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ABSTRACT

The Motherhood Penalty: Gender Norms, Occupational Sorting, and Labor Supply

In this paper, we examine how pre-birth gender norms shape women's labor market trajectories and occupational choices around motherhood in the United Kingdom. Using data from the British Household Panel Survey, we first quantify the impact of gender norms on earnings and labor supply post-childbirth. Our results show that traditional mothers experience a 18-percentage-point (*pp*) higher motherhood penalty in earnings and a 20-*pp* higher motherhood penalty in hours worked compared to egalitarian mothers. Second, we investigate the role of pre-birth comparative advantage within couples, finding that this mechanism applies only to egalitarian parents. Third, we examine the interaction between occupational characteristics, including their degree of family-friendliness, and pre-birth gender norms. We find that accounting for occupational sorting significantly reduces the average earnings penalty for both traditional and egalitarian mothers, driven entirely by hours worked for traditional mothers. In addition, we show that occupational sorting explains 80% of the short-run earnings penalty gap between traditional and egalitarian mothers and eliminates the difference in hours worked penalties entirely. Thus, traditional women seem to sort pre-birth into occupations that facilitate a larger reduction in hours worked post-motherhood, which in turn have a substantial impact on their earnings trajectory.

JEL Classification: J160, J220, J240

Keywords: gender norms, occupational sorting, motherhood penalty

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1 Introduction

Juggling motherhood and career poses a significant challenge for women. Although women have caught up and surpassed men in human capital accumulation, there is still a persistent and large gender gap in the labor market mostly concentrated among parents, and opening up after the birth of the first child (Cortés and Pan, 2023). This well-documented phenomenon, commonly known as the "child penalty" or the "motherhood penalty", contributes to the persistence of gender inequalities throughout the life course. Yet, the mechanisms contributing to the varying magnitudes of the motherhood penalty — both across and within countries — remain inconclusive, whether attributed to factors such as the policy environment (*e.g.*, Kleven, Landais, and Søgaard, 2021; Lassen, 2021; Rabaté and Rellstab, 2022; Andresen and Nix, 2022; Kleven et al., 2024), or family income maximization (Costa Dias et al., 2021).[1] An emerging result is that the motherhood penalty endures despite the implementation of generous family policies (Kleven et al., 2024). Gender norms are one possible explanation for this persistence, as beliefs that shape behavioral expectations among women and men (Seguino, 2007; Cortés and Pan, 2023). Traditional gender norms often suggest perceptions of women as better suited for domestic duties and child rearing. This influence may manifest itself in two key ways in the labor market: first, by prompting women to reduce their involvement in the labor market post-motherhood, and second, by guiding women's occupational choices to align with these norms and beliefs. These two implications guide our research questions.

In this paper, we study how pre-birth gender norms shape women's labor market trajectories and occupational choices around motherhood using the British Household Panel Survey (BHPS) — a representative panel of the UK's population spanning over 18 years (1991-2009). We measure gender norms through a composite score derived from six questions about a woman's role at home capturing the interplay between work, parenthood, and family life. We then use an event study methodology proposed by Kleven et al. (2019) to examine four main findings about motherhood labor market penalties: (i) how pre-birth norms drive the magnitude of the motherhood penalty in earnings, hours worked and wages; (ii) explore alternative drivers of penalties through relative comparative advantages in productivity differentials within couples, and across pre-birth gender norms; (iii) examine the role of occupational disparities in explaining motherhood penalties, and their link with gender norms; and (iv) analyze the dynamics of gender norms and occupational mobility around the first childbirth.

We start by examining labor market responses after the first childbirth of men and women.[2] Our first main result shows that pre-birth gender norms are important for the magnitude of the motherhood penalty in earnings and hours worked. Indeed, traditional women experi-

[1] Also see Kleven, Landais, and Leite-Mariante (2023) for a review of the child penalty across countries.

[2] While Kleven et al. (2019) also employ BHPS for their analysis on the United Kingdom, our analytical sample slightly differs because we condition on parents working at least once pre-birth (*i.e.*, reporting at least one year of positive labor earnings) in order to characterize their pre-birth occupational characteristics.

ence a significant 18-percentage-point (*pp*) higher reduction in earnings, and a 20-*pp* larger decrease in the number of hours worked — compared to their more egalitarian counterparts.[3] In the recent literature, Boelmann, Raute, and Schonberg (forthcoming) find that exposure to peer women with more egalitarian norms increased post-birth labor supply among West German women, and Moriconi and Rodríguez-Planas (2021) show that gender norms significantly influence women's employment across various European Union countries. Furthermore, Mensinger and Zimpelmann (2024) model norms as scaling women's elasticity of labor supply, and predicting their post-birth employment penalties. Thus, our first result contributes to this recent evidence base supporting a conclusion that gender norms have enduring effects on women's career trajectories, notably around motherhood.

We then move further and investigate alternative drivers of penalties through relative labor market comparative advantages within couples, and their heterogeneity across gender norms. Neoclassical models (*e.g.*, Becker, 1985) suggest that families maximize household earnings, and therefore prioritize the market work of the parent with the greater comparative advantage.[4] We find that the size of the earnings penalty increases for women whose partner has a comparative advantage in the labor market before the first childbirth, especially when the difference in comparative advantage within couples is large. This pattern, however, is distinctly different across pre-birth gender norms, and women with more egalitarian norms are the primary drivers of responses to comparative advantage.

The literature on motivated beliefs indicates that individuals derive utility directly from holding certain beliefs, thus incentivizing them to avoid information or actions that might challenge these beliefs (Bénabou and Tirole, 2016). A theoretical application of this concept to family dynamics is discussed in Akerlof and Rayo (2020). They suggest that different families may be invested in opposite narratives, with incentives to reinforce their respective narratives. When applied to the motherhood penalty, this theory implies that families adhering to more traditional gender roles and norms have an incentive to disregard evidence contradicting these roles — such as the woman's comparative advantage. Thus, acting on this comparative advantage would harm their utility even if it improved their budget. Conversely, more egalitarian families may be invested in narratives where the woman's comparative advantage does not conflict with the narrative, making it more likely for the woman to maintain the same labor market attachment post-birth. Our results indicate that the response to comparative advantage is particularly strong for women holding more egalitarian norms. To the best of our knowledge, this finding is novel in the literature and supports the interpretation of gender norms through the theoretical framework proposed by Akerlof and Rayo (2020).

Finally, our paper links pre-birth occupational features, such as family-friendliness, with pre-birth gender norms and their relative contribution to the motherhood penalty. To our

[3]We also show that these results are robust to how we classify prospective parents' norms, not confounded by socioeconomic status, unlikely to be driven by differences in fertility patterns by gender norms, and hold across a range of additional robustness checks.

[4]In this literature, men typically have a lower labor supply elasticity compared to women due to their comparative advantage in market work, leading to gender differences in labor market attachment and gendered reactions to the first childbirth (*e.g.*, Mincer and Polachek, 1974; Akerlof and Kranton, 2000).

knowledge, our paper is the first to explore how these factors intersect. First, in line with findings from the literature (*e.g.*, Costa Dias, Joyce, and Parodi, 2020), we show that occupational characteristics explain about 19% of the overall gender gap in earnings that emerges after parenthood. Second, we then look at the impact of occupational sorting across gender norms, and find that accounting for occupational sorting reduces the *average* motherhood earnings penalty by $13pp$ for traditional mothers and $12pp$ for egalitarian mothers, with the reduction entirely driven by hours worked for traditional mothers. In the short run, occupational sorting accounts for 80% of the earnings penalty gap between the two groups and fully eliminates the difference in hours worked penalties. These results suggest that traditional women self-select into occupations more conducive to balancing family responsibilities, that in turn have a substantial impact on their earnings trajectory in response to motherhood. We then find no evidence of mobility across occupations or industries, nor changes in gender norms between genders from before to after the first childbirth, suggesting that pre-birth gender norms drive a degree of occupational sorting prior to childbirth.

The evidence here has significant implications for understanding the perseverance and heterogeneity of the motherhood penalty across countries. Norms and beliefs do not only serve as a marker of women's post-childbirth behavioral responses, they also guide their pre-birth labor market attachment. Thus, family policies aimed at reducing post-birth gaps between traditional and egalitarian parents will remain ineffective if they do not consider the influence of norms and beliefs on pre-birth occupational sorting.

2 Data

2.1 The British Household Panel Survey

Our main dataset is the British Household Panel Survey (BHPS) — a nationally representative survey covering the years 1991 to 2009. Over the course of 18 years, it includes comprehensive information on a random sample of individuals, who are interviewed annually. The first wave of the panel consists of around 5,500 households and 10,300 individuals, sampled from 250 areas of Great Britain.[5] The BHPS provides comprehensive data on a range of aspects, including information on children, and detailed individual- and household-level data on earnings, labor supply, occupation, and other variables relevant for our analysis, such as attitudes towards gender norms. We constructed our final dataset by exploiting the longitudinal dimension of the original data, and identifying parents and their first childbirth.

[5]To continue tracking individuals after 2009 and up to the present day, the initial BHPS was succeeded by a follow-up survey known as Understanding Society. This longitudinal study includes about 40,000 individuals, among which approximately 8,000 are from the original BHPS households. In our study, we focus exclusively on the BHPS segment of the survey, as it provides richer and more frequent data on interviewees' attitudes towards gender norms.

2.2 The Quarterly Labour Force Survey

In addition, we make use of the UK Quarterly Labour Force Survey (LFS) to supplement our analysis, and to capture pre-birth occupational characteristics of prospective parents. The survey includes approximately 36,000 respondent households each quarter since 1993, aiming for a representative sample of the UK population.[6] The quarterly survey adopts a panel design, retaining households for five consecutive quarters, while introducing a rotational replacement of one-fifth of the sample every quarter. Consequently, this means there is an 80% sample overlap across consecutive waves. Since we are interested in using LFS to rank occupations based on the extent to which they accommodate family commitments, we construct various measures, described in Subsection 2.4.3 below, and rank occupations, for each available quarter between 1993:Q1 and 2008:Q4. We then match these measures and ranks to individual records in the BHPS, by quarter-year and reported occupation.

2.3 Final Sample

The implementation of our event study analyses, as described in Section 3 below, follows the methodology of Kleven et al. (2019). We define our analytical sample in the BHPS in three steps. First, we retain parents observed at least five times within our event window, spanning from five years before the first childbirth to ten years after.[7] They must as well be observed at least once before and after childbirth. Second, considering factors related to fertility and the labor market, we apply age restrictions and focus on individuals experiencing their first childbirth between the ages of 20 and 45. Finally, we keep individuals who were working, at least one year, prior to the first childbirth and trim the top and bottom first percentiles of the annual earnings distribution to mitigate the impact of outliers.[8] Following these sample restrictions, we compute our main indicators for gender norms and occupational characteristics, respectively outlined in Subsection 2.4.2 and Subsection 2.4.3. We further provide descriptive statistics in the Appendix for our analytical sample of 755 parents (equivalent to 8,350 person-year observations), spanning from 1991 to 2009, categorized by their gender (Table A.1) and pre-birth gender norms (Table A.2).

[6] Since we lack information for the years 1991 and 1992, we cannot characterize occupational characteristics of BHPS parents for those two particular years. However, this should not present an issue regarding missing data, as all pre-birth characteristics — including those on occupations — are computed as an average across pre-treatment (*i.e.*, pre-birth) years. In addition, we omit observations for the first quarter of 2001 due to missing information on occupations in the LFS.

[7] Kleven et al. (2019) adhere to a minimum threshold of eight observations per parent within the event window. Nonetheless, to ensure an adequate sample size for subgroup analyses, we choose to relax this criterion to a minimum of five observations. We confirm in the Appendix, Subsection C.1, Figure C.1, that our main result split by gender norms (Figure 1) is robust to restricting the analysis to parents observed at least eight times.

[8] In essence, to characterize parents' pre-birth occupational characteristics, we drop those who reported zero labor earnings for the five years prior to the first childbirth, and retain parents who reported at least one pre-birth observation of positive labor earnings. We further show, in the Appendix, Subsection C.1, that our results are robust to different sample selection criteria for pre-birth employment (Table C.1), as well as for various trimming versions of the annual earnings distribution (Table C.2).

2.4 Variables of Interest

2.4.1 Labor Market Outcomes

Our main aim is to examine the impact of the first childbirth on the motherhood penalty in earnings, defined as the annual individual labor income reported by the primary BHPS respondent. Our analysis focuses on two different margins potentially explaining the motherhood penalty in earnings — the intensive margin of labor supply, and wages.[9]

We measure the intensive margin of labor supply by the self-reported number of hours worked per week in each job, excluding any overtime hours.[10] This is calculated as the sum of weekly hours worked in the main job and, if applicable, any additional job(s) held by the respondent. Hourly wages are computed using monthly labor income and the number of hours worked (both self-reported), excluding overtime hours.[11]

Table 1 below provides descriptive statistics illustrating overall gender differences in our labor market outcomes. It shows that, on average, men earn significantly more and work longer hours per week than women. Additionally, men have higher hourly wages. Figure A.1 in the Appendix displays the trend of these labor market outcomes by gender over time, adjusting for year effects. These findings point to a consistent negative impact of being a woman on all outcomes, with the most pronounced effects observed for labor earnings and hours worked.

Table 1. Labor market outcomes, by gender

	Men	Women	Diff. (Men – Women)	Diff.(%)	S.E.	N
Earnings	21514.099	13602.162	7911.937***	58.167	246.723	8350
Weekly hours worked	41.318	30.161	11.157***	36.990	0.341	8342
Hourly wages	10.606	8.902	1.703***	19.133	0.150	8342
LFP	0.989	0.947	0.042***	4.446	0.004	8347

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the mean of our four labor market outcomes, by gender. Earnings correspond to self-reported annual labor earnings. Weekly hours worked refer to the self-reported number of hours worked per week in each job, excluding any overtime hours. Hourly wages are computed using labor earnings and the number of self-reported hours worked, also excluding overtime hours. Both labor earnings and hourly wages are expressed in British pounds (£). LFP stands for labor force participation, and is a binary variable set to one if the respondent is either self-employed, employed, unemployed, or on maternity leave. Note that the sample is restricted to individuals with at least one pre-treatment observation with strictly positive labor earnings.

[9] We also include findings related to the extensive margin of labor supply (see Figure B.4 reporting results for labor force participation), based on the self-reported current labor force status, and consider those who are either self-employed, employed, unemployed, or on maternity leave. However, as outlined in Subsection 2.3, it is important to note the limitation in terms of external validity of these results, since our sample is predominantly skewed towards working parents.

[10] This choice is determined by a high rate of missing values for the number of overtime hours worked among working parents (≈11%).

[11] We compute hourly wages by dividing the monthly labor income by 4.3 × the number of weekly hours worked — excluding overtime hours, as we also lack information on whether these are paid at the same rate as regular hours.

2.4.2 Gender Norms

The BHPS provides a wide range of questions on gender norms, answered solely by the primary survey respondent. Therefore, our focus is on individuals rather than on possible dynamics within couples. We consider six questions as in Flèche, Lepinteur, and Powdthavee (2020), detailed in Table 2 below, where respondents indicate their level of agreement with each statement, every odd survey wave.

Table 2. Gender norms variables

	Answer categories
A pre-school child is likely to suffer if his or her mother works All in all, family life suffers when the woman has a full time job A woman and her family would all be happier if she works Both the husband and wife should contribute to the household income Having a full-time job is the best way for a woman to be an independent person A husband's jobs is to earn money; a wife's job is to look after the home and family	1. Strongly agree 2. Agree 3. Neither agree, nor disagree 4. Disagree 5. Strongly disagree

Notes: Gender norms variables are asked to the BHPS main survey respondent, every odd survey wave, starting in wave 1, until wave 17.

We reverse code the measures where needed and compute the within-respondent and *pre-birth* average across these measures to form a gender norms score (see, *e.g.*, Farré and Vella, 2013; Flèche, Lepinteur, and Powdthavee, 2020). This score ranges from one (indicating more traditional attitudes) to five (more egalitarian attitudes), and represents the average response to the above gender norms questions across all pre-treatment years (*i.e.* before the first childbirth). We also calculate this individual gender norms score for each every other survey year over both the pre- and post-birth years to assess whether norms change after the birth of the first child.

Then, we classify prospective parents as holding more or less traditional attitudes compared to their counterparts in two steps. First, we regress our pre-birth gender norms score on age fixed effects using our analytical sample, and derive the residuals from this regression. Second, we compute the median value of these residuals, and split the sample into two groups — above and below this median. Thus, individuals above the median are labeled as egalitarian, while those below are labeled as traditional. Individuals defined as traditional by our categorization tend to think that women should not work as much as men for various reasons — such as for the child or the overall family well-being. This gender norms indicator is the one we will mostly use for heterogeneity throughout the paper.

Table 3 provides an overview of gender norms both before and after the first childbirth. Panel A displays these attitudes within our analytical sample, while Panel B breaks down the data by gender, and Panel C by pre-birth gender norms. This descriptive analysis allows us to track the evolution of gender norms over time, and to discern potential drivers behind any shifts observed post childbirth. The findings point to a general trend towards more traditional gender norms following the first childbirth, as shown by a significant decrease in the gender norms score. This shift appears similar in magnitude across genders, suggesting

that the effect is not gender specific. Interestingly, while egalitarian parents tend to adopt more traditional attitudes post-childbirth, this does not apply to those with traditional gender norms pre-birth.[12] Thus, at least descriptively, the birth of the first child is associated with increased traditional norms, particularly among individuals who held more egalitarian beliefs prior to the first childbirth.

Table 3. Gender norms, before and after childbirth

	Post-birth	Pre-birth	Diff. (Post – Pre)	S.E.	N
Panel A: overall	3.274	3.409	-0.135***	0.018	4450
Panel B: by gender					
Women	3.374	3.494	-0.120***	0.026	2108
Men	3.190	3.323	-0.133***	0.025	2342
P-value (men – women)	0.000	0.000			
Panel C: by norms					
Egalitarian	3.541	3.817	-0.276***	0.023	2204
Traditional	3.014	3.023	-0.009	0.020	2216
P-value (egal. – trad.)	0.000	0.000			

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the means of the gender norms score — ranging from 1 (more traditional views) to 5 (more egalitarian views) — equal to the within-individual average answer to the six questions presented in Table 2. Means are displayed post-birth and pre-birth, and a negative (positive) difference between the post- and pre-birth scores indicates more traditional (egalitarian) attitudes.

2.4.3 Occupational Characteristics

To proxy the level of flexibility and/or family-friendliness of each occupation prior to the first childbirth, we also construct two indices (based on scores) using LFS data and the 2-digit-level occupation.[13] The first index is based on the average number of hours worked within each occupation, including overtime hours, as longer-hours occupations usually constitute a good proxy for less family-friendly occupations (*e.g.*, Goldin, 2014; Bertrand, Kamenica, and Pan, 2015). The second index, drawn from Costa Dias, Joyce, and Parodi (2020), calculates the proportion of part-time workers within each occupation to measure the degree of temporal flexibility within different occupations. Using these two indices, we establish quarterly and yearly rankings of occupations, with the lowest value indicating the most flexible and family-friendly occupations. We then match these rankings to individual records in the

[12]Grinza et al. (2022), using Understanding Society data, showed a notable shift in women's attitudes towards more traditional views upon entering parenthood, with no significant impact observed for men. Nevertheless, their results are not directly comparable to ours (*e.g.*, those presented in Figure 3), as they employ a different identification approach, and a different sample selection.

[13]We use the Standard Occupational Classifications (SOC) 1990 and 2000, at the 2-digit level, encompassing the minor occupation group of the main survey respondent in the BHPS. Indeed, in the public version of the BHPS, the SOC90 was released at the 2-digit level, while the SOC00 was released at the 3-digit level. For comparison purposes between SOC90 and SOC00, we can only work at the 2-digit level since we do not have the 3-digit information before 2000.

BHPS by quarter-year, and reported occupation. This provides us with quarterly-updated information on job flexibility for our sample of BHPS participants.

Table 4 presents descriptive evidence of pre-birth occupational characteristic scores across gender, and within each gender group, by pre-birth gender norms, providing some preliminary insights. First, women exhibit significantly ($p < 0.01$) lower scores than men for both rankings, indicating that they work in family-friendlier occupations compared to men. Second, comparing within gender across pre-birth norms, women who hold traditional gender norms prior to the first childbirth demonstrate a similar inclination towards family-friendlier occupations. They have significantly lower scores, for both ranks, relative to their egalitarian counterparts ($p < 0.01$). However, men exhibit statistically significant differences in their pre-birth sorting into longer-hours occupations based on their gender norms, although their differences in magnitudes within rank and across gender norms are relatively small. Given the significant difference in scores between genders, it appears that the temporal flexibility of occupations — reflected by shorter working hours and a higher prevalence of part-time employment — emerges as an important driver for women, and particularly for those with traditional pre-birth gender norms.

Table 4. Occupational characteristics before childbirth, by gender

	Men	Women	Diff. (Men – Women)	S.E.	N
Rank 1: working hours	44.636	28.567	16.070***	0.439	7980
Egalitarian	43.779	30.445	13.333***	0.605	3970
Traditional	45.303	25.639	19.665***	0.650	3949
P-value (egal. – trad.)	0.013	0.000			
Rank 2: part-time workers	29.837	16.315	13.521***	0.424	6583
Egalitarian	28.769	17.691	11.077***	0.581	3309
Traditional	30.603	14.415	16.189***	0.634	3223
P-value (egal. – trad.)	0.006	0.000			

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the means of our two occupational characteristics scores, based on our two ranking measures of family-friendliness, by gender. Specifically, a lower value here represents working in family-friendlier occupations, *i.e.*, respectively for each rank, in occupations (1) with lower working hours, and (2) higher shares of part-time workers. The above ranks range from 10 to 99, with 10 (99) being the minimum (maximum) value.

Based on these rankings we also create indicators denoting whether prospective parents are employed in occupations deemed more or less family-friendly. We construct these as we did for gender norms in a two-step process. First, we regress separately each pre-birth family-friendliness score on age fixed effects and derive the residuals from this regression. Next, we compute the median value of these residuals, and split the sample into two groups — above and below this median — indicating the relative family-friendliness of their occupations compared to others. Individuals with values below the median are considered as working in family-friendlier occupations compared to those above the median.

3 Methodology

3.1 Empirical Strategy

Our empirical strategy relies on the event study design, as first proposed by Kleven et al. (2019), and our discussion here follows theirs. This event study design involves a staggered setup, where the treatment (*i.e.*, the first childbirth) occurs at different times across individuals. We estimate equation (1) below for each gender g and outcome Y_{it}:

$$Y_{it}^{g} = \sum_{t \neq -1} \beta_t^g \mathbb{1}[event_{it} = t] + \sum_{y=1991}^{2009} \gamma_y^g \mathbb{1}[year_{it} = y] + \sum_{k=20}^{45} \alpha_k^g \mathbb{1}[age_{it} = k] + v_{it} \quad (1)$$

The first term on the right hand side corresponds to event time dummies, ranging from five years before the first childbirth denoted by $t = 0$ (the event) to ten years after.[14] These dummies are computed relative to the year prior to the first childbirth ($t = -1$), which means that the estimated event time coefficients (*i.e.*, $\widehat{\beta_t^g}$) will measure the impact of having a child relative to the year just before the first childbirth. The second term refers to year fixed effects to control for calendar time and business cycle effects. Finally, the third term refers to age fixed effects to control for life-cycle trends. The OLS estimates of equation (1) above enable us to derive two main measures — the within-gender impact of having a child, and the motherhood penalty, described in the next subsections.

3.2 Within-Gender Penalty

We compute, for both men and women, the percentage change in the outcome due to the first childbirth for all t. To quantify this, we first estimate the predicted outcome in absence of a child $\tilde{Y}_{it}^g = \sum_s \gamma_y^g \mathbb{1}[year_{it} = y] + \sum_k \alpha_k^g \mathbb{1}[age_{it} = k] + u_{it}$. Second, we use the average of this predicted outcome to normalize the within-gender effect of having a child, as such:

$$P_t^g = \frac{\widehat{\beta_t^g}}{E[\widetilde{Y}_{it}^g]}, \forall t \in [-5; 10] \quad (2)$$

When presenting our graphical results in Section 4, we plot the estimated values of P_t for both men and women, across each event time.

[14] The "event-time" variable is computed using the interview year minus the year of birth of the first child due to limited information in the public version of BHPS.

3.3 Motherhood Penalty

We compare mothers and fathers as in Kleven et al. (2019), and express the motherhood penalty as being the percentage change[15] in the outcome of men m compared to women w, as follows:

$$P_t = \frac{\widehat{\beta}_t^m - \widehat{\beta}_t^w}{E[\widetilde{Y}_{it}^w | t]} \tag{3}$$

We further provide three different specifications of this motherhood penalty. First, the average gap, *i.e.*, the mean of the motherhood penalty across the 10 years after becoming parent. Second, the short-run penalty, which corresponds to the mean of P_t in the first three years after the first childbirth, *i.e.*, for $t \in [0; 3]$. Third, the long-run penalty, which provides an estimate of the average of all P_t, for $t \in [7; 10]$. Yet, as highlighted by Kleven et al. (2019), the results can become less informative as we move further away from the event time $t = 0$, because the smoothness assumption may not longer hold in the long run due to for example having another child in the event window $t \in [1; 10]$. We should therefore exercise caution when interpreting the longer-term results. Nonetheless, results remain robust when we change the definition of the control group to men and women with no children, which should minimize concerns about unobserved factors.[16]

3.4 Subgroup Differences

To understand the drivers of the motherhood penalty as defined above, we estimate equation (1) by different pre-birth indicators such as gender norms and occupational characteristics. To examine whether effects are statistically different between subgroups, we estimate a simple static difference-in-differences specification given by the following equation:

$$Y_{iat} = \alpha + \beta W_i + \theta D_{it} + \gamma_a + \lambda_t + v_{iat} \tag{4}$$

Where α is the intercept, W_i is a dummy variable for gender and is equal to 1 if the individual is a woman, and D_{it} is our treatment indicator equal to 1 if the individual is a woman and has a child at time t, and 0 otherwise. Additionally, γ_a and λ_t are age, and year fixed effects, respectively. We finally run a t-test on the difference across subgroups, using a Wald test.

[15] As mentioned in Section 2, we merge BHPS and LFS based on pre-birth reported occupations in the BHPS. This means that, for the post-birth periods, it is possible that respondents do not work and report 0 as labor earnings. We therefore cannot make use of the log specification or any log-like re-scaling (Chen and Roth, 2023).

[16] We also estimate the earnings impact by number of children and display our results in Subsection B.8 in the Appendix. The results suggest that effects are substantial for the first and only child, and additional children tend to increase the short-run penalty, while the long-run penalty becomes not significant.

3.5 Internal Validity

This event study design relies on several assumptions, which we discuss below. First, the estimation of the motherhood penalty considers men as a counterfactual for women, under the assumptions that (i) men's labor market outcomes remain unaffected by childbirth, and (ii) the timing of the first childbirth is exogenous to relative expectations in labor market outcomes within the couple (Angelov, Johansson, and Lindahl, 2016). These seem substantiated by a clear discontinuity in women's labor market outcomes coinciding with the first childbirth, while no such discontinuity is observed for men (*e.g.*, Figure 1).

Second, the analysis rests on the validity of the Stable Unit Treatment Value Assumption (SUTVA), which requires that outcomes of each treated individual are independent from untreated individuals' outcomes, thus assuming no spillover effects to the control group. Graphical inspection of event study point estimates (*e.g.*, Figure 1) suggests that this assumption is likely met, as earnings trajectories for men remain consistent with pre-treatment trends. To this extent, all pre-birth estimates are close to zero and non-significant, which additionally points to the absence of pre-trends. We further demonstrate in Section 5 that our results are robust to a placebo test on treatment timing and to heterogeneity in treatment effects across groups and time.

