VILNIUS UNIVERSITY
FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

SOFIJA VOLUNGEVIČIŪTĖ
Quantitative Economics
Bachelor Thesis

THE LABOR MARKET CONSEQUENCES OF MOTHERHOOD IN LITHUANIA: EVIDENCE FROM SOCIAL SECURITY DATA

Supervisor: Dr. Jose Garcia-Louzao Perez
Date of submission of the academic paper:
June 25, 2024
Registration No.
Assessment of the academic paper:

Vilnius, June 25, 2024

CONTENTS

INTRODUCTION

The literature has long attributed the gender pay gap to gender differences in labor market participation, educational attainment, and experience (McCall, 2000; Bobbitt-Zeher, 2007). However, due to the great convergence of both genders in these areas (Goldin, 2014), the persistent gender gap has recently been explained mainly by family formation (Albanesi et al., 2023; Goldin et al., 2022). Specifically, the birth of the first child, whose impact on labor market outcomes for mothers relative to fathers is commonly referred to in the literature as the child penalty (Kleven et al., 2019b).

The aim of this thesis is to quantify the impact of the first child's arrival on mothers' labor market outcomes in Lithuania over the different horizons. More specifically, I quantify the consequences of motherhood for the dynamics of total income as well as place the effect relative to fathers and a group of non-mothers. In addition, I seek to document the underlying sources of the estimated gap in terms of job retention, receipt of labor earnings, sickness and unemployment incidence, as well as wage adjustments. To estimate the motherhood penalty, I implement an event study following Kleven et al. (2019b), which involves analyzing how the earnings of mothers change relative to the baseline period before the birth of the first child compared to fathers and non-mothers. I estimate such a model using rich administrative data from Social Security records provided by the State Social Insurance Fund Board (SoDra) and covering the years 2000-2020.

Analyzing the motherhood penalty in Lithuania is interesting for several reasons. First, Lithuania is among the top 10 most advanced countries in the world in achieving a complete gender equality.[1] Second, the remaining employment gender gap in Lithuania can be fully explained by the child penalty, as suggested by Kleven et al. (2023). Third, the Lithuanian context provides an opportunity to study the motherhood penalty in a country that offers the 4th most generous childcare leave among all OECD countries.[2] Yet, only one study by Černiauskas (2023) has analyzed the short-term impact of a woman's first birth on her earnings in Lithuania, which is based on survey data.

The results indicate that due to the arrival of their first child, mothers in Lithuania are experiencing a substantial loss of total income. In the short run the motherhood penalty is around 48% relative to fathers and around 50% relative to non-mothers. It persists in the long run at around 19% compared to both fathers and non-mothers.

Part of the penalty in total income can be explained by the fact that due to the birth of their first child mothers are around 10% more likely than fathers and 11% more likely than non-mothers to terminate their employment contract in the short term. The difference remains around 9% relative to fathers and around 7% relative to non-mothers in the long run. Additionally, some of those mothers

[1] The World Economic Forum's 2023 Global Gender Gap Report shows that Lithuania is among the countries with a Global Gender Gap Index score of at least 80 in 2023. The scores range from 0 to 100, with 100 representing complete gender parity. The index reflects: economic participation and opportunity, educational attainment, health and survival, and political empowerment.

[2] According to the 2016 OECD statistics on the length of maternity leave, parental leave and paid paternity leave.

who remain employed do not receive any labor earnings. For those who are registered with an employer, the short-run motherhood penalty in the probability of receiving labor earnings (that do not include any collected benefits) is about 80% relative to the comparison groups and remains about 10% in the long run.

Furthermore, the findings indicate that among those who receive some labor earnings in a quarter, in the short run, mothers are about 36% less likely than fathers and 29% less likely than non-mothers to take some days off work compared to the reference period. In the medium term, however, mothers' probability of taking days off increases most, relative to the baseline period, exceeding that of fathers and non-mothers. This probability for mothers remains the highest even 40 quarters after childbirth, with mothers being about 43% and 74% more likely to take days off compared to fathers and non-mothers, respectively. Importantly, for workers who do not miss work days, the short-run motherhood penalty in terms of daily labor earnings, is about 32% in contrast to fathers, and around 35% in contrast to non-mothers. In the long run it remains at 17% and 20%, respectively.

My thesis contributes to existing literature in several dimensions. First, expand on Černiauskas (2023) study by estimating the long-run motherhood penalty using rich Lithuanian administrative data. I also add to this study by not only examining the penalty in total income, but also other dimensions of the employment relationship that may shape career outcomes. Additionally, I introduce a comparative analysis between mothers and non-mothers to the general motherhood penalty estimation which usually compares mothers to fathers. Moreover, to the best of my knowledge, I am only the 3rd, after two Belgian studies Albanese et al. (2022) and Fontenay et al. (2023), to use quarterly data to estimate the child penalty, which improves the precision of the results. Finally, I shed light on a dimension that has been overlooked in most studies on this topic, namely the dynamics of the various benefits collected around the first birth.

The remaining thesis is organized as follows: Section 1. provides some existing literature context for the analysis. Section 2. introduces the Lithuanian institutional setting regarding the state support for parents. Then, Section 3. presents the methodology. Section 4. introduces and summarizes the data for which the method is applied. The results are presented and discussed in the Section 5., while the final section concludes.

1. LITERATURE REVIEW

In this section, I offer a review of the existing literature on gender differences in the labor market with a focus on the unequal consequences of parenthood. The analysis on gender gaps has a long tradition in the economics literature, and the fact that women earn less is well documented (Averett et al., 2018). Traditional explanations for the existence of the gender gap in earnings were related to differences in educational attainment (McCall, 2000), labor market participation, or experience (Reskin and Hartmann, 1986; Bobbitt-Zeher, 2007). However, nowadays these sources of the gender gap are no longer relevant due to the substantial convergence of men and women in these areas (Goldin et al., 2006; Goldin, 2014). Remaining gender gaps seem to be mostly explained by the differential consequences of family formation (Albanesi et al., 2023; Goldin et al., 2022; Kleven et al., 2023).

Most of the literature on the effects of family formation in explaining the remaining gender gap relates to the unequal impact of parenthood, as women tend to fall behind men in career outcomes after childbirth. This effect is labeled in the literature as the 'child penalty', after Kleven et al. (2019b)'s work. The authors introduce a generalized event study method to estimate the effect of first childbirth in Denmark and find that after birth mothers experience a significant long-term earnings reduction of approximately 20%, while men's earnings remain unaffected. They also document that child penalty for mothers arises from post-birth reduction in labor force participation, hours worked, and wage rates. This paper has spurred an important line of research seeking to document the penalty across different countries.

Table 1
Long-term child penalty in earnings across countries

Country	Relative to fathers	Relative to non-mothers
Denmark	19%	20%
Italy	-	52%
Spain	25%	-
Finland	25%	-
United States	31%	-
United Kingdom	44%	-
Austria	51%	-
Germany	61%	-

Note: The reported penalties for Denmark and Italy are child penalties at the moment the child is 10 years old. Penalties for other countries are estimated as an average penalty between 5 and 10 years after birth. Sources: Kleven et al. (2019b); Casarico and Lattanzio (2023); de Quinto et al. (2021); Sieppi and Pehkonen (2019); Kleven et al. (2019a).

Table (1) summarizes some of the long-run child penalties in different countries estimated following the seminal work of Kleven et al. (2019b). Mothers in Denmark experience the lowest 19% long-term earnings loss due to the birth of their first child relative to fathers. In Germany, the mothers'

loss is the highest: 61%. The literature measuring the long-term motherhood penalty relative to non-mothers is still scarce. However, it can be noticed that there is a considerable difference between this penalty in Denmark and Italy, which is 20% and 52% respectively.

The literature which focuses on the impact of parenthood on mothers' labor market outcomes continues to document not only the magnitude of the motherhood earnings penalty across countries, but also its underlying sources. Importantly, de Quinto et al. (2021) use Spanish data and find that while fathers' figures do not exhibit any considerable changes, after the birth of their first child women become more likely to work less days, switch to part-time jobs and work on a fixed-term contract. They also provide some evidence that after childbirth, college-educated women experience smaller declines in earnings and days worked, are more likely to switch to part-time work, and are less likely to work on a temporary contract than non-college-educated women. In addition, Sieppi and Pehkonen (2019) documents that in Finland the impact of the birth of the first child on mothers' earnings is determined by the total number of children they have. Mothers with larger families experience a more pronounced child penalty after their first child because they tend to be less educated and less likely to be employed than those with smaller families. Furthermore, Melentyeva and Riedel (2023) use German data and show that the size of the penalty depends on the mother's age. Younger mothers tend to experience the largest loss in earnings after the birth of their first child because career growth is fastest at the beginning of the working life. Casarico and Lattanzio (2023) evidence from Italy indicate that the magnitude of motherhood earnings penalty varies with different firm-specific characteristics. It is greater in smaller firms with less generous pay policies, worse peer relations, and a higher proportion of female workers compared to male workers.

Other papers highlight more dimensions of motherhood penalty, such as hiring, skills, mental and physical health. For instance, Albanese et al. (2022) findings show that in Belgium, mothers are more likely than fathers to give up a non-local job to take care of a child, and the new local jobs tend to be lower paid. This pattern accounts for 75% of the child penalty in employment. Also, Adda et al. (2017) using a structural model investigate the cost of the child's arrival on the mother's career in Germany and conclude that, on average, mothers lose more earnings than fathers due to the loss and atrophy of skills during the childcare period. The loss varies across occupations and is non-linear through the career cycle, with the largest loss occurring in mid-career. Importantly, Halla et al. (2024) emphasize the cost of the first child on the women's mental health. Their results show that in the long-run after the first childbirth mothers become 93.2% more likely to be prescribed antidepressants than men in Austria and 64.8% more likely in Denmark. Similarly, Angelov et al. (2020) document that due to motherhood the occurrence of sickness leave for mothers more than doubles relative to fathers. They also find evidence suggesting that this increase is related to greater incentives for mothers to stay home and not work, rather than to actual health problems. Furthermore, Fontenay and Tojerow (2020) show that in Belgium, 8 years after the first birth, mothers are 40% more likely to experience work disability than fathers, and fathers' probability of entering disability is not affected by birth.

Gender norms are also still central in determining the size of the earnings' child penalty and in

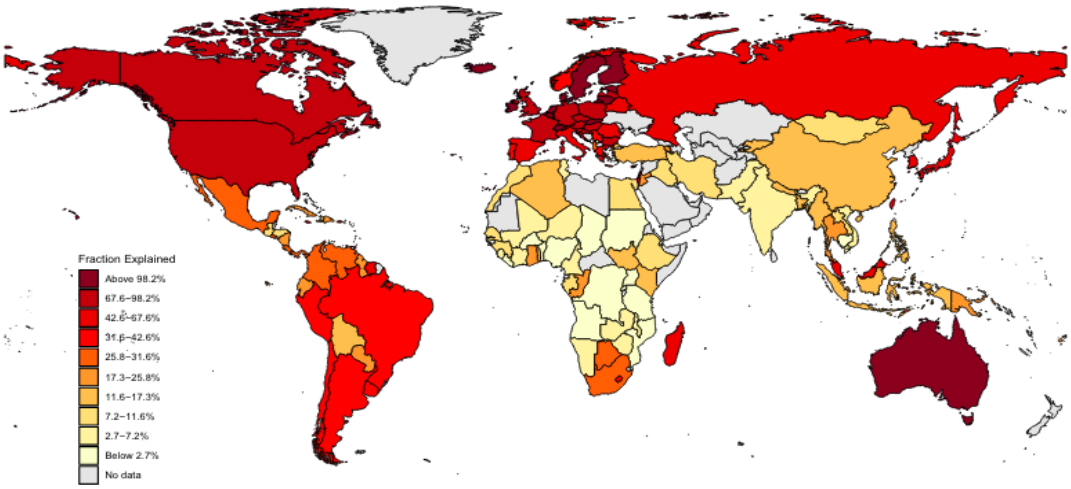
explaining why women are more likely than men to interrupt their careers after the birth of their first child. Analyses based on different couple compositions highlight the importance of gender stereotypes for the magnitude of the motherhood penalty. Compared to the child penalty for mothers in heterosexual couples, mothers in same-sex couples tend to experience a smaller penalty relative to their co-mothers (Moberg, 2016; Rosenbaum, 2019). A lower impact of childbirth on individual earnings is due to a more equal distribution of responsibilities within a same-sex couple. Andresen and Nix (2022) show that for lesbian mothers child penalty holds only in the short run, and converges to almost nonexistent in the long run. Cortés and Pan (2023) adds to this by showing that in heterosexual couples even those women who have a comparative advantage in the labor market relative to their spouses experience a substantial motherhood penalty because they are expected to be the primary caregiver for a child.

Social preferences are usually influenced by the cultural standards of the region. Recently, Kleven et al. (2019a) using harmonized survey datasets and methods show that the magnitude of the child penalty varies significantly between countries based on their social norms. Their study examines results from six developed countries and finds considerable differences. Building on this, Kleven et al. (2023) analyze child penalties in 134 countries and show that in countries with high GDP per capita, the child penalty accounts for 100% of the employment gap between men and women (Figure (1)). Lithuania is one of those countries.

To date, there has been only one attempt to estimate the short-term penalty associated with having children in Lithuania. Černiauskas (2023) examines the loss of income linked to the first childbirth in the Baltic countries: Lithuania, Latvia and Estonia. The author finds that women in the Baltic states tend to lose half of their earnings in the first year after the birth of the first child, and roughly 33%-37% after two years. Meanwhile, men's earnings are little affected. The findings also reveal that the short-run child-related earnings loss for women after their first birth is higher in the Baltics than in the comparison group, which included Denmark, Finland, Sweden, the Netherlands and Norway. This thesis builds upon this work to quantify the child penalty using quarterly administrative data, which allows me to measure the impact of childbirth at different horizons and thus compare with the literature, i.e. to place Lithuania in the Table (1). Moreover, I add a non-mother dimension to the traditional event study and investigate the motherhood penalty not only by comparing mothers with fathers, but also by comparing mothers with childless women. In addition, I investigate different channels through which the total income child penalty may emerge in Lithuania by looking at labor force participation, incidence of sickness and unemployment, as well as changes in wage rates.

Figure 1

Heat map of fraction of gender gap explained by child penalties



Source: Kleven et al. (2023)

2. INSTITUTIONAL SETTING

In this section I provide a description of how mothers and fathers are supported by the state with respect to child-related benefits regarding both parental leave as well as child-care allowances. I will also provide an overview of the sickness benefit settings that can be accessed to compensate for days off work due to the child's sickness.[3]

Maternity leave eligibility and duration According to the Lithuanian law, maternity benefit is paid to women who have been registered in the sickness and maternity insurance scheme for at least 12 months during the 24 months before the start of their maternity leave. There are some exceptions, including women younger than 26 who during that time were in full-time secondary, professional or higher education, and those who were in civil or military service. Importantly, the period between the change of status and the start of their insurance record cannot exceed 3 months. From January 1st, 2020, women who were not employed during their pregnancy but who had a qualification period of at least 12 months in the previous 24 months are entitled to the benefit as well. The maternity leave allowance is paid 70 days before the childbirth and 56 days after the delivery. In case of any complications or if more than one child was born, 14 additional days are added to the total (126) maternity leave.

