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Motherhood penalty: The Brazilian peculiarity

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ABSTRACT

In this study, we investigate the motherhood penalty in Brazil by tracking mothers in administrative databases from the years before to after the birth of the child. In particular, we analyze the wage trajectories using econometric models to estimate the counterfactuals if these women had not been mothers. In doing so, we have to take into account a Brazilian peculiarity: there is a government policy that allows mothers to opt for self-employment in order to spend more time with their children. After adapting our modeling to this specificity, the estimated wage losses of mothers are around 25% and 10% when the children are of infant and school age, respectively. The message in terms of social impact is that it is necessary to help mothers to return to the labor market after childbirth under the same conditions and with the same opportunities for professional development as before pregnancy. We believe that this support can be provided, for example, through better childcare policies in society.

SPECIFICATIONS TABLE

Subject area	***Economics and Econometrics***
Category/categories of societal impact	Economic
Sustainable Development Goals (SDGS) the research contributes to	***GOAL 5: Gender Equality***
Resource availability [optional]	*The data set used in the manuscript is available at* ***https://petterini.ufsc.br/papers/child-penalty/***
Related research article OR Related supporting information	***This research is still at an early stage. A published article (written in Portuguese) with more details about the initial results can be found at https://doi.org/10.5007/2175-8085.2023.e93370***
Please provide a link to the webpage if relevant	
Stage of research	***In Progress***

1. Social impact

In many cultures, women generally bear most of the responsibility for children and housework. Even though the birth rate has dropped significantly in several countries and they have made great strides in the labor market.

Women's working lives in particular are severely affected by motherhood, as they have to take a break from work to care for a newborn. When they return to work, it is usually a challenge to maintain the status in the labor market that they had before the birth of the child. As a result, many women continue to postpone motherhood.

From this point of view, mothers often have fewer employment opportunities than childless women with comparable characteristics. The predominant explanation for this is that employers believe that mothers care more about their children than about their work. As a result, they are discriminated against in terms of recruitment, pay and work experience. This phenomenon is commonly known as the "motherhood penalty" or "child penalty". [1–4,10]

Modern studies analyze longitudinal administrative microdata from different countries, and the results suggest that motherhood is not just a short-term effect that influences women's careers only during their children's infant or toddler years. In short, the average result is that mothers have a pay gap of 20–60% ten years after the birth of their child, depending on the comparison group. [7]

In light of these facts, many studies have attempted to understand this phenomenon in order to provide elements for the formulation of public policies to mitigate its social impact. Identification strategies for short- and long-term child penalties usually follow basic steps. First, a (treatment) group of mothers is delineated, preferably mothers who have had their first and only child, and their job outcomes are tabulated for the pre- and post-birth periods – all using government microdata. Second, a (control) group is defined with childless women and/or men (or fathers) who have similar predictors as the mothers. Third, penalties

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over time are estimated using event study (EE) and/or difference-in-differences (DD) models. [5,9,11]

In Brazil, we are conducting the first studies on child penalties, similar in scope, objectives and methods to the groundbreaking project reported on for Denmark by Kleven et al. [8]. With the support of the National Council for Scientific and Technological Development (CNPq), we aim to understand the child penalties on gender inequality in the labor market in the Brazilian context – Gonçalves and Petterini [6] describe this project in detail.

Nevertheless, it is not easy to apply some of the procedures discussed in Kleven et al. [8] to the Brazilian case. In particular, because in a typical state database a mother may find herself in two different situations at the end of her "maternity leave": (i) she has a job or (ii) she does not have a job. In the Brazilian databases, however, there is a third possibility: (iii) she has a job but is registered as unemployed.

The latter case occurs because in some situations the government allows mothers to become self-employed in order to spend more time with their children. Under these circumstances, mothers work without a formal company contract but retain the social rights of formal employees. This is a special provision of the "Microempreendedor Individual", in Portuguese, or MEI program. The legal figure of the MEI, introduced by Law No 128/2008, was created to grant simplified and differentiated treatment to small businesses, especially for people who work informally and without adequate legal protection. In this case, women who have a MEI arrangement have different security rights in relation to maternity.