Finally, concerns may arise regarding the endogeneity of our gender norms and occupational flexibility indicators. On the one hand, women's perceptions of their roles in the workplace (*i.e.*, their gender norms) may affect their labor market decisions and at the same time the latter can in turn influence their gender norms (Moriconi and Rodríguez-Planas, 2021). On the other hand, parenthood can also affect gender norms. However, we measure gender norms pre-birth, and show that parenthood does not affect them in a significant way as these exhibit relatively stable patterns over time (Figure 3, Subsection 4.3) and, more importantly, there is no differentiated effect across gender. Similarly, we compute our occupational index pre-birth, and further show in Subsection 4.6 that parenthood has a negligible influence on occupational mobility.

4 Results

In this section, we investigate the heterogeneity in the magnitudes of the motherhood penalty in labor earnings in the UK, reviewing factors commonly discussed in the literature. This facilitates a better understanding of the components that contribute to the observed dynamics of the motherhood penalty.

4.1 Pre-Birth Gender Norms

We first replicate the results of Kleven et al. (2019) using our analytical sample. These results are presented in Subsection B.1 in the Appendix, highlighting two key points. First, becoming a parent implies a 48% drop in women's labor earnings compared to men's, who

are unaffected by parenthood. Second, changes in the intensive margin of labor supply primarily drive the effects of motherhood on women's labor earnings. Additionally, changes in labor force participation in the short term and hourly wages in the long term also contribute to the motherhood penalty in earnings, albeit to a lesser extent. Next, we investigate heterogeneity by parents' pre-birth gender norms, primarily to understand whether norms and beliefs contribute to differentiated effects of motherhood on labor market trajectories.

We estimate our event study regressions on labor earnings, stratified by the indicator reflecting individuals' pre-birth gender norms (defined in Subsection 2.4.2) and report these graphically in Figure 1. Overall, our results indicate that men do not experience any impact on their labor earnings trajectories from becoming parents, regardless of their pre-birth gender norms, while women do. Indeed, women's earnings trajectories upon motherhood vary based on their pre-birth gender norms. After becoming mothers, women who adhere to traditional norms tend to fall behind men with similar attitudes by a margin of 61%, whereas egalitarian women experience an average gap of 43% — an 18-percentage-point (pp) difference. Moreover, estimated average effects for egalitarian and traditional women obtained from equation (4) are statistically different ($p < 0.0452$), indicating that pre-birth gender norms significantly influence the extent of the motherhood penalty in earnings.[17]

Second, we observe a consistent pattern for the intensive margin of labor supply, which we report in Figure B.5 in the Appendix. Men, again regardless of their pre-birth gender norms, do not appear to be affected by parenthood, whereas women are. The average impact of motherhood on weekly hours worked for traditional women is 20-pp larger than that of more egalitarian women, with average penalties respectively equal to 58% for traditional women, and 38% for egalitarian women. Additionally, using equation (4), the estimated average effects on hours worked for women across gender norm groups are statistically different ($p < 0.0104$). Finally, this reduction in hours worked may come together with additional family commitments. We explore this dimension descriptively in Subsection B.3 in the Appendix, and we see consistent evidence that traditional women report a higher rate of family commitments potentially interfering with career choices than their more egalitarian peers.

Third, the effects on earnings do not seem to be driven by wages. We observe no difference in the motherhood penalty in wages between egalitarian and traditional women, suggesting the above patterns are not driven by differentiated changes in wages across norms (Figure B.6 in the Appendix).[18]

Finally, we find some effects on labor force participation (Figure B.7), particularly in the short term, with traditional women experiencing an average gap relative to men of 15% —

[17]A potential identification issue may arise if the effects observed for traditional women are influenced by different fertility patterns compared to those of egalitarian women. In the Appendix, Figure A.2, we report the breakdown of single *versus* multiple births by respondent's pre-first-childbirth gender norms. The distribution of multiple births is similar between egalitarian and traditional parents, indicating that disparities in fertility patterns, based on gender norms, are unlikely to explain the large effects we find.

[18]The estimated average effects obtained from estimating equation (4) on hourly wages for traditional and egalitarian women are not statistically different ($p < 0.2569$).

three times larger than that of egalitarian women (5%). This suggests that traditional women are therefore more likely to drop out of the labor force after the first childbirth.[19]

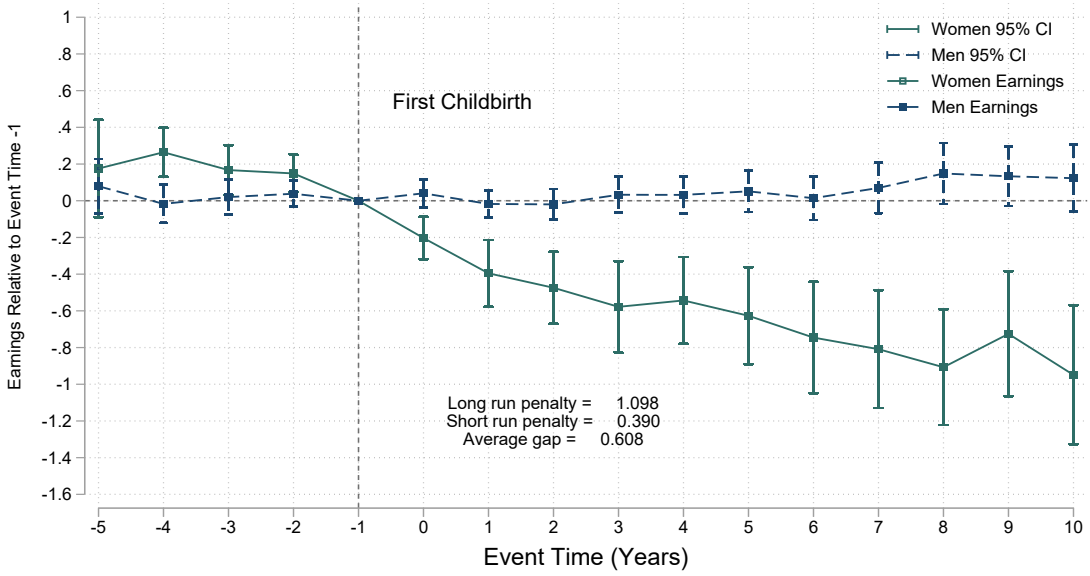
To support the robustness of our pre-birth gender norms results, we conducted different checks, which we report in the Appendix, Section C. First, our results can be interpreted as conservative as we remove outliers by trimming the bottom and top first percentiles of the earnings distribution. We show in Table C.2 that our results are qualitatively similar (i) without trimming the earnings distribution, and (ii) by trimming only the top first percentile to retain all observations with zero labor earnings. Second, we change the definition of traditional and egalitarian by dividing our sample based on the *average* value of the pre-birth gender norms score, rather than using the *median* value, and run our main specification (equation (1)) on labor earnings split by this new definition of gender norms. Graphical evidence reported in Figure C.2 in the Appendix indicates that our main result remains robust to this new definition. Finally, we try to disentangle the effect of socioeconomic status (SES) from that of gender norms. While the latter refers to societal expectations and perceptions regarding gender roles, SES encompasses factors such as income, education, or occupation. Given their correlation (0.13, $p < 0.01$), we examine, in Subsection C.2.3 in the Appendix, whether the observed results persist when controlling for socioeconomic factors, and show that our findings remain robust. This suggests that our main results are not sensitive to changing the criterion we use to classify individuals based on gender norms, and are not simply driven by differences in SES.

Overall, our findings highlight the substantial influence of individual beliefs and gender norms on the magnitude of the motherhood penalty in earnings, with distinct patterns emerging following childbirth between traditional and egalitarian mothers. Traditional women experience a higher reduction in labor force participation in the short run compared to their egalitarian counterparts, as well as a significantly larger decrease in hours worked following the first childbirth.

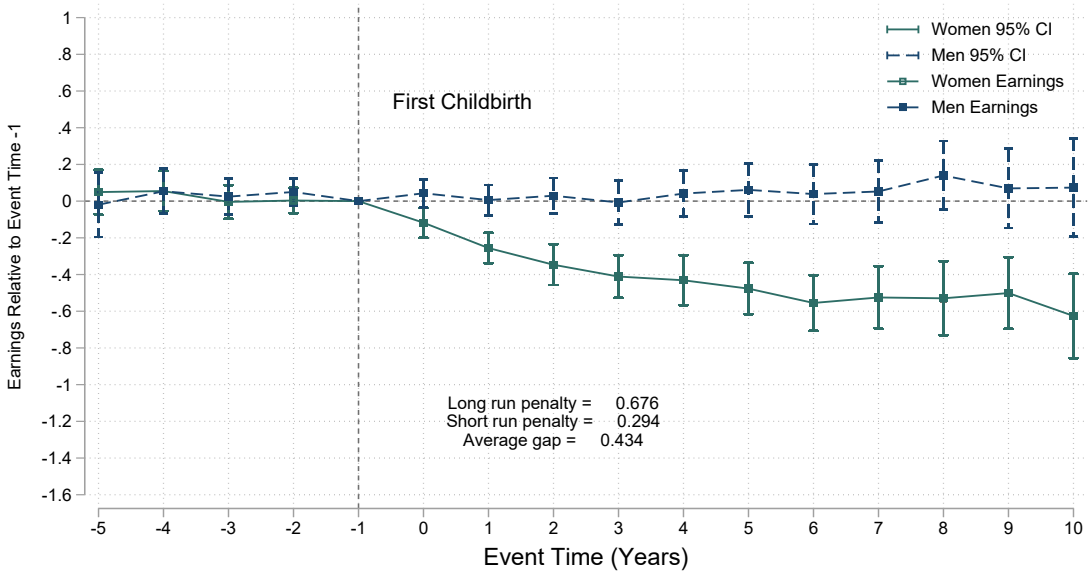
[19]Estimated average effects for labor force participation vary significantly by pre-birth gender norms ($p < 0.0009$).

Figure 1. Impact of parenthood on earnings, by pre-birth gender norms

(a) Traditional



(b) Egalitarian



Notes: OLS results for equation (1) on annual labor earnings presented alongside the motherhood penalties (short, long and average gaps) for parents with pre-birth (a) traditional and (b) egalitarian norms, as defined in Subsection 2.4.2. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

4.2 Pre-Birth Comparative Advantage

Here, we explore alternative mechanisms potentially driving the motherhood penalty, and particularly differences in comparative advantage between women and men, *i.e.*, differences in relative labor market productivity pre-birth. As we discussed in the introduction, if couples have different labor supply elasticity (*e.g.*, Becker, 1985), they may aim to maximize total household income choosing to prioritize the market work of the parent with the greater comparative advantage. The parent with the lowest comparative advantage would assume a relatively larger share of domestic responsibilities with effects on their earnings trajectory and the motherhood penalty.[20] Gender norms can in turn affect the labor market response to parenthood based on differences in comparative advantage pre-birth within the couple.

We assess the role of comparative advantage, proxied by labor market productivity, through pre-birth hourly wage differentials. Specifically, for each couple, we compute the *average* difference in hourly wages prior to their first childbirth, and further construct a binary indicator. The latter equals one if the father had a higher average hourly wage than the mother before the first childbirth, thereby identifying which partner held the comparative advantage. To quantify the impact of parenthood on earnings by pre-birth comparative advantage, we run our main specification (equation (1)) split by the comparative advantage indicator, and present our results in Figure 2.

We first present the results using the full sample (Panels (a) and (b)). However, around the median, wage differentials within the couple are very small (less than one pound (£)), which may imply that couples with similar wages do not perceive a clear comparative advantage for either partner. In such cases, decisions may be driven by expectations of future career potential or individual preferences regarding career progression. Conversely, a larger wage differential likely makes the existing comparative advantage more salient, and more influential in decision-making. Thus, we further present results dropping observations between the 45^{th} and the 55^{th} percentiles of the pre-birth wage difference distribution (Panels (c) and (d)), and dropping observations between the third and the seventh deciles of the wage difference distribution (Panels (e), and (f)). The results presented below suggest that the role of comparative advantage in the motherhood penalty starts to emerge for the 30-70 trimming sample, where comparative advantage can be more salient within the couple, though it is not consistently significant across trimming levels.[21] We now turn to explore whether comparative advantage mechanisms may operate differently across pre-birth gender norms.

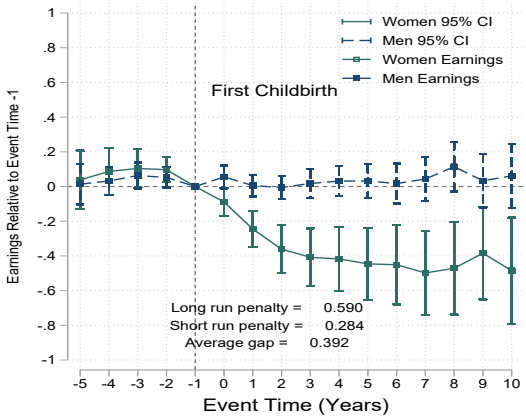
[20] For descriptive evidence on this issue, see Costa Dias et al. (2021).

[21] Table B.5 in the Appendix shows the results of a pooled difference-in-differences model broken down by pre-birth comparative advantage. These results show that the motherhood penalty in earnings is higher for women with no comparative advantage, especially for the 30-70 trimming sample.

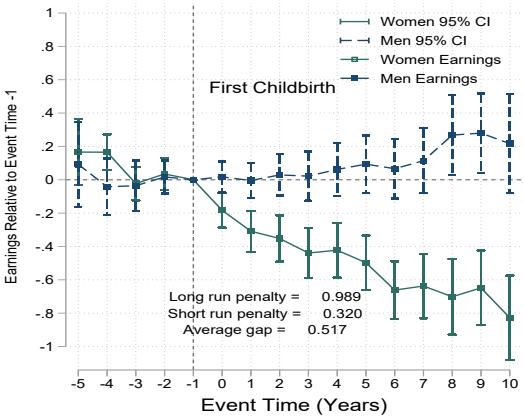
Figure 2. Impact of parenthood on earnings, by pre-birth comparative advantage

No Trimming

(a) C.A.: man = 1



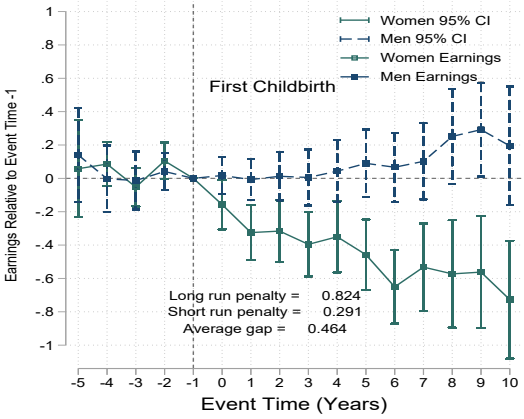
(b) C.A.: man = 0



Trimming 45-55 Percentiles

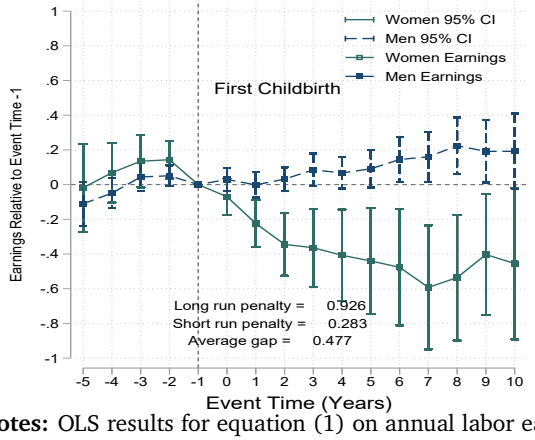
(c) C.A.: man = 1

(d) C.A.: man = 0

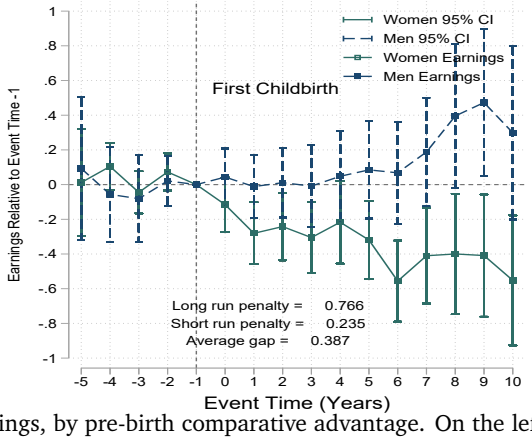


Trimming 30-70 Percentiles

(e) C.A.: man = 1



(f) C.A.: man = 0



Notes: OLS results for equation (1) on annual labor earnings, by pre-birth comparative advantage. On the left hand side (Figures (a), (c) and (e)), results are displayed for when men had a comparative advantage (C.A.: man = 1). On the right hand side (Figures (b), (d) and (f)), results are displayed for when women had a comparative advantage (C.A.: man = 1). Results are displayed for the full distribution of the pre-birth average wage difference (Figures (a) and (b)), dropping observations between the 45^{th} and 55^{th} percentiles of this distribution (Figures (c) and (d)), and dropping observations between the third and seven deciles of this distribution (Figures (e) and (f)). Refer to Figure 1 for the definition of the gaps.

Next, we examine the different role of comparative advantage across traditional and egalitarian women. To do so, we estimate a triple-difference specification — outlined in equation (5) below — to analyze how the average effects of motherhood on labor earnings change by comparative advantage and across gender norms:

$$Y_{iat} = \alpha + \beta W_i + \theta Post_t + \delta CA_i + \phi(W_i \times Post_t) + \psi(W_i \times CA_i) + \chi(Post_t \times CA_i) \quad (5)$$
$$+ \eta(W_i \times Post_t \times CA_i) + \gamma_a + \lambda_t + u_{iat}$$

In equation (5), α denotes the intercept, W_i is a dummy variable for gender and is equal to 1 if the individual is a woman, $Post_t$ is a dummy denoting the post-childbirth period, and CA_i is a dummy set to 1 if a man had a comparative advantage (*i.e.*, a greater average hourly wage than their spouse or partner) prior to the first childbirth. Additionally, γ_a and λ_t are respectively age, and year fixed effects. We report the estimates of this regression in Table 5 below using the same sample restrictions as in Figure 2.

Overall and across the different samples, these results suggest that the comparative advantage mechanism is heterogeneous across gender norms. Results become clearer as we trim the sample but are qualitatively consistent also for the full sample (columns (1)–(2)), suggesting that the comparative advantage mechanism operates for egalitarian women only. The strongest results are shown in columns (5)–(6) for the 30-70 trimming, where there is a clear difference in pre-birth comparative advantage between men and women. Here, the earnings penalty for egalitarian mothers with no comparative advantage is significantly larger (about 56-pp higher) than for egalitarian mothers with comparative advantage.[22] In contrast, the motherhood earnings penalty is similar for traditional women regardless of their comparative advantage. This evidence substantiates the role of the comparative advantage mechanism in shaping earnings trajectories for egalitarian women around motherhood, while it appears to play no role for traditional women.

A theoretical explanation, from Akerlof and Rayo (2020), and in line with these results, is that households may be invested in different narratives, and the utility retrieved from mothers' post-birth labor supply differs across gender norms — even under the same change in their budget constraint. Our results therefore underscore the significance of individual beliefs and preferences as credible sources of disparities in the magnitude of the motherhood penalty in earnings, notably as a driver of post-birth labor supply. However, this evidence is much stronger if gender norms do not change as a consequence of parenthood, which we turn to test in the next subsection.

[22]The estimated motherhood penalty coefficients for women with and without a comparative advantage — $\hat{\phi}$ and $\hat{\eta}$ respectively — are normalized (divided) by women's pre-birth average of labor earnings.

Table 5. Impact of parenthood on earnings, by pre-birth comparative advantage and gender norms

	No Trimming		Trimming 45-55 Percentiles		Trimming 30-70 Percentiles	
	(1) Egalitarian	(2) Traditional	(3) Egalitarian	(4) Traditional	(5) Egalitarian	(6) Traditional
Post	779.144	536.576	821.989	-651.197	-286.140	-292.770
	(1407.559)	(1377.524)	(1597.458)	(1501.612)	(2166.917)	(2000.516)
Woman	269.810	-578.290	1838.793	1386.107	1634.960	2378.324
	(1091.798)	(1727.153)	(1286.732)	(3110.570)	(1679.402)	(3576.378)
Woman × Post **(a)**	-5672.439***	-9918.804***	-4977.637**	-8400.923**	-2082.884	-9230.018**
	(1634.092)	(2039.481)	(2009.218)	(3404.234)	(2514.737)	(3991.487)
C.A.: man	3141.909***	1497.397	4176.617***	1541.844	3459.363**	1811.065
	(1113.477)	(1217.349)	(1310.376)	(1343.366)	(1715.001)	(1779.461)
Post × C.A.: man	1146.050	1303.435	2459.047	3451.944**	4112.726*	2905.540
	(1718.321)	(1517.967)	(1935.641)	(1653.130)	(2427.993)	(2057.312)
Woman × C.A.: man	-3753.624**	-4592.155**	-5985.445***	-7495.896**	-6865.149***	-8840.579**
	(1463.475)	(1908.151)	(1696.103)	(3160.515)	(2089.856)	(3638.224)
Woman × Post × C.A.: man **(b)**	-2596.019	406.913	-4464.942*	-1928.940	-8291.040***	-380.818
	(2148.303)	(2293.892)	(2545.386)	(3535.670)	(3117.326)	(4128.194)
Normalized Average Effects (%)						
(a)	-41.61	-72.76	-34.74	-58.64	-14.07	-62.34
(a)+(b)	-60.65	-69.77	-65.91	-72.10	-70.07	-64.91
Observations	4150	4131	3203	3115	2405	2516
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

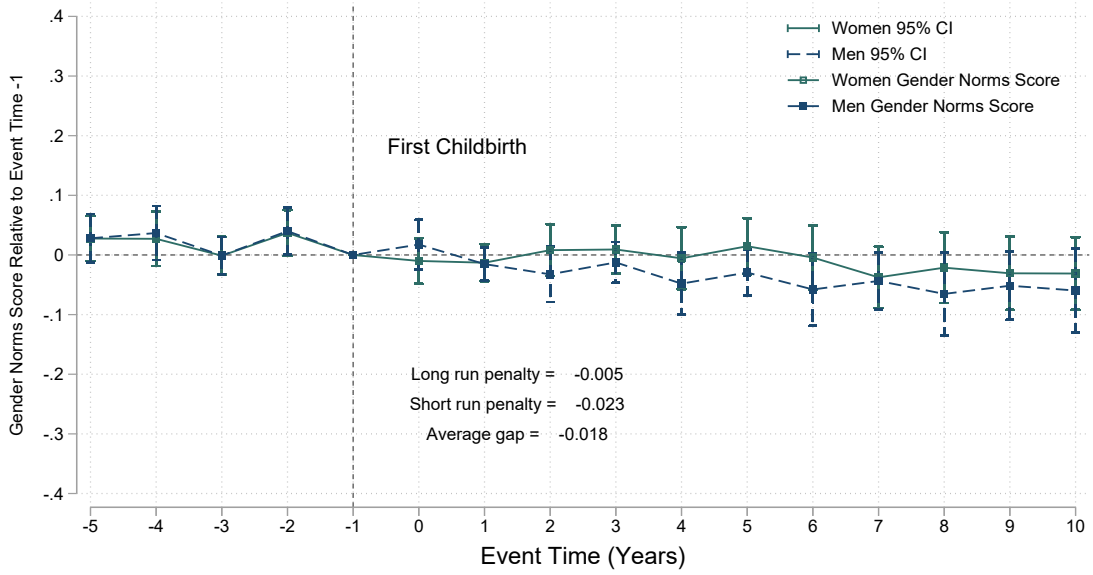
Notes: * p <0.10; ** p <0.05, *** p <0.01. OLS results for equation (5) on annual labor earnings for egalitarian and traditional parents, as defined in Subsection 2.4.2. We display results for the full distribution of the pre-birth wage difference in columns (1) and (2). In addition, we drop observations between the 45th and 55th percentiles of this distribution in columns (3) and (4), and we drop observations between the third and seventh decile of this distribution in columns (5) and (6). The variable 'C.A.: man' is a dummy set to 1 if a man had a greater comparative advantage pre-birth than her female partner, 0 if a woman had a greater comparative advantage pre-birth, and 'post' is a dummy set to 1 for the post-childbirth period. Having a greater comparative advantage pre-birth translates in having a greater hourly wage pre-birth. Further, we report the normalized average effects for the coefficients of interested (a) $\hat{\phi}$ and (b) $\hat{\eta}$, where we divide (a) and (a) + (b) by the pre-birth average of women's labor earnings, separately by trimming scenario. These display the relative drop in labor earnings due to childbirth relative to the average of all women pre-birth.

4.3 Gender Norms Around Childbirth

We examine here whether gender norms are affected by the event of having a child, whether there is any gendered effect, and whether effects vary by pre-birth gender norms. If, for example, women (but not men) become more traditional after becoming parents, part of the differential effects by gender norms could be driven by compositional changes. Descriptive evidence presented earlier in Table 3 suggests that individuals tend to become overall slightly more traditional after the first childbirth, particularly those who hold more egalitarian gender norms prior to the first childbirth. To quantify the impact of the first childbirth on gender norms, we run our main event study specification using the gender norms score as an outcome (Figure 3 below), and further split our regressions by the original gender norms indicator

for when individuals have pre-birth egalitarian *versus* traditional gender norms (Figure B.8 in the Appendix).

Figure 3. Impact of parenthood on gender norms



Notes: OLS results for equation (1) on gender norms ("gender norms score") defined in Subsection 2.4.2 presented alongside the motherhood penalties (short, long and average gaps). The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

In summary, our findings indicate that becoming parents does not alter the relative difference in gender norms between men and women, regardless of the gender norms they hold pre-birth. Therefore, potential changes in gender norms cannot threaten the validity of our results, and we can carefully conclude that pre-birth gender norms constitute an important driver of labor supply responses to motherhood, contributing to the motherhood penalty in earnings.[23]

4.4 Occupational Characteristics

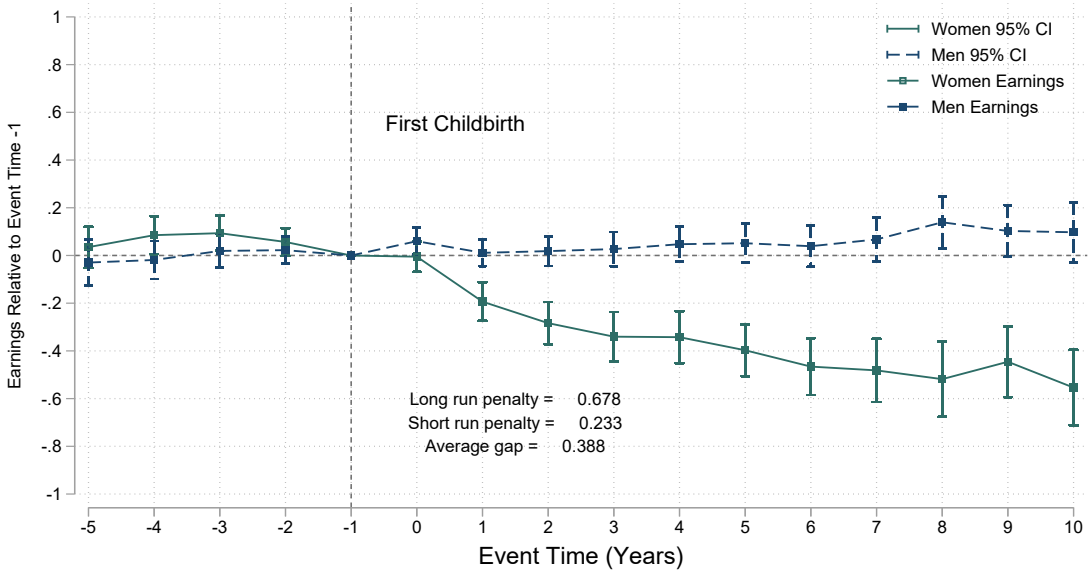
We now turn to the relationship between gender inequalities and occupational characteristics and examine the link between pre-birth occupational characteristics, occupational sorting and gender norms, as well as their contribution to the motherhood penalty.

[23] In addition, we also test whether the first childbirth affects a broader measure of norms, *i.e.*, social norms. Results are presented in the Appendix, Figure C.3, and confirm that the first childbirth does not imply more conservative and/nor more traditional social norms.

