	Sister		Brother		Per capita family income < ½ minimum wage	
	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)	First stage	Second stage (RDF estimate)
<i>MSE-Optimal</i>	<i>Bandwidth = 59.803</i>		<i>Bandwidth = 50.126</i>		<i>Bandwidth = 51.201</i>	
Cut-Off	0.089*	-0.355*	0.086*	-0.316**	0.141***	-0.426***
	(0.049)	(0.201)	(0.045)	(0.154)	(0.039)	(0.139)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	933	933	804	804	1032	1032

Note: Standard errors are reported in parentheses, and we use the Robust Bias Correction. \* p < 0.1. \*\* p < 0.05. \*\*\* p < 0.01. The value for the cutoff effect in the second stage is the “RDF estimate” we defined in equation 3.2.

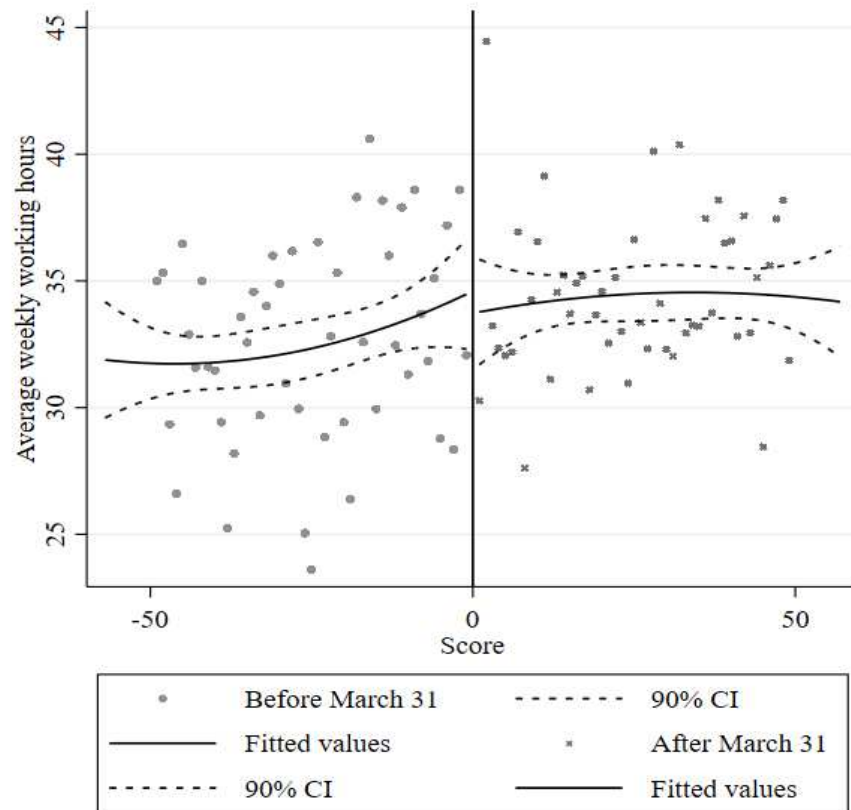
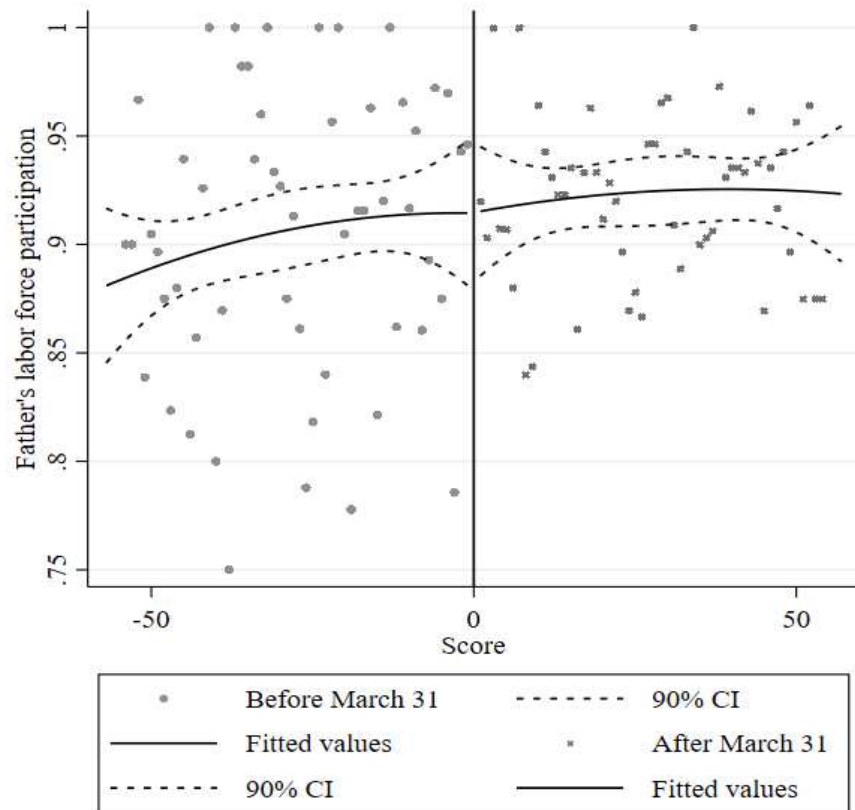
Appendix K - Validity of regression discontinuity design: Effects of score value on mothers' predeterminate variables.