Given this fact, it is unfortunately not possible to distinguish between (ii) and (iii) unless the researcher has access to many different databases and uses prohibitively expensive computing power to tabulate them. In other words, in Brazil the researcher knows the job outcomes if the person has an employment contract with a company. However, if there is no registered contract, the person may be unemployed or employed, and due to the clutter of records, labor outcomes are observed inaccurately. Of course, if the researcher does not take this situation into account, it is likely that the motherhood penalty and other impact indicators will be measured in a biased way. This diminishes the credibility of the study.

In our research, we have not only studied the child penalty in Brazil, but also developed solutions to mitigate possible distortions related to measures such as the MEI program. This is an important contribution to the literature because what happens in Brazil can also happen in other countries.

In this paper, we present our initial results, using a 5% sample of the database. The reason for limiting these observations to the first exercises is that we are developing techniques to analyze the approximately two billion employment contracts signed in the country since the early 2000s in an unprecedented way, which requires a series of computer routines that are still under development.

2. Methodology

The microdata come from the Annual Social Information Report (RAIS), which maps the Brazilian labor market on the basis of all formal employment contracts. More specifically, it is a set of thousands of digital text files that contain the main elements of labor contracts in the country by geographical sections and time periods. At the most disaggregated level, personal information can be identified and tracked over the years, although this requires immense computing power.

Since 2007, the RAIS has also included data on maternity leave. 2008 is the first year in which complete information on the start and end of these leaves is available. Then, we can explore this fact.

We want to measure the long-term impact of motherhood on the labor market, which means that we need to track millions of labor contracts in an unprecedented way. In this context, we are still in the process of developing computer codes that can perform this task accurately. In this first phase of the study, we randomly selected 5% of women between the ages of 20 and 39 who gave birth in 2008 – this age group accounted for 78% of all births in Brazil in 2008, according to official records.

The employment contracts of these women were analyzed since 2005. That is, three years before maternity leave to create a baseline. And then they were followed up until 2018 to calculate the salary effects when the children are 10 years old, as standardized in the literature.

The women who were likely to be mothers of more than one child during this period were excluded from the sample, as standardized in the literature. The resulting group consists of a total of 17,130 mothers.

Race, age, address, and education are always filled in. We focus on these variables to avoid a large amount of missing data on predictors. To describe the mothers: about 2/3 are white; and in 2008 the mean age was 28 years old, more than 4/5 lived and worked in urban areas, and the mean education was equivalent to a high school diploma in Brazil.

Based on these variables, we drew a stratified random sample in 2008 to select childless women and men in equal numbers of mothers. The goal of stratification is to improve accuracy in representing a counterfactual population of mothers, similar to propensity score matching methods in the public policy evaluation literature. Naturally, the external validity of our results depends on this stratification.

Men with children were not included in the database due to underreporting. This is because, unlike women, men do not have to register paternity leave in order to continue receiving their salary during this time, or because they simply do not take the leave. Therefore, the men referred to here as "childless men" are in fact men who do not have children according to the RAIS records.

In light of that, if these variables predict self-employment in the MEI program, a similar proportion of self-employed individuals are found in each group in this sample. Moreover, the panel that follows all of these workers between 2005 and 2018 includes a total of 719,460 observations. In other words, we are working with a random sample, which is also very large.

The employment rate trends by group between 2005 and 2018 are in Fig. 1, where the gray areas represent 95% confidence intervals and the light blue rectangle is an allusion to the timing of pregnancy – the following graphs are in the same standard. In all groups, about 70% of tracked individuals had a contract in 2005, but the result is always lower for mothers after 2009. It is possible that sampled mothers included in the sample are more likely to be self-employed under the MEI program. However, due to the sampling procedure, we presume that in reality they are more likely to be unemployed.

The outcome we are interested in is the mean monthly wage per hour based on the months worked in the year. To avoid problems related to inflation, we use the current legal minimum wage as an offset variable. Fig. 2 shows these trajectories by group, where there are three points to highlight. First, the wages of mothers and childless women were statistically equal in 2008, and men earned 34% more than both groups – i.e., the gender gap is present here. Second, mothers earned 8% more than childless women before pregnancy (in 2005 and 2006), suggesting that women may anticipate the effects of motherhood by seeking better conditions before becoming pregnant. Third, all trajectories exhibited a relative upward trend.