4.4.1 Differences Between Occupations

We examine first the potential overall influence of differences between occupations on the extent of the motherhood penalty. We estimate our main specification on earnings controlling for 2-digit occupation fixed effects and report our findings in Figure 4 below. Compared to the model without occupation fixed effects (Figure B.1), the average gap in labor earnings diminishes by 9 percentage points (pp), which indicates that about 19% of the overall motherhood penalty can be attributed to differences between occupations. We also report the results of estimating the average effect (equation (6)) in the Appendix, Table B.6, where we control for occupation fixed effects. The inclusion of occupation fixed effects leads the normalized average effect to reduce by $4pp$, which confirms that between-occupation differences only explain a small part of the overall motherhood penalty.

Figure 4. Impact of parenthood on earnings, conditional on occupations



Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in annual labor earnings conditional on 2-digit occupation fixed effects. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

4.4.2 Family-Friendly Occupations

Next, we examine the influence of flexible occupations on the magnitude of the motherhood penalty using the two measures we developed in Subsection 2.4.3 to capture pre-birth occupational characteristics in terms of family-friendliness. We report our results in Subsection B.6.2 in the Appendix. Overall, our findings suggest that family-friendly occupations do not have a significant role in shaping the overall magnitude of the motherhood penalty in earnings. These conclusions align with those of Costa Dias, Joyce, and Parodi (2020), im-

plying that differences in job characteristics contribute only a small proportion to the overall motherhood penalty in earnings.

4.5 Occupational Characteristics and Gender Norms

We now explore variations in the motherhood penalty based on pre-birth gender norms, accounting for occupational differences. Using our preferred event study specification, we analyze the impact of parenthood on annual labor earnings, weekly hours worked, and hourly wages, separately for traditional and egalitarian parents, while additionally controlling for occupation fixed effects. We provide graphical representations of our findings for annual labor earnings, weekly hours worked, and hourly wages respectively in Figures 5, 6, and B.15. In addition, in Table B.7 in the Appendix, we provide a summary of the short, long, and average motherhood penalties associated with these outcomes.

On average, the inclusion of occupation fixed effects in our event study regressions leads to a significant reduction in labor earnings penalties for both traditional and egalitarian mothers by $13pp$, and $12pp$ respectively (Figure 5). This reduction is entirely driven by hours worked with a much more pronounced role for traditional mothers, where the average penalty is reduced by $20pp$ when controlling for occupational sorting, compared to $4pp$ for egalitarian mothers (Figure 6). Results for hourly wages - reported in Figure B.15 in the Appendix - point to no role of wage differences on the motherhood penalty across traditional and egalitarian mothers regardless of controlling for occupation fixed effects.

Focusing on the short-run results, we find that the inclusion of occupation fixed effects in our event study regressions leads to a substantial reduction in the short-run earnings gaps, more pronounced for traditional mothers (Figure 5). In particular, controlling for occupation fixed effects, the difference in short-run earnings gaps between traditional and egalitarian women decreases by $8pp$ — from $10pp$ to $2pp$. This suggests that occupational sorting accounts for a substantial share (80%) of the difference in the short-run motherhood penalty in earnings between traditional and egalitarian women. In addition, our results indicate that accounting for occupational sorting completely removes the short-run difference in hours worked penalties between traditional and egalitarian women (see Figure 6).

Consistent with the descriptive insights reported in Table 4, our results seem to indicate a tendency for traditional women (as opposed to egalitarian women) to self-select into occupations that better accommodate family responsibilities and facilitate a reduction in working hours upon motherhood (*e.g.*, Figure B.5). We believe that these results, which combine gender norms and occupational sorting in a dynamic way, are novel to the literature on the motherhood penalty.

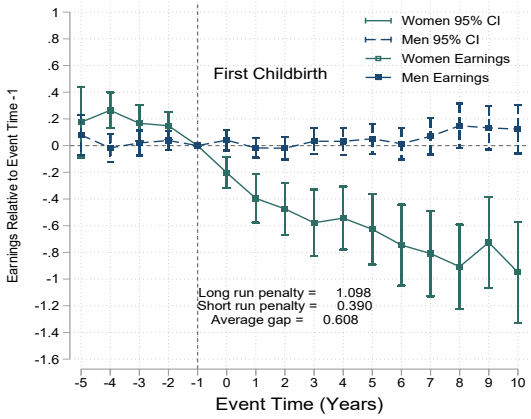
Part of the remaining difference in the motherhood penalty between traditional and egalitarian women could be influenced by other aspects of the labor market, such as differences in firm characteristics *e.g.*, firm size and industry sector (Casarico and Lattanzio, 2024).[24]

[24]We are unable to explore this aspect thoroughly as this would require matched employer-employee data. However, in Figure B.16, we show the event study results for labor earnings when including occupation and industry fixed effects. The average motherhood penalty in earnings, controlling for 2-digit occupation fixed

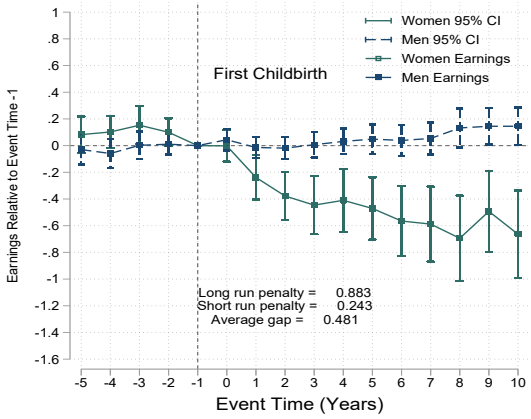
Figure 5. Impact of parenthood on earnings by pre-birth gender norms, (un)conditional on occupations

Traditional

(a) Without occupation fixed effects

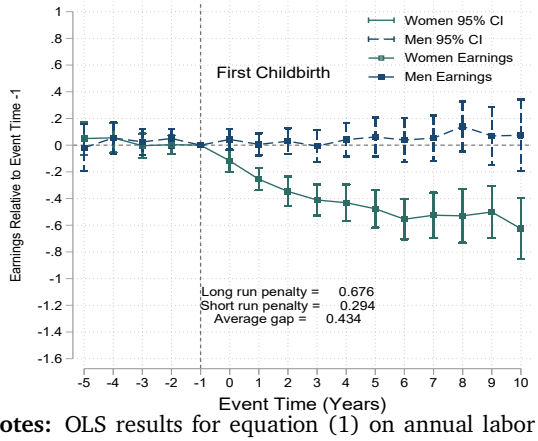


(b) With occupation fixed effects

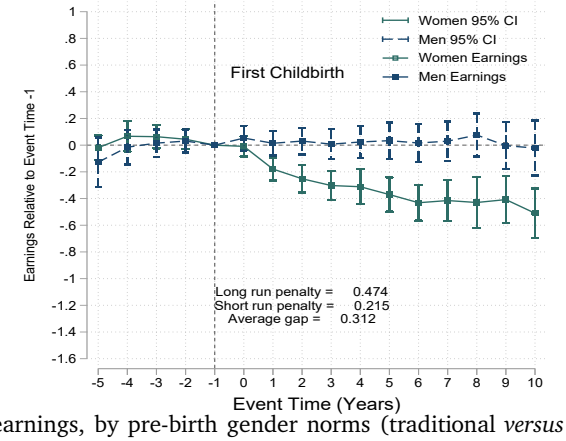


Egalitarian

(c) Without occupation fixed effects



(d) With occupation fixed effects



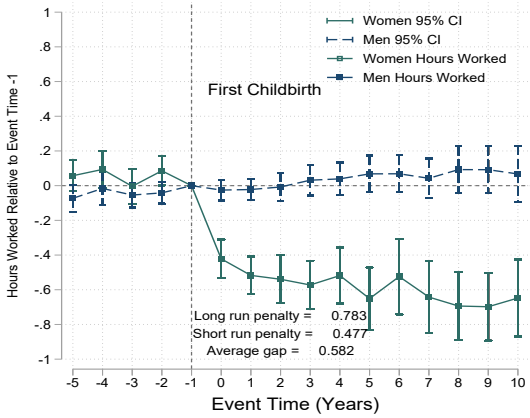
Notes: OLS results for equation (1) on annual labor earnings, by pre-birth gender norms (traditional *versus* egalitarian). Figures (a) and (c) on the left hand side display results unconditional on occupation fixed effects, while Figures (b) and (d) on the right hand side display results controlling for 2-digit occupation fixed effects.

effects, is estimated at 39%, whereas considering both occupation and industry fixed effects reduces this estimate by 4*pp* (35%). This suggests that sorting into different industries, within the same occupation, can account for a small part of the penalty.

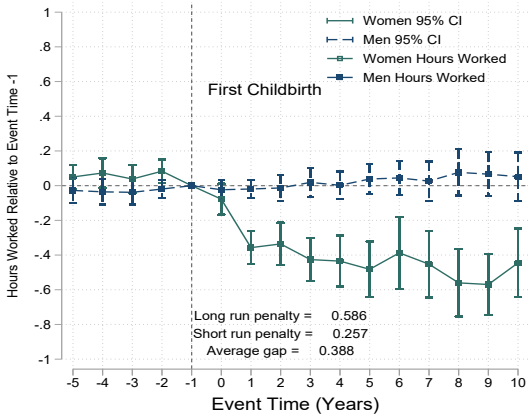
Figure 6. Impact of parenthood on hours worked by pre-birth gender norms, (un)conditional on occupations

Traditional

(a) Without occupation fixed effects

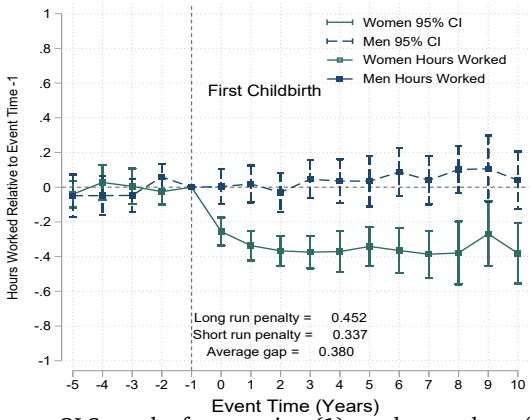


(b) With occupation fixed effects

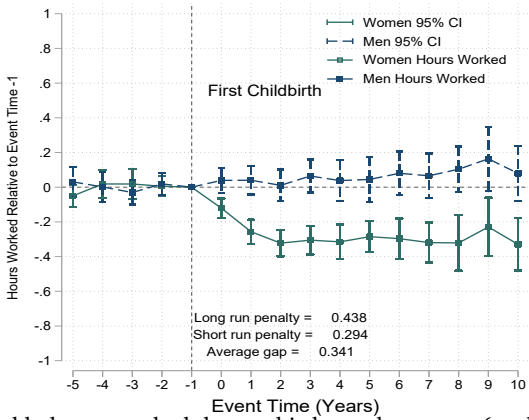


Egalitarian

(c) Without occupation fixed effects



(d) With occupation fixed effects



Notes: OLS results for equation (1) on the number of weekly hours worked, by pre-birth gender norms (traditional *versus* egalitarian). Figures (a) and (c) on the left hand side display results unconditional on occupation fixed effects, while figures (b) and (d) on the right hand side display results controlling for 2-digit occupation fixed effects.

4.6 Mobility Around Childbirth

Here, we aim to examine whether childbirth affects labor market mobility, considering mobility across occupations, industries, and sectors (private *versus* public). This analysis allows us to examine the dynamics of occupational sorting, in particular whether the latter precedes the first childbirth — and is therefore linked with pre-existing gender norms — or whether there is labor mobility around the first childbirth. If sorting precedes the first childbirth, rather than being a consequence of it, then this would corroborate our result on gender norms, suggesting that traditional women tend to choose occupations *prior to the birth* that

are more accommodating to family responsibilities compared to their egalitarian counterparts and men.

4.6.1 Occupations

First, we examine how the first childbirth affects job mobility. We measure occupations at 2-digit level, and further create a binary variable taking the value one if the individual changed occupation between $t-1$ and t; and zero otherwise. The event study results presented in the Appendix, Figure B.17, suggest no effect of the first childbirth on occupational mobility. We also descriptively examine in Table 6 the share of individuals working in family-friendlier occupations, based on our two constructed ranks, separately pre- and post-treatment considering different time-points. These are defined as follows: (i) post-birth ($t \geq 0$), (ii) pre-birth ($t < 0$), (iii) between five years and two years prior to parenthood ($t \in [-5; -2]$), and (iv) between two years prior to parenthood and ten years after ($t \in [-2; -10]$). Our descriptive analysis shows that, regardless of the time restriction, the share of individuals working in family-friendlier occupations varies only slightly. This suggests that sorting into specific occupations occurs mainly before the first childbirth, as there seems to be no job mobility induced by the first childbirth.

Table 6. Share of parents working in family-friendly occupations

	Mean	SD	Min	Max	N
Rank 1: working hours					
Post-birth: $t \geq 0$	0.500	0.500	0.000	1.000	5351
Pre-birth: $t < 0$	0.501	0.500	0.000	1.000	2939
$t \in [-5; -2]$	0.506	0.500	0.000	1.000	2302
$t \in [-2; 10]$	0.498	0.500	0.000	1.000	5988
Rank 2: part-time workers					
Post-birth: $t \geq 0$	0.484	0.500	0.000	1.000	3493
Pre-birth: $t < 0$	0.521	0.500	0.000	1.000	2660
$t \in [-5; -2]$	0.532	0.499	0.000	1.000	2177
$t \in [-2; 10]$	0.483	0.500	0.000	1.000	3976

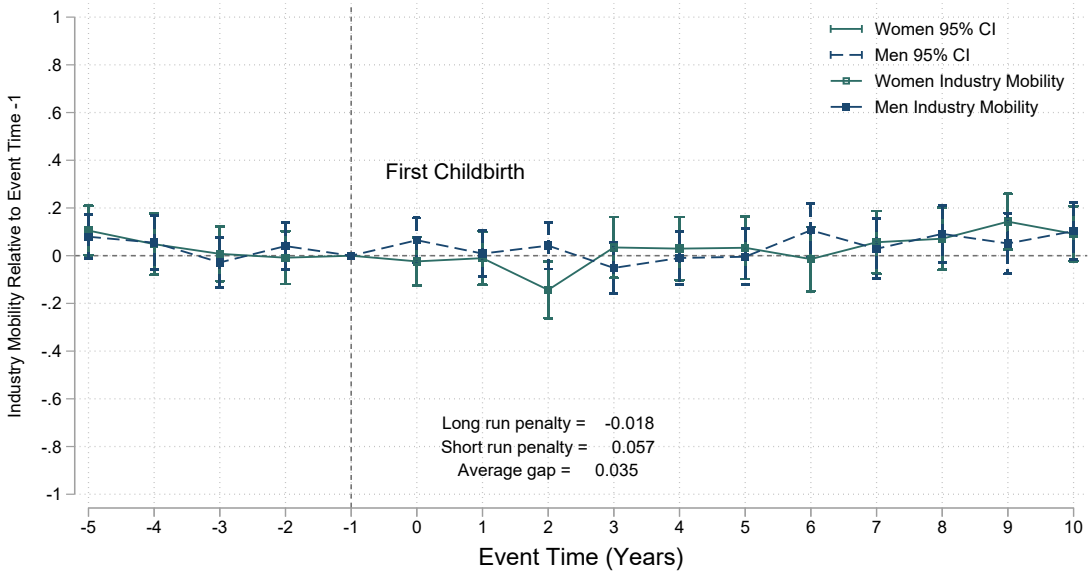
Notes: This table presents the share of individuals working in family-friendly occupations (as defined in Subsection 2.4) *i.e.*, in occupations with shorter working hours (rank 1) and higher shares of part-time workers (rank 2), at different time-points. These time-points represent the (i) post-birth ($t \geq 0$) and (ii) pre-birth ($t < 0$) periods, as well as (iii) between five years and two years prior to parenthood ($t \in [-5; -2]$), and (iv) between two years prior to parenthood and ten years after ($t \in [-2; -10]$).

4.6.2 Industry

The BHPS maintains a consistent 4-digit industry classification aligned with the UK Standard Industrial Classification (SIC), encompassing both the 1980 and 1992 versions across all

panel waves. To examine mobility between industries, we create a binary variable set to one if a respondent changed industry (reflected by a change in the 4-digit SIC code) between $t-1$ and t, and zero otherwise. We use this variable as an outcome and run our main event study specification (equation (1)). Figure 7 reports the results of this exercise, and points to no effect — as well as no difference by gender — of parenthood on mobility between industries. These findings suggest that individuals tend to sort into specific industries prior to their first childbirth, rather than changing the sector they work in as a consequence of becoming parents.

Figure 7. Impact of parenthood on mobility between industries



Notes: OLS results for equation (1) on a dummy variable equal to 1 if the participant changed industry (reflected by a change in the 4-digit SIC code provided in BHPS) between $t-1$ and t; 0 otherwise. This figure shows the estimated impact of having a first child on any mobility between industries. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

4.6.3 Public *versus* Private Sectors

Finally, we construct our main outcome to capture whether the respondent works in the public sector at time t, regardless of where they were working at time $t-1$.[25] We run this regression to investigate whether childbirth affects moving into the public sector, under the assumption that working in the public sector is associated with amenities such as shorter working hours, higher flexibility, and job security, and employment protection often preferred by workers

[25]This information is reported by BHPS respondents. In each wave the respondent is asked the following: "Do you work for a private firm or business or other limited company, or do you work for some other type of organisation?". We use this variable as opposed to the alternative variable indicating whether parents work in the private sector at time $t-1$ and in the public sector at time t, as the latter does not have enough variation. This occurs for fewer than 50 observations.

with care responsibilities (Chassamboulli and Gomes, 2023; Niederle and Vesterlund, 2007; Anghel, de la Rica, and Dolado, 2011). Our results are presented in Figure B.18 in the Appendix, and point to no effect of the first childbirth on sorting into the public sector, as well as no difference by gender. This further suggests that sorting into a specific sector, *e.g.* characterized by family-friendlier features, happens prior to becoming a parent.

5 Robustness Checks

In this section, we examine the robustness of our results to potential failures of the main assumptions. First, we run a placebo exercise that can help shed light on potential pre-trends or anticipation effects. Second, we employ the method developed by Sun and Abraham (2021) to account for potential heterogeneity in treatment effects. Finally, we examine the robustness of our main results to an alternative control group, using individuals who remain childless as control group.

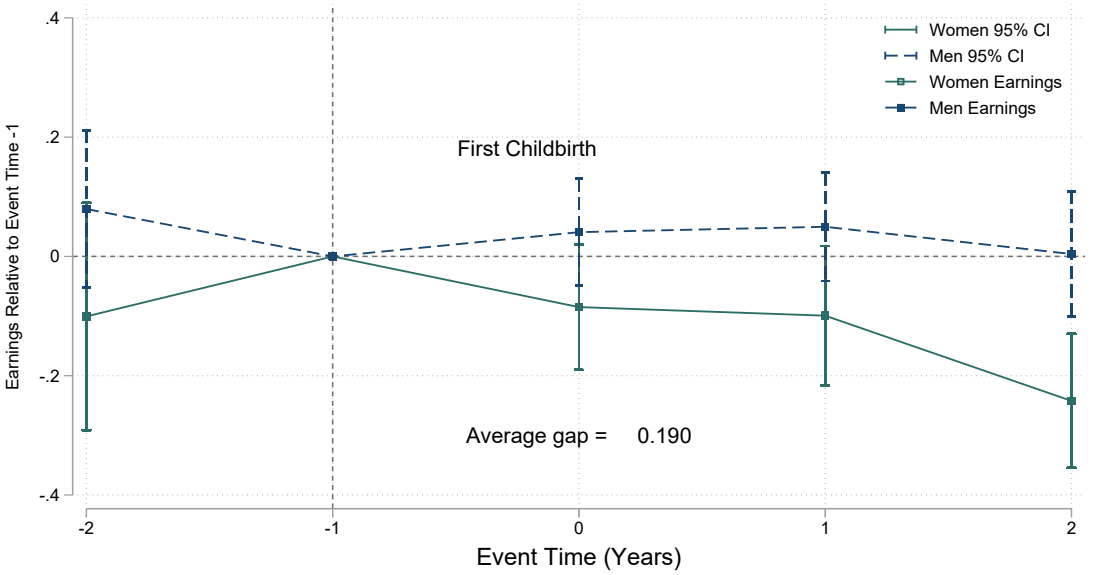
5.1 Pre-Trends

The main assumption behind an event study design is the parallel trends assumption. A common way to test for this is to investigate whether the treatment appears to have an effect on the outcome before it actually occurs (Freyaldenhoven, Hansen, and Shapiro, 2019). Therefore, we run a placebo event study regression, in which we set the event date to three years before the actual event, and exclude post-treatment observations, thus focusing on not-yet-parents over the period $[-5; 0]$.

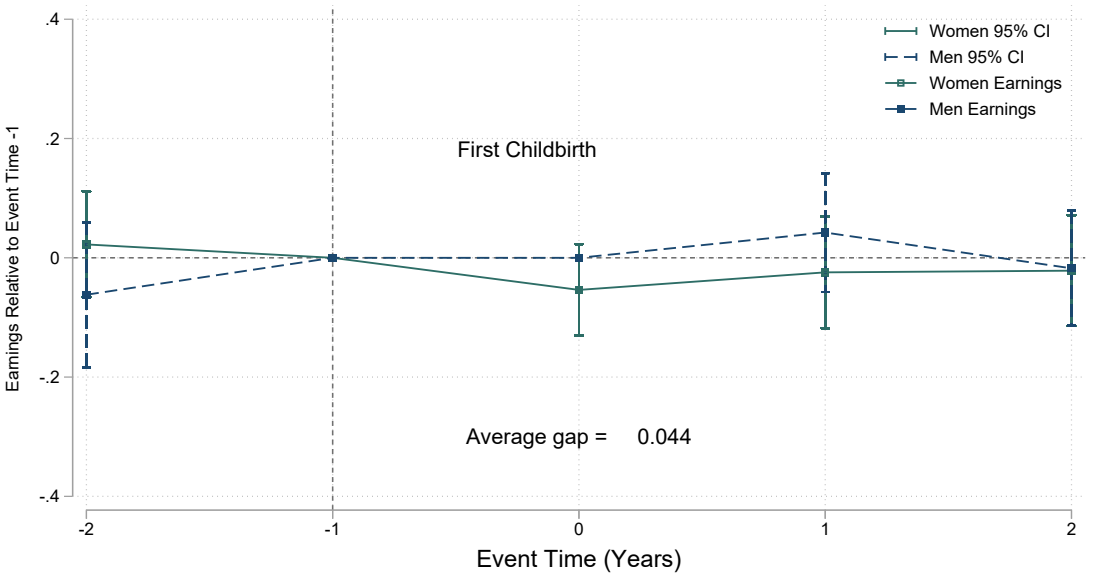
We can thus display the placebo test results (below in Figure 8) for the event window $[-2; 2]$ with $t = 0$ representing the event 'first childbirth'. We undertake this analysis for parents with both traditional and egalitarian gender norms before childbirth, to validate our main findings. The results of this placebo exercise suggest the absence of pre-trends, as well as no anticipatory behavior on the part of prospective parents, regardless of their gender norms pre-birth. None of the post-treatment point estimates are statistically different between men and women, across gender norms, ruling out potential failures of the parallel trends assumption.

Figure 8. Placebo test for the motherhood penalty in earnings, by pre-birth gender norms

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: OLS results of equation (1) on annual labor earnings for (a) traditional and (b) egalitarian parents, as defined in Subsection 2.4.2. This figure presents a placebo test for the motherhood penalty in earnings to test for the timing of fertility, where the first child year of birth has been set to 3 years prior the actual year of birth. For each $t \in [-2; 2]$ and gender g, we present the percentage effects of parenthood on earnings. The average gap represents, for $t \geq 0$, the mean of P_t.

5.2 Heterogeneous Treatment Effects

As mentioned in Section 3, our event study regressions provide the average effects, assuming an homogeneous treatment effect across all treated individuals and using not-yet-treated-parents as a control. A caveat of such setup is that the event can induce heterogeneous responses not accounted for by the standard event study set up we implemented, that can contaminate leads and lags by effects from other periods (Sun and Abraham, 2021).[26]

To verify that our results are not contaminated by heterogeneous treatment effects, we employ the interaction-weighted method developed by Sun and Abraham (2021). Figure B.20 in the Appendix report the results for labor earnings. We carry out this exercise separately for egalitarian and traditional parents, and pool different cohorts together to increase our control group's sample size.[27] Naturally, we expect different magnitudes of the motherhood penalty because the control group definition has changed. Yet, we should still observe i) a penalty in earnings, *i.e.*, a significant gender gap opening post-birth, and ii) parallel trends pre-birth. The results of this exercise align with our main results, indicating that traditional women suffer from a larger motherhood penalty in earnings compared to egalitarian women.

5.3 Difference-in-Differences Event Study

Here, we follow Kleven, Landais, and Søgaard (2019) and run an additional robustness check by employing individuals who remain childless as an alternative control group. This also allows us to assess potential gender-specific effects of parenthood. Those without children as of 2009 — the last observed year in our survey — are assigned "placebo" births based on the age distribution of first childbirth among parents. We provide additional methodological details in Subsection B.9 in the Appendix, along with the results stratified by the pre-birth indicator of gender norms attitudes. For the control group, this indicator is calculated across all (placebo) pre-birth years.

The difference-in-differences event study results for individuals with traditional attitudes are presented in Figure B.22, while those for egalitarian parents are shown in Figure B.23. Overall, they confirm the main findings outlined in Subsection 4.1, as per our primary specification (equation (1)). First, women, both with and without children, exhibit similar pre-trends but experience a clear divergence following the first childbirth notably in the short run. Second, men, whether parents or not, remain unaffected regardless of the timing of the event and regardless of their pre-birth gender norms, supporting the choice of using them as a appropriate control group for women. Finally, pre-existing gender norms contribute to the widening gap in earnings in the short-term observed among women, with traditional mothers experiencing a more pronounced and long-lasting decrease in earnings than egalitarian women.

[26] See Goodman-Bacon (2021); Callaway and Sant'Anna (2021); Roth et al. (2023), among others, for recent developments in this literature.

[27] The last treated cohort (*i.e.*, last "first childbirth" year) in our data is 2008, and contains only 30 observations for egalitarian parents, and 54 observations for traditional parents. We thus decided to pool together those with a first childbirth year equal to 2004, 2005, 2006, 2007 and 2008 to construct a larger control group.

6 Conclusion

Despite the implementation of various family policies — such as parental leave, or early childcare policies — the motherhood penalty remains persistent and large, and its heterogeneity across countries remains puzzling, not least regarding the factors that influence it (Kleven et al., 2024). In light of previous findings from this literature, this paper investigates how pre-birth gender norms shape women's occupational choices and labor market trajectories around motherhood. Using data from the BHPS, we employ an event study design, as first proposed by Kleven, Landais, and Søgaard (2019), to quantify the impact of motherhood on various labor market outcomes in the United Kingdom. We explore how these penalties vary across different factors commonly discussed in the literature.

First, we examine how pre-birth norms drive the magnitude of the motherhood penalty in earnings and hours worked. Traditional mothers experience an 18-percentage-point larger penalty in earnings and a 20-percentage-point larger penalty in hours worked compared to egalitarian mothers. Gender norms can therefore guide the labor supply responses of mothers and serve as a marker for their labor market attachment, pointing to larger gaps for traditional women due to their preference for shorter working hours (Mensinger and Zimpelmann, 2024).

Second, we explore alternative drivers of penalties through relative comparative advantages in productivity within couples. Our findings show that, particularly when the difference in comparative advantage within couples is large, the earnings penalty increases for women whose partner had a comparative advantage in the labor market prior to the first childbirth. This pattern is distinctly different across pre-birth gender norms, and women with more egalitarian norms drive responses to comparative advantage. Therefore, we argue that more egalitarian parents may prioritize the market work of the parent with the greater comparative advantage to rationally maximize household income, while this mechanism does not seem to apply to traditional parents. To the best of our knowledge, this finding is novel in the literature, and speaks to the literature on motivated beliefs. Our results therefore support the interpretation of gender norms as narratives families may want to pursue (Akerlof and Rayo, 2020), guiding behaviors in line with these beliefs to derive a greater utility (Bénabou and Tirole, 2016).