Paternity leave eligibility and duration The paternity leave benefit was only introduced on 1st July 2006. To be eligible for this benefit, men must have a contribution record for at least 12 months out of the previous 24 months. This does not apply to those younger than 26 who were previously in full-time secondary, professional or higher education, provided that the gap between the change of status and the start of the contribution record was not more than 3 months. The law for paternity leave duration is not that generous for the fathers compared to mothers. Until 2020 fathers were able to take only a one-month paternity leave during the first three months after the child was born. They were permitted a substantially shorter parental leave than mothers, and were not allowed to postpone their childcare leave. Since January 1st, 2020, fathers have been entitled to take a one-month leave during the first year after the childbirth.

Parental leave payments' structure Regardless the longer maternity leave period, maternity and paternity leave payments' structure remains very similar. Hence, mothers may sacrifice a significant portion of their career for childcare without receiving any additional compensation for this. Both parental benefits were equal to 100% of the recipient's average monthly insured income (AMII) (with minimum and maximum values determined) until 2019. Since 2011 the amount of the benefit is

[3]The information presented in this section is based on the EUROMOD Country Report for Lithuania, which was published in 2023.

reduced if a person had received any kind of additional insured income. From 1st January 2017, the amount of the parental leave allowance cannot be less than 20% of the average monthly wage in the country for the last quarter (AMSp) before becoming eligible for the allowance. And it cannot be higher than 2 AMSp. In addition, from 2018 the minimum amount of maternity or paternity leave benefit can not be less than 6 BSA (Basic Social Allowance) (or 228 EUR), with a ceiling of 2 national average monthly salaries (1752.8 EUR). Due to the tax reform in 2019 the maternity and paternity benefit is reduced to 77.58% of the recipient's compensatory income. It is important to note that the self-employed only become eligible for the benefit from January 1st, 2021.

Childcare allowances Further, Lithuania provides parents with a childcare benefit for an exceptionally long period. Parents and adoptive parents are eligible for the benefit until the child reaches the age of 1 year or 2 years. The benefit is computed according to the AMII, with minimum and maximum levels. From 1st January 2017, the amount of childcare allowance could not be higher than 2 AMSp. From 1 January 2018, the minimum amount of childcare benefit is 6 BSA. Then, starting from 1st January 2019, the amount of the childcare allowance is multiplied by the number of births, but can not exceed the previous AMII. Regarding the duration, from the 1st of January 2012 onward, beneficiaries can determine the length of leave: either 1 or 2 years, which is linked to varying childcare benefit compensation rates: 100% when opting for 1 year leave or 70% and 40% for the initial and second year. Since the implementation of tax reforms on January 1st, 2019, the compensation rate for a one-year benefit is reduced to 77.58%, therefore for a two-year period, the compensation rate was 54.31% in the first year and 31.03% in the second year. Since January 1st of 2020, if one parent receiving childcare benefit qualifies for another for a different child, they shall receive both benefits. However, the total amount of benefits must not exceed 77.58% of the higher amount of earnings used to calculate these benefits. It is worth mentioning that if person receives any kind of insured income, the initially calculated child benefit is reduced by the amount of this income during the first year of receipt.

Sickness benefit In addition to those who take a sickness leave due to their own health conditions, sickness benefit is also paid to parents (grandparents, stepparents, guardians) caring for a sick child who is younger than 18 year old, if the child id seriously ill or disabled. In these circumstances the benefit is paid for maximum 364 days. For the first two days, the sickness benefit is paid by the employer, and from the third day, it is paid by the State Social Insurance Fund Board. Importantly, from the 1st of January 2019, the maximum amount of sickness benefit received cannot be less than 11.64% and cannot exceed 200% of the national average monthly salary of the previous quarter. The benefit paid by the employer cannot be less than 62.06% or more than 100% of the beneficiary's average wage. The amount of sickness benefit paid by the State Social Insurance Fund is 62.06% of the compensatory income. The exceptions are transplant donors, who receive 77.58%, and parents caring for a sick child, who receive 65.94% of the beneficiary's average wage. From 1st of January 2020,

sickness benefit is paid once a year for a total of 28 days to persons in institutions for the treatment of serious gambling addiction and addiction to psychoactive substances. Additionally, parents (grandparents, stepparents, guardians) taking care of a child in preschool, pre-primary or primary education who is unable to attend school due to the spread of infectious diseases are also entitled to sickness benefit.

3. EMPIRICAL STRATEGY

To estimate the impact of having a child on the labor market outcomes of women and men, I follow Kleven et al. (2019a) seminal work to implement an event study around the birth of the first child.

Event Study. The method captures changes in the outcomes of interest relative to the reference period before the arrival of the first child, which is referred to as the event or the treatment. I use the age at which parents get their first child or non-mothers are imputed a 'placebo' birth to index time relative to the arrival of the first child. The quarter in which the actual or the simulated child is born is equivalent to $t = 0$. Individuals are then observed for at most 20 quarters before and 40 quarters after the childbirth. I examine the changes in the labor market outcomes over event time by running a regression model below for the outcome of interest Y^g_{iqt} for individual i of group g in quarter q and at event time t

$$Y^g_{iqt} = \sum_{k \neq -4} \alpha^g_k \cdot 1(k = t) + \sum_j \beta^g_j \cdot 1(j = age_{iq}) + \sum_y \gamma^g_y \cdot 1(y = q) + \varepsilon^g_{iqt} \tag{1}$$

where the first term on the right-hand side is a full set of event time dummies. The event time dummy at $t = -4$ is omitted because that is the reference period. Hence, the event time coefficients α^g_k measure the child effect relative to four quarters before the arrival of a child (assuming that parents can be informed about the child at the earliest nine months or three quarters before the birth). Further, to control for the life-cycle trends, the full set of age dummies $\sum_j \beta^g_j \cdot 1(j = age_{iq})$ are included in the regression, along with the full set of quarterly time dummies $\sum_y \gamma^g_y \cdot 1(y = q)$ to capture the calendar time fixed effects. In order to accurately capture the heterogeneity in labor market outcomes between different individual groups, it is necessary to consider age and time fixed effects separately for mothers and the comparison group. Pooled fixed effects fail capturing a group-specific economic dynamics related to age and calendar time (Figure (B.3A), Figure (B.3B)).

It is important to consider the analysis periods during which individuals are not engaged in work activities. Therefore, I allow for labor outcomes to be zero and measure them in levels rather than logs. Converting the level effects estimated by equation (1) into the percentage share is done by calculating

$$P^g_t = \frac{\hat{\alpha}^g_t}{E[\tilde{Y}^g_{iqt}|t]} \tag{2}$$

where $\hat{\alpha}^g_t$ is an estimated event time t coefficient and $E[\tilde{Y}^g_{iqt}|t]$ is the mean for a given event time t of the predicted dependent variable outcome when the effect of the event time dummies $\hat{\alpha}^g_t$ is omitted.

Further, the penalty in the labor market outcomes for mothers, relative to the reference group, is calculated as follows:

$$P_t = \frac{(\hat{\alpha}_t^i - \hat{\alpha}_t^m)}{E[\tilde{Y}_{iqt}^m | t]} \tag{3}$$

where $\hat{\alpha}_t^i$ is an event time t coefficient for a comparison group i, and $\hat{\alpha}_t^m$ is an event time t coefficient for mothers m. A positive penalty suggests that the gap between mothers and the counterfactual increases after the arrival of their first child relative to four quarters prior.

The literature usually compares the individual outcomes of parents between genders (Kleven et al. (2019b), de Quinto et al. (2021)). However, part of the estimated child penalty may be explained by gender heterogeneity, therefore some studies address this concern by estimating the child-related losses for mothers compared to non-mothers (Casarico and Lattanzio, 2023). Hence, in addition to fathers, I also add a second dimension of comparison group, non-mothers.

Imputation of the non-mothers. Selecting mothers and fathers is straightforward. They are individuals who I observe to experience the arrival of their first child during their fertile period (age between 20 and 40). On the other hand, constructing a non-mothers group is more complex. Women without children can be divided into three categories: non-truncated females without any children, truncated females who are predicted to never have children, and truncated women who are expected to have children after their last observation. The sample used for the imputation is women generations born in 1960-2000. The non-truncated generations are 1960-1980 because until the end of the sample period (2020 Q4) they can be observed through their whole fertile period. The truncated generations are born in 1982-2000. Non-truncated persons without children automatically belong to the estimation group of non-mothers. However, some out of those who are truncated will never have a child and some might still have one in the future. The final non-mothers category should only consist of two types of people: 1) non-mothers born in 1960-1980 2) non-mothers born in 1982-2000 who are unlikely to have any children later.

The rationale for being strict about who goes to the counterfactual lies in the aim of the analysis within the same gender, which is to compare the career path patterns of mothers to non-mothers. Thus, including truncated non-mothers who are assumed to never have a child into the counterfactual group is preferred to including those who are likely to have a child in the future. Individuals who are assumed to become parents in the future may have already planned the child's arrival and made corresponding career decisions leading them to a more stable lifestyle. These people lose in a career growth compared to the never parents. Including them into the counterfactual could potentially result in an underestimated child penalty.

Hence, in this section I expand on the methodology used to form a non-mothers baseline group. This requires selecting individuals from the sample who do not have and are not expected to have children, and imputing them a 'placebo' age at birth. For that I follow two different approaches suggested by Kleven et al. (2019b) and Casarico and Lattanzio (2023).

First, in order to define which non-parents from the truncated generations are expected to

have children, both methods require predicting them a probability of not having a child. I do that by estimating a linear probability model for 1960-1980 generations. In particular, I regress a dummy taking value 1 if individual has a child on the set of dummy variables: quartiles of the personal fixed effects, registered location, year of birth, and marital status. Then, I assign a predicted cohort-specific birth probability to the truncated individuals. To obtain the probability of never having children I subtract the fertility probability from 1. The latter is further used to select predicted never parents.

Kleven et al. (2019b). Following the methodology proposed by Kleven et al. (2019b) I compare the probability of not having a child to the fraction of individuals who are expected but have not had children yet. The second-mentioned takes the following form:

$$p_g = \frac{(N_g * r - N_g^p)}{N_g^n} \tag{4}$$

where g indicates generation from 1982 to 2000. N_g is a gender-specific total number of individuals, r is a fertility rate of a non-truncated period between 1976 and 1980. The fertility rate of only the youngest non-truncated cohorts is used because the 1976 generation is one of the first to enter the labor market after Lithuania regained its independence in 1990. They are therefore more comparable to the younger cohorts, who were not observed during their entire fertile period and who also worked in an independent country. Further, N_g^p is a number of mothers and N_g^n is a number of women without children in the given birth year g. If the probability of not having a child in the generation g is lower than p_g, the person is predicted to have a child. Then, the expected non-mothers who are truncated are grouped with the non-truncated childless women, thereby establishing the category of non-mothers.

Casarico and Lattanzio (2023). Using the methodology suggested by Casarico and Lattanzio (2023) the predicted never mothers are imputed by following the further steps. First, I rank the truncated individuals without children by birth cohorts from the least to the most likely to have children, therefore women with the lowest fertility probability will be further preferred. Then I start assigning women to the predicted never mothers' group as long as the fraction of them in the given generation reaches the fraction of non-mothers in cohort between 1976 and 1980. As a result, the both groups of the non-mothers category are defined: 1) never mothers born in 1960-1980 2) predicted never mothers born in 1982-2000.

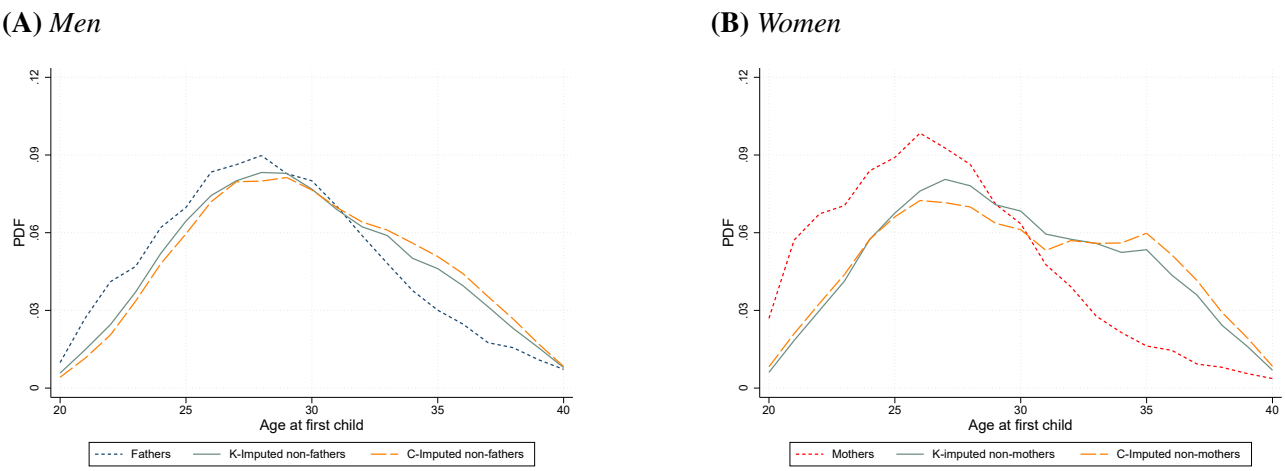
The second step is imputing a 'placebo' childbirth for the non-mothers and assigning a random age at that event. For the non-truncated individuals the imputed age is a random draw from the age at birth of actual parents which is assumed to have a log-normal distribution. The age distribution is drawn and then imputed by quartiles of personal fixed effects and birth cohorts. Assigning a 'placebo' birth for the group of predicted never parents is slightly different. To assign an age at birth specific to the generation and personal fixed effects I use random draws from the following distribution. The

standard deviation is taken from the distribution of the five closest (1976-1980) non-truncated cohorts' log age at the first childbirth. For obtaining the mean I regress the age at first child on a quadratic time trend and then predict it separately for different individual fixed effects. After that, the mean of the distribution used for assigning a random 'placebo' birth following the Kleven et al. (2019b) method is based on the average log predicted age at birth specific to the worker fixed effects of the 1976-1980 cohorts. Whereas the mean according to the Casarico and Lattanzio (2023) method is an average of the log predicted age at birth specific for the given cohort and personal fixed effects.