Fig. 3 shows the evolution of the mean education (years of study) and reinforces the idea of motherhood anticipation once mothers also acquire more years of education before pregnancy, which explains their higher salaries before 2008 compared to childless women. Additionally, all groups tend to become more educated over time. This last point, combined with the natural accumulation of experience with age, could account for the relative wage growth across all groups. However, it is worth noting that this trend decelerates among mothers after childbirth.

Finally, Fig. 4 shows years of job tenure – i.e., how long workers have been employed by their current employer. According to Brazilian labor law, a woman cannot be fired once she becomes pregnant until the end of her maternity leave. Consequently, the job tenure indicator reveals that mothers tend to be employed for a longer period around the year of

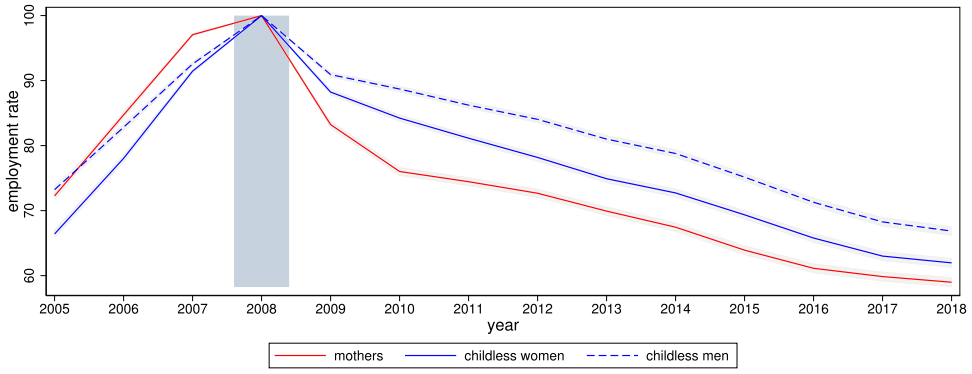


Figure 1. Employment rates by group between 2005 and 2018.

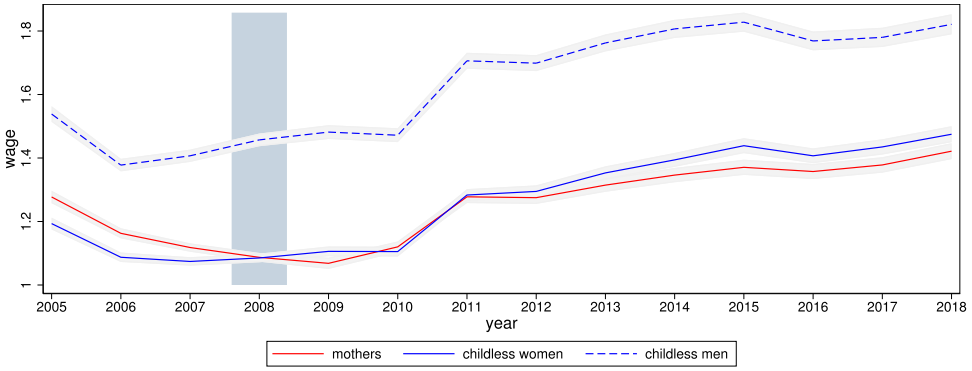


Figure 2. Wage trajectories by group between 2005 and 2018.

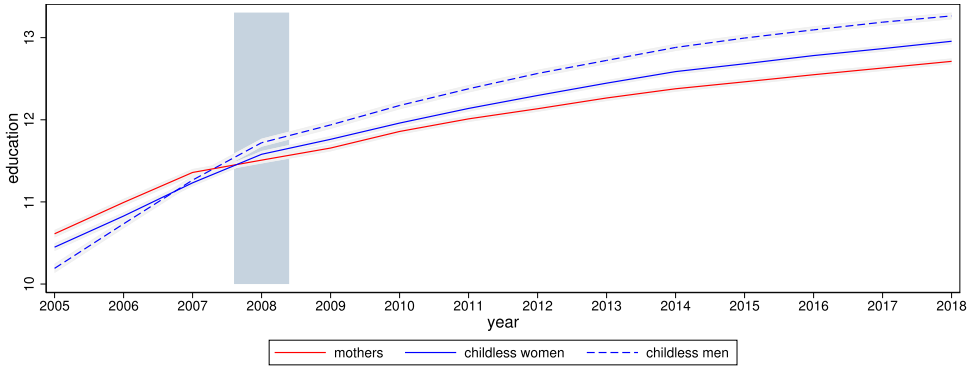


Figure 3. Education trajectories by group between 2005 and 2018.