Finally, we examine the role of occupational features, such as family-friendliness, in explaining motherhood penalties, and illustrate the significance of pre-birth gender norms in shaping occupational preferences, and sorting patterns *pre-birth*. We find that occupational characteristics explain about 19% of the overall gender gap in earnings that emerges after parenthood, with distinctive patterns across gender norms. On the one hand, accounting for occupational sorting reduces the *average* motherhood earnings penalty by $13pp$ for traditional mothers and $12pp$ for egalitarian mothers, with the reduction entirely driven by hours worked for traditional mothers. On the other hand, in the short-run, occupational sorting accounts for 80% of the earnings penalty gap between the traditional and egalitarian women,

and fully eliminates the difference in hours worked penalties. These results suggest that traditional women sort into occupations more conducive to balancing family responsibilities, that in turn have a substantial impact on their earnings trajectory upon motherhood. We then find no evidence of mobility across occupations or industries, nor changes in gender norms across genders from before to after the first childbirth, suggesting that pre-birth gender norms drive a degree of occupational sorting *prior* to the first childbirth — further explaining part of the differences in post-childbirth experiences between traditional and egalitarian women.

These results hold significant implications for policies that aim at reducing post-birth gaps in the labor market, particularly between traditional and egalitarian women. These policies can remain ineffective if they do not consider the influence of norms and beliefs on pre-birth sorting into specific occupations, and how they contribute to the overall earnings gaps.

Our main findings remain robust across various checks, including a placebo test, heterogeneous treatment effects, and an alternative definition of our control group. Yet, our survey data have limitations when it comes to exploring in more details occupational sorting, and job characteristics. We provide a descriptive analysis using the UK Labour Force Survey, suggesting that more traditional women tend to sort pre-birth into 'family-friendly' jobs — characterized by higher proportions of part-time workers and shorter working hours. More detailed data on occupational characteristics will allow further research to examine more in depth the contribution of occupational sorting, and job features in the motherhood penalty.

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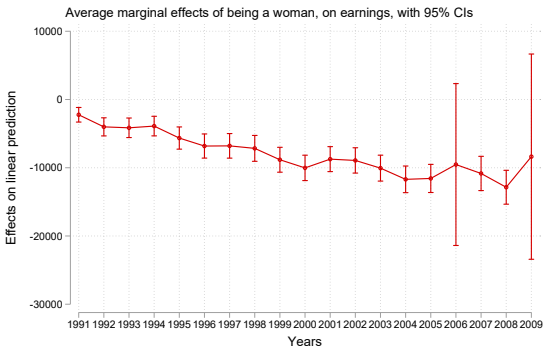
Appendix

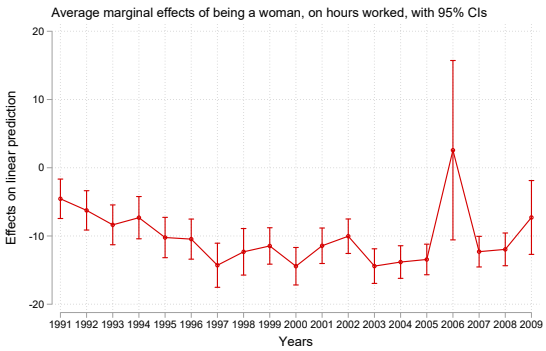
A Additional Descriptive Statistics

Figure A.1. Evolution of labor market outcomes, by gender

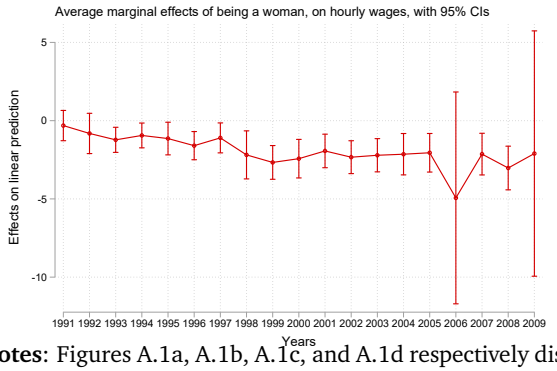
(a) Labor earnings



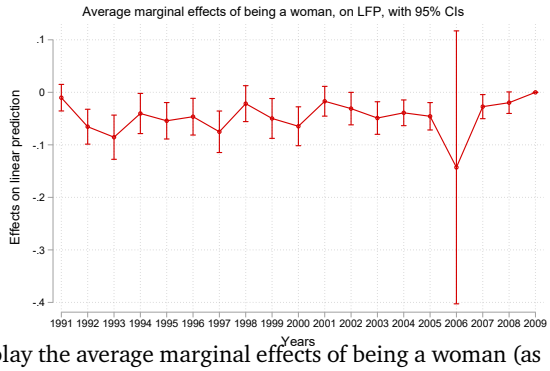
(b) Weekly hours worked



(c) Hourly wages



(d) Labor force participation



Notes: Figures A.1a, A.1b, A.1c, and A.1d respectively display the average marginal effects of being a woman (as opposed to a man) on annual labor earnings, the weekly number of hours worked (excluding overtime), hourly wages, and labor force participation (LFP) for our analytical sample. Specifically, we regress our labor market outcomes on an indicator for being a woman, controlling for year fixed effects. The spikes arising for certain years (*e.g.*, 2006) are explained by the low ($N < 10$) sample sizes for these specific years driven by our sample restrictions.

Table A.1. Summary statistics for the analytical sample, by gender

	Men	Women	Diff. (Men – Women)	S.E.	N
Age	34.839	33.444	1.395***	0.145	8350
Age at parenthood	32.864	31.899	0.965***	0.095	8350
First child age	3.527	3.344	0.183**	0.093	8350
Second child age	2.162	2.275	-0.113	0.095	5086
Household size	3.054	2.945	0.109***	0.024	8350
Number of children	1.798	1.715	0.083***	0.016	8350
Education					
Primary	0.049	0.028	0.021***	0.004	8350
Low secondary	0.054	0.024	0.031***	0.004	8350
Low secondary/vocational	0.234	0.282	-0.049***	0.010	8350
High secondary/vocational	0.138	0.115	0.023***	0.007	8350
Higher vocational	0.234	0.255	-0.021**	0.009	8350
First degree	0.232	0.253	-0.021**	0.009	8350
Higher degree	0.058	0.043	0.015***	0.005	8350
Marital status					
Never married	0.229	0.259	-0.030***	0.009	8347
Married	0.697	0.668	0.029***	0.010	8347
In a civil partnership	0.000	0.000	-0.000	0.000	8347
Separated	0.019	0.024	-0.005*	0.003	8347
Divorced	0.053	0.047	0.006	0.005	8347
Widowed	0.003	0.001	0.001	0.001	8347

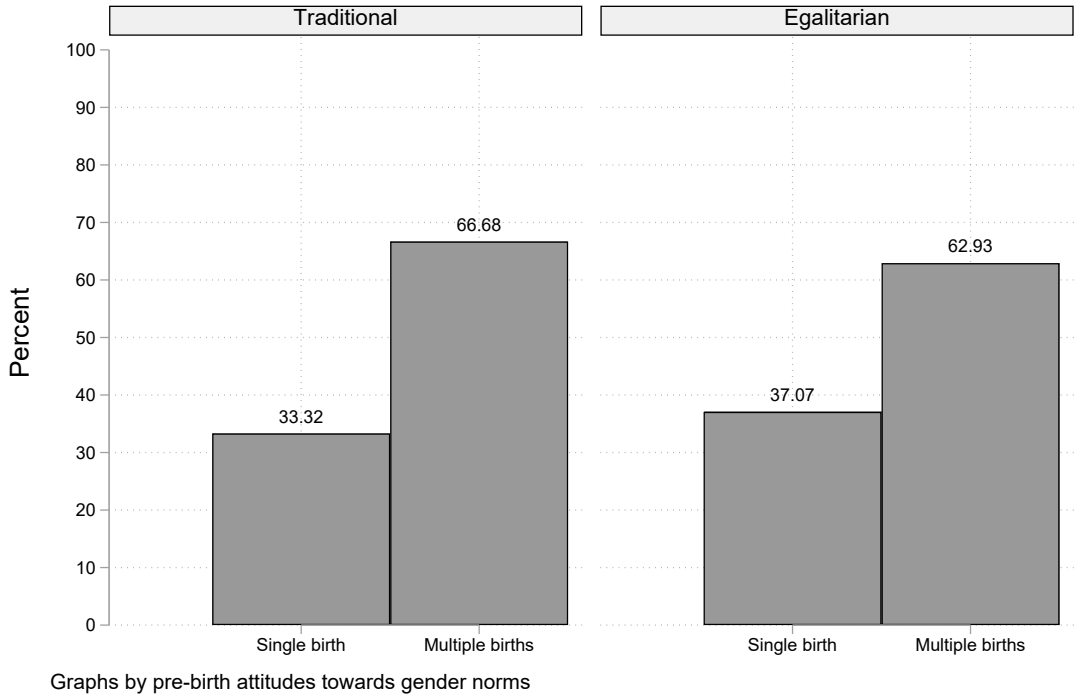
Notes: Summary statistics for our analytical sample, by respondent's gender. * p <0.10; ** p <0.05, *** p <0.01. Levels of educational attainment follow ISCED coding, *i.e.*, Primary — level 1; Low secondary — levels 2A/B; Low secondary/vocational — level 3C; High secondary/vocational — level 3A; Higher vocational — level 5B; First degree — level 5A; Higher degree — level 6.

Table A.2. Summary statistics for the analytical sample, by pre-birth gender norms

	Traditional	Egalitarian	(Trad. – Egal.)	S.E.	N
Age	34.172	34.235	-0.063	0.147	8281
Age at parenthood	32.544	32.333	0.211**	0.096	8281
First child age	3.321	3.563	-0.241***	0.093	8281
Second child age	2.207	2.236	-0.029	0.096	5022
Household size	2.994	3.010	-0.016	0.024	8281
Number of children	1.769	1.738	0.031*	0.016	8281
Education					
Primary	0.047	0.032	0.014***	0.004	8281
Low secondary	0.044	0.036	0.008*	0.004	8281
Low secondary/vocational	0.290	0.223	0.068***	0.010	8281
High secondary/vocational	0.125	0.130	-0.005	0.007	8281
Higher vocational	0.259	0.231	0.028***	0.009	8281
First degree	0.187	0.298	-0.110***	0.009	8281
Higher degree	0.048	0.050	-0.002	0.005	8281
Marital status					
Never married	0.246	0.244	0.002	0.009	8278
Married	0.684	0.681	0.003	0.010	8278
In a civil partnership	0.000	0.000	-0.000	0.000	8278
Separated	0.024	0.019	0.006*	0.003	8278
Divorced	0.043	0.056	-0.014***	0.005	8278
Widowed	0.004	0.000	0.004***	0.001	8278

Notes: Summary statistics for our analytical sample, by respondent's pre-birth gender norms. * p <0.10; ** p <0.05, *** p <0.01. Levels of educational attainment follow ISCED coding, see Table A.1 for a detailed description of categories.

Figure A.2. Distribution of single *versus* multiple births, by pre-birth gender norms



Notes: This figure presents the distribution of single *versus* multiple births by respondent's pre-birth gender norms.

B Additional Results

B.1 The Motherhood Penalty in the UK

Before diving into the factors influencing the motherhood penalty, we replicate the findings of Kleven et al. (2019) for the motherhood penalty in earnings in the UK on our analytical sample,[1] and further explore the components of labor earnings contributing to the motherhood penalty. First, before running our main specification outlined in our main specification (equation (1)), we present below the gendered trajectories of annual labor earnings in the post-birth period, by employing the following standard pooled difference-in-differences (DiD) model:

$$Y_{iat} = \alpha + \beta W_i + \theta D_{it} + \gamma_a + \lambda_t + v_{iat} \tag{6}$$

Where α is the intercept, W_i is a dummy variable for gender and is equal to 1 if the individual is a woman, and D_{it} is our treatment indicator equal to 1 if the individual is a woman and has a child in time t, and 0 otherwise. Additionally, γ_a and λ_t are respectively age, and year fixed effects. OLS results of the DiD model are presented in Table B.1 below. We are interested here in the magnitude of $\hat{\theta}$ — the average effect of having a child on women's earnings relative to men's, *i.e.*, the average motherhood penalty. Given that we do not condition on employment in the post-birth period, the labor earnings can include zeros. To express this average effect in percentage, we follow Chen and Roth (2023), and normalize the average effect by the baseline mean — here, the average labor earnings, for women, in the pre-birth period. Our first results suggest that being a mother is associated with a 59% loss of their annual labor earnings compared to fathers, while controlling for age, and time effects. These estimates thus point to suggestive evidence of a strong penalty in the labor market from being a mother with respect to being a father.

[1] Note that our analytical sample differs slightly from that of Kleven et al. (2019) due to our requirement of having at least one pre-treatment (pre-birth) observation in which the respondent reported positive labor earnings.

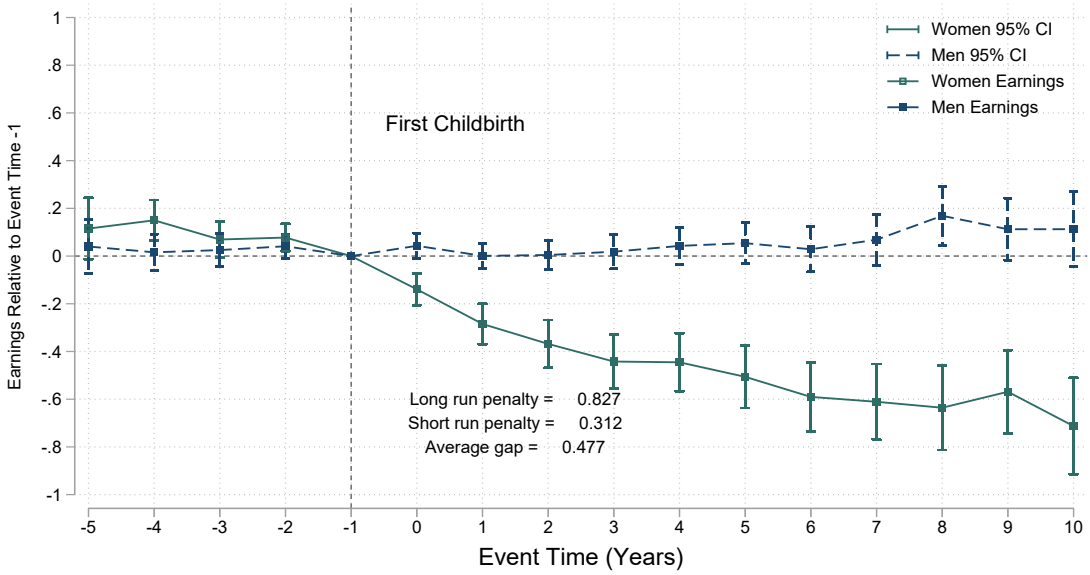
Table B.1. Post-birth gendered trajectory of earnings

	Annual Labor Earnings
Post	1361.975**
	(624.944)
Woman	-2558.248***
	(584.245)
Woman × Post	-7989.865***
	(775.178)
Observations	8350
Normalized Average Effect (%)	-58.61
Year Fixed Effects	Yes
Age Fixed Effects	Yes

Notes: OLS results for equation (6) on our analytical sample defined in Subsection 2.3. The 'post' variable is dummy set to 1 if $t \geq 0$, corresponding to the post-childbirth period. The normalized average effect is expressed in percentage (%) and corresponds to the estimated average effect ($\hat{\theta}$) divided by women's pre-birth average labor earnings (baseline mean).

We then turn to our main specification (equation (1)) to quantify the impact of having a child on working-parents' labor earnings, and present our results graphically in Figure B.1 below. Some interesting trends emerge from this and confirm both the DiD results presented above, and those presented in the existing literature for the UK (*e.g.*, Kleven et al., 2019). Indeed, prior to the first childbirth, the evolution of men's and women's labor earnings follows a similar pattern, with no notable gender difference. This is evidenced by point estimates that are close to zero and lack statistical significance. Yet, right after the first childbirth, women (now mothers) experience a sharp and long-lasting drop in earnings, while men are unaffected. In particular, women undergo a decline in labor earnings in the 10-year period following parenthood by approximately 48%, as compared to men. Our results are qualitatively consistent with those estimated by Kleven et al. (2019) for the UK and of similar magnitude.[2]

Figure B.1. Impact of parenthood on earnings



Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in annual labor earnings. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

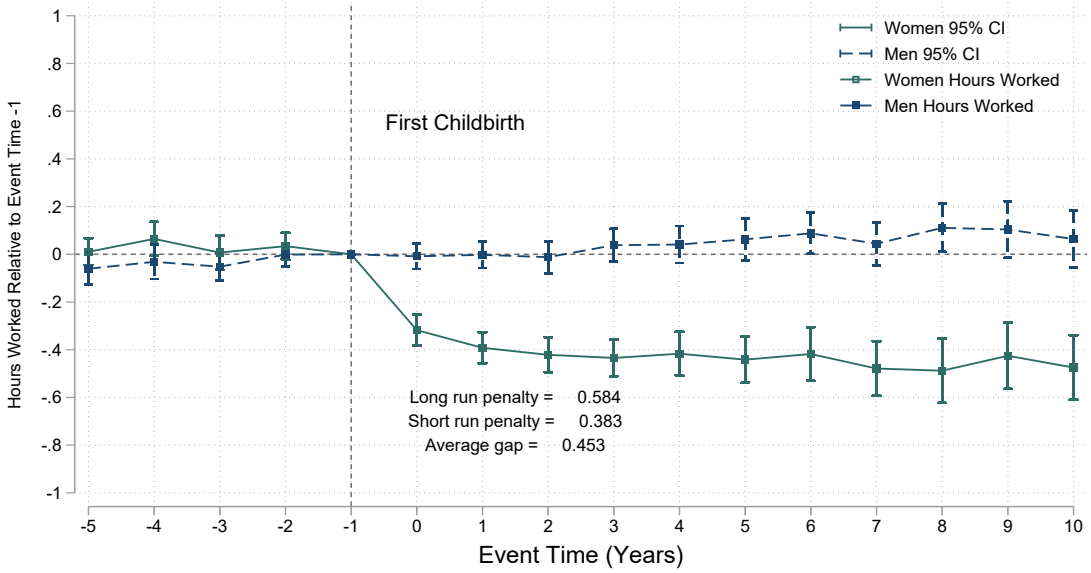
We now focus on disentangling the drivers of the labor earnings effects by looking at the different components of labor earnings. We estimate equation (1) on weekly hours worked (Figure B.2), hourly wages (Figure B.3), and labor force participation (Figure B.4). Our findings indicate that changes in the intensive margin of labor supply primarily underlie the effects on labor earnings. Additionally, changes in labor force participation in the short term

[2]In Kleven et al. (2019), without conditioning on working at least once pre-birth, the average gap in earnings opening after childbirth is also equal to 44%.

and hourly wages in the long term also contribute to the motherhood penalty in earnings, albeit to a lesser degree.

Hours worked. Our findings for the penalty in weekly hours worked closely mirror those observed for labor earnings, indicating a decline of around 45% for women compared to men.

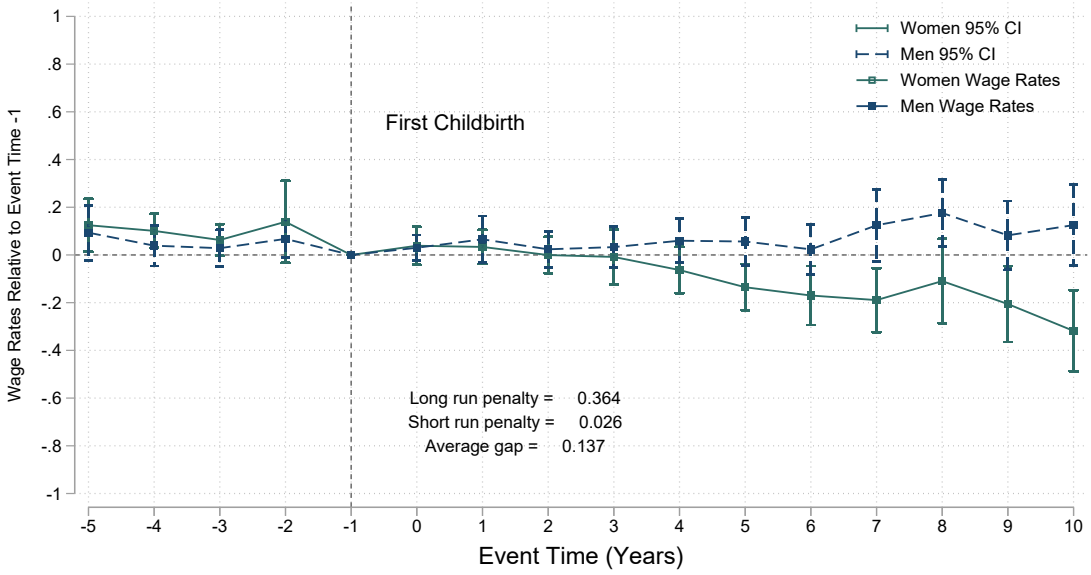
Figure B.2. Impact of parenthood on hours worked



Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in weekly hours worked excluding overtime hours. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Hourly wages. Our results show no motherhood penalty in hourly wages in the short run, but a significant 36% in the long run, *i.e.*, at least 7 years after the first childbirth.

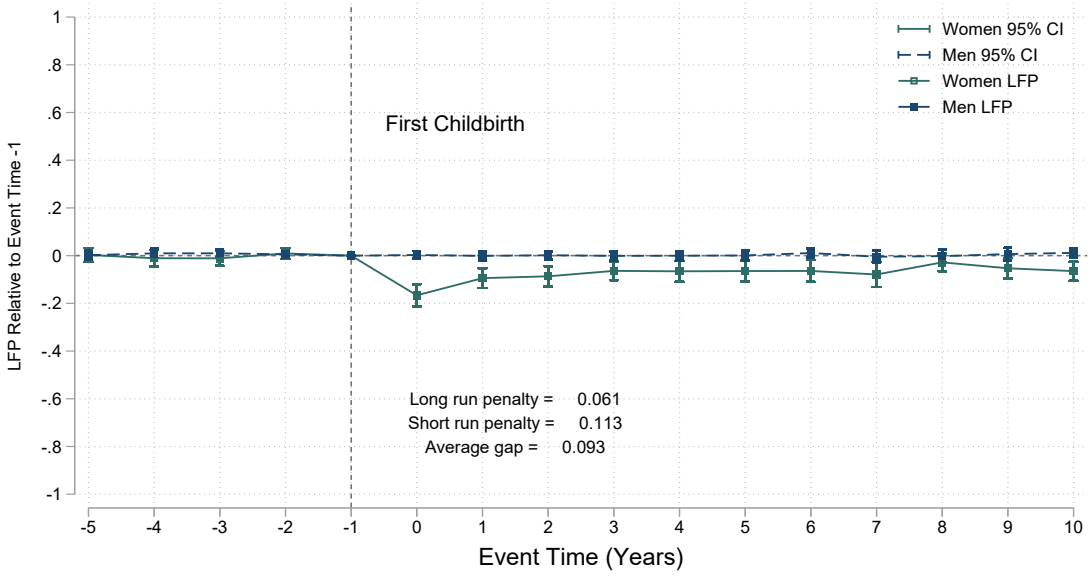
Figure B.3. Impact of parenthood on hourly wages



Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in hourly wages (wage rates). The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Labor force participation. Our results indicate a relatively low (9%) average gap, which also fades away in the long term. However, note that the results on labor force participation must be considered with caution as our sample is restricted to parents that have been employed (*i.e.*, reported positive labor earnings) for at least one year prior to the first childbirth.

Figure B.4. Impact of parenthood on labor force participation

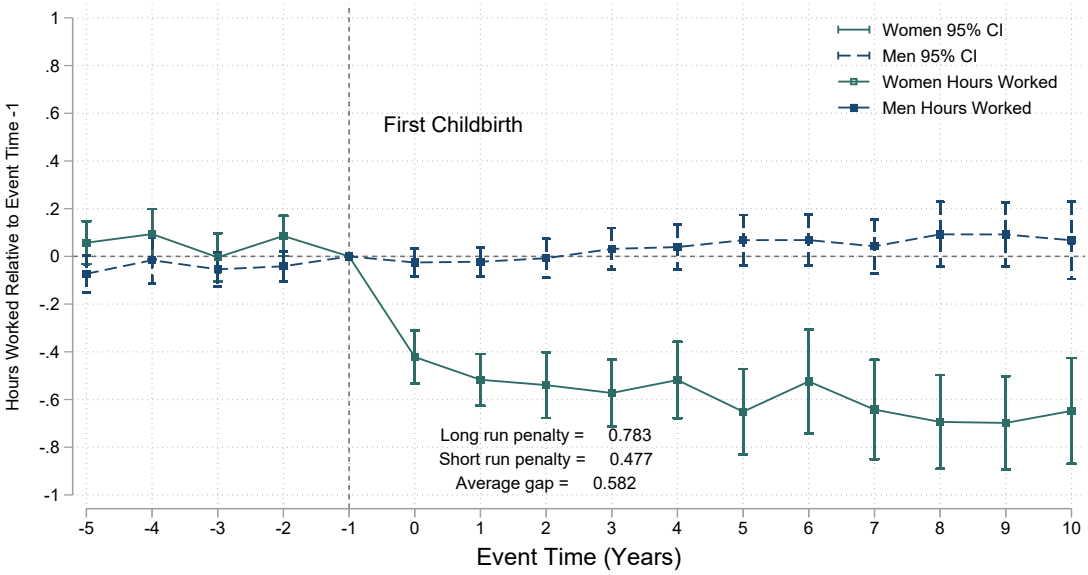


Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in labor force participation (LFP). LFP is a dummy set to 1 if the individual is either self-employed, employed, unemployed, or on maternity leave. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10. LFP stands for labor force participation. The relatively low gaps are partially due to the sample restriction on parents being employed (*i.e.*, reported positive labor earnings) for at least one year prior to the first childbirth.