Figure (2) illustrates that the distribution of an actual age at the arrival of the first child almost coincides with the imputed age for males, whereas the distribution of imputed age for females is slightly shifted right using both imputation methods. Imputed non-mothers are, on average, born in earlier cohorts than actual mothers (Table (2)), so it makes logical sense to allow them, on average, to have a 'placebo' birth later in life. Figure (A.1) shows that the fit of the simulated and actual age-at-birth distributions is slightly modified by the sample restrictions applied later.

Figure 2

Age at first birth: actual vs imputed



Note: distribution of the actual and simulated age at the arrival of the first child, before imposing any final restrictions related to the event time index.

Testing the imputation methods. To check the accuracy of the prediction for never parents, I truncate the generations born in 1972-1980 that are not truncated in the full sample by removing observations after 2010. Then, I apply the imputation techniques using the restricted sample. Lastly, I compare the simulated fertility rates with the actual fertility in the full sample specific to each cohort.

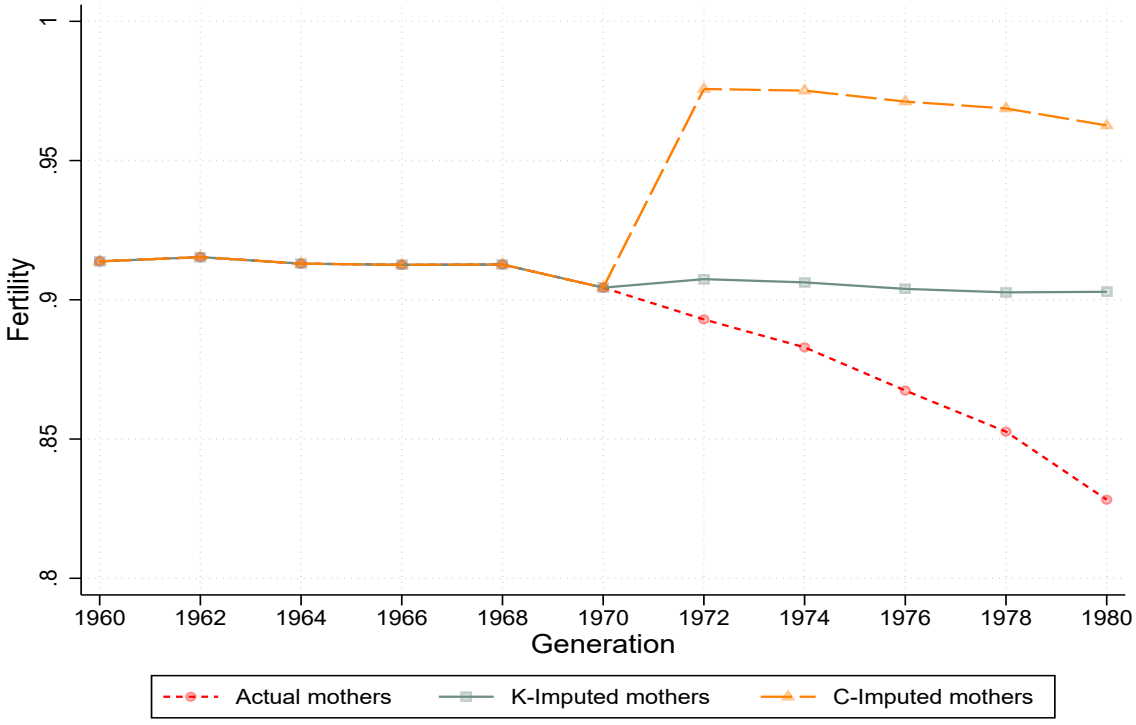
First, to perform the test I use the same female individuals as in both imputation methods. Then, I recover any missing observations between the first and the last time individual appears in the data. That is to prevent losing any information on childbirth during unobserved periods (for instance, if person is unobserved in a certain period but has children before and after, it is assumed that they had children during that unobserved period too). After that, a sub-sample is created containing observations only until 2010. In addition, only the last observation per person is kept. Using this

limited information on the individuals I select the predicted mothers using the approach suggested by Kleven et al. (2019b). That is used to create a new binary variable indicating females who are already mothers before and during 2010 and non-mothers whose fertility period is truncated but the method predicts them to have children later. To be more precise, the women are either actual or simulated non-mothers when the dummy takes the value 0. I also replicate these steps using the exact same individuals but this time with Casarico and Lattanzio (2023) method and save the results. I then bring the information about the actual fertility before 2011 and the predicted fertility for 2011-2020 to the full dataset containing the actual fertility in 2000-2020.

The actual birth cohort-specific fertility rates are compared with the simulated fertility in the Figure (3). Where actual and simulated birth rates coincide for the 1960-1970 generations because these generations were not truncated in the limited sub-sample with information only up to 2010. As a result, none of these individuals were predicted to have children after 2010. The difference in fertility rates appears from the 1972 generation onward - the first cohort for which fertility is recorded not only for actual mothers but also for predicted mothers that were manually truncated. Both imputation methods predict a higher number of females getting their first child after 2010 than the number actually is. Therefore, the process of forming the counterfactual is very selective and individuals are only accepted if their behavior does not signal any patterns that could be associated with ever having a child.

Figure (2) and Figure (3) show that the imputation method proposed by Kleven et al. (2019b) produces results that better match the actual distribution of ages at birth and fertility rates. Therefore, for the analysis I will stick to the imputed non-mothers using the latter approach.

Figure 3
Fertility rates: actual vs imputed



4. DATA

Social Security records. The data source used for the analysis is part of the State Social Insurance Fund Board (SoDra) records. I use a 25% random sample of individuals who were registered at the Lithuanian Social Security system any time between 2000-2020.[4] The dataset provides detailed information on each individual which is relevant for the Social Security. The data range from 2000 to 2009 is quarterly, whereas the data from 2010-2020 is collected on a monthly basis. Hence, the 2010-2020 data is collapsed to a quarterly frequency for consistency, leaving one observation per individual per quarter, where all monetary variables are a total amount collected by the worker in that quarter. The monetary variables include insured labor earnings as well as any type of collected welfare benefits. The most important variables among the last-mentioned category are sickness, unemployment, paternity/maternity benefits, and childcare allowances. This information is then used to define a total earnings variable, which includes earnings from work and any type of public benefit or pension received. All the monetary variables were deflated using the Consumer Price Index (CPI).

Additionally, I observe the start and end dates of the employment contract that provide the necessary details to define the duration of the labor relationship between the worker and the employer. The duration of employment is measured by the number of days the employee is registered with the employer. This measure is crucial since Lithuanian administrative data does not offer data regarding the number of hours worked or the hourly wages. However, these days might not refer to actual days worked if the individual is, for instance, on maternity or sickness leave as they will still be registered with the employer. To investigate actual days worked, I will exploit information on benefits to identify situations when the individual is likely to have missed at least a day of work.

The data also provides details about the number of children individuals have. Tracking the number of children overtime allows me to create a variable for their quarterly date of arrival.[5] The latter is defined one quarter before the child appears in the data, because individuals tended to access children benefits one quarter before they can according on the Lithuanian law. Therefore, I assume that administrative records capture child's arrival one quarter later. In addition, the observation of individuals' date of birth is another important feature of the data, as it makes it possible to create a variable for individuals' age and to track workers over their life cycle. The data also identifies a range of other characteristics of the workers that are useful to consider. These include their marital status, nationality, and their registration location as well as the location of their employer.

Sample selection. To select my analysis sample, I impose the following constraints in the quarterly panel. First, only individuals who experience their first child's arrival or an imputed birth between the

[4]The random sample consists of individuals with an even birth year and uneven birth month.

[5]The arrival of a first child observed in the sample could refer to either childbirth or adoption. However, I cannot distinguish between the two and I will further use the term 'childbirth' or 'arrival of the first child' interchangeably for both events.

age of 20 and 40 (which is assumed to be their fertile period) are considered. Hence, only generations born in 1960-2000 remain. Second, only employees with positive earnings in at least four quarters of their observation period are included in the analysis. Also, I drop individuals for whom the AKM (Abowd et al., 1999) model yields missing worker fixed effects. The two last-mentioned restrictions result in the removal of individuals who have no variation in income or who have only a few observations. After that, I eliminate workers who start receiving maternity or paternity benefits earlier than they are eligible. Also, workers who collected child-related benefits but did not have any children during the sample period or experienced first child's arrival more than once were also removed from the panel because they could have experienced the loss of a child. In addition, to ensure some workers' attachment to the labor market, only those remain who are observed at least four times before the arrival of the first child and at least four times after. This restriction also removes any parents who get their first-child before 2001 and after 2019. Individuals are then observed for a maximum of 61 quarters over an unbalanced event window: 20 quarters before the actual or simulated arrival of the first child and 40 quarters after.

Summary statistics. The final sample contains 4,311,005 quarterly observations for 103,197 unique individuals. Around 47% of them are first-time mothers, 9% are imputed non-mothers, and 44% are first-time fathers between 18 and 50 year old. Their characteristics are summarized in the Table (2).

Table 2
Summary statistics of the estimation sample

	Men		Women			
	Fathers		Mothers		Non-mothers	
Married	0.77		0.76		0.14	
Lithuanian	0.99		0.99		0.99	
Number of children	1.57	(0.65)	1.58	(0.62)	0.00	(0.00)
Year of birth	1981.86	(5.91)	1983.10	(5.90)	1979.19	(8.25)
Age at the first childbirth	28.65	(4.21)	27.39	(3.99)	29.67	(4.67)
Registered in bigger cities	0.55		0.62		0.67	
Working in bigger cities	0.71		0.76		0.80	
Year of the first employment	2001.94	(5.55)	2003.46	(5.65)	2001.00	(6.74)
Days registered with employer	3237.42	(1411.53)	3233.98	(1402.83)	3361.08	(1434.98)
Days with positive earnings	3188.51	(1414.34)	2415.08	(1228.62)	3348.58	(1438.82)
Total income	119109.32	(132442.77)	82334.97	(79832.65)	109430.18	(95822.41)
Labor earnings	114342.29	(130922.84)	66118.52	(70910.73)	107732.10	(95946.40)
Unemployment benefits	333.00	(873.77)	458.16	(933.38)	342.21	(948.76)
Sickness benefits	1439.29	(2152.50)	1312.65	(1715.68)	742.69	(1281.56)
Other benefits	308.68	(2455.07)	179.66	(1803.80)	600.19	(3415.30)
Child-related benefits	2672.19	(5233.60)	14262.92	(14792.45)	0.00	(0.00)
no. of individuals	45424		48651		9122	

Note: The number of days and each type of income or benefit is a sample mean of the individual total amount received throughout the observation period.

In terms of personal characteristics, mothers are more similar to fathers than to non-mothers. In the final sample, the share of married mothers and fathers is almost identical, approximately 5.5 times greater than that of non-mothers. Mothers tend to be 2 years younger than fathers and about 4 years younger than non-mothers. Accordingly, mothers typically experience the arrival of their first child about 1 year earlier in life than fathers, and about 2 years earlier than the imputed "placebo" age at birth for non-mothers. Moreover, non-mothers are the most likely to be registered or working in one of Lithuania's largest urban areas, while fathers are the least likely. Furthermore, the average year of first employment for fathers and non-mothers is about 2 years earlier than for mothers.

It is important to note the different career patterns of mothers, non-mothers and fathers which can already be seen in the summary statistics. Non-mothers and fathers tend, on average, to have a higher number of days registered with an employer and a higher number of days receiving labor earnings. Mothers are typically registered with an employer for only 4 days less than fathers. However, they spend on average 127 days less under the employment contract compared to non-mothers. The difference between mothers and fathers in the number of days receiving labor earnings is much higher: about 773 days, and between mothers and non-mothers it is about 933 days. This finding can at least partly be attributed to the fact that mothers are more likely than fathers and non-mothers to receive

unemployment and child-related benefits, as well as higher sickness benefits than non-mothers.

Despite the fact that mothers collect a greater number of benefits designed to compensate for earnings losses resulting from unemployment, childbirth or sickness leave, they still lag about 27,000 euros behind non-mothers in terms of total income. They also lag behind fathers by about 36,000 euros. The disparity is even larger in terms of labor earnings. The difference between the labor earnings of non-mothers and mothers is approximately 41,000 euros, and approximately 48,000 euros between fathers and mothers. Labor market outcomes and personal traits that may evolve over time are also summarized around the arrival of the first child for mothers, non-mothers, and fathers in Table (A.1).

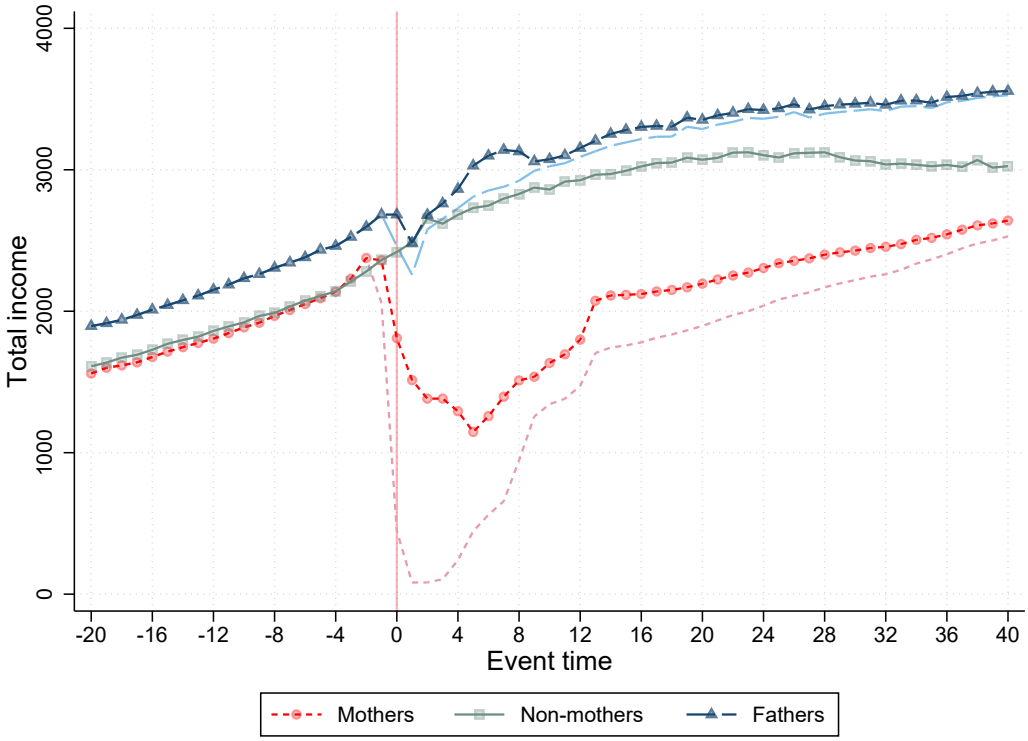
Empirical profile. The impact of motherhood on labor market outcomes can be observed from the raw total income profile over the event time. Prior to the childbirth, the total income levels for mothers and non-mothers are nearly identical, as illustrated in Figure (4). In contrast, fathers consistently have higher income levels. Following the childbirth, mothers begin to fall behind non-mothers in terms of total income, a gap that persists and continues to widen until approximately the 5th quarter post-birth. At its peak, the difference in total income between mothers and non-mothers is higher than 1,500 euros per quarter. Fathers, on the other hand, experience a less significant loss of total income post-childbirth compared to mothers, which recovers within a quarter. However, the income gap between mothers and fathers is even larger, almost 1,800 euros by event time $t = 5$. Although mothers' total income begins to grow five quarters after the birth and the gaps begin to converge, they still persist in the long-term, even after 40 quarters.