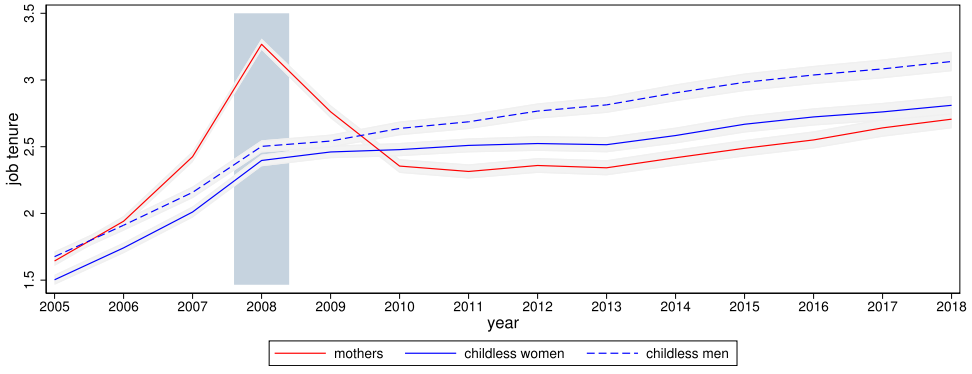


Figure 4. Job tenure trajectories by group between 2005 and 2018.

childbirth. However, this trend reverses after a few years, and mothers typically remain in the same job for a shorter duration compared to other groups.

Penalties are usually measured as a percentage decrease in labor outcomes compared to the estimated counterfactuals. Here we apply EE and DD models as in the Online Appendix of Kleven et al. [8] to estimate penalties, and the procedures 3.1 and 4.1.1 of Wooldridge [12] to test and correct selection bias possibly caused by the MEI program, respectively. The specifications are:

$$w_{it} = f_i + \sum_{t \neq 2007} \beta_t \times \mathbb{1}(t) + \delta' X_{it} + \eta \widehat{h}_{it} + u_{it} \quad (1)$$

$$\ln w_{it} = f_i + \sum_{t \neq 2007} (\beta_t \times \mathbb{1}(t) + \gamma_t \times \mathbb{1}(t) \times M_i) + \delta' X_{it} + \eta \widehat{h}_{it} + u_{it} \quad (2)$$

where: the baseline is 2007, when most mothers became pregnant; w represents wage of an individual i in the year t; f is a fixed effect to capture unobserved idiosyncrasies; Greek letters are parameters; $\mathbb{1}$ is the indicator function; M is a dummy for mothers; X is a vector of predictors; $\widehat{h}$ is an ancillary variable; and u is the error.

First we run $h_{it} = \max\{0, \alpha' X_{it} + v_{it}\}$ by standard Tobit for each t, where: h is the job tenure, and α and v are a vector of parameters and an error, respectively. The ancillary variable, $\widehat{h}$, is the predicted job tenure – hats indicate predictions/estimates. If $\widehat{\eta} \neq 0$, we can not reject the selection bias hypothesis, and the presence of $\widehat{h}$ would mitigate the bias.

Equation (1) is an EE specification that includes dummies for age in X and ignores dummies for cohorts, since we are working with a single cohort of mothers. The regressions are run separately for each group and the penalties are calculated by $(\widehat{\beta}_t^{mothers} - \widehat{\beta}_t^{others})/\widetilde{w}_t$, where: superscripts denote the comparison groups, and $\widetilde{w}_t$ is the mean $\widehat{w}$ without the effects of $\mathbb{1}(t)$. Equation (2) is run contrasting the wage trajectories of mothers and childless women/men. Under the regular assumptions of DD, each $\widehat{\gamma}_t$ is directly interpreted as penalty.

The models were estimated with many combinations of predictors. Surprisingly, the estimated penalties do not change significantly between the specifications without and with corrections for self-employment (MEI). The explanation for this probably lies in our sampling procedure, which yielded a similar proportion of individuals with the unobserved characteristic of self-employment. Consequently, the bias remains consistent across all comparison groups and is eliminated in the models without corrections, as the penalties are measured by differences.