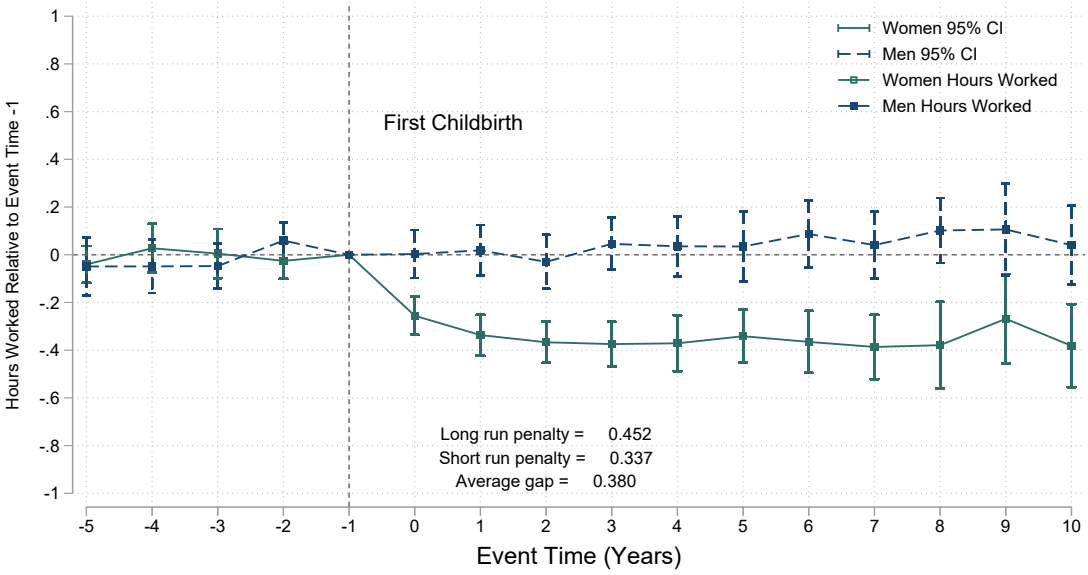
B.2 Pre-Birth Gender Norms

Figure B.5. Impact of parenthood on hours worked, by pre-birth gender norms

(a) Traditional pre-birth



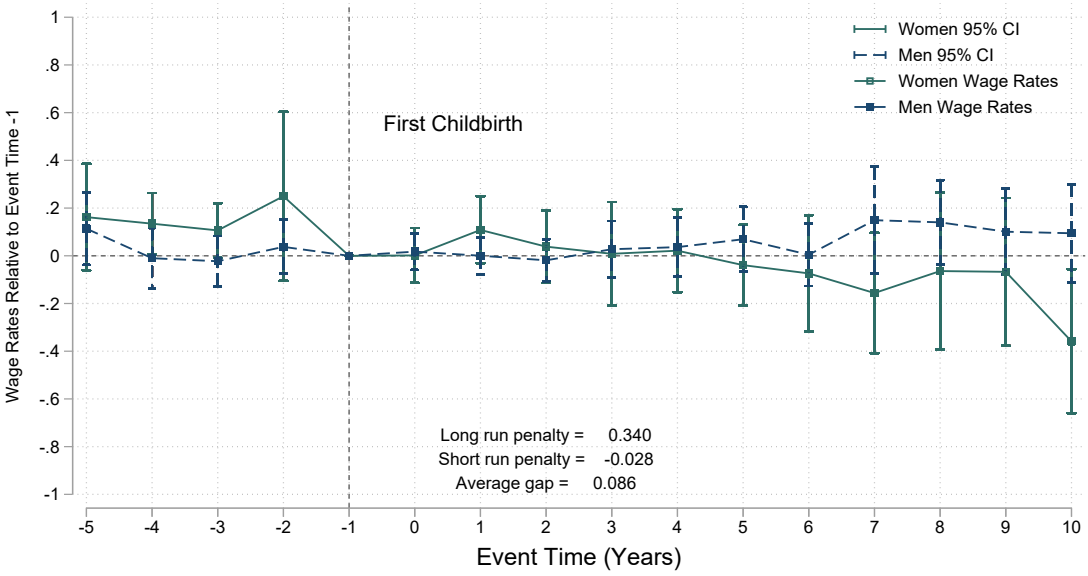
(b) Egalitarian pre-birth



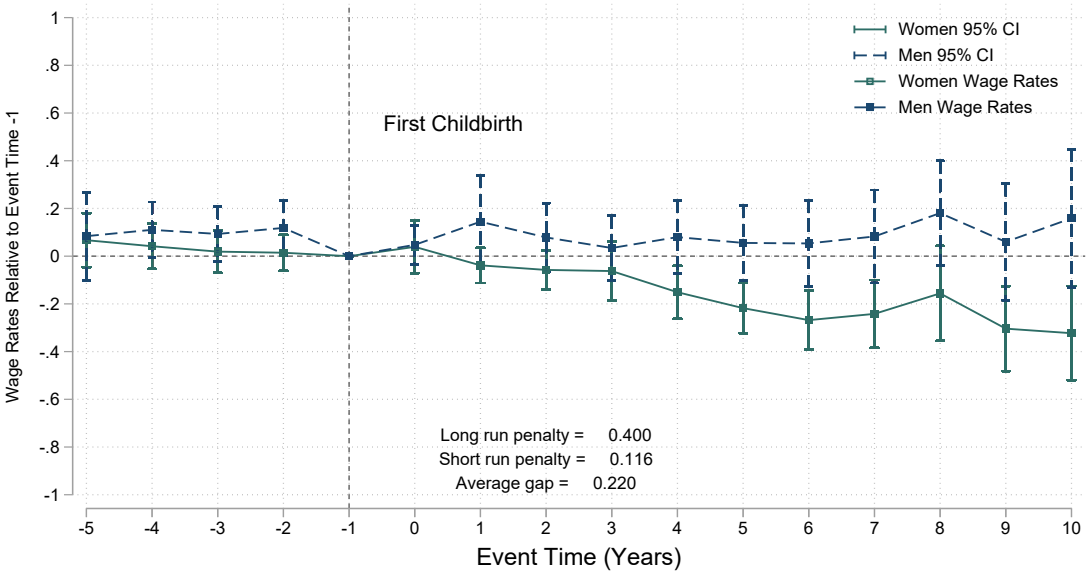
Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in weekly hours worked for parents with pre-birth (a) traditional and (b) egalitarian norms, as defined in Subsection 2.4.2. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.6. Impact of parenthood on hourly wages, by pre-birth gender norms

(a) Traditional pre-birth



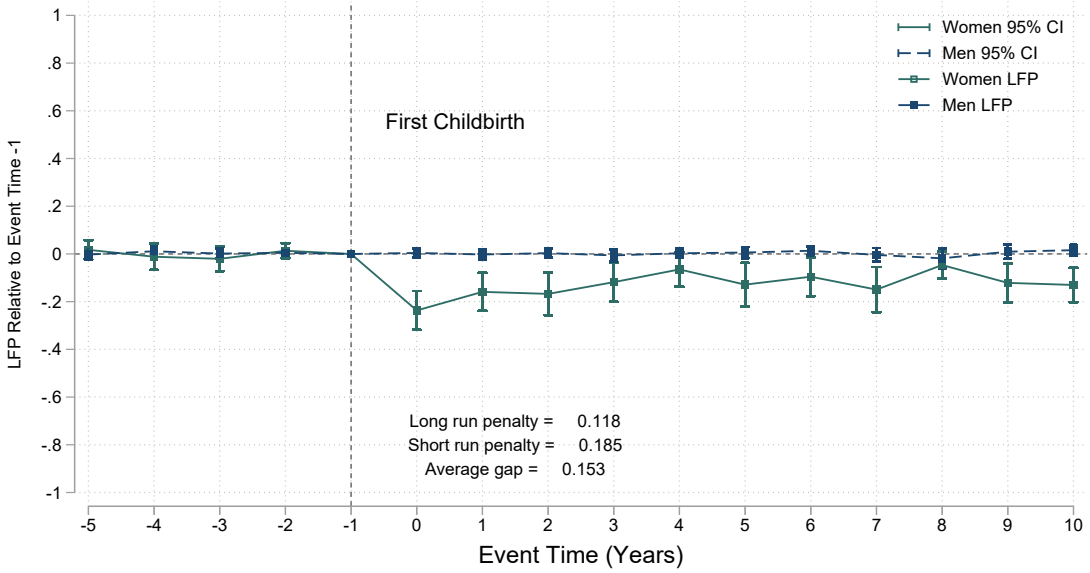
(b) Egalitarian pre-birth



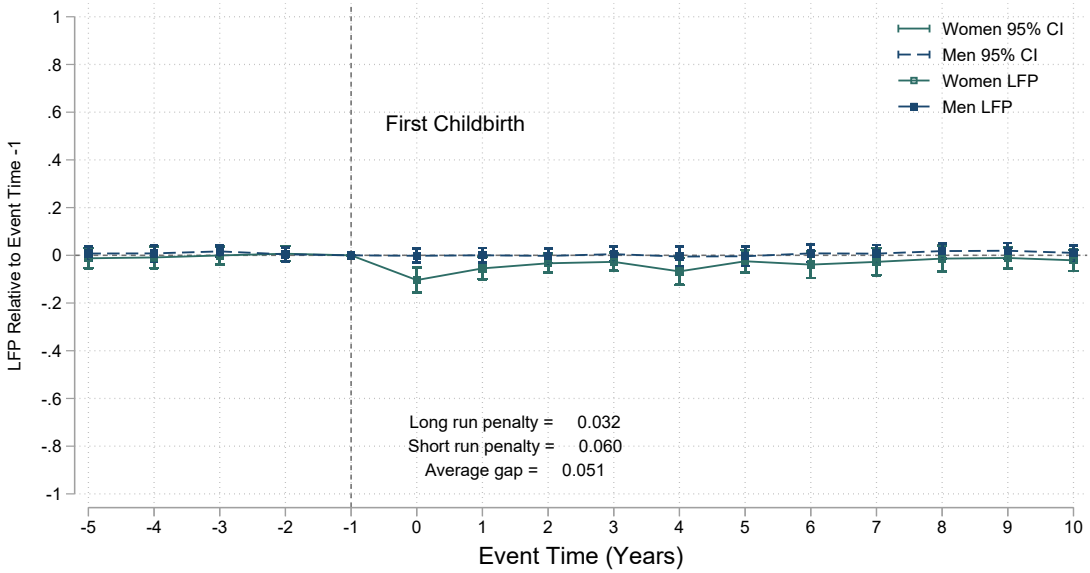
Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in hourly wages for parents with pre-birth (a) traditional and (b) egalitarian norms, as defined in Subsection 2.4.2. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.7. Impact of parenthood on labor force participation, by pre-birth gender norms

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: OLS results for equation (1) on our analytical sample defined in Subsection 2.3 presented alongside the motherhood penalties (short, long and average gaps) in labor force participation (LFP) for parents with pre-birth (a) traditional and (b) egalitarian norms, as defined in Subsection 2.4.2. LFP is a dummy set to 1 if the individual is either self-employed, employed, unemployed, or on maternity leave. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10. LFP stands for labor force participation. The relatively low gaps are partially due to the condition imposed on parents, for working at at least one year prior to the birth.

B.3 The Interplay Between Family Commitments and Employment

We focus here on how family commitments can affect jobs on various aspects, with a gender dimension. We expect women to over-report (compared to men) such situation, and especially if they hold traditional norms. Table B.2 below presents descriptive evidence by gender for such variables provided in BHPS. Unsurprisingly, women tend to report a significantly higher number of family commitments affecting their employment, compared to men. Specifically, nearly 8% of women indicate that family commitments have resulted in reduced working hours. Consequently, various forms of family commitments appear to have a noticeable effect on women's employment, whereas they seem to pose a considerably lesser challenge for men. As a result, these job-related decisions interacted with family commitments can significantly influence women's career trajectories and lead to larger gender inequalities in response to childbirth.

We further anticipate that these decisions vary depending on their gender norms. We provide descriptive evidence by pre-birth gender norms in Table B.3 below, for the full sample (Panel A) and for women only (Panel B). First, we observe a noteworthy distinction between traditional and egalitarian parents in the way family commitments interact with the number of hours worked. This may be attributed to the fact that, on average, egalitarian parents work longer hours than traditional ones, thus having a larger margin to reduce their working hours. Second, shifting our attention to women specifically, we see that family commitments required traditional women to leave jobs significantly more than their egalitarian counterparts, but also prevented job search. Thus, family commitments appear to hinder traditional women from taking up new employment opportunities, implying a lower level of job mobility for them.

Lastly, Table B.4 below explores the relationship between family commitments and women's employment, categorized by the type of occupation held pre-birth defined in Subsection 2.4.3. We display below results for the "working hours" index. Our findings show that women in occupations with shorter working hours report significantly more family commitments that interact with their working hours. This relationship may be due to the greater flexibility of shorter-hours occupations, which allows women to adjust their hours as needed, particularly when they have family obligations.

Table B.2. Interaction between family commitment(s) and job, by gender

	Men	Women	Diff. (Men – Women)	S.E.	N
Any family commitment affected job	0.0504	0.1903	-0.1400***	0.0112	3076
Family commitment prevented job search	0.0174	0.0768	-0.0594***	0.0074	3073
Family commitment prevented taking job	0.0072	0.0399	-0.0327***	0.0053	3070
Family commitment prevented job change	0.0210	0.0456	-0.0245***	0.0064	3070
Family commitment required job change	0.0090	0.0349	-0.0259***	0.0052	3068
Family commitment required leaving job	0.0042	0.0605	-0.0563***	0.0061	3070
Family commitment led to less working hours	0.0156	0.0826	-0.0669***	0.0075	3070

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the means of variables related to the interaction between family commitments and job, by gender.

Table B.3. Interaction between family commitment(s) and job, by pre-birth gender norms

	Traditional	Egalitarian	Diff. (Trad. – Egal.)	S.E.	N
Panel A: full sample					
Any family commitment affected job	0.1100	0.1166	-0.0066	0.0115	3058
Family commitment prevented job search	0.0500	0.0364	0.0136*	0.0074	3055
Family commitment prevented taking job	0.0207	0.0240	-0.0034	0.0054	3052
Family commitment prevented job change	0.0301	0.0323	-0.0022	0.0063	3052
Family commitment required job change	0.0188	0.0234	-0.0046	0.0052	3051
Family commitment required leaving job	0.0338	0.0261	0.0077	0.0062	3052
Family commitment led to less working hours	0.0351	0.0570	-0.0219***	0.0075	3052
Panel B: women only					
Any family commitment affected job	0.2088	0.1713	0.0375*	0.0210	1401
Family commitment prevented job search	0.1013	0.0546	0.0467***	0.0142	1399
Family commitment prevented taking job	0.0376	0.0419	-0.0043	0.0106	1398
Family commitment prevented job change	0.0426	0.0445	-0.0019	0.0110	1398
Family commitment required job change	0.0344	0.0356	-0.0012	0.0099	1398
Family commitment required leaving job	0.0835	0.0432	0.0403***	0.0128	1398
Family commitment led to less working hours	0.0687	0.0915	-0.0227	0.0148	1398

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the means of variables related to the interaction between family commitments and job, for our analytical sample (Panel A) and for women only (Panel B).

Table B.4. Interaction between family commitment(s) and job, for women, by type of occupation

	Longer-hours	Shorter-hours	Diff. (Longer – Shorter)	S.E.	N
Any family commitment affected job	0.1770	0.2119	-0.0349	0.0220	1401
Family commitment prevented job search	0.0732	0.0806	-0.0074	0.0149	1399
Family commitment prevented taking job	0.0394	0.0393	0.0001	0.0109	1398
Family commitment prevented job change	0.0339	0.0682	-0.0343***	0.0117	1398
Family commitment required job change	0.0306	0.0435	-0.0128	0.0104	1397
Family commitment required leaving job	0.0656	0.0475	0.0181	0.0133	1398
Family commitment led to less working hours	0.0701	0.1072	-0.0371**	0.0155	1398

Notes: * p <0.10; ** p <0.05, *** p <0.01. This table presents the means of variables related to the interaction between family commitments and job, for our analytical sample by type of occupation defined in Subsection 2.4.3. Specifically, longer-hours occupations refer to occupations above the median of the number of working hours across occupations, while shorter-hours occupations are the ones below the median.

B.4 Pre-Birth Comparative Advantage

Table B.5. Impact of parenthood on earnings, by pre-birth comparative advantage

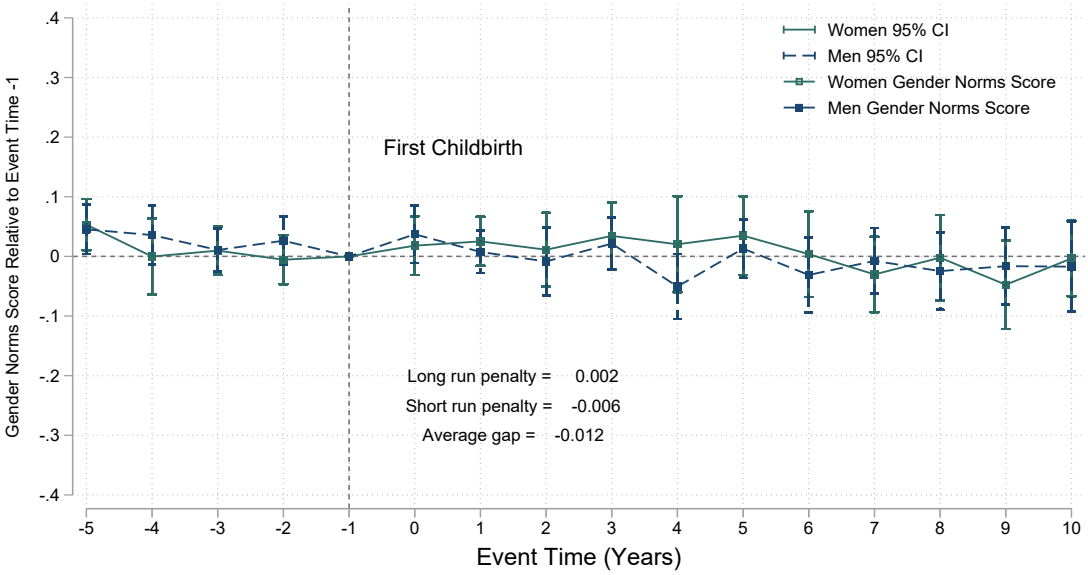
	No Trimming		Trimming 45-55 Percentiles		Trimming 30-70 Percentiles	
	(1)	(2)	(3)	(4)	(5)	(6)
	Man has C.A.	Woman has C.A.	Man has C.A.	Woman has C.A.	Man has C.A.	Woman has C.A.
Post	2010.218***	526.192	3361.518***	-361.573	3396.829***	39.076
	(741.326)	(1144.011)	(866.206)	(1368.415)	(924.391)	(1863.618)
Woman	-4188.921***	-70.111	-5021.481***	1499.120	-5764.594***	1987.606
	(681.236)	(1023.816)	(762.161)	(1377.497)	(856.253)	(1725.659)
Woman × Post	-8540.921***	-6945.492***	-9483.866***	-5552.221***	-9740.908***	-4532.034**
	(940.650)	(1333.321)	(1057.296)	(1792.665)	(1204.894)	(2227.387)
Observations	5034	3316	4074	2287	3333	1617
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: * p <0.10; ** p <0.05, *** p <0.01. OLS results for equation (6) on annual labor earnings, further split by the pre-birth comparative advantage indicator. We display results for the full distribution of the pre-birth wage difference in columns (1) and (2). In addition, we drop observations between the 45^{th} and 55^{th} percentiles of this distribution in columns (3) and (4), and we drop observations between the third and seventh decile of this distribution in columns (5) and (6). C.A. stands for comparative advantage.

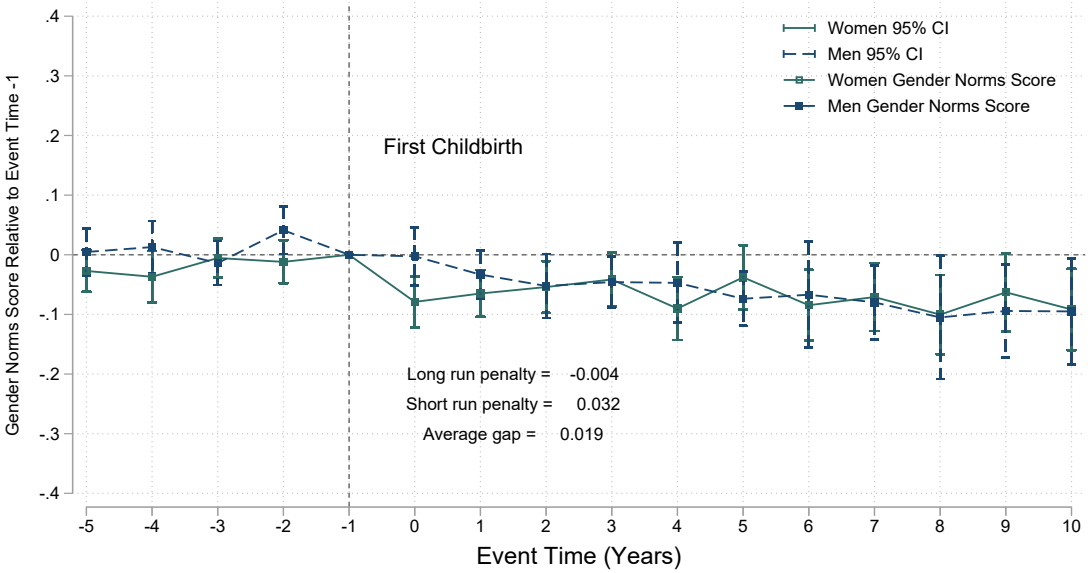
B.5 Gender Norms Around Childbirth

Figure B.8. Impact of parenthood on gender norms, by pre-birth gender norms

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: OLS results for equation (1) on the gender norms score, for (a) individuals with traditional and (b) egalitarian gender norms pre-birth — as defined in Subsection 2.4.2 — to investigate the impact of the first childbirth on gender norms. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

B.6 Occupational Characteristics

B.6.1 Differences Between Occupations

Below are the results of equation (6) on earnings unconditional (column 1) and conditional (column 2) on occupation fixed effects.

Table B.6. Post-birth gendered trajectory of labor earnings

	Annual Labor Earnings	
	(1)	(2)
Woman	-2558.248***	-2322.985***
	(584.245)	(542.065)
Post	1361.975**	2147.064***
	(624.944)	(553.801)
Woman × Post	-7989.865***	-7436.672***
	(775.178)	(685.697)
Observations	8350	7980
Year Fixed Effects	Yes	Yes
Occupational Fixed Effects	No	Yes
Age Fixed Effects	Yes	Yes
Normalized Average Effect (%)	-58.61	-54.55

Notes: * p <0.10; ** p <0.05, *** p <0.01. OLS results for equation (6) on our analytical sample unconditional (column 1) and conditional on occupation fixed effects. The 'post' dummy takes the value 1 if $t \geq 0$, and corresponds to the post-childbirth period. The normalized average effect corresponds to the estimated average effect ($\hat{\theta}$) divided by the baseline mean *i.e.*, women's pre-birth average labor earnings.

B.6.2 Family-Friendly Occupations

We present below our main event study regression on labor earnings, hours worked, and hourly wages, stratified by our three measures reflecting occupations' family-friendliness pre-birth to further investigate if there is any heterogeneity in the motherhood penalty. Overall, our results, based on our two measures reflecting pre-birth occupational characteristics and their family-friendliness, point to no significant effect of such characteristics in shaping the overall magnitude of the motherhood penalty. Our conclusions are in line with Costa Dias, Joyce, and Parodi (2020) and suggest that differences in job characteristics only partially explain the different magnitudes of the overall motherhood penalty.

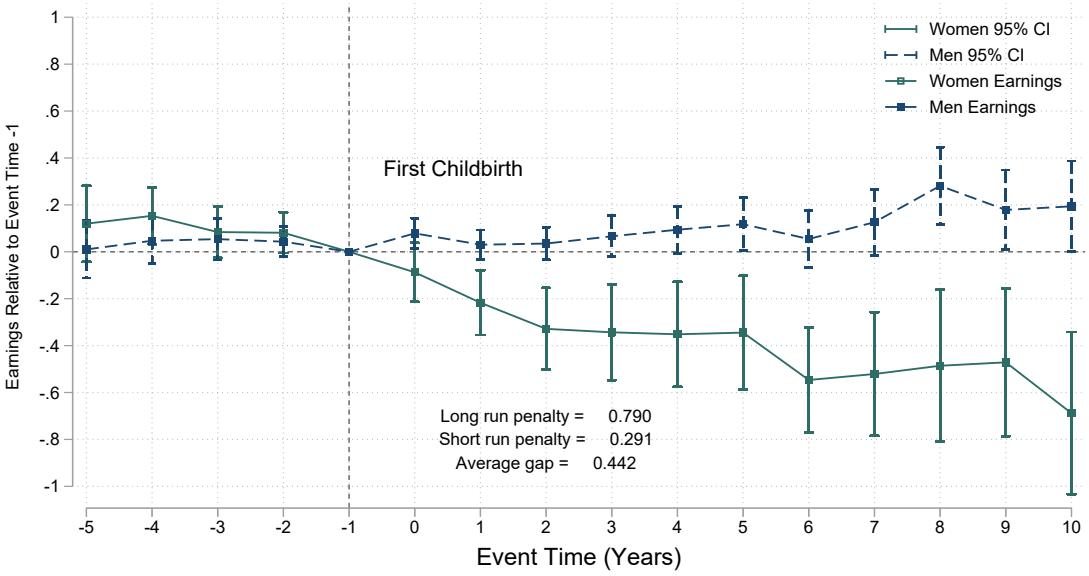
Working hours. We present first our results on labor earnings (Figure B.9), hours worked (Figure B.10), and hourly wages (Figure B.11), stratified by whether respondents worked in (a) shorter- or (b) longer-hours occupations before the first childbirth. Although the penalty in hours worked for shorter-hours occupations is significantly lower than that experienced by women in longer-hours occupations, it seems to have no effect on the penalty in earnings.

Indeed, the average effects for women, based on their pre-birth working hours profile are not statistically different for labor earnings ($p < 0.1410$), and wage rates ($p < 0.2268$), and significant for weekly hours worked ($p < 0.0004$). This suggests that family-friendlier occupations do not contribute to shaping the motherhood penalty in earnings. Yet, these results are only suggestive, as the SUTVA condition, assuming no spillover effects on the control group, appears no longer valid in the long run, leading to an overestimation of the motherhood penalty for these groups.

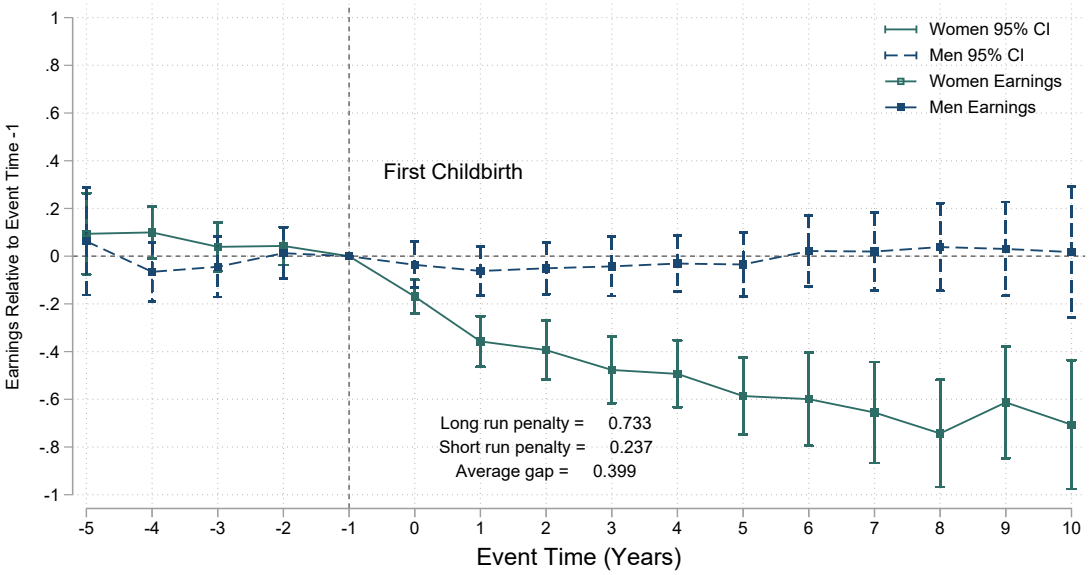
Share of part-time workers. Finally, we investigate whether working, pre-birth, in occupations with different exposures to part-time workers, reflecting more flexible occupations (see Costa Dias, Joyce, and Parodi, 2020), helps understand the magnitude of the motherhood penalty. Results for labor earnings, hours worked, and hourly wages are presented in Figures B.12, B.13, and B.14 below. The average effects, for each subgroup, are not statistically different for earnings ($p < 0.9417$), weekly hours worked ($p < 0.4605$), and hourly wages ($p < 0.1748$), confirming that family-friendly occupations do not contribute to shaping the magnitudes of the motherhood penalty in earnings.