Positive total income do not necessarily imply work-related payments, as they may also include sickness, parental or childcare leave, unemployment benefits, or pensions. Following the first child's arrival, mothers receive substantially higher child-related benefits, as shown in the profiles of other relevant variables in Figure (A.2). However, these benefits do not fully compensate for the earnings loss experienced by mothers post-birth, nor do they compensate for the comparatively smaller loss experienced by fathers.[6] In the next section, I quantify the impact of motherhood based on the normalized point estimates from the event study model discussed in Section 3.

[6]It is worth noting that the total income figure for fathers shows a temporary increase between the 5th and the 8th quarter after the birth, which can be attributed to childcare allowances. This increase disappears if these allowances are excluded from income.

Figure 4

Total income levels for mothers, non-mothers, and fathers around the arrival of the first child



Note: The dashed red and blue lines correspond to total income excluding the contribution of child-related benefits for mothers and fathers respectively.

5. RESULTS

In this section I present the estimated effects of first childbirth on labor market outcomes for mothers, fathers and imputed non-mothers, P_t^g (from equations (1) and (2)). To determine how much mothers are disadvantaged relative to the comparison groups, I concentrate on discussing the motherhood penalty, P_t (from equation (3)). The primary focus is on total income, which includes labor earnings and any welfare benefits or pensions collected by the individual. Then, I look at the probability of being insured by an employer, the probability of receiving labor earnings conditional on being registered with employer, the probability that a worker misses some days of work, proxied by receiving some welfare benefits (e.g., sickness pay), and daily labor earnings of those who do not miss any days of work.

Total income. The Figure (5) shows the normalized point estimates of the first child's impact on total income over time, together with 95% confidence intervals and calculated motherhood penalty. The penalty is calculated at the 4th, 20th, and 40th quarters after birth, representing the short-run, medium-run, and long-run penalties, respectively. Additionally, it is calculated over all periods after birth to represent the average penalty. On average, the motherhood penalty in total income is 29.2% compared to fathers and 31.2% compared to non-mothers. Before the reference point ($t = -4$), mothers' total income is lower than the baseline amount and the figure exhibits a gradual increase. A sudden spike in total income of about 5% is observed at $t = -2$, and total income remains higher than in the reference period until $t = -1$. This could be rationalized by anecdotal evidence pointing to mothers-to-be and employers bargaining over current wages before maternity leave in order to increase the level of benefits.

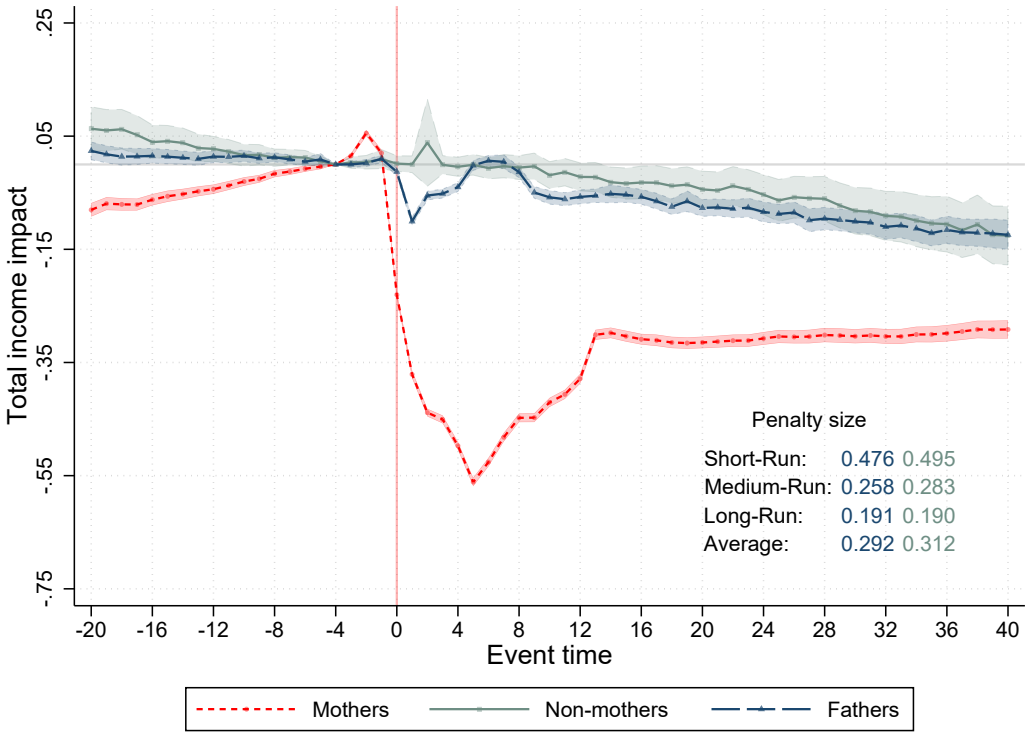
Starting from the quarter in which the child is born, mothers experience a decline in total income relative to the baseline period. The negative effect continues to grow until the 5th quarter after the birth. Compared to the reference period, fathers also see an initial drop in their total income after the birth of a child. However, the loss for fathers is less pronounced than that observed for mothers, and quickly diminishes. As a result, the short-run motherhood penalty in total income compared to fathers is around 47.6%. This number is consistent with the short-run penalty documented by Černiauskas (2023) for the Baltic countries. Since, compared to their baseline period, figure of non-mothers do not show any significant changes during the first 4 quarters after the imputed birth, the short-run motherhood penalty relative to non-mothers is 49.5%.

From around the event time $t = 7$, or when the kid is almost 2 year old, fathers' and non-mothers' total income gradually decline. As the event study estimates presented later in this thesis suggest, this steady decline may be due to changes in career trajectories, such as after actual or imputed births fathers and non-mothers become more likely to terminate their employment contracts (Figure (6)) or switch to part-time or lower-paid jobs (Figure (9)). Figure (A.3) offers an alternative

explanation, which is that fathers and non-mothers with time are more likely to be unemployed or out of work due to incapacity or illness. Mothers' total income, on the other hand, increases around the event time $t = 13$ and stabilizes. Hence, the gaps in total income changes relative to the reference period, both between mothers and fathers as well as between mothers and non-mothers, narrow slightly over time. However, the negative impact of the first child on mothers' total income remains substantial. The medium-run motherhood penalty is 25.8% compared to fathers, and 28.3% compared to non-mothers. The penalty for mothers relative to fathers and non-mothers persists in the long run, at 19.1% and 19%, respectively. The Lithuanian long-term motherhood penalty in total income relative to both fathers and non-mothers is almost exactly the same as in Denmark (see Table (1)). Importantly, Lithuanian mothers experience the smallest penalty relative to the other comparison countries. The largest difference in penalties relative to fathers is with Germany, where mothers experience more than 3 times the income loss that persists over the long term than in Lithuania.

Figure 5

Event study estimates of first child's impact on total income



Note: Impact on different labor market outcomes is measured in the percentage share relative to the event time $t = -4$. The short-run, medium-run, and long-run penalties correspond to the documented motherhood penalties at 4, 20 and 40 quarters after birth, respectively. The motherhood penalty is calculated according to the equation (3).

Robustness. To assess the robustness of the results, I conduct event study estimations for total income under various settings, including different methods for removing time and age fixed effects, varied panel structures, and different baseline period.

Figure (B.4) shows the normalized event study estimates of the first child's impact on residu-

alized total income. I remove quarter and age fixed effects before conducting the event study either in the pooled full sample, which is restricted to the 18-50 age range only, or in the pooled estimation sample. The normalized estimates of total net income residualized in the full sample show the opposite trends for fathers and non-mothers compared to the baseline results, with nearly identical pre-trends for all: mothers, non-mothers, and fathers. Removing fixed effects in the pooled estimation sample results in figures which are more aligned with the main estimation, but with more consistent pre-trends as well. Short-run penalties calculated following the two robustness check methods closely align with the baseline results, although medium-run, long-run, and average penalties are lower in the main results.

In Panel (A) of Figure (B.5), the first child's effect on total income is estimated only for individuals (7,717 in total) observed in 61 quarters around the birth. The motherhood penalty relative to fathers remains very close to the baseline estimates in the medium and long run, with a slightly lower penalty in the short run in these settings. However, the motherhood penalty relative to non-mothers is lower across all time frames in the results produced using the strongly balanced panel. Panel (B) illustrates estimates using an estimation sample where missing observations between the first and last appearance in the data are recovered, with any type of income or benefits set to zero. The difference between calculated motherhood penalties relative to fathers and non-mothers in this and the main setup is minor.

Figure (B.6) demonstrates that using the 8th quarter before the birth as the reference period produces very similar results to the baseline estimation. In this setting, all estimated motherhood penalties are slightly lower due to marginal increases in total income for mothers at the event time $t = -4$ relative to $t = -8$. Despite differing sensitivity analysis results, the short-run, medium-run, and long-run motherhood penalties relative to fathers and non-mothers remain significant across almost all examined settings, except for the event study conducted for individuals observed over 61 quarters. In this setup, only the short-term mothers' penalty compared to fathers and non-mothers remains significant, and the medium-term penalty compared to fathers only. However, in this setting, the confidence bounds are very wide due to a small number of individuals.

Sources of the motherhood's penalty. To better understand the sources of the impact of parenthood on total income, I look at different dimensions of the employment relationship that may affect the dynamics. For example, mothers may lose more of their total income than fathers and imputed non-mothers because of the time they miss from work after the childbirth. Although mothers and fathers have the opportunity to take maternity and paternity leave while remaining registered with the employer, some may still choose to terminate their employment contracts. Therefore, I first examine the effect of the first child on the probability of being covered by employer insurance for mothers, fathers, and non-mothers.

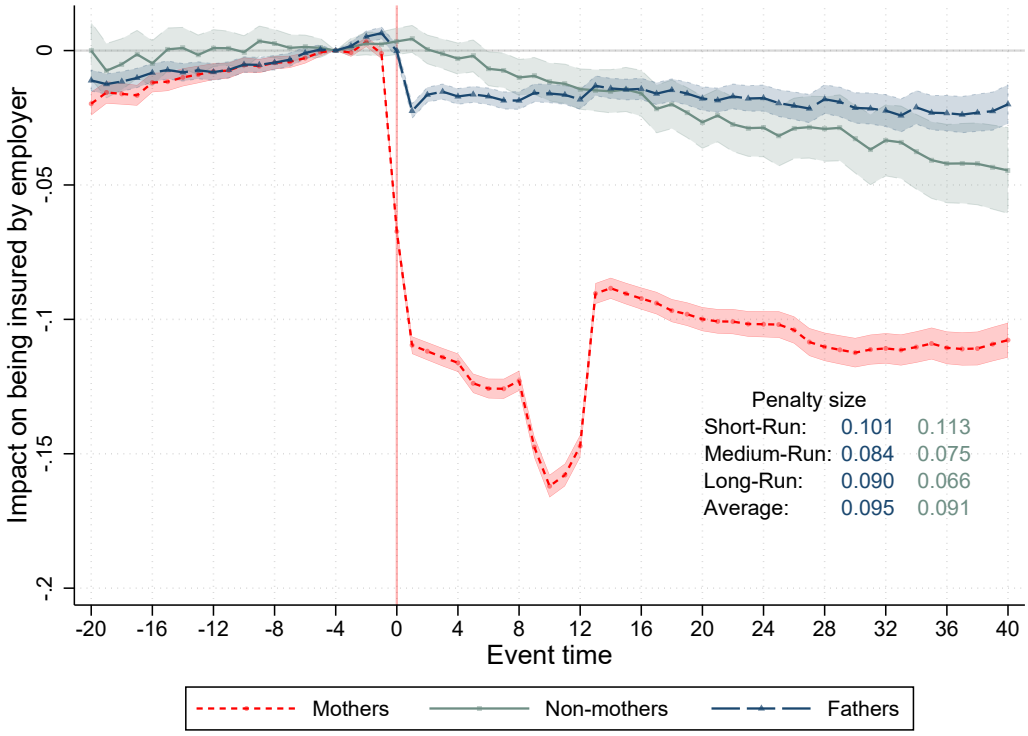
As maternity leave tends to secure the mother's pre-birth job, Figure (6) shows that the average motherhood penalties in the probability of being insured by the employer are low compared

to the penalties in total income. The average penalty is 9.5% relative to fathers and 9.1% relative to non-mothers. The probability of having an employment contract falls sharply for mothers from the 1 quarter before to the 1 quarter after the birth and remains steadily decreasing until the 4th quarter post-birth. The probability for fathers decreases considerably less than for mothers in the quarter following the birth, relative to the baseline period, and then stabilizes. As the result, in the short run, the motherhood penalty in the probability of being insured by the firm is 10.1% higher compared to fathers. After the simulated birth, this probability decreases steadily for non-mothers relative to the reference period. Thus, the short-run motherhood penalty relative to non-mothers is 11.3%. This indicates that although mothers are protected by the law to remain registered with their employer during their maternity leave, after the first childbirth some of them still decide to terminate the contract. One of the reasons for that could be mothers giving up jobs that require longer commuting, and switching to jobs that are closer to their home as suggested by Albanese et al. (2022).

Mothers become ineligible for childcare allowances 8 quarters after the child's arrival. Therefore, unless they are expecting a second child or taking another leave of absence that allows them to remain insured by the employer, employed shall return to work or terminate their contract. Hence, some individuals choose to leave the firm and that results in a larger decline in the probability that mothers have a work contract between the event time $t = 8$ and $t = 12$ (see Figure (6)). Around the event time $t = 13$ the probability that mothers are registered with employer rises slightly but remains fluctuating around the lower level than the baseline period. The resulting medium-run motherhood penalty on the probability of being insured by the employer is 8.4% relative to fathers, and 7.5% relative to non-mothers. The long-run penalty compared to fathers and non-mothers remains somewhat similar at 9% and 6.6%, respectively. These findings are consistent with the Casarico and Lattanzio (2023) study, which shows that mothers are more likely to move from employment to non-employment after childbirth and that this persists over the long term.