3. Results and implications

Figs. 5 and 6 summarize the initial results of our research and implications observed in our modeling, by combining the estimated penalties (with correction) by year and 95% confidence intervals in the gray areas. Penalties before 2008 are statistically zero, indicating good fit because the treatment group had not yet become a mothers group. The observed pattern reveals persistent penalties, although the magnitudes and shapes vary across different models and comparison groups.

The penalties from the EE models vary from 5–9% to 8–11% when the references are childless women and men, respectively, in both the short- and long-term. On the other hand, from the DD models, the pattern observed for both control groups is: initially, a substantial penalty in the first year following childbirth; and, a subsequent stabilization of this effect after the in subsequent years. The short- and long-term motherhood penalties in these terms vary from 21–29% and 8–12%, respectively.

In summary, we estimate that the representative motherhood penalties in Brazil, expressed as a reduction in counterfactual wages, are around 25% in the first year of the child's life and stabilize at around 10% when the child reaches school age. The long-term persistence of this penalty is consistent with the results of studies in other countries, even though our analysis focuses exclusively on the formal labor market in Brazil.

The final message in terms of social impact is that all the results presented here suggest that it is necessary to help mothers return to the labor market after childbirth under the same conditions and with the same opportunities for professional development as before pregnancy. This support can be provided either within the family, with partners sharing household tasks, or as a public measure by increasing the availability of daycare centers.

Ethics statements

This manuscript adheres to the guidelines for Ethics in Publishing.

We declare that this manuscript complies with the guidelines for ethics in publishing.

Moreover, we declare that we have not used any artificial intelligence tools in this manuscript.

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CRediT authorship contribution statement

Francis Petterini: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jeniffer Gonçalves**: Investigation, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

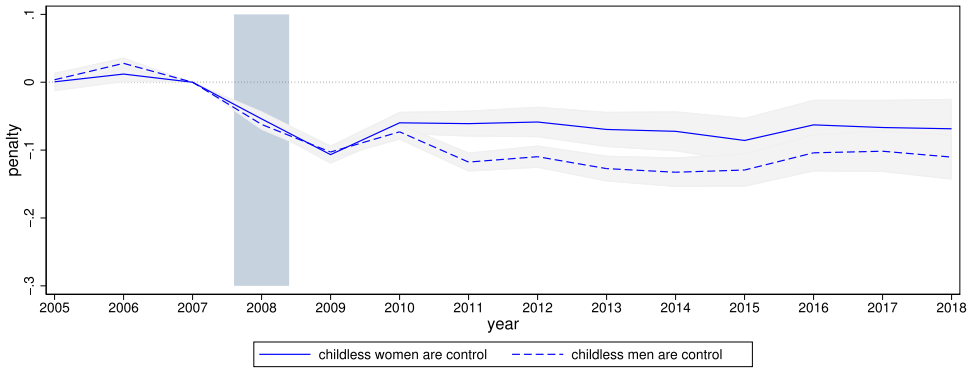


Figure 5. EE motherhood penalties on wages.

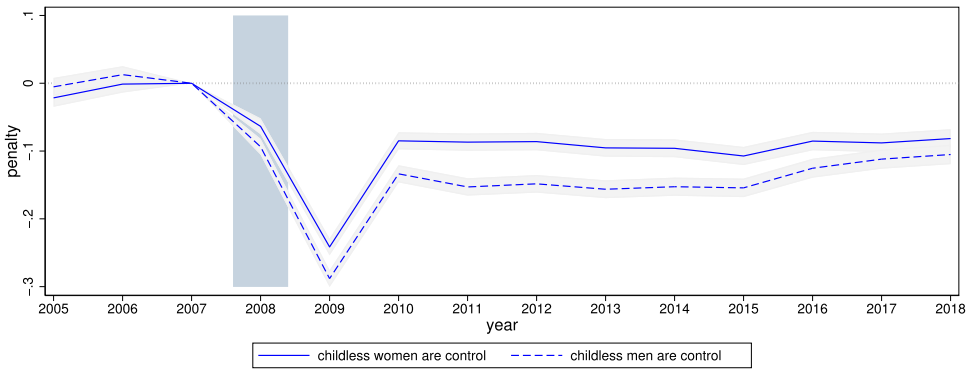


Figure 6. DD motherhood penalties on wages.

the work reported in this paper.

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