Appendix L - Validity of regression discontinuity design: Effects of score value on older siblings' predeterminate variables.



Appendix M - Validity of regression discontinuity design: Effects of score value on fathers' labor market outcomes (placebo variables).



## 4 CONCLUSION

A growing literature has shown that early childhood education positively affects several individual outcomes. These positive effects are observed in schooling, health stock, work productivity, and the future wages of individuals. Besides personal effects, early childhood education may have social effects, such as reducing the crime rate, teenage pregnancy rate, and school dropout rate, thereby increasing social welfare. The improvement of the human capital accumulation process caused by early childhood education explains the abovementioned impacts.

However, early childhood education can also impact other outcomes beyond those already studied. For instance, preschool attendance of the younger child may affect her intra-household behavior and the allocation of time and resources among family members. Therefore, this doctoral thesis sought to analyze the preschool's effect on intra-household relationships in Brazilian families. To do so, we divided the dissertation into two chapters.

To answer the research questions of this doctoral dissertation, we exploit the educational reform caused by the Brazilian Constitutional Amendment N° 59 of 2009 and the CNE/CEB Resolution N° 2/2016 as part of our identification strategy. The educational reform underlies the application of RDD. Although we used the exact source of exogeneity in both chapters, each chapter used different databases and approaches to RDD. For instance, in the first chapter, we used data from POF 2017-2018; in the second chapter, we used data from the PNAD from 2011 to 2015.

The first question we answer in this dissertation is about the preschool's impact on the bargaining power of children in the family decision-making process when buying products of interest to them. Although we need to be cautious when analyzing the ITT, we found the earliest evidence that preschool frequency may affect the children's bargaining power in family decision-making. It means that children who attend preschool have greater bargaining power over the decision-making in purchasing within the household, especially items of interest to them. Based on that, we infer that the accumulation of human capital enhanced by preschool provides the children with different strategic approaches to achieving their goals regarding the consumption of goods.

Therefore, our findings indicate that children actively participate in household decision-making. It implies that children should be considered when analyzing resource allocation and household consumption because this will provide a more accurate analysis of family welfare. Moreover, we can infer that early childhood investment in human capital may affect how

parents and children make shared decision-making; it changes the strategies they use to negotiate, given their greater stock of skills. Thus, policies directed at financial education or consumer awareness may be more effective when directed at children.

At the same time, in the second chapter, we investigate the effects of preschool on maternal labor supply, the older sibling's domestic and productive work, and the demand for education for older siblings. Our results show preschool attendance increases the mother's average weekly working hours and older siblings' household chores in low-income families. These results lead us to identify a substitution effect between mother time and older child time in Brazilian low-income families to perform chores in non-care activities. Concerning the demand for education of older siblings, we show that a child's attendance at preschool harms older siblings' school attendance.

To summarize, the second chapter endures us to infer that preschool attendance of the younger child does not cause significant household allocation time changes that motivate the mother to enter the labor market or affect their reservation wage. Therefore, we suggest that public policies aim to reduce women's double workday significantly, considering local market characteristics and the substitution effect we identified in this thesis. In this way, they can avoid sacrificing the older siblings' schooling.

All in all, both studies developed show that providing preschool access is an investment with high effectiveness. Beyond the personal effects on the beneficiaries, the child's preschool frequency affects the intra-household relationships. The magnitude of these effects depends on the family structure. This dissertation shows that preschool impacts the negotiation process between parents and children to decide the family consumption and the allocation of family members' time and resources. In this way, preschool can be an excellent investment channel for public policies aimed at changing individuals' consumption patterns or the distribution of tasks within the household.

This doctoral dissertation allows us to conclude that access to preschool is a strategic element for improving the individual's human capital and the well-being of families. Therefore, according to our findings, public policies should not only focus on expanding access to preschool but also should seek to enhance its quality. At the latter, public policies should update the discussion about their objectives, considering children as potential consumers. Finally, with the first chapter, we are paving the way to study how children become effective economic agents and the role of human capital in this process.

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que trata o art. 212 da Constituição Federal, dá nova redação aos incisos I e VII do art. 208, de forma a prever a obrigatoriedade do ensino de quatro a dezessete anos e ampliar a abrangência dos programas suplementares para todas as etapas da educação básica, e dá nova redação ao § 4º do art. 211 e ao § 3º do art. 212 e ao caput do art. 214, com a inserção neste dispositivo de inciso VI. Brasília, DF, 11 de nov. de 2009. Disponível em: [http://www.planalto.gov.br/ccivil\\_03/constituicao/emendas/emc/emc59.htm](http://www.planalto.gov.br/ccivil_03/constituicao/emendas/emc/emc59.htm). Acessado em: 20 de maio de 2020.

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