Figure 6

Event study estimates of first child's impact on the probability of being insured by an employer



Note: Impact on different labor market outcomes is measured in the percentage share relative to the event time $t = -4$. The short-run, medium-run, and long-run penalties correspond to the documented motherhood penalties at 4, 20 and 40 quarters after birth, respectively. The motherhood penalty is calculated according to the equation (3).

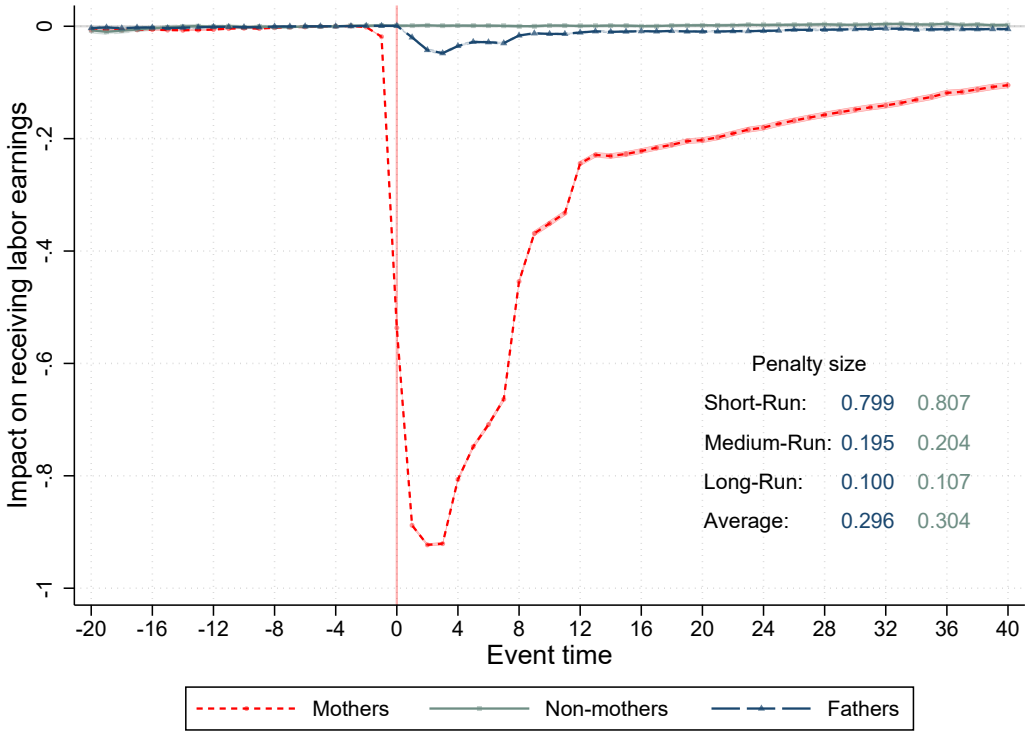
As parents on maternity/paternity leave or childcare leave may remain registered with the same employer as they were before the childbirth, the analysis of the probability of being insured by the employer does not capture the reduced participation of those who remain registered with the employer but do not receive any labor earnings. Figure (7) shows that the probability for mothers to receive labor earnings is considerably lower after the birth than before the birth. The average motherhood penalty is 29.6% in contrast to fathers and 30.4% relative to non-mothers. At time $t = 0$, more than half of the mothers who were receiving labor earnings during the baseline period stopped collecting them. The probability of mothers receiving labor earnings hits the lowest point relative to the reference point between event times $t = 1$ and $t = 4$. After the birth, there is a slight decline in the probability of fathers receiving labor earnings which immediately begins to converge to their probability in the reference period. Thus, shortly after the birth of their first child ($t = 4$), mothers experience a larger decline in the probability of receiving labor earnings than fathers, with a difference of about 79.9%.

As the figure for non-mothers remain unchanged, the decline in the short run is approximately 80.7% higher for mothers compared to non-mothers (Figure (7)). Later, the probability of mothers receiving labor earnings rises sharply and continues to grow steadily from event time $t = 13$ onward, reducing the motherhood penalty in the medium run to 19.5% relative to fathers and 20.4% relative

to non-mothers. However, the substantial reduction in the probability of mothers receiving earnings from work persists in the long run. They still have a higher negative impact on the probability to receive labor earnings of about 10% compared to fathers and about 10.7% compared to non-mothers 40 quarters after the birth.

Figure 7

Event study estimates of first child's impact on the probability of receiving labor earnings



Note: Labor earnings are only defined if person receives any earnings from work. Probability of receiving labor earnings is conditional on being insured by the employer. Impact on different labor market outcomes is measured in the percentage share relative to the event time $t = -4$. The short-run, medium-run, and long-run penalties correspond to the documented motherhood penalties at 4, 20 and 40 quarters after birth, respectively. The motherhood penalty is calculated according to the equation (3).

Importantly, some individuals who receive labor earnings in the quarter may still not work fully either because they go on a maternity/paternity or sickness leave, or because they become unemployed. Hence, I further analyze the event study estimates regarding the impact of the first child on the probability that a worker misses at least 3 days of work, proxied by receiving some welfare benefits, including sickness, unemployment, maternity/paternity benefits. Figure (8) shows that, on average, the motherhood penalty in terms of spending at least a few days away from work is -43.2% relative to fathers, and -95.6% relative to non-mothers. The negative motherhood penalty means that, relative to the reference period, the probability increases more for mothers than for fathers or non-mothers. While the effect for non-mothers remains flat over all periods, during the quarter of the childbirth the share of mothers and fathers taking a leave increases by around 50% and 25% respec-

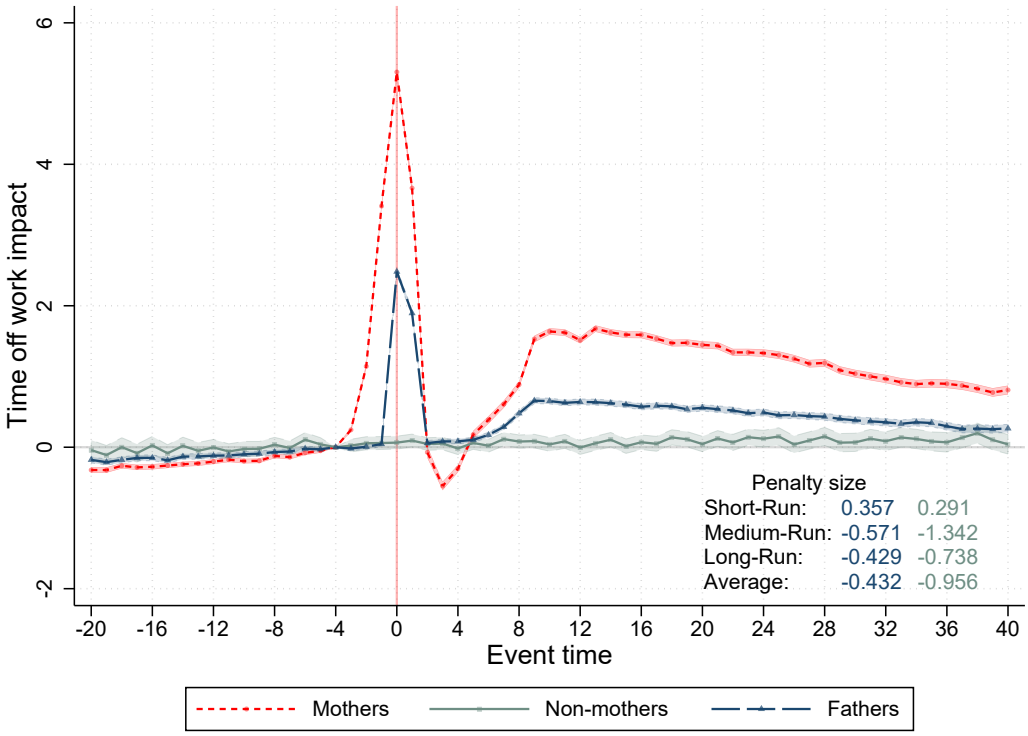
tively, compared to the event time $t = -4$. The timing of this sharp increase coincides with the timing of maternity/paternity leave, so the estimates during this period mostly reflect the receipt of this type of benefit (see Panel (C) in Figure (A.2)).

At the event time $t = 2$, the effect of the child relative to the baseline period for mothers and fathers converges to 0% (see Figure (8)). The figure for mothers continues to decrease until the 5th quarter after the birth, at which point working mothers are less likely to miss some days of work than they were 4 quarters before the arrival of their first child, while fathers become slightly more likely. This could be linked to the fact that mothers receive a higher amount of sickness benefits before the birth than during the periods after the birth up to the event time $t = 8$ (Figure (A.3)). In the short run, the decline in the probability of receiving social benefits and not working for at least 3 days is 35.7% greater for mothers than for fathers, and it is 29.1% greater for mothers than for non-mothers.

In comparison to the reference period, the probability that parents who receive labor earnings take at least 3 days' leave in a certain quarter rises again around the event time $t = 8$, more so for mothers (Figure (8)). There is change in dynamics: initially, fathers were more likely to take leave, resulting in a positive short-run motherhood penalty. However, over time, the probability of mothers taking leave becomes higher than that of non-mothers and surpasses that of fathers. Consequently, in the medium run, the motherhood penalty in the probability of missing some days of work is -57.1% relative to fathers, and -134.2% relative to non-mothers. The penalty remains even in the long run at -42.9% and -73.8% correspondingly. This suggests that, in addition to the amount of time a mother loses from work during pregnancy, a mother who receives labor earnings is still more likely than a father to be absent from work for at least a few days 40 quarters after the birth. These findings are consistent with the Angelov et al. (2020) results, indicating that after the arrival of the first child, mothers more than double their sickness leave accidents relative to fathers.

Figure 8

Event study estimates of first child's impact on the probability that a worker misses some days of work



Note: The probability that a worker misses some days of work is defined using a dummy variable that takes the value one if the person received any amount of sickness, maternity, paternity or other benefits, indicating that the person was on involuntary leave for at least a few days during the quarter. Also, impact on different labor market outcomes is measured in the percentage share relative to the event time $t = -4$. The short-run, medium-run, and long-run penalties correspond to the documented motherhood penalties at 4, 20 and 40 quarters after birth, respectively. The motherhood penalty is calculated according to the equation (3).

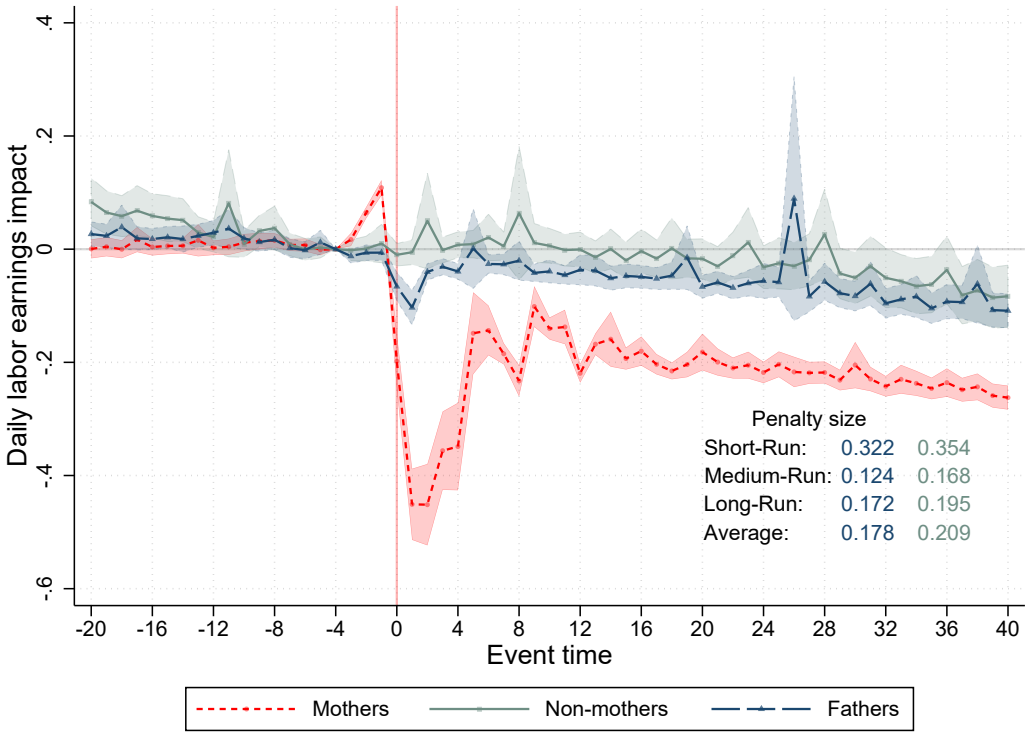
I continue the analysis by examining whether the motherhood penalty also exists among individuals who are registered with an employer, receive labor earnings, and do not miss more than 2 days of work. This group of people allows me to shed light on whether there is also an adjustment on the wage rate that mothers receive for the same amount of work time (as measured in days) relative to fathers and non-mothers. Figure (9) illustrates that in this sub-set of individuals, on average, mothers' daily labor earnings are reduced by 17.8% more than fathers' and by 20.9% more than non-mothers' compared to the baseline period. It is important to note that the figure captures the increase in the labor income for mothers 1 quarter prior to the arrival of the first child that is also visible in the Figure (5). Together with Figure (6) and Figure (7), this suggests that the jump is not due to an increase in the probability of being insured by an employer, an increase in the probability of receiving earnings from work, or an increase in the number of days actively working, but to some other factors. For example, an increase in their daily labor earnings because of a higher number of hours worked, a pay rise, or a switch to a higher paid job.

The daily labor earnings for mothers decreases from the reference period and stays at the lowest point during the after-birth period between the 1st and 2nd quarter (Figure (9)). From the event time $t = 2$, the earnings of mothers start growing. Since in the short run fathers only experience a drop at the event time $t = 1$ of about 10%, from which they recover immediately, and non-mothers do not experience any considerable changes compared to the event time $t = -4$, the short-run motherhood penalty in daily labor earnings is 32.2% compared to fathers, and 35.4% compared to non-mothers.

The daily labor earnings of fathers and non-mothers slowly decline over time (see Figure (9)). Around 5 quarters after the birth, mothers' daily labor earnings get closer to their baseline level, and the figure begins to decline steadily as well. Hence, the motherhood penalty does not diminish over time: in the medium run it is 12.4% compared to fathers and 16.8% compared to non-mothers. In the long run, it increases to 17.2% and 19.5% respectively. The greater reduction in daily earnings for mothers, relative to the reference period, suggests that they are paid less for a day's work than men with children and non-mothers. This could imply that they start working part-time, as de Quinto et al. (2021) proved this hypothesis to hold in Spain. Alternatively, they might switch to lower-paid jobs, as demonstrated by Albanese et al. (2022). The persisting difference means that some mothers remain in these jobs even 40 quarters after the arrival of their first child.