Figure B.9. Impact of parenthood on earnings, by the "working hours" index

(a) Shorter-hours occupations



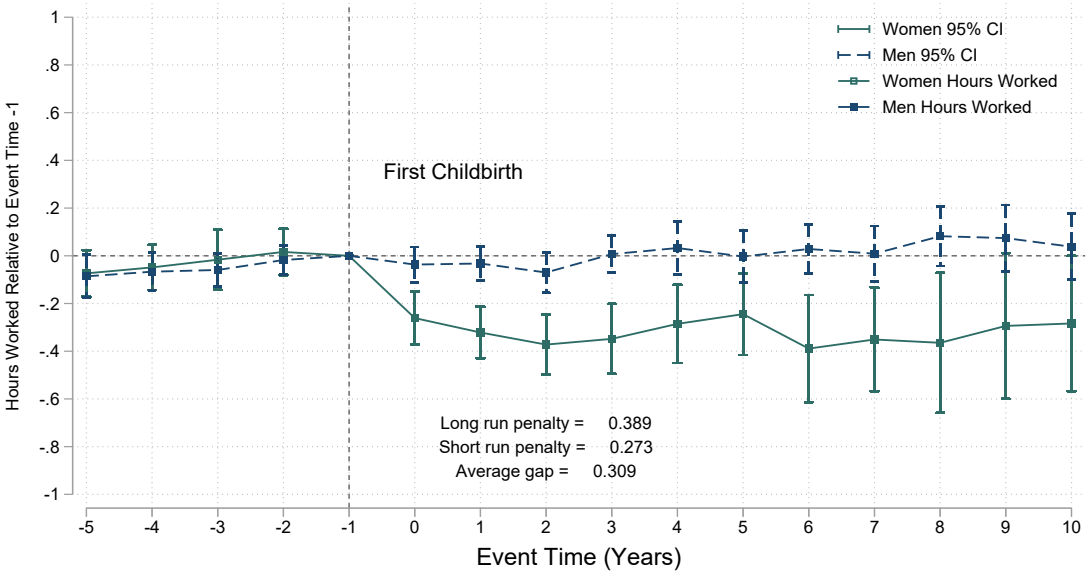
(b) Longer-hours occupations



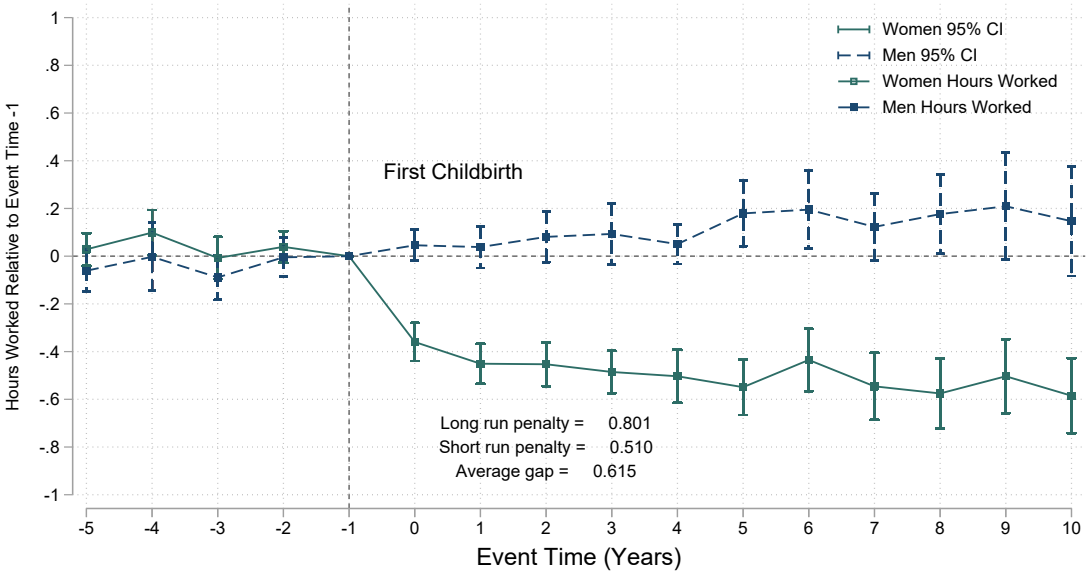
Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in annual labor earnings for parents working pre-birth in (a) shorter-hours and (b) longer-hours occupations, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.10. Impact of parenthood on hours worked, by the "working hours" index

(a) Shorter-hours occupations



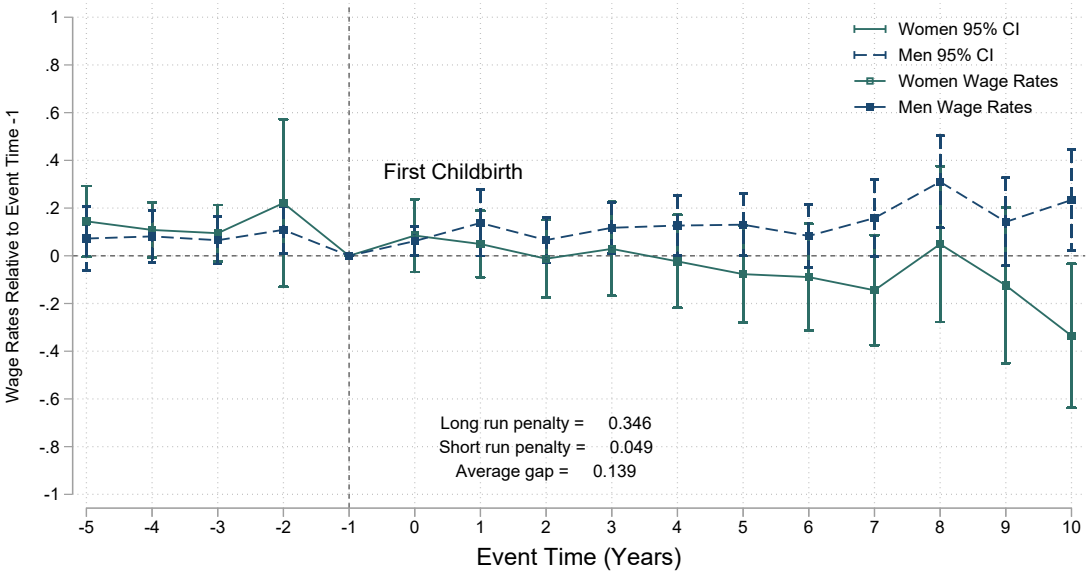
(b) Longer-hours occupations



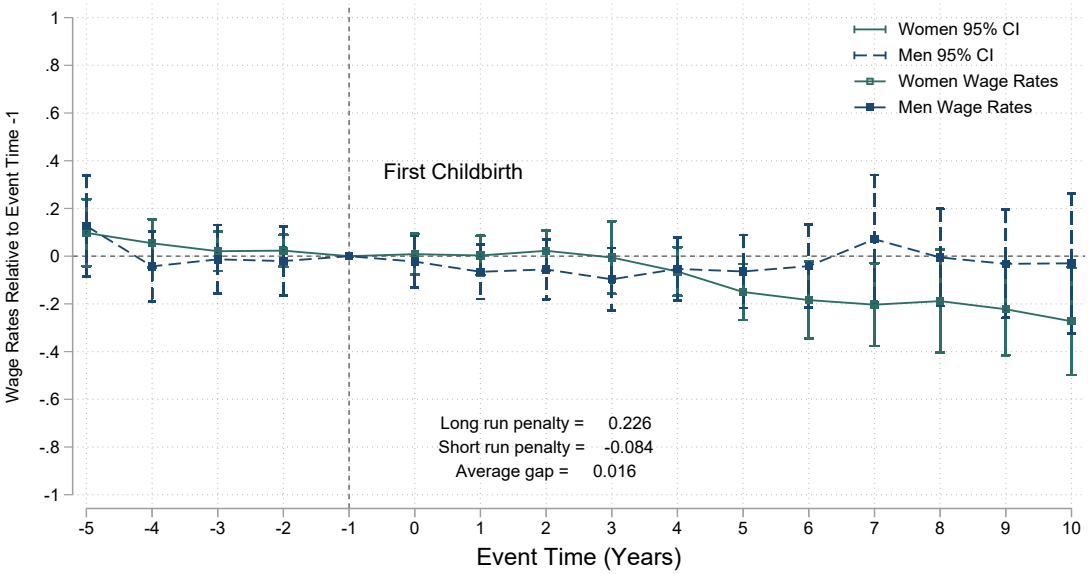
Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in weekly hours worked for parents working pre-birth in (a) shorter-hours and (b) longer-hours occupations, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.11. Impact of parenthood on hourly wages, by the "working hours" index

(a) Shorter-hours occupations



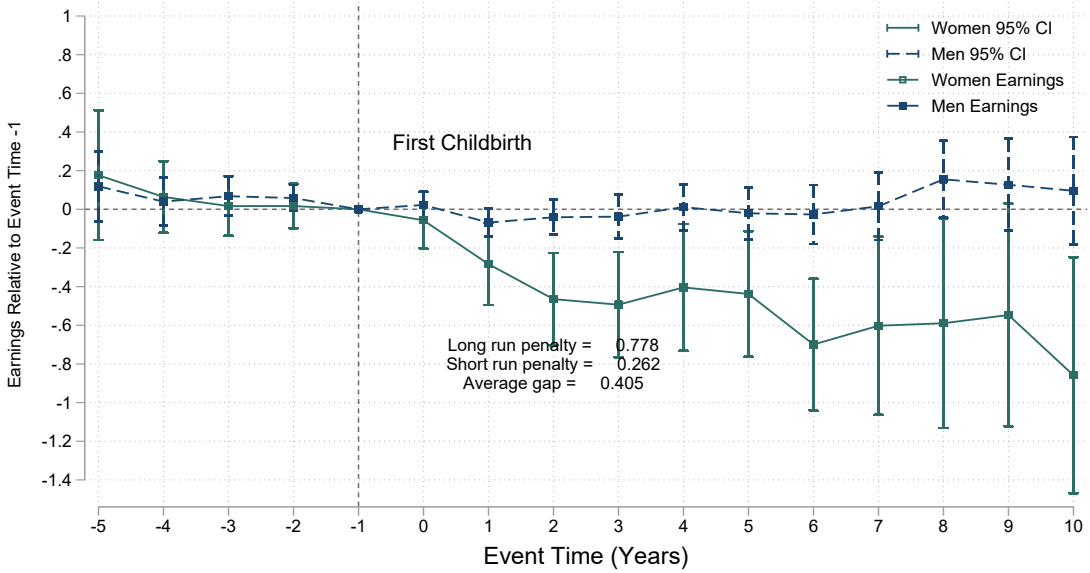
(b) Longer-hours occupations



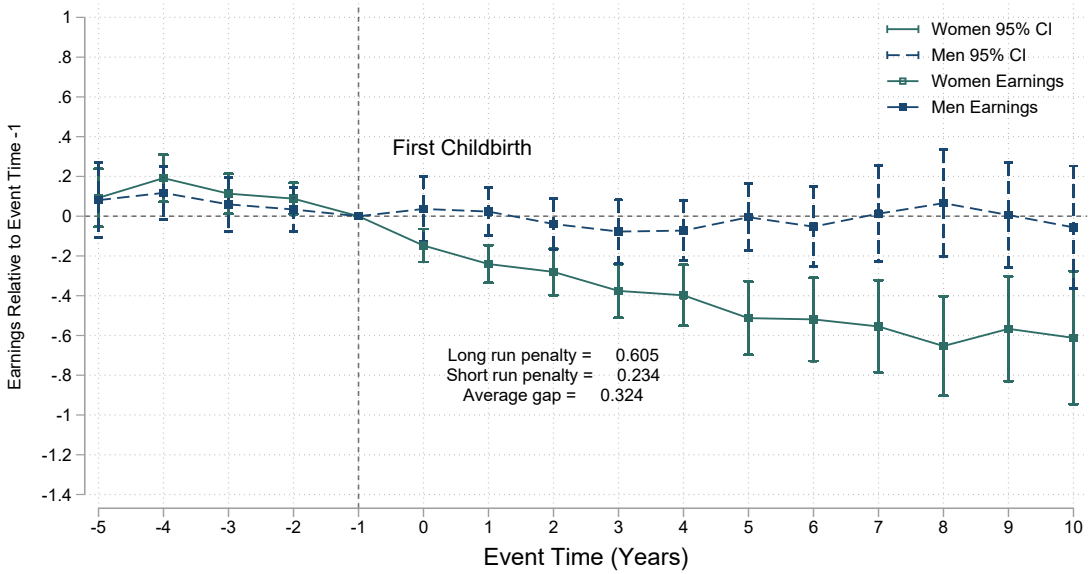
Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in hourly wages for parents working pre-birth in (a) shorter-hours and (b) longer-hours occupations, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.12. Impact of parenthood on earnings, by the "share of part-time workers" index

(a) Higher shares of PT workers occupations



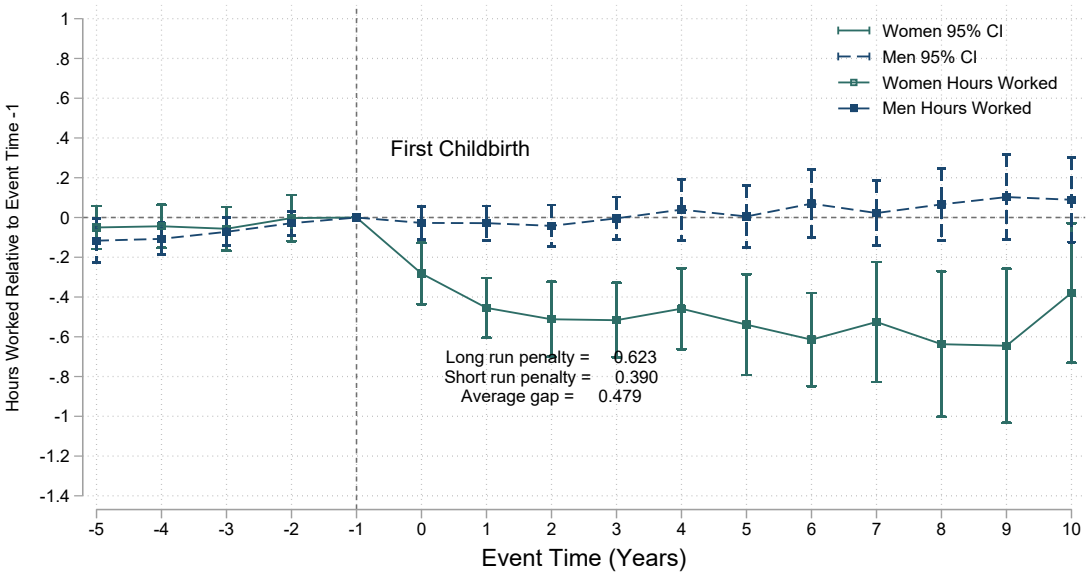
(b) Lower shares of PT workers occupations



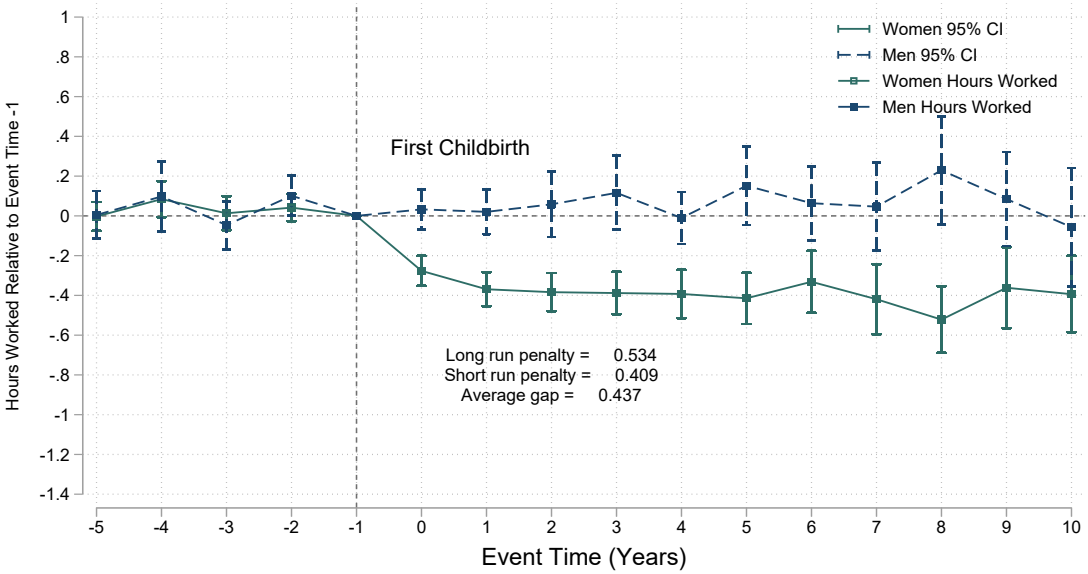
Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in annual labor earnings for parents working pre-birth in occupations with (a) higher shares of part-time workers and (b) lower shares, before childbirth, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10. PT stands for part-time.

Figure B.13. Impact of parenthood on hours worked, by the "share of part-time workers" index

(a) Higher shares of PT workers occupations



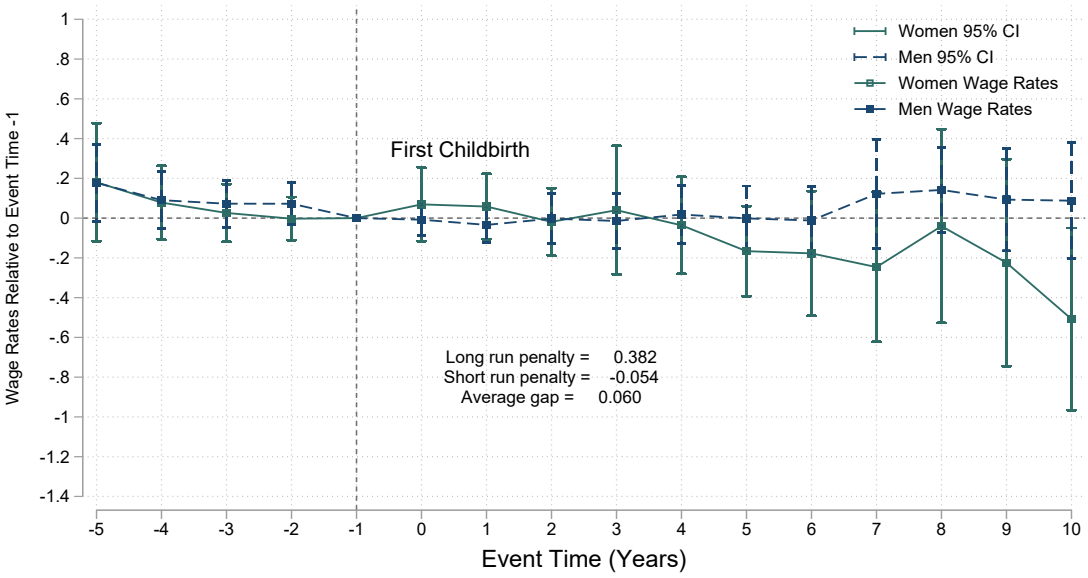
(b) Lower shares of PT workers occupations



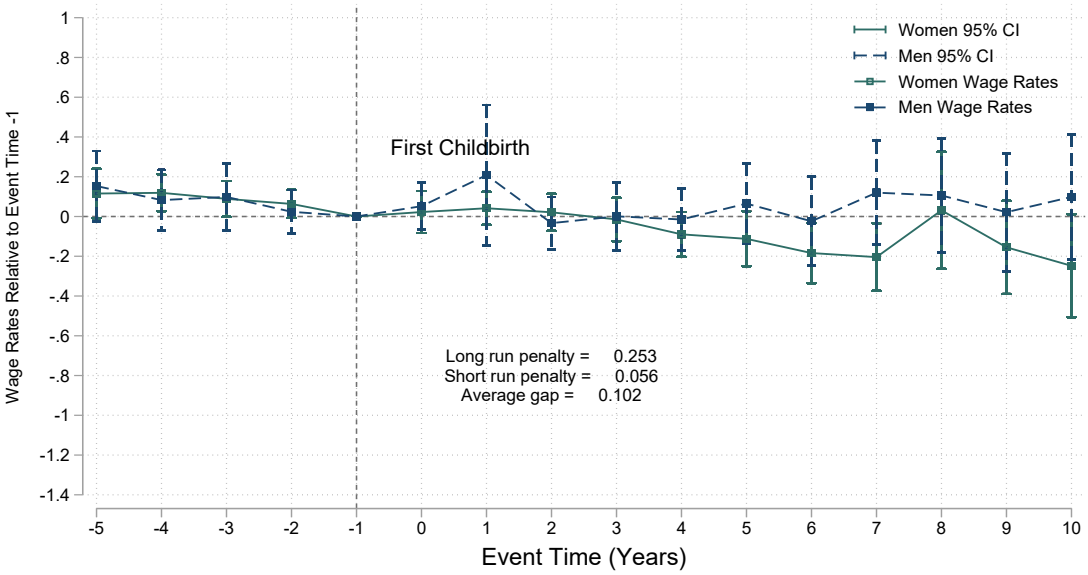
Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in weekly hours worked for parents working pre-birth in occupations with (a) higher shares of part-time workers and (b) lower shares, before childbirth, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10. PT stands for part-time.

Figure B.14. Impact of parenthood on hourly wages, by the "share of part-time workers" index

(a) Higher shares of PT workers occupations



(b) Lower shares of PT workers occupations



Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in hourly wages for parents working pre-birth in occupations with (a) higher shares of part-time workers and (b) lower shares, before childbirth, as defined in Subsection 2.4.3. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10. PT stands for part-time.

B.6.3 Occupational Characteristics and Gender Norms

Table B.7. Motherhood penalties, conditional and unconditional on occupations, by pre-birth gender norms

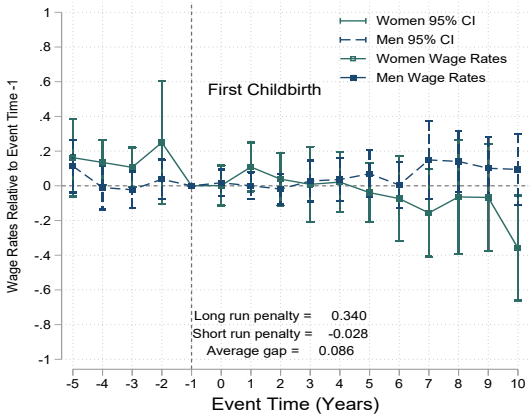
	(1)	(2)	(3)	(4)
	Traditional		Egalitarian	
Average gaps (%)				
Labor earnings	0.61***	0.48***	0.43***	0.31*
	(.12)	(.13)	(.09)	(.09)
Hours worked	0.58***	0.39***	0.38***	0.34***
	(.09)	(.09)	(.08)	(.08)
Hourly wages	0.09	-0.02	0.22***	0.15**
	(.1)	(.1)	(.08)	(.08)
Short-run gaps (%)				
Labor earnings	0.39***	0.24**	0.29***	0.21***
	(.09)	(.09)	(.06)	(.07)
Hours worked	0.48***	0.26***	0.34***	0.29***
	(.07)	(.06)	(.07)	(.06)
Hourly wages	-0.03	-0.09	0.12	0.08
	(.08)	(.08)	(.07)	(.07)
Long-run gaps (%)				
Labor earnings	1.10***	0.88***	0.68***	0.47***
	(.24)	(.22)	(.18)	(.15)
Hours worked	0.78***	0.59***	0.45***	0.44***
	(.16)	(.15)	(.13)	(.12)
Hourly wages	0.34**	0.14	0.40***	0.25*
	(.17)	(.16)	(.15)	(.13)
Occupational FE	✗	✓	✗	✓

Notes: This table displays the motherhood penalties in annual labor earnings, weekly hours worked, and hourly wages by pre-birth gender norms. Specifically, the motherhood penalties presented here are the average, short- and long-run gaps, respectively encompassing the 10-year period following parenthood (average gaps), the 3 years after (short-run gaps), and between 7 and 10 years after parenthood (long-run gaps). Specifications in columns (1) and (3) are unconditional on occupation fixed effects, while specifications in columns (2) and (4) control for 2-digit occupation fixed effects. Standard errors, bootstrapped with 1000 replications, are presented in parentheses. Results are statistically significant from zero in a two-sided test at * 10%, ** 5%, and *** 1%; NS otherwise.

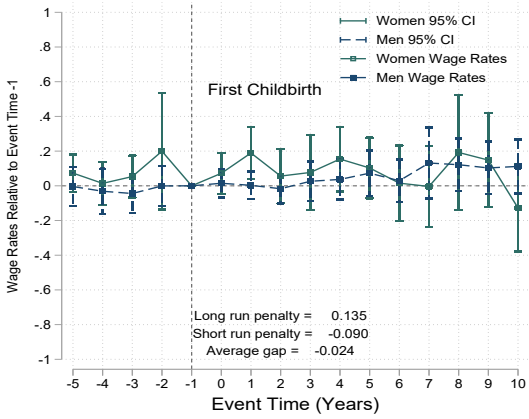
Figure B.15. Impact of parenthood on hourly wages by pre-birth gender norms, (un)conditional on occupations

Traditional

(a) Without occupation fixed effects

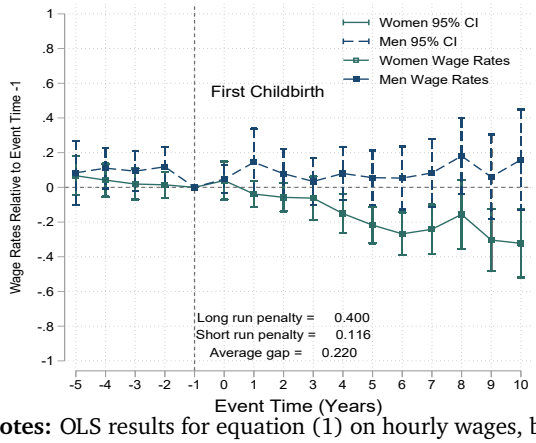


(b) With occupation fixed effects

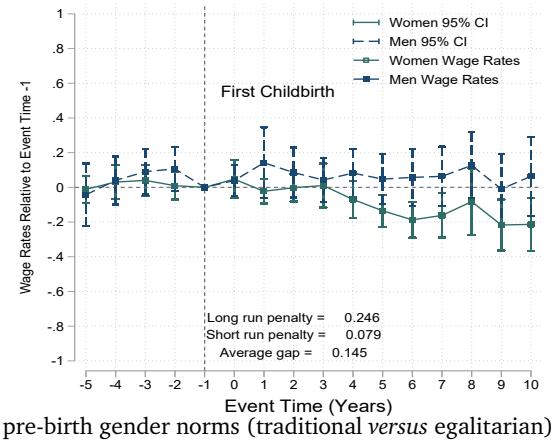


Egalitarian

(c) Without occupation fixed effects

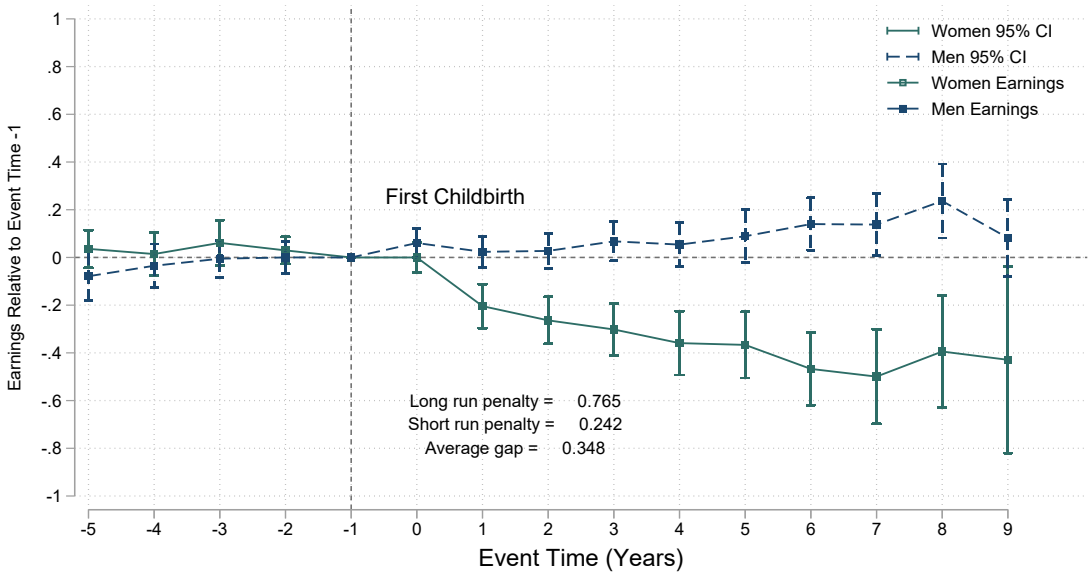


(d) With occupation fixed effects



Notes: OLS results for equation (1) on hourly wages, by pre-birth gender norms (traditional *versus* egalitarian). Figures (a) and (c) on the left hand side display results unconditional on occupation fixed effects, while Figures (b) and (d) on the right hand side display results controlling for 2-digit occupation fixed effects.