Figure 9

Event study estimates of first child's impact on the daily labor earnings of those who do not miss any day of work



Note: Labor earnings are only defined if person receives any earnings from work. Also, daily labor earnings are only defined for individuals with no more than 2 days' absence from work in a given quarter. Additionally, impact on different labor market outcomes is measured in the percentage share relative to the event time $t = -4$. The short-run, medium-run, and long-run penalties correspond to the documented motherhood penalties at 4, 20 and 40 quarters after birth, respectively. The motherhood penalty is calculated according to the equation (3).

CONCLUSIONS

Family formation has been documented to be a key driver of the persistent gender pay gaps. This thesis looks at the so-called motherhood penalty in the Lithuanian context. Specifically, using the Social Security data for 2000-2020, I estimate the impact of the arrival of the first child on the total income and other aspects of the employment relationship for mothers relative to fathers and non-mothers.

My analysis indicates that mothers lose almost 50% of their total income in the short run due to the first birth compared to fathers and non-mothers. The reduction remains at about 19% in the long run. In addition, I show that mothers are less likely than fathers and non-mothers to be insured by their employer after the arrival of their first child. Similarly, even those mothers who remain registered with the employer after childbirth become much less likely to receive any labor earnings. My results also point to the fact that mothers spend more time out of work, and are more likely to miss additional days even when they do return to work. Finally, my results show that the penalty in total income also emerges from the substantial decline in daily labor earnings for mothers who are actively working for almost the entire quarter.

This thesis adds to the Kleven et al. (2023) finding that the motherhood penalty in employment accounts for the remaining gender gap in Lithuania and highlights the impact of the arrival of the first child on various labor market outcomes for mothers. The results hint that in order to reduce gender inequality in the labor market, workplaces should implement more family-friendly policies. Such policies could prevent first-time mothers from terminating their employment contracts or switching to part-time or lower-paid jobs after birth. Additionally, to promote a more equal division of family responsibilities and reduce the time mothers spend away from work, policies encouraging father involvement in childcare, such as more flexible paternity leave conditions and higher benefits for fathers, are also important.

Future research. There are a number of things that could be implemented to enhance upon the current analysis or for follow up work. For instance, an insight into whether after the arrival of their first child mothers experience more health problems, take sickness leave more often, or become unemployed to take care of their child. Additionally, an analysis of whether the marriage or subsequent births affect the mother's career as much as the first birth. Importantly, as Lithuanian law provides one of the most generous childcare leave policies among OECD countries, an examination of how the childcare leave length affects the labor market outcomes would be interesting.

Methodologically, the analysis could also be improved in two key dimensions. On the one hand, the method for imputing the 'placebo' births to non-mothers could be augmented, so that the simulated and actual fertility rates and distribution of age at the first childbirth align better. On the other hand, the heterogeneous Difference-in-Differences approach proposed by Callaway and

Sant'Anna (2021) to estimate the motherhood penalty could be used in future research to obtain results that are robust to heterogeneous effects. Melentyeva and Riedel (2023) argue that the event study approach which was specified by Kleven et al. (2019b) and is used to estimate the child penalty for individuals of all age at once, produce biased results.

REFERENCES

Abowd, J. M., Kramarz, F., and Margolis, D. N. (1999). High wage workers and high wage firms. *Econometrica*, 67(2):251–333.

Adda, J., Dustmann, C., and Stevens, K. (2017). The career costs of children. *Journal of Political Economy*, 125(2):293–337.

Albanese, A., Nieto Castro, A., and Tatsiramos, K. (2022). Job location decisions and the effect of children on the employment gender gap.

Albanesi, S., Olivetti, C., and Petrongolo, B. (2023). Families, labor markets, and policy. In *Handbook of the Economics of the Family*, volume 1, pages 255–326. Elsevier.

Andresen, M. E. and Nix, E. (2022). What causes the child penalty? evidence from adopting and same-sex couples. *Journal of Labor Economics*, 40(4):971–1004.

Angelov, N., Johansson, P., and Lindahl, E. (2020). Sick of family responsibilities? *Empirical Economics*, 58(2):777–814.

Averett, S., Hoffman, S. D., et al. (2018). *The Oxford handbook of women and the economy*. Oxford University Press.

Bobbitt-Zeher, D. (2007). The gender income gap and the role of education. *Sociology of Education*, 80(1):1–22.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Casarico, A. and Lattanzio, S. (2023). Behind the child penalty: understanding what contributes to the labour market costs of motherhood. *Journal of Population Economics*, pages 1–23.

Černiauskas, N. (2023). The short run effects of childbirth on parents' earnings in the baltics. *Baltic Journal of Economics*, 23(1):45–63.

Cortés, P. and Pan, J. (2023). Children and the remaining gender gaps in the labor market. *Journal of Economic Literature*, 61(4):1359–1409.

de Quinto, A., Hospido, L., and Sanz, C. (2021). The child penalty: evidence from Spain. *SERIEs*, 12:585–606.

Fontenay, S., Murphy, T., and Tojerow, I. (2023). Child penalties across industries: why job characteristics matter. *Applied Economics Letters*, 30(4):488–495.

Fontenay, S. and Tojerow, I. (2020). Work disability after motherhood and how paternity leave can help.

Goldin, C. (2014). A grand gender convergence: Its last chapter. *American economic review*, 104(4):1091–1119.

Goldin, C., Katz, L. F., and Kuziemko, I. (2006). The homecoming of american college women: The reversal of the college gender gap. *Journal of Economic Perspectives*, 20(4):133–156.

Goldin, C., Kerr, S. P., and Olivetti, C. (2022). When the kids grow up: Women's employment and earnings across the family cycle. Technical report, National Bureau of Economic Research.

Halla, M., Ahammer, A., Glogowsky, U., and Hener, T. (2024). The parenthood penalty in mental health: Evidence from austria and denmark. Technical report, WU Vienna University of Economics and Business.

Kleven, H., Landais, C., and Leite-Mariante, G. (2023). The child penalty atlas. Technical report, National Bureau of Economic Research.

Kleven, H., Landais, C., Posch, J., Steinhauer, A., and Zweimüller, J. (2019a). Child penalties across countries: Evidence and explanations. In *AEA Papers and Proceedings*, volume 109, pages 122–126. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Kleven, H., Landais, C., and Søgaard, J. E. (2019b). Children and gender inequality: Evidence from denmark. *American Economic Journal: Applied Economics*, 11(4):181–209.

McCall, L. (2000). Gender and the new inequality: Explaining the college/non-college wage gap. *American Sociological Review*, 65(2):234–255.

Melentyeva, V. and Riedel, L. (2023). Child penalty estimation and mothers' age at first birth. Technical report, ECONtribute Discussion Paper.

Moberg, Y. (2016). Does the gender composition in couples matter for the division of labor after childbirth? Technical report, Working Paper.

Reskin, B. F. and Hartmann, H. I. (1986). *Women's Work, Men's Work. Sex Segregation on the Job.* ERIC.

Rosenbaum, P. (2019). The family earnings gap revisited: A household or a labor market problem? *Available at SSRN 3314102*.

Sieppi, A. and Pehkonen, J. (2019). Parenthood and gender inequality: Population-based evidence on the child penalty in Finland. *Economics Letters*, 182:5–9.

THE LABOR MARKET CONSEQUENCES OF MOTHERHOOD IN LITHUANIA: EVIDENCE FROM SOCIAL SECURITY DATA

SOFIJA VOLUNGEVIČIŪTĖ

Bachelor thesis

Quantitative Economics

Faculty of Economics and Business Administration of Vilnius University

Supervisor - Dr. Jose Garcia-Louzao Perez

Vilnius, June 25, 2024

SUMMARY

This thesis investigates the motherhood penalty in Lithuania. The main goal is to quantify the short- and long-term consequences of motherhood from the beginning of pregnancy by looking at total income received by mothers relative to fathers and non-mothers. In addition, I focus on trying to better understand the underlying sources of the motherhood impact on total income by looking at job retention, receipt of labor income, sickness and unemployment incidence, and wage adjustments.

To implement my analysis, I exploit detailed Social Security data in quarterly frequency covering the period between 2000 and 2020. Using this dataset, I follow the seminal work of Kleven et al. (2019b) and implement a generalized event study method. The approach involves estimating how a specific labor market outcome of mothers evolves around childbirth. To quantify the consequences of motherhood, I then compare the estimates for mothers with those of fathers as well as non-mothers.

My results indicate that in the short-run Lithuanian mothers lose roughly 50% of their total income relative to fathers and non-mothers. The estimated penalty shrinks over time but it remains at 19% in the long-run, or 10 years after childbirth. Moreover, I show that the costs of motherhood emerge through different channels. For instance, mothers are more likely to terminate their employment contract after childbirth and remain without a job time after. Importantly, even when they are employed for most of the quarter, they are still more likely, relative to fathers and non-mothers, to miss some days of work either because they are more likely to collect sickness benefits or to spend some time unemployed. Finally, my results indicate that even mothers who do not spend any official day out of work still experience a decline in daily wage rates after childbirth relative to fathers and non-mothers.

My analysis reveals that while the magnitude of the long-term child penalty in Lithuania is not among the highest documented in the literature, it is substantial and persistent over time. The unequal impact

of parenthood on labor market outcomes for mothers relative to fathers and women who decided not to have children calls for policy action. For instance, policies that promote family-friendly workplaces, as well as improved paternity leave conditions that encourage fathers to be more involved in childcare, have the potential to reduce the negative consequences of motherhood.

MOTINYSTĖS PASEKMĖS LIETUVOS DARBO RINKOJE: SOCIALINIO DRAUDIMO DUOMENŲ RODIKLIAI

SOFIJA VOLUNGEVIČIŪTĖ

Bakalauro darbas

Kiekybinė ekonomika

Vilniaus universitetas, ekonomikos ir verslo administravimo fakultetas

Vadovas - Dr. Jose Garcia-Louzao Perez

Vilnius, June 25, 2024

SANTRAUKA

Šiame darbe tiriamas vadinamasis „motinystės nuobaudos" (angl. motherhood penalty) reiškinys Lietuvoje. Pagrindinis tikslas – kiekybiškai įvertinti trumpalaikes ir ilgalaikes motinystės pasekmes moterų bendrosioms pajamoms nuo nėštumo pradžios, lyginant jas su vaikų tėvų ir moterų, neturinčių vaikų, pajamomis. Tyrimo metu taip pat siekiama geriau suprasti pagrindinius veiksnius, lemiančius neigiamą motinystės įtaką bendrosioms pajamoms. Šiuo tikslu analizuojami tokie rodikliai kaip darbo vietos išsaugojimas, darbo užmokesčio gavimas, ligos ir nedarbingumo atvejų dažnumas bei darbo užmokesčio pokyčiai.

Analizei atlikti naudojami išsamūs 2000-2020 m. ketvirtiniai socialinės apsaugos duomenys. Remiantis šiais duomenimis, taikomas Kleven et al. (2019b) apibendrintas įvykių analizės (angl. event study) metodas, kuris padeda įvertinti motinų darbo rinkos rezultatų pokyčius prieš ir po vaiko gimimo. Siekiant kiekybiškai įvertinti motinystės pasekmes, motinų rezultatai lyginami su tėvų ir moterų be vaikų rezultatais.

Tyrimo rezultatai rodo, kad trumpalaikėje perspektyvoje moterys, palyginti su vaikų tėvais ir moterimis, neturinčiomis vaikų, praranda apie 50% savo bazinių bendrųjų pajamų po pirmojo vaiko gimimo. Praėjus 10 metų po vaiko gimimo, šis pokytis, nors ir sumažėja, išlieka apie 19%. Neigiamos motinystės pasekmės kyla dėl kelių priežasčių. Pavyzdžiui, po gimdymo motinos dažniau nustoja dirbti ir tam tikrą laiką negauna darbo užmokesčio. Be to, net ir gaudamos darbo užmokestį, jos dažniau nedirba dėl ligos ar laikino nedarbingumo. Galiausiai, lyginant su vaikų tėvais ir moterimis be vaikų, net ir tos motinos, kurios neima laisvų dienų nuo darbo, po pirmojo vaiko gimimo patiria dienos uždarbio sumažėjimą.

Apibendrinant, nors Lietuva nepriklauso šalims, kuriose motinystė daro didžiausią neigiamą poveikį

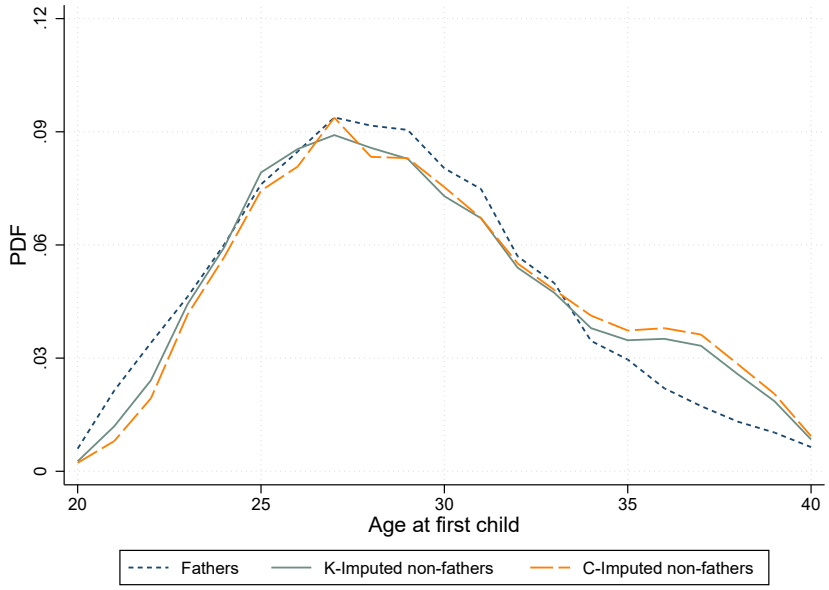
darbo rinkoje, po pirmojo vaiko gimimo moterys vis tiek praranda reikšmingą dalį savo pajamų. Lyčių nelygybė darbo rinkoje išlieka, ir siekiant ją sumažinti, rekomenduojama taikyti keletą politinių priemonių, tokių kaip šeimai palanki politika darbo vietoje ir geresnės tėvystės atostogų sąlygos vyrams.

ANNEXES

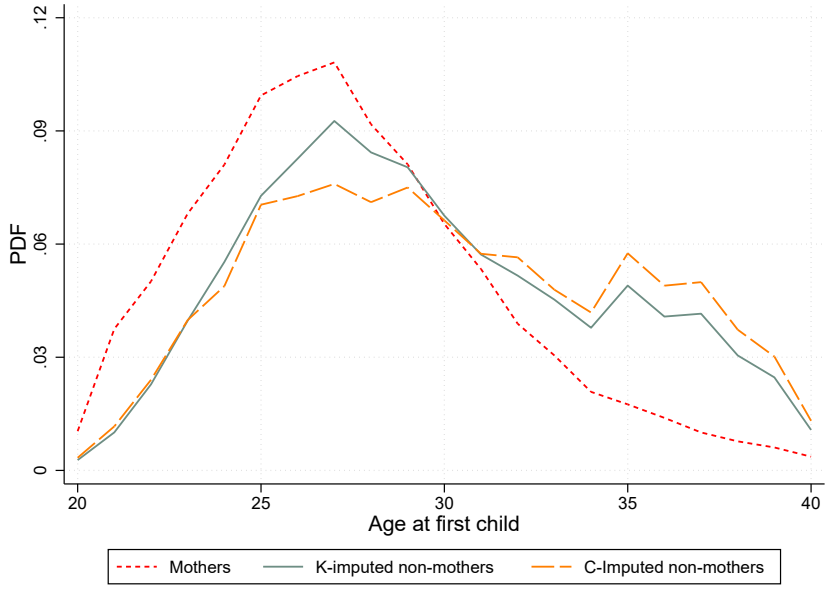
A. SUPPLEMENTARY FIGURES AND TABLES

Figure A.1
Age at first birth in the estimation sample: actual vs imputed

(A) *Men*



(B) *Women*

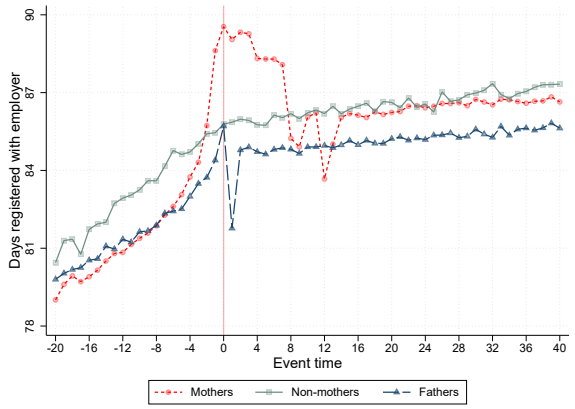


Note: Figures illustrate the distribution of the actual and simulated age at the arrival of the first child in the final analysis sample, which is summarized in Table 2.

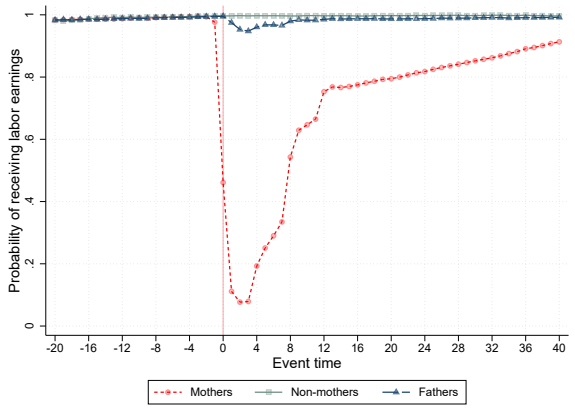
Figure A.2

Levels of different labor market outcomes for mothers, non-mothers, and fathers around the arrival of the first child

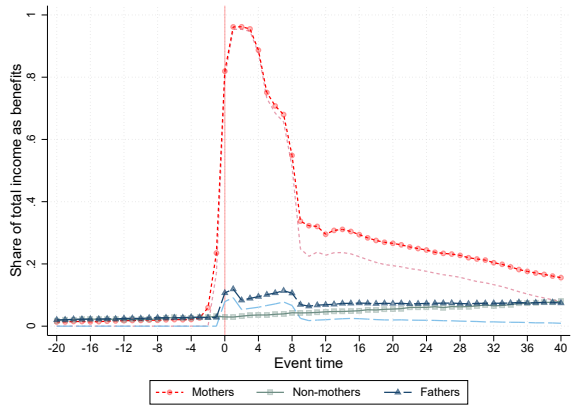
(A) *Days registered with employer*



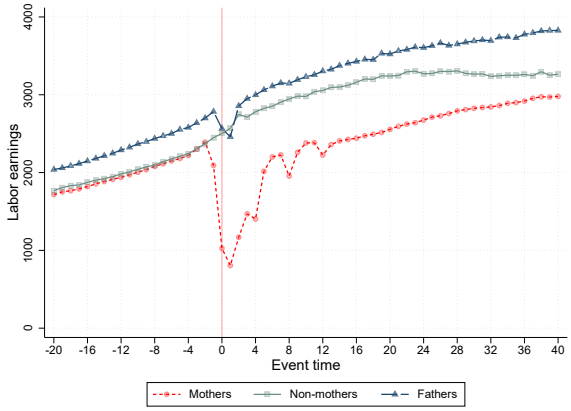
(B) *Probability of receiving labor earnings*



(C) *Share of total income that is welfare benefits*



(D) *Labor earnings*

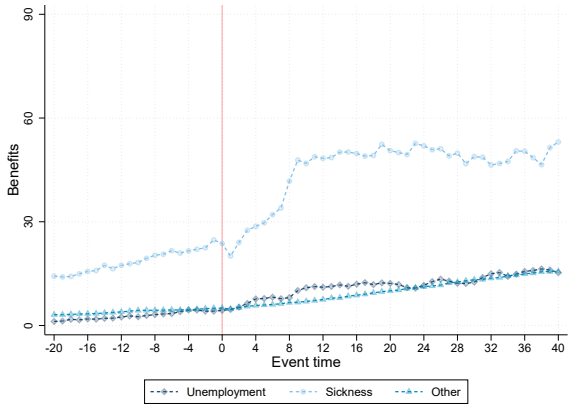


Note: The positive days registered with employment are those days spent under the employment contract in a given quarter, if such duration is not equal to zero. Then, the probability of receiving labor earnings in panel (B) is conditional on being registered with employer. Also, in panel (C) the share of total income that is child-related benefits for mothers and fathers are shown by the dashed red and blue lines respectively. Lastly, labor earnings are defined as the positive insured income received from work.

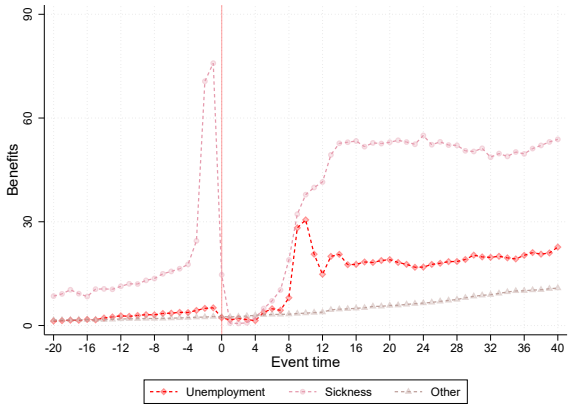
Figure A.3

Unemployment, sickness, and other benefits collected around the arrival or the first child

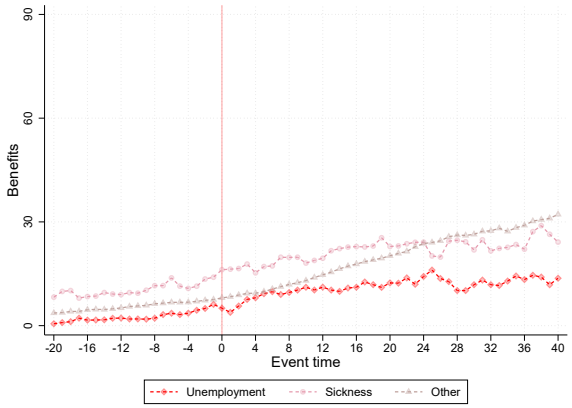
(A) *Fathers*



(B) *Mothers*



(C) *Non-mothers*



Note: Other benefits include incapacity benefits and other benefits; the latter are not defined in the data.

Table A.1

Summary statistics of the estimation sample around their first childbirth

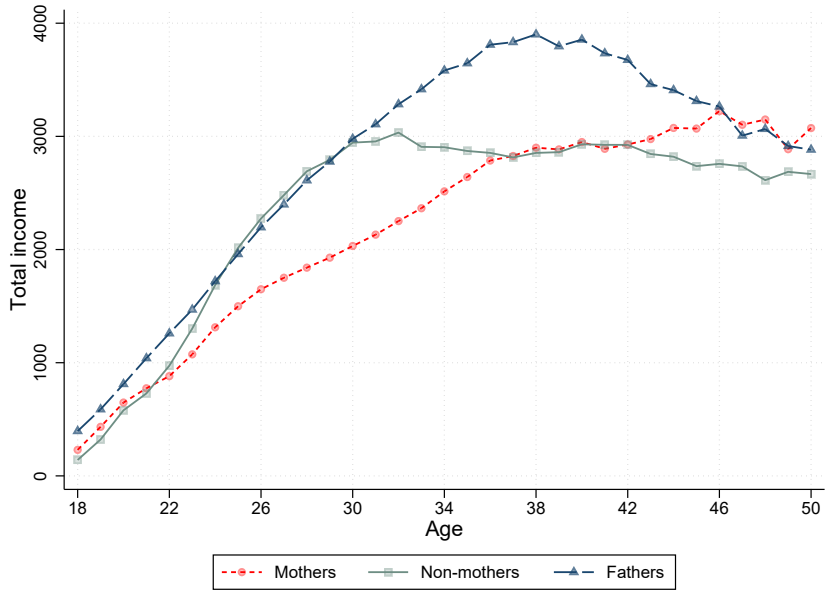
	Fathers				Mothers				Non-mothers			
	Before childbirth		During and after childbirth		Before childbirth		During and after childbirth		Before childbirth		During and after childbirth	
Married	0.59		0.77		0.60		0.76		0.11		0.14	
Number of children	0.00	(0.00)	1.57	(0.65)	0.00	(0.00)	1.58	(0.62)	0.00	(0.00)	0.00	(0.00)
Working in bigger cities	0.69		0.71		0.72		0.76		0.77		0.80	
Days registered with employer	74.02	(20.27)	75.93	(21.33)	74.72	(19.47)	73.28	(25.38)	76.41	(20.42)	78.97	(19.19)
Days with positive earnings	78.52	(13.91)	82.45	(11.49)	79.31	(13.02)	81.58	(13.58)	80.86	(13.34)	84.27	(9.68)
Total income	1967.73	(1998.89)	3130.60	(3234.56)	1696.70	(1469.06)	1823.21	(1680.42)	1767.62	(1563.00)	2978.71	(2783.98)
Labor earnings	2049.02	(1989.54)	3157.90	(3159.19)	1746.22	(1446.42)	2141.53	(1883.07)	1848.13	(1550.99)	3081.23	(2780.47)
Unemployment benefits	2.83	(15.03)	14.44	(49.33)	2.74	(13.77)	18.31	(46.12)	2.60	(14.35)	15.70	(55.11)
Sickness benefits	16.84	(39.11)	44.26	(73.00)	19.89	(36.67)	33.14	(50.42)	9.14	(26.07)	21.28	(39.92)
Other benefits	3.40	(36.79)	7.88	(60.11)	1.62	(24.42)	4.76	(44.90)	5.11	(40.23)	14.80	(80.34)
Child-related benefits	0.00	(0.00)	126.07	(254.66)	20.11	(39.15)	562.56	(606.13)	0.00	(0.00)	0.00	(0.00)
no. of individuals	45424		45424		48651		48651		9122		9122	

Note: Variables representing the labor market outcomes (such as days, earnings, or benefits) are the mean value of all individuals average amounts per one quarter before the actual/imputed birth, and during or after the actual/imputed birth.

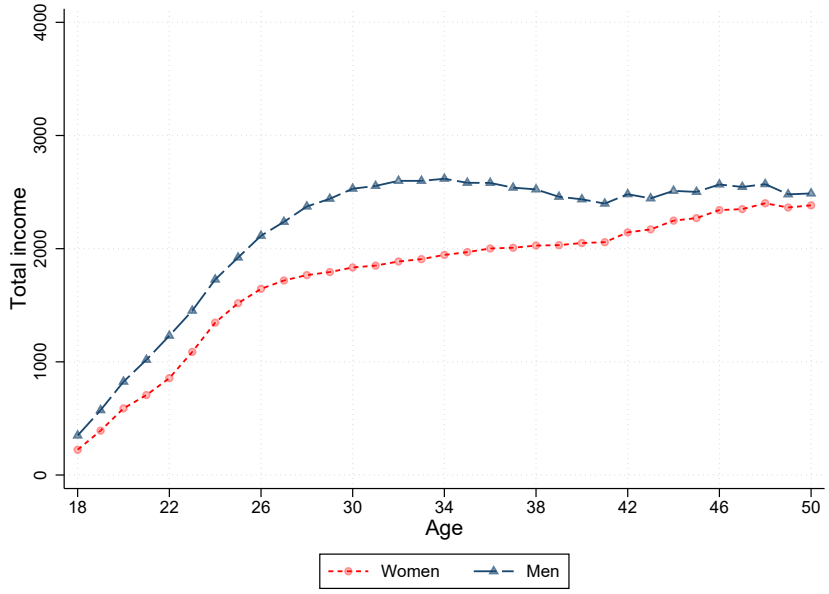
B. ROBUSTNESS CHECKS

Figure B.1
Total income levels by age

(A) *Estimation sample*



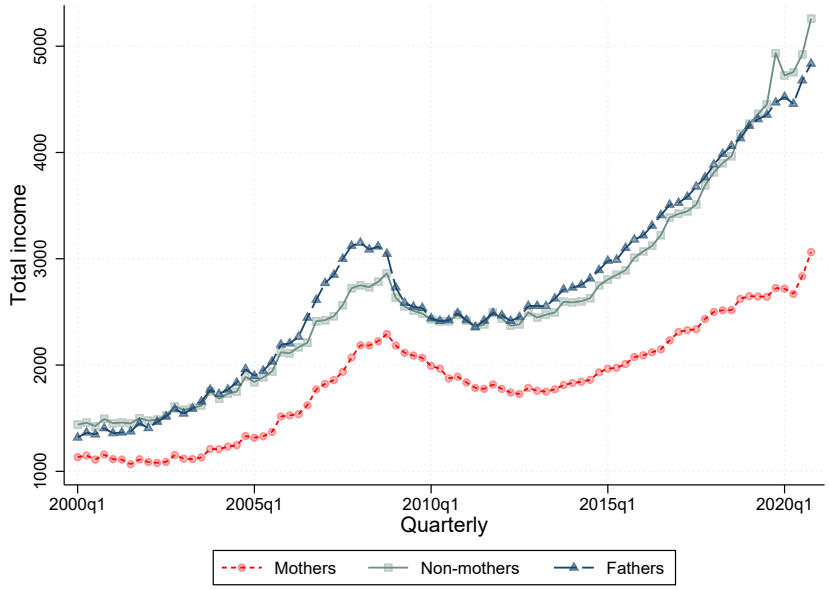
(B) *Full sample*



Note: In the full sample, individuals are restricted only to the 18-50 age range.