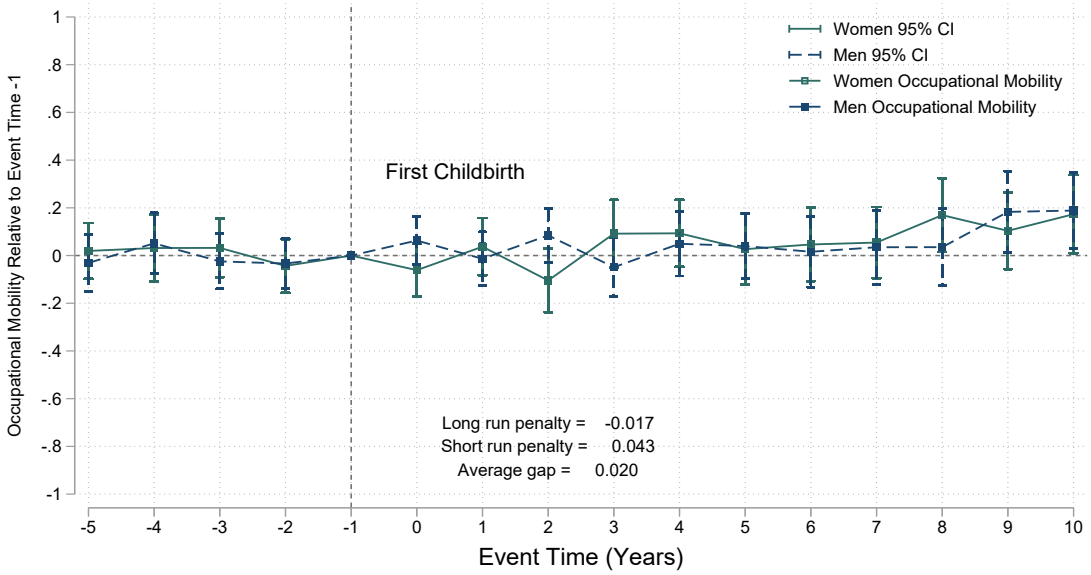
Figure B.16. Impact of parenthood on earnings, conditional on occupation and industry fixed effects



Notes: OLS results for equation (1) presented alongside the motherhood penalties (short, long and average gaps) in annual labor earnings, conditional on 2-digit occupation fixed effects — Standard Occupational Classification (SOC) codes — and 4-digit industry fixed effects — Standard Industrial Classification (SIC) codes. We cannot display men's estimates for $t = 10$ due to lack of observation. Thus, the average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 9, encompassing the 9-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 9.

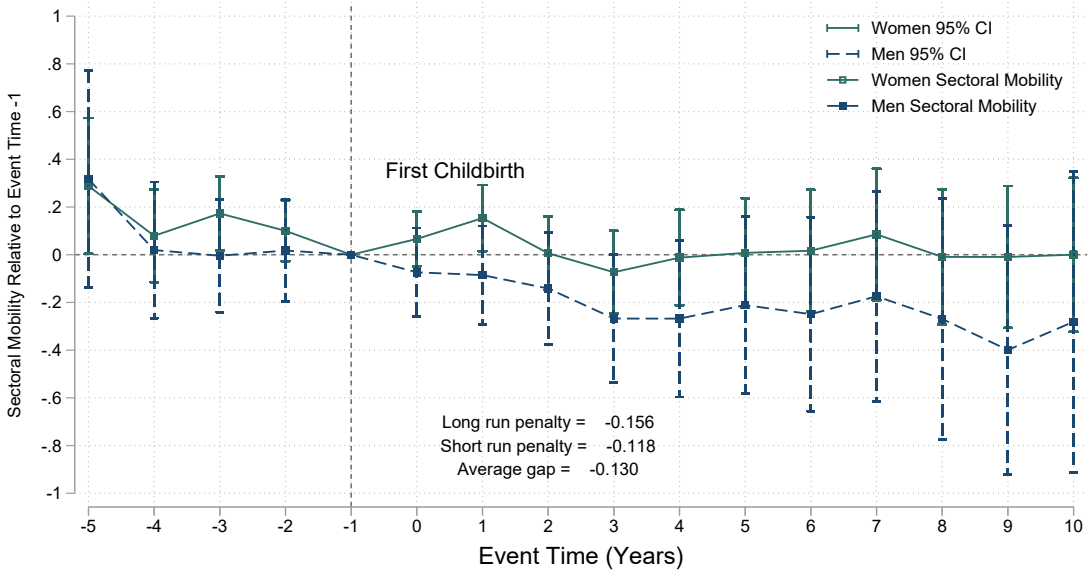
B.7 Mobility Around Childbirth

Figure B.17. Impact of parenthood on occupational mobility



Notes: OLS results for equation (1) on a dummy variable equal to 1 if the participant changed occupation between $t-1$ and t, 0 otherwise. This figure shows the estimated impact of having a first child on any job mobility. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

Figure B.18. Impact of parenthood on mobility between sectors



Notes: OLS results for equation (1) on a dummy variable equal to 1 if the respondent works in the public sector in time t, regardless of where they were working in $t-1$. This figure shows the estimated impact of having a first child on mobility towards the public sector. The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

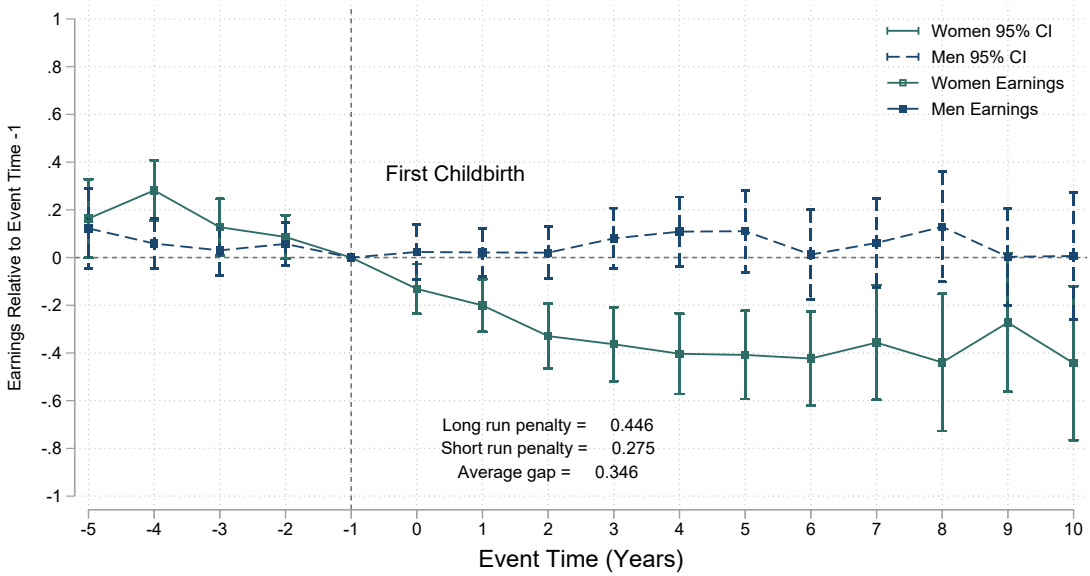
B.8 Robustness

B.8.1 Earnings Impacts by Number of Children

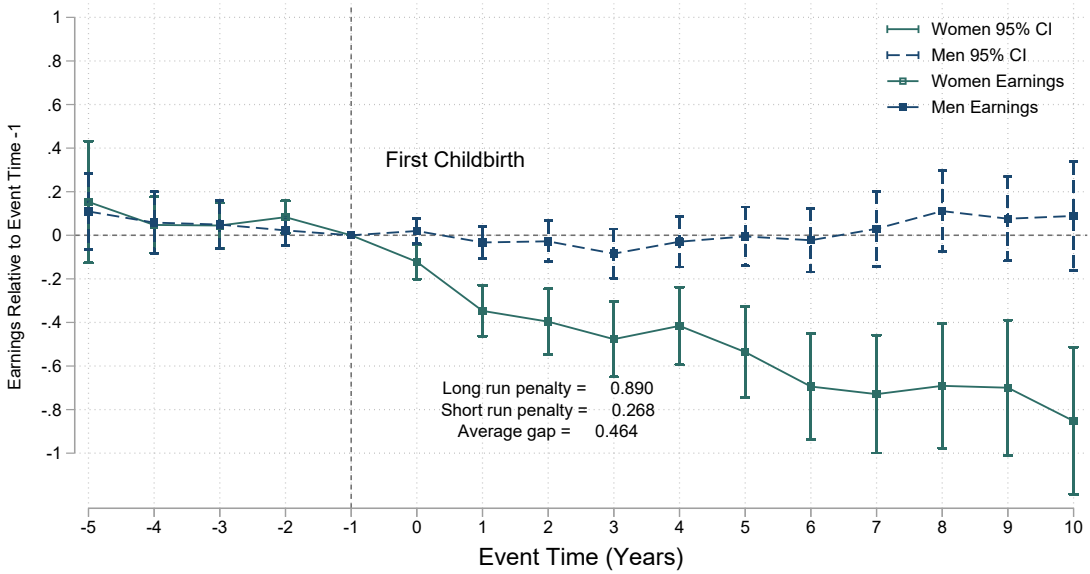
In the idea of replicating Kleven, Landais, and Søgaard (2019) and particularly the checks provided in the online appendix, we study the earnings impacts by number of children as of the last year of the panel. We do not have enough observations to study separately the impact of the third or the fourth child, so we study separately the earnings impacts for one-child parents, two-child parents and parents that have three or more kids. We do not report results for the last group because point estimates are too imprecisely estimated due to sample size.

Figure B.19. Impact of parenthood on earnings by number of children

(a) One-child parents



(b) Two-children parents

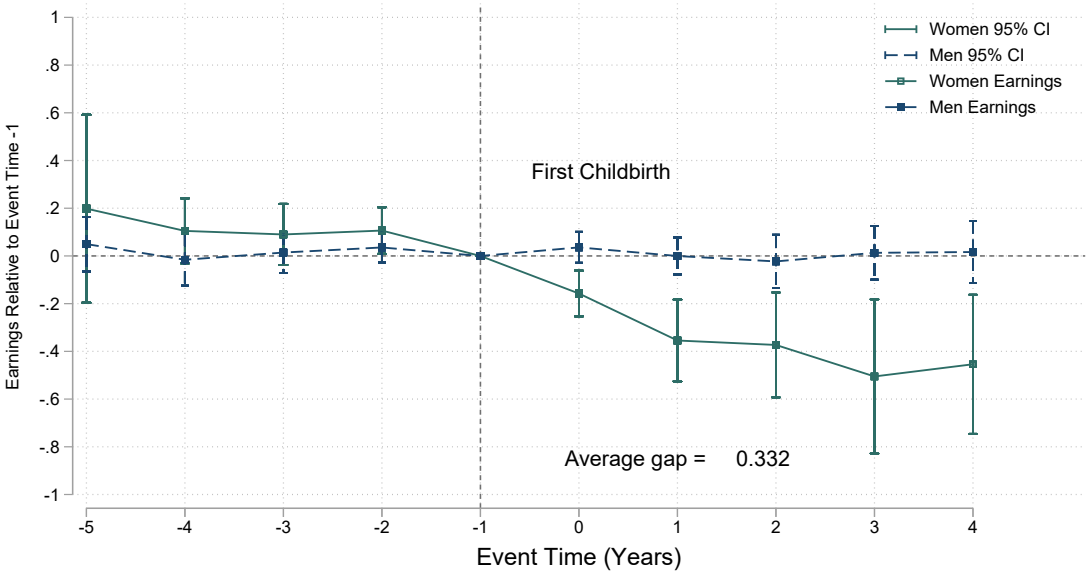


Notes: The figures show the impacts of children on earnings, for parents of (a) only one child as of 2009, and (b) two children as of 2009.

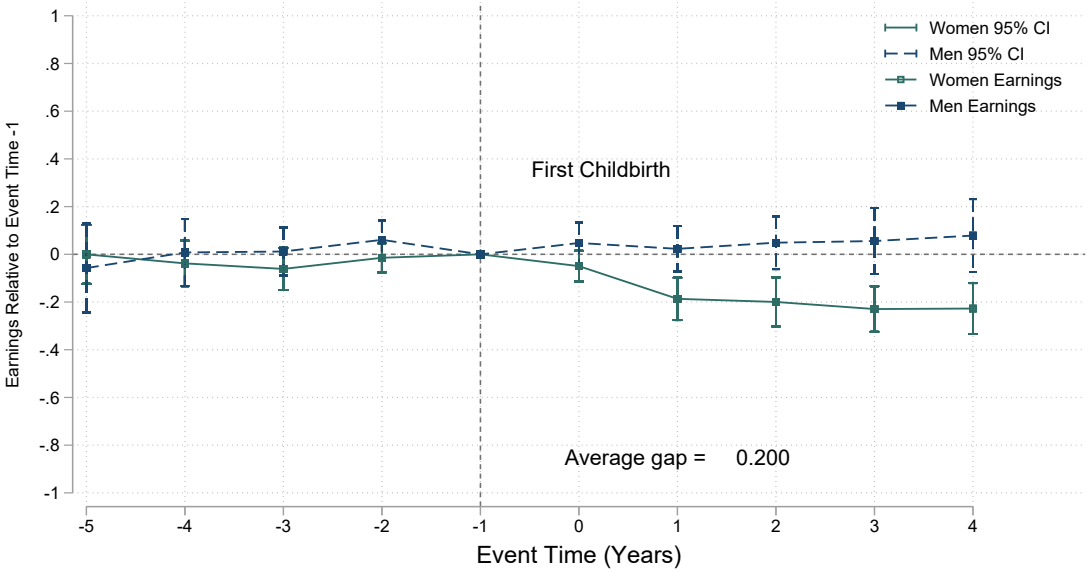
B.8.2 Heterogeneous Treatment Effects: Sun and Abraham (2021)'s Interaction Weighted Estimates

Figure B.20. Impact of parenthood on earnings, by pre-birth gender norms

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: Both figures show the estimated impact of having a first child on annual labor earnings within each gender group using Sun and Abraham (2021)'s estimator to account for heterogeneous treatment effects, for (a) traditional and (b) egalitarian parents, as defined in Subsection 2.4.2. We use the last treated cohorts (year of the first childbirth being either 2004, 2005, 2006, 2007 or 2008 due to sample size issues) as a control group. Therefore, we plot $P_t^g = \hat{\beta}^g / \tilde{Y}^g$, where the counterfactual outcome is the last treated cohort's.

B.9 DiD Event Study

We follow Kleven, Landais, and Søgaard (2019) who use men and women who never have children as controls, and further assign placebo births using the actual distribution of age at first child among those who have children — the treated. Our last observed year is 2009, which further implies the following truncation:

Figure B.21. Control cohorts set-up

1. Non-truncated cohorts born in 1964 or before (45 or older) unlikely to have children after the end of the survey in 2009 — in blue (1) above (Figure B.21).
2. Truncated cohorts born after 1964 (aged less than 45) that do not have children but might have some after the end of the survey — in red (2) above.

Therefore, for those born after 1964 and younger than 45 (the truncated cohorts), we select those who are most likely never to have children based on a linear probability model as in Kleven, Landais, and Søgaard (2019), and estimated separately for men and women.[3] The selection criteria within the truncated cohorts also relies on Kleven, Landais, and Søgaard (2019) and consists in selecting a subset n_c of respondents with the highest estimated probabilities of never having children, written as $n_c = N_c \times \mathbb{P}_{<1964}$, with N_c the total number of individuals in the cohort, and $\mathbb{P}_{<1964}$ the average share of childless respondents before 1964. Our control group is then constituted of 1) those born before 1964 without children, and 2) those selected as described above, and born after 1964.

We now need to assign placebo births to both cohorts within the control group. Again, considering the truncation, we distribute the age at first child following Kleven, Landais, and Søgaard (2019),[4] and can now implement event studies that compare our treatment group — those who have their first child and meet our analytical sample restrictions — to a control group — a panel of those who do not have children as of 2009, have been assigned placebo births and also meet our analytical sample restrictions. Descriptive statistics for this new analytical sample are presented in Table B.8 below.

We estimate the impact of children as such, and run our main event study specification without controlling for year dummies, as in Kleven, Landais, and Søgaard (2019), on labor

[3]The linear probability model corresponds to estimating $P[\kappa_{iT} = 0] = X'\beta$ where κ_{iT} is a dummy for zero lifetime fertility, and X includes the following dummy variables: mother's and father's educational qualifications in five categories, within-cohort quantiles of labor earnings, a dummy for holding a college degree, and 13 dummies for government office regions.

[4]For the non-truncated cohorts, we assign a log-normal distribution of age at first child ($A_{c,e} \sim LN(\hat{\mu}_{c,e}, \hat{\sigma}^2_{c,e})$) where $\hat{\mu}_{c,e}$ is the observed mean within each cohort-college-educated *vs.* college-educated cohorts cells, and $\hat{\sigma}^2_{c,e}$ their variance. For the *truncated cohorts*, we assign a log-normal distribution of age at first child ($A_{c,e} \sim LN(\tilde{\mu}_{c,e}, \hat{\sigma}^2_{c,e})$) where $\tilde{\mu}_{c,e}$ is the predicted average age at first child obtained by estimating a linear trend on the older cohorts.

Table B.8. Summary statistics for the new analytical sample, by treatment status

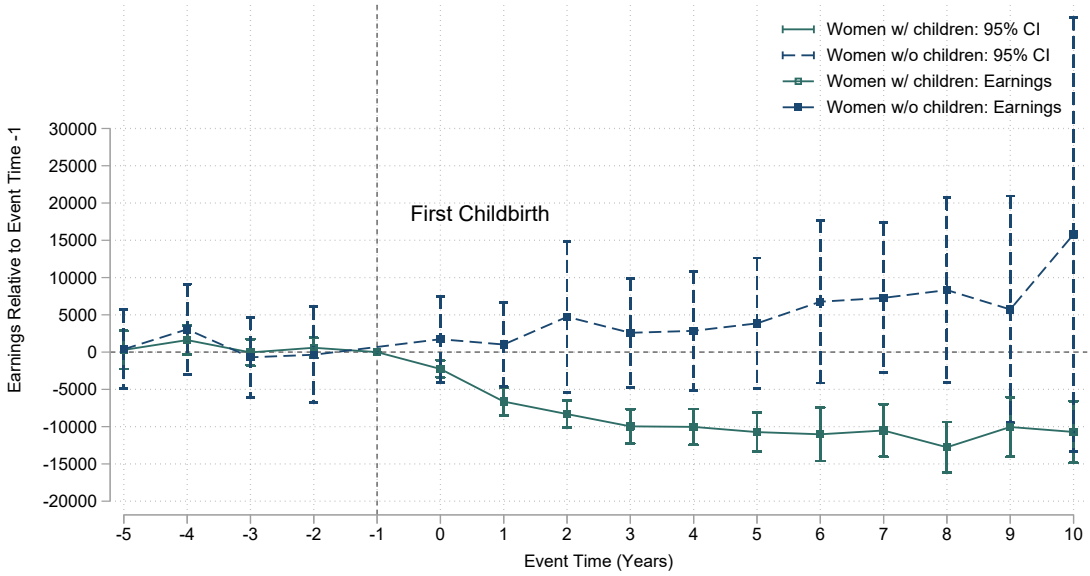
	Treated	Control	Diff. (Treated – Control)	S.E.	N
Age	29.191	34.087	-4.896***	0.097	20458
Age at parenthood	25.507	32.372	-6.865***	0.047	22256
Household size	3.105	3.004	0.102***	0.018	20458
Education					
Primary	0.075	0.045	0.030***	0.003	20224
Low secondary	0.064	0.035	0.029***	0.003	20224
Low secondary/vocational	0.313	0.254	0.059***	0.006	20224
High secondary/vocational	0.188	0.133	0.056***	0.005	20224
Higher vocational	0.187	0.233	-0.046***	0.006	20224
First degree	0.146	0.243	-0.097***	0.006	20224
Higher degree	0.022	0.056	-0.035***	0.003	20224
Marital status					
Never married	0.596	0.261	0.335***	0.007	20450
Married	0.333	0.666	-0.333***	0.007	20450
In a civil partnership	0.001	0.000	0.001*	0.000	20450
Separated	0.021	0.020	0.001	0.002	20450
Divorced	0.046	0.051	-0.005*	0.003	20450
Widowed	0.003	0.001	0.002***	0.001	20450
Labor market outcomes					
Labor earnings	11773.503	17196.701	-5423.198***	196.697	20209
Weekly hours worked	29.749	33.229	-3.479***	0.275	20432
Hourly wage	8.411	10.945	-2.534***	0.136	16818
LFP	0.793	0.897	-0.104***	0.005	20453

Notes: Summary statistics for the new analytical sample, by treatment status. * p <0.10; ** p <0.05, *** p <0.01. Levels of educational attainment follow ISCED coding, see Table A.1 for a detailed description of categories. Treated respondents correspond to our analytical sample described in Subsection 2.3, while the control cohort is a panel of those who do not have children as of 2009 (last survey year) and have been assigned placebo births. These also meet our analytical sample restrictions. LFP stands for labor force participation.

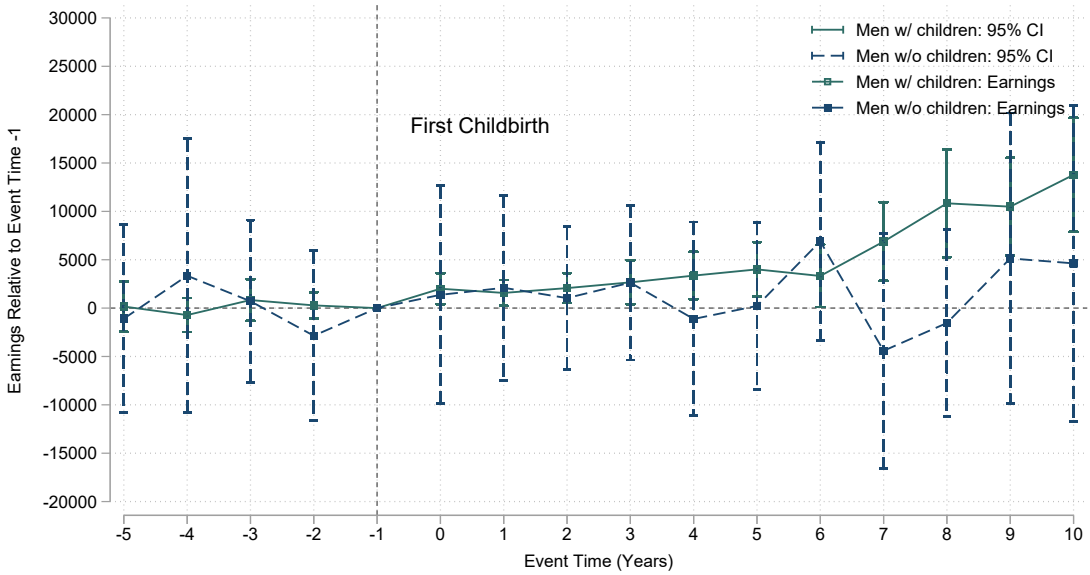
earnings, by pre-birth gender norms. Overall, this implementation check confirms the key findings from Section 4.1 concerning the standing of the motherhood penalty by gender norms. Mothers experience a sharp decrease in their short-run labor earnings as a reaction to the first child birth, while men, on the other hand, are unaffected by fatherhood. The reduction is significantly more important for mothers with traditional views pre-birth.

Figure B.22. Impact of parenthood on earnings for traditional parents in a difference-in-differences event study design

(a) Pre-birth traditional women who have children *vs*. women who do not



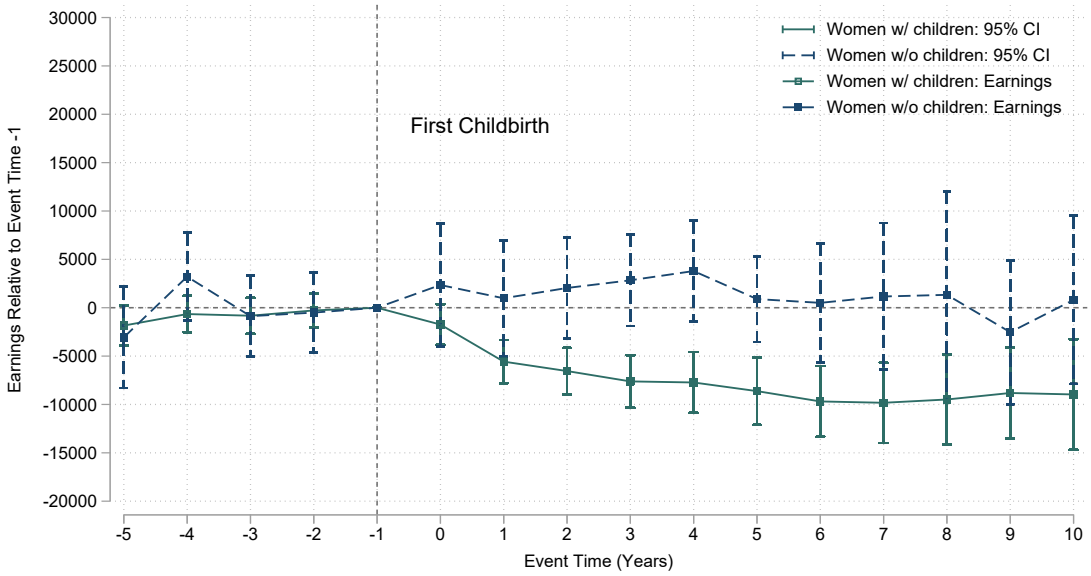
(b) Pre-birth traditional men who have children *vs*. men who do not



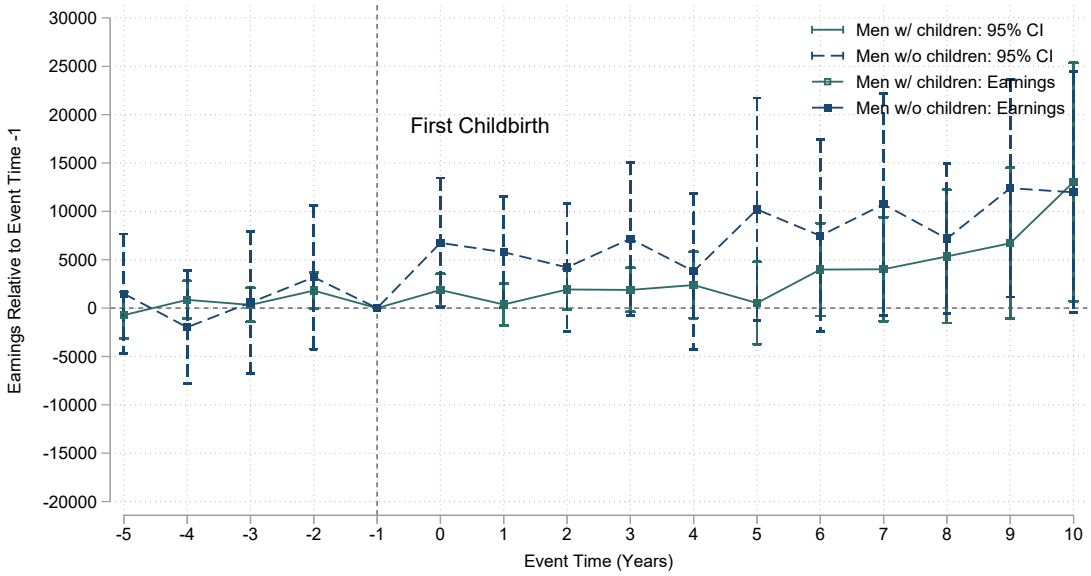
Notes: The figures show the evolution of labor earnings relative to the year before the first child for (a) women and (b) men with traditional gender norms pre-birth, as defined in Subsection 2.4.2. We compare those with children (treated) to those without children as of 2009 — last available year of BHPS — but that have been assigned placebo births (control). In the legend of both graphs, w/ stands for with, and w/o for without.