Figure B.2
Total income levels by calendar time

(A) *Estimation sample*

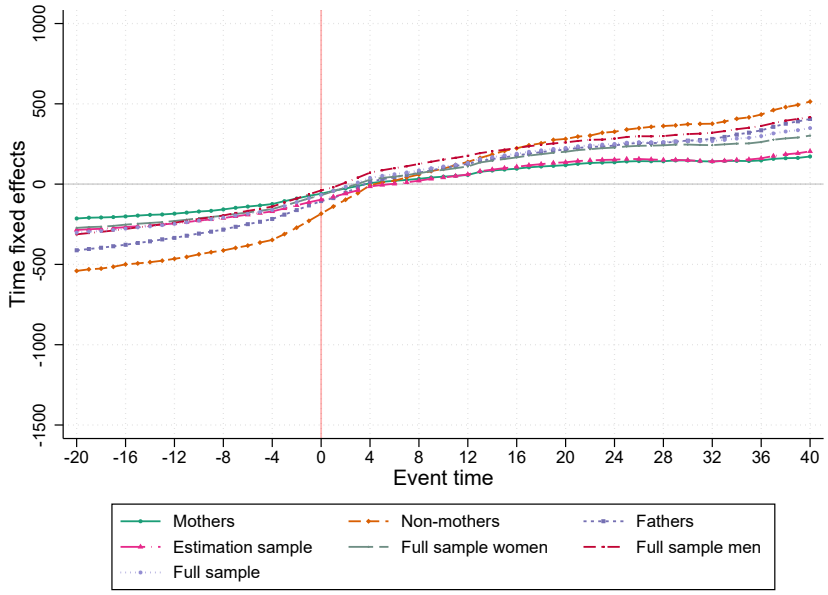


(B) *Full sample*

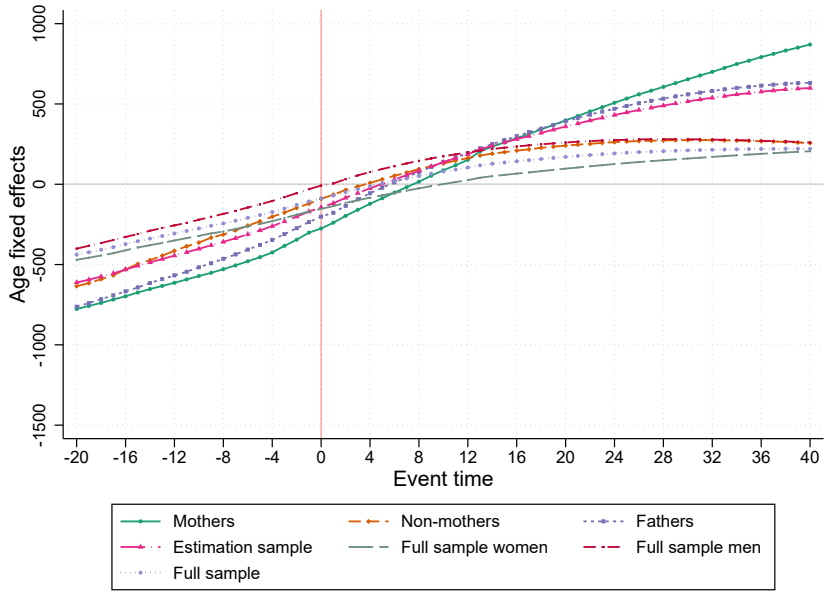
Note: In the full sample, individuals are restricted only to the 18-50 age range.

Figure B.3
Quarter and age fixed effects

(A) *Quarter*



(B) *Age*

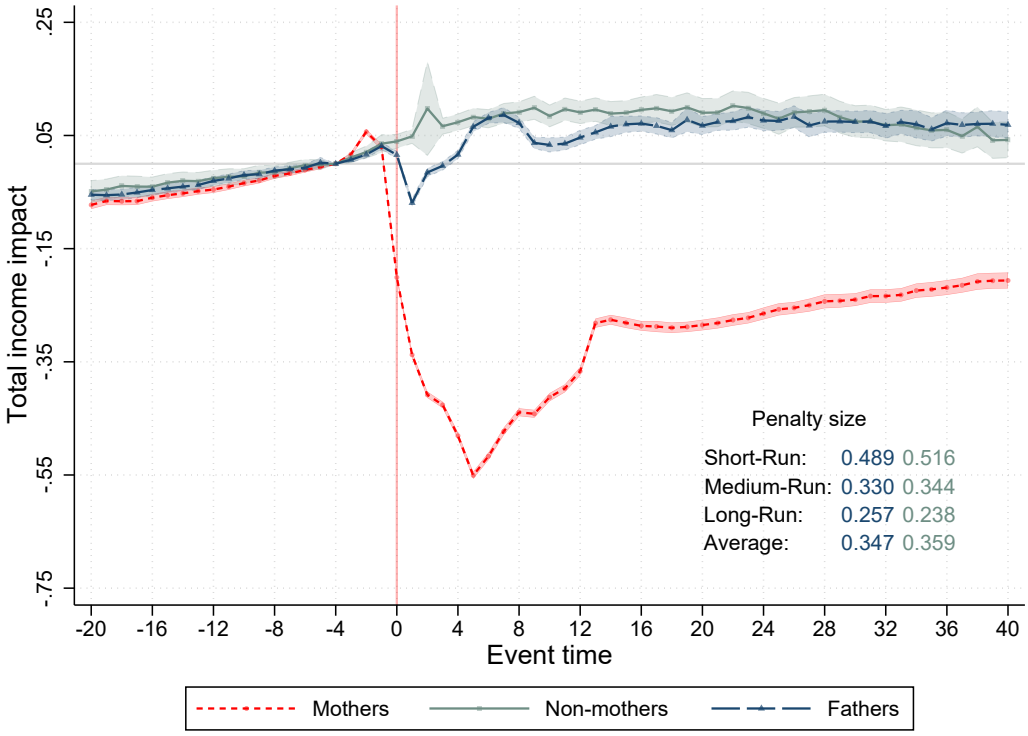


Note: The figures illustrate quarter and age fixed effects obtained by regressing the total income on the set of quarter and age dummies in different samples. 'Mothers', 'Non-mothers', and 'Fathers' figures represent time and age fixed effects extracted from the regression equation estimated separately for all three groups in the estimation sample. 'Estimation sample' line illustrates the fixed effects saved from the regression ran pooling mothers, non-mothers, and fathers together. Then, the full sample fixed effects figures by gender illustrate the values obtained separately for women and men in the full sample (restricted only to the 18-50 age range), whereas the 'Full sample' line show fixed effects estimated pooling the full sample altogether (restricted only to the 18-50 age range).

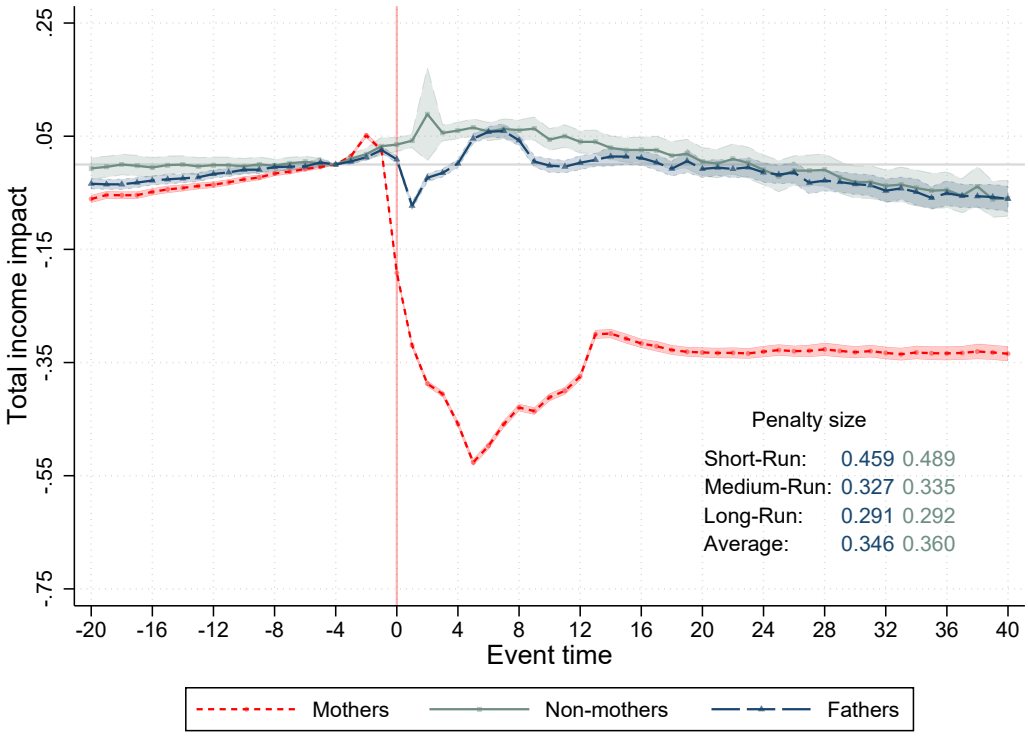
Figure B.4

Event study estimates of first child's impact on residualized total income

(A) *Age and quarter fixed effects are removed in the pooled full sample*



(B) *Age and quarter fixed effects are removed in the pooled estimation sample*

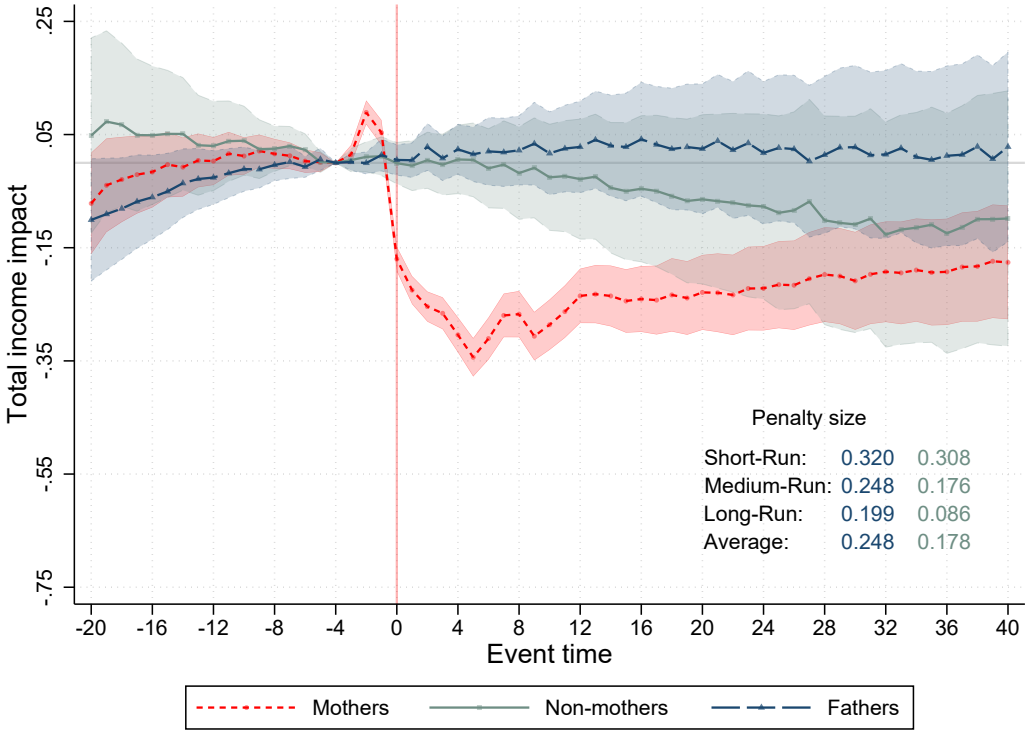


Note: The full sample, in which age and quarter fixed effects are omitted from total income variable in panel (A), is restricted only to the 18-50 age range.

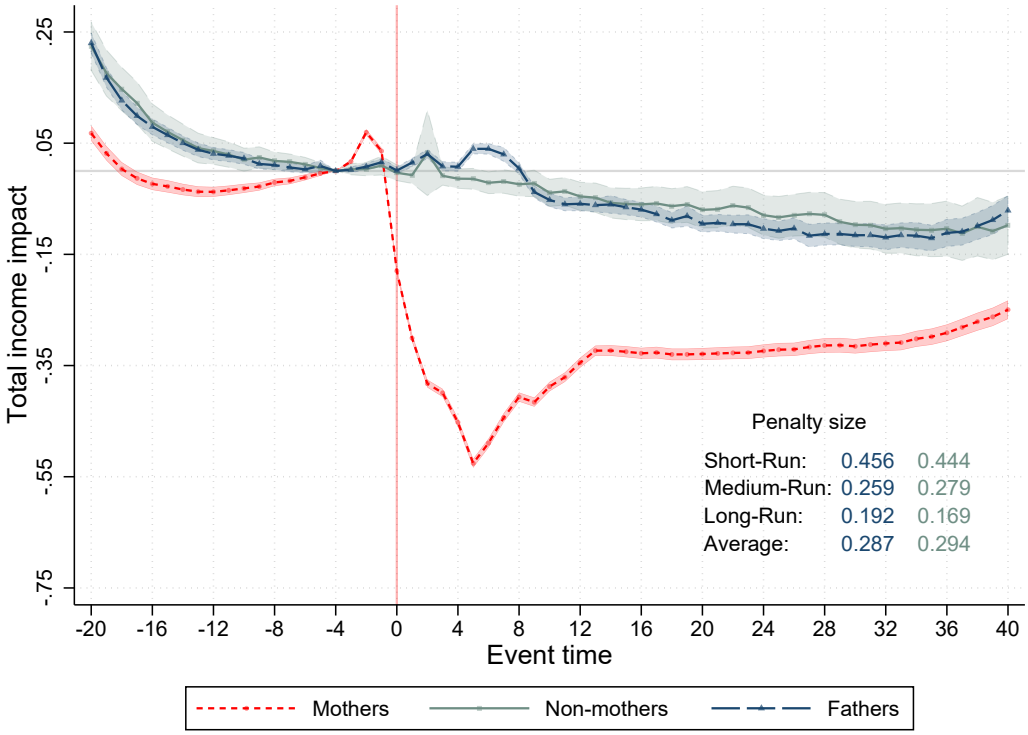
Figure B.5

Event study estimates of first child's impact on total income across differently structured panels

(A) *Individuals are observed over 61 quarter*



(B) *A zero value is assigned to missing observations before the first and last real observed value*



Note: In the panel (A) estimation sample only consists of individuals observed over 61 quarters. In panel (B), if an estimation sample individual has missing observations after first and before last appearance in the data, these observations are recovered by assigning zeros to their labor market values.

Figure B.6

Event study estimates of first child's impact on total income where $t = -8$ is the reference period