Figure B.23. Impact of parenthood on earnings for egalitarian parents in a difference-in-differences event study design

(a) Pre-birth egalitarian women who have children *vs*. women who do not



(b) Pre-birth egalitarian men who have children *vs*. men who do not



Notes: The figures show the evolution of labor earnings relative to the year before the first child for (a) women and (b) men with egalitarian gender norms pre-birth, as defined in Subsection 2.4.2. We compare those with children (treated) to those without children as of 2009 — last available year of BHPS — but that have been assigned placebo births (control). In the legend of both graphs, w/ stands for with, and w/o for without.

C Technical Details

C.1 Sample Checks

C.1.1 Condition on Pre-Birth Employment

We present in Table C.1 below the average gaps in earnings under two scenarios of pre-birth employment, (1) including parents who reported at least one year of positive labor earnings prior to the first childbirth, and (2) dropping observations with zero annual labor earnings prior to the first childbirth. Note that the version (1) is the one used throughout the paper. The results of this check appear qualitatively similar across the two sample restrictions, confirming the robustness of our main findings.

Table C.1. Average gaps in earnings, for various conditions of pre-birth employment

	(1)	(2)
Average gaps (%)		
Full sample	47.7	47.6
Traditional	60.8	59.5
Egalitarian	43.4	44.4
Difference (in pp)	17.4	15.1
Individuals	755	761
Observations	8350	8368

Notes: Average gaps in annual labor earnings retrieved from estimating equation (1) under two scenarios of pre-birth employment. In column (1), the sample includes parents who reported at least one year of positive labor earnings prior to the first childbirth. This is the version used throughout the paper. In column (2), we drop observations with zero annual labor earnings prior to the first childbirth.

C.1.2 Trimming of the Annual Labor Earnings Distribution

Table C.2 presents the average gaps in earnings for various trims of the annual earnings distribution, showing qualitatively consistent gaps across different versions.

Table C.2. Average gaps in earnings, for various trimming versions

	(1) Trimming 1st and 99th Percentiles	(2) Trimming 99th Percentile	(3) No Trimming
Average gaps (%)			
Full sample	47.7	73.6	80.9
Traditional	60.8	115.8	124.8
Egalitarian	43.4	53.6	58
Difference (in *pp*)	17.4	62.2	62.6
Individuals	755	755	755
Observations	8350	9230	10223

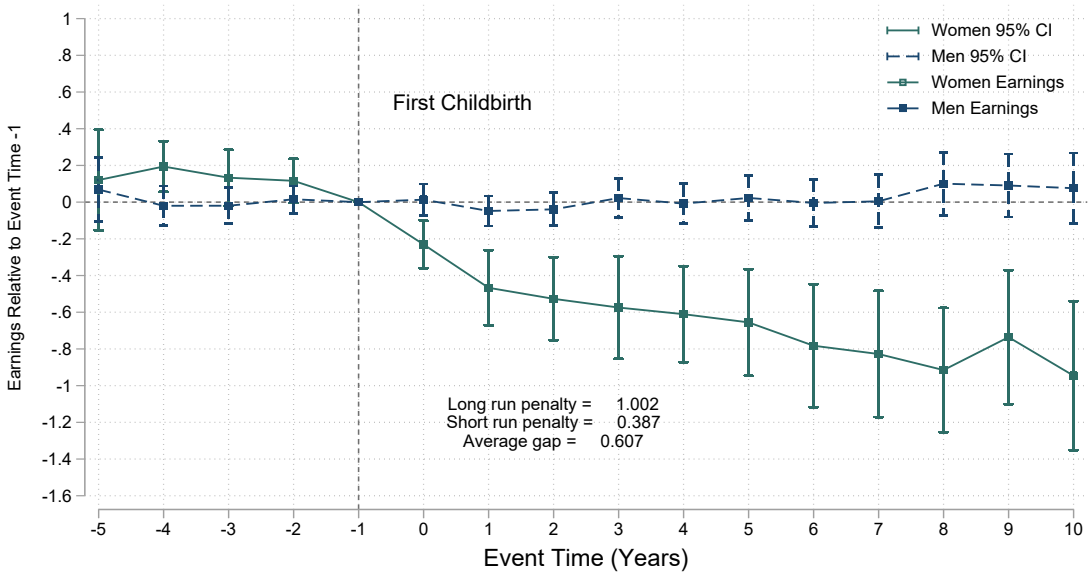
Notes: Average gaps in annual labor earnings retrieved from estimating equation (1) trimming (1) the bottom and top percentiles (1%) of the annual earnings distribution, (2) only the top 1%, and (3) not trimming this distribution. Results in column (1) correspond to the approach used throughout the paper.

C.1.3 Observations Within the Event Window

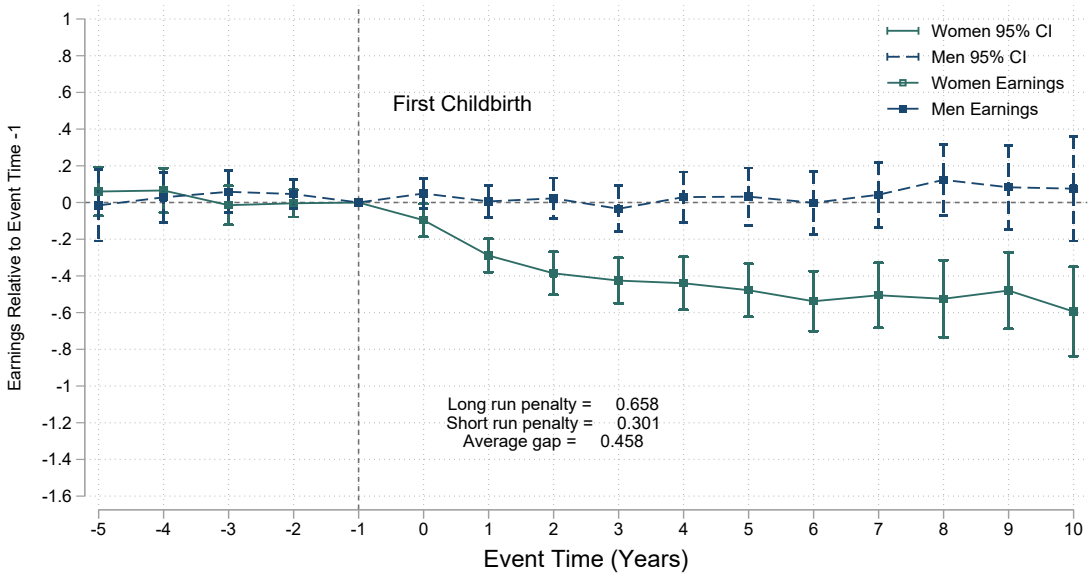
We run our main specification (equation (1)) on earnings by pre-birth gender norms, now retaining at least eight (instead of five in the paper) observations within the event window as done in Kleven et al. (2019). Graphical results displayed in Figure C.1 below confirm that our findings remain consistent with this sample selection criterion, substantiating the robustness of our results.

Figure C.1. Impact of parenthood on earnings, by pre-birth gender norms

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: This figure illustrates the impact of motherhood on earnings, for (a) traditional and (b) egalitarian parents as defined in Subsection 2.4.2, with parents observed at least *eight* times within the event window, as opposed to our criterion of five observations in the paper. With at least eight observations within the event window, we have a sample of 608 parents and 7,600 observations. When conditioning on five observations to increase sample size (see Figure 1), traditional women exhibited an average earnings gap of approximately 61%, while egalitarian women showed a gap of 43%. These figures closely align with our main result, confirming the robustness of our findings to different sample selection criteria.

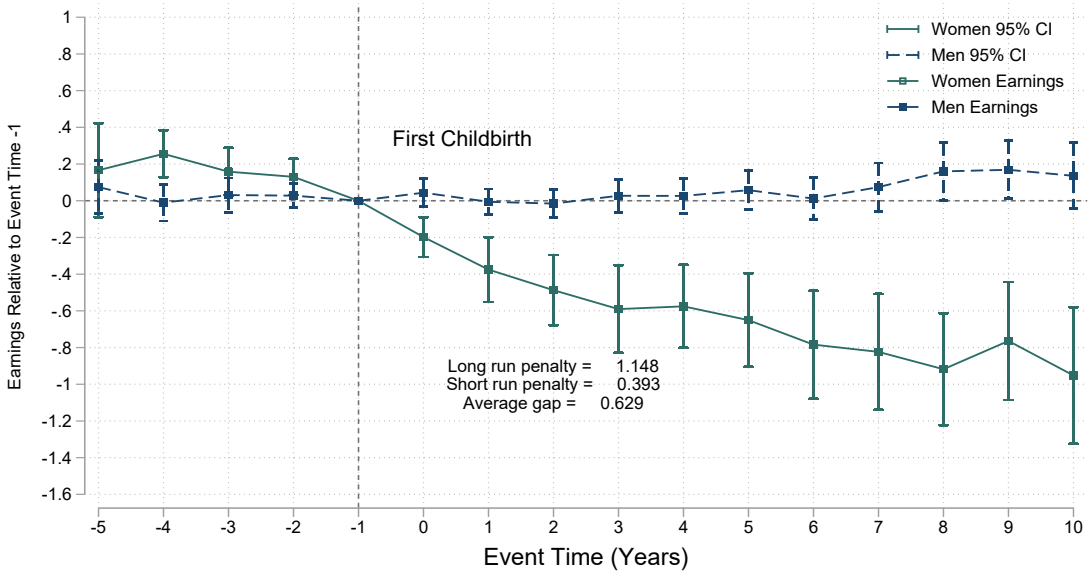
C.2 Reliability of the Gender Norms Indicator

C.2.1 Indicator Construction

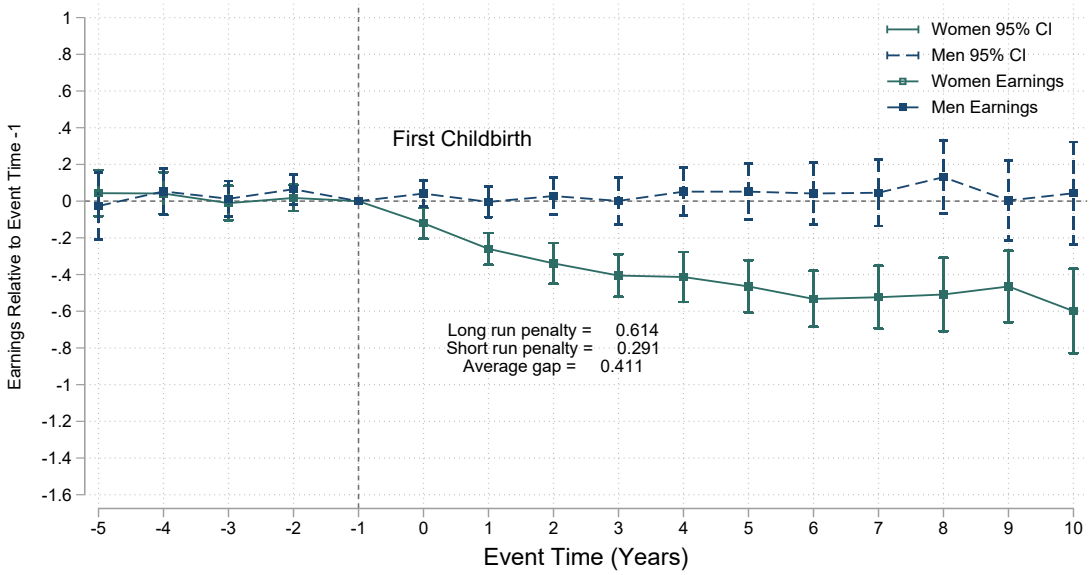
To ensure that the results based on gender norms are not influenced by the way we constructed our indicator, we modify its definition, and instead of dividing the sample into two groups based on the *median* value of the pre-birth gender norms score, we divide the sample in two groups based on the *average* value of the pre-birth gender norms score. Individuals below the average value are considered more 'traditional' while individuals above the mean are considered more 'egalitarian'. We run the same event study regressions as presented in Figure 1 but with this new indicator. Figure C.2 below presents the percentage effects of parenthood on earnings for the two new panels. The main specification in the paper suggests that traditional women suffer from a 18-*pp*-larger motherhood penalty in earnings than more egalitarian women (Figure 1). With this new specification, we find a similar pattern experienced by traditional and egalitarian women, with qualitatively similar magnitudes as per our main specification. The results of these checks are reassuring for the validity of our previous conclusions, particularly on the role of pre-birth gender norms in contributing to the motherhood penalty in earnings.

Figure C.2. Impact of parenthood on earnings, by pre-birth gender norms (new definition)

(a) Traditional pre-birth



(b) Egalitarian pre-birth



Notes: OLS results for equation (1) on annual labor earnings by the new definition of pre-birth gender norms for (a) traditional and (b) egalitarian parents using a new definition. Here, we redefine traditional *versus* egalitarian by dividing our sample based on the *average* value of the pre-birth gender norms score, rather than using the *median* value (as defined in Subsection 2.4.2). We further illustrate the motherhood penalty (P_t, equation (3)) for the short-term (within three years of becoming parents), and the long-term (in the last three observed years, $t \in [7; 10]$), as well as the average gap (within ten years of becoming parents).

C.2.2 Measuring Gender Norms: The Role of Social Norms

The concept of norms has been advocated in the economics literature as being an important driver of individuals' behaviors (*e.g.*, Akerlof and Kranton, 2000). However, norms are difficult to capture and hence to describe as they are largely internalized within individuals, who are mainly unaware of such norms. This calls for carefulness in categorizing people as being either 'traditional' or 'egalitarian'. This is why we often use more relative expressions, such as "more traditional" or "more egalitarian" and divide our sample by the median value, enabling individuals to be relatively more or less egalitarian or traditional compared to their peers. Additionally, the notion of "gender norms" we use and how the variables reflect this concept within BHPS is based on pseudo-arbitrary choices, despite some authors using the same variables (Flèche, Lepinteur, and Powdthavee, 2020; Schober and Scott, 2012 and Grinza et al., 2022).[5] To make sure we are actually capturing "gender norms", we tested the effect of childbirth on a broader measure of norms — "social norms."[6] We assess this as, first, we would expect the effect of childbirth to be smaller or null on social norms, and, second, as we assume that there is no incentive *a priori* to become more conservative as regards social norms upon parenthood.[7] Table C.3 below presents the 6 variables asked to reflect individuals' social norms. These are asked to the primary survey respondent in BHPS, collected at each odd wave, commencing from wave 1 and up to wave 17. The answer categories are also presented below.

Table C.3. Social norms variables

	Answer categories
Ordinary people get their fair share of the nation's wealth There is one law for the rich, and one law for the poor Private enterprise is the best way to solve Britain's economic problems Major public services and industries ought to be in state ownership It is the government's responsibility to provide a job for everyone who wants one Strong trade unions are needed to protect the working conditions and wages of employees	1. Strongly agree 2. Agree 3. Neither agree, nor disagree 4. Disagree 5. Strongly disagree

Notes: Social norms variables are asked to the main survey respondent, every odd wave, starting wave 1, until wave 17.

The scale is reversed where needed (Questions 3, 4 and 5 in the above Table), to enable the highest value to reflect more progressive social norms. A lower value thus corresponds to more conservative norms.

As for gender norms variables, we construct a score reflecting whether individuals are more or less progressive as regards social norms. We take the average answer to these six questions to compute this score — where one is the minimum value (conservative norms), and six is the maximum value (more progressive norms). As in Subsection 4.3, we run our

[5]We are cautious in interpreting our results however. The data provider of BHPS classified the 6 variables we are using as reflecting "gender roles" which confirms our intuitions of capturing the right concept.

[6]Also referred as "social opinions" in BHPS.

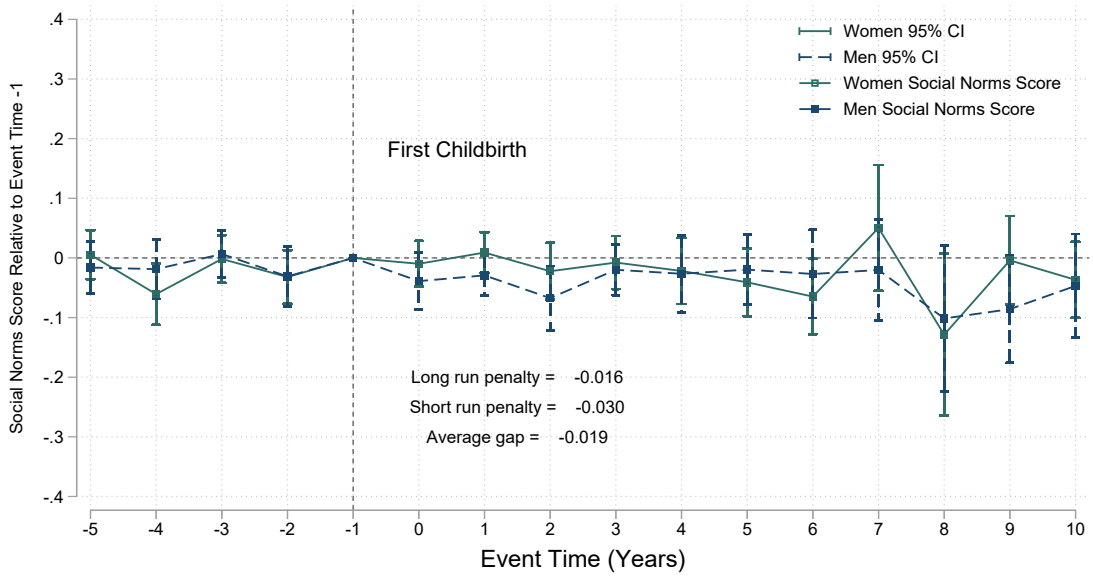
[7]The unconditional correlation between social norms pre-birth and gender norms pre-birth (both continuous scores) is equal to 0.0926 ($p < 0.01$).

main specification described in equation (1) on this social norms score in order to understand whether such norms are affected by the event of having a child, and whether there is any gendered effect. Similarly, this exercise enables to understand if there is any compositional change that could affect the validity of our main results split by gender norms.

Intuitively, we expect the effect of the first childbirth to be smaller or null on social norms, as one would think there is no obvious incentive to become more conservative on such social aspects after parenthood. Yet, social norms can also constitute a broader measure, themselves including — and reflecting — gender norms. Indeed, conservative social opinions can be associated with a broader traditional background, and therefore more traditional gender norms (*e.g.*, Sanbonmatsu, 2002)

OLS results for equation (1) on social norms are displayed in Figure C.3 below and confirm the validity of our main results split by gender norms. Indeed, we do not see any clear emerging pattern after parenthood for mothers and fathers, as well as no gender difference.

Figure C.3. Impact of parenthood on social norms



Notes: OLS results for equation (1) on the social norms score, *i.e.*, the estimated impact of having a first child on the social norms score within each gender group (P_t^g, as described in equation (2)). The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.

C.2.3 Disentangling Socioeconomic Status and Gender Norms

The aim here is to investigate whether our findings are influenced more by socioeconomic status (SES) than by gender norms, as these positively correlate (0.1158, $p < 0.01$). The majority of available data in BHPS concerning respondents' social class relies on information related to current or past occupations (*e.g.*, Goldthorpe Social Class, RG Social Class, Cambridge Scale provided by the survey), which may not be ideal for assessing labor market outcomes. Consequently, we opt to use educational attainment, specifically a binary variable denoting whether participants hold at least a college degree, to proxy broadly for socioeconomic status.

First, we run the pooled difference-in-differences (as in equation (6)) for four different panels presented in Table C.4: lower education (Panel A), higher education (Panel B), traditional (Panel C), and egalitarian (Panel D), and we can finally compare the magnitudes and signs of the estimated average effects ($\hat{\theta}$). Second, we run the same specification but interacting the treatment dummy with an indicator for holding a college degree or less, and stratifying the regressions by pre-birth gender norms. Results are presented in Table C.5. Finally, Figure C.4 presents the results of our event study regressions split by college education.

Overall, our results suggest two key things. First, SES as captured by the highest educational level at the individual level, does not significantly contribute in shaping the trajectory of labor earnings as both groups experience a significant drop in their labor earnings of almost comparable magnitudes. Second, a gap opens up between traditional women and egalitarian women with a significant difference. It therefore suggests that our results are not driven entirely by the socioeconomic status, as norms hold stronger than education in shaping the magnitude of the motherhood penalty.

Table C.4. Post-birth gendered earnings trajectory, by highest educational achievement, and pre-birth gender norms (1/2)

	Panel A	**Panel B**	**Panel C**	**Panel D**
	Low education	Higher education	Traditional	Egalitarian
Female	-2852.872***	-3165.579***	-3280.310***	-2103.550***
	(539.229)	(1113.260)	(949.018)	(738.070)
Post	1521.725**	2323.349*	1437.921*	1277.890
	(624.076)	(1268.511)	(782.739)	(985.646)
Female × Post	-6984.086***	-9428.358***	-9981.738***	-6950.029***
	(758.897)	(1538.996)	(1117.266)	(1069.696)
Observations	5698	2652	4131	4150
Normalized Average Effect (%)	-.614	-.532	-.767	-.492
Year Fixed Effects	Yes	Yes	Yes	Yes
Age Fixed Effects	Yes	Yes	Yes	Yes

Notes: * p <0.10; ** p <0.05, *** p <0.01. OLS results for equation (6) on annual labor earnings. High education corresponds to holding at least a college qualification. The 'post' dummy takes the value 1 if $t \geq 0$, and corresponds to the post-childbirth period. The normalized average effects divide the estimated average effect ($\hat{\theta}$) for each panel, by the baseline mean for each panel, respectively: for Panel A, by the pre-birth labor earnings average of lower educated women; for Panel B, by the pre-birth earnings average of higher educated women; and for Panel C (D), by the pre-birth earnings average of traditional (egalitarian) women.

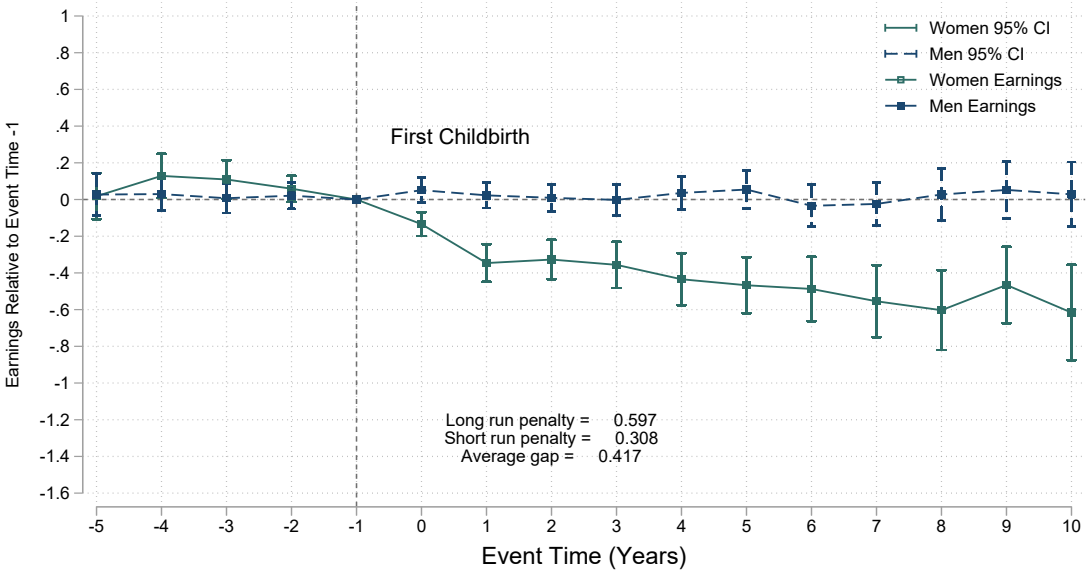
Table C.5. Post-birth gendered earnings trajectory, by highest educational achievement, and pre-birth gender norms (2/2)

	Panel A	**Panel B**
	Egalitarian	Traditional
Post	5374.782***	4521.043***
	(1584.104)	(1636.486)
Woman	-2207.265*	-4112.518**
	(1241.140)	(2063.843)
Post × Woman	-10000.534***	-10197.460***
	(1845.637)	(2592.788)
Low education	-4827.698***	-6193.421***
	(1150.020)	(1204.404)
Post × Low education	-5975.784***	-3133.573*
	(1720.026)	(1778.996)
Woman × Low education	-106.311	1038.815
	(1466.661)	(2141.316)
Woman × Post × Low education	5140.831**	650.305
	(2145.319)	(2760.199)
Observations	4150	4131
Normalized Average Effect (%)	.364	.05
Year Fixed Effects	Yes	Yes
Age Fixed Effects	Yes	Yes

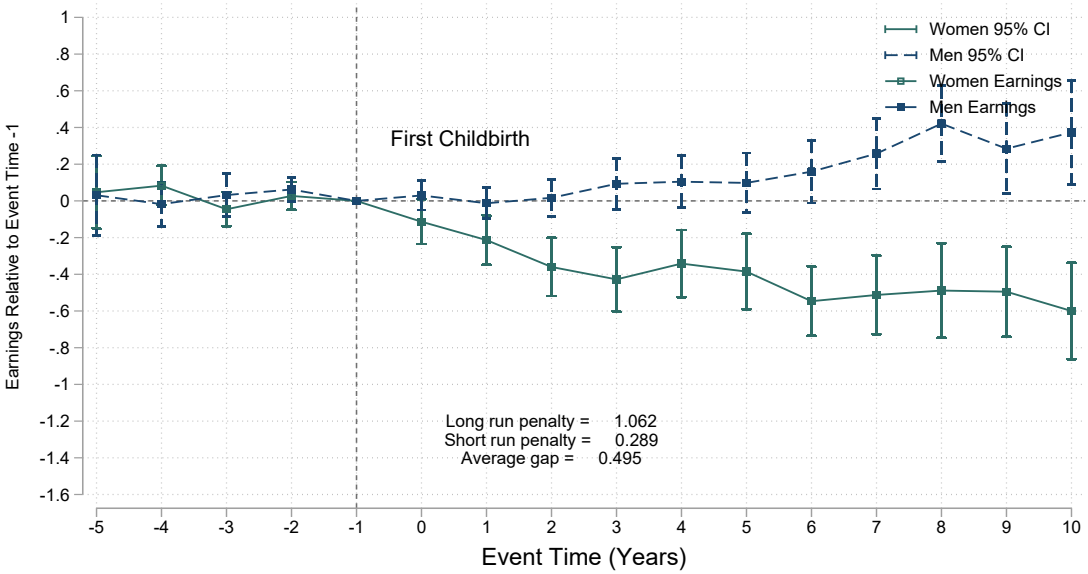
Notes: * p <0.10; ** p <0.05, *** p <0.01. OLS results for equation (6) on annual labor earnings for egalitarian and traditional parents, as defined in Subsection 2.4.2. The 'post' dummy takes the value 1 if $t \geq 0$, and corresponds to the post-childbirth period. The normalized average effects correspond to the estimated average effect ($\hat{\theta}$) divided by the baseline mean for each panel, respectively: for Panel A, by the pre-birth labor earnings average of egalitarian women; for Panel B, by the pre-birth earnings average of traditional women.

Figure C.4. Impact of parenthood on earnings, by highest educational achievement

(a) Does not have a college degree



(b) Does have at least a college degree



Notes: OLS results for equation (1) on annual labor earnings for parents who do not have a college degree (a) and those who have at least a college degree (b). Both figures show the estimated impact of having a first child on earnings within each gender group (P_t^g, as described in equation (2)). The average gap indicates the mean of P_t (as described in equation (3)) for t spanning from 0 to 10, encompassing the 10-year period following parenthood. The short-run gap represents the mean of P_t during the initial 3 years after the first childbirth, covering t from 0 to 3, while the long-run gap corresponds to the average of all P_t for t from 7 to 10.