Parenthood and the Gender Gap in Commuting

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Abstract

Childbirth raises the opportunity cost of commuting and makes it difficult for both parents to work far away from home. Using detailed Norwegian employer-employee matched register data, we show that the commuting behavior of men and women diverges immediately after childbirth and that those differences persist for at least a decade. This divergence in commuting behavior exposes mothers to more concentrated and suburban labor markets with fewer job opportunities and lower establishment quality. These findings uncover a key mechanism underlying the child penalty documented in prior work and have important implications for the design of policies seeking to address the remaining gender wage gap.

JEL Classification: J16, J22, J42, J61

Keywords: Commuting, Gender Wage Gap, Parenthood

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1 Introduction

The gender pay gap has narrowed substantially over the past decades, yet notable disparities in labor market outcomes remain. The causes of these persistent gender disparities continue to be actively debated within economics (see Blau and Kahn, 2017).

The literature suggests that the remaining gender gap may stem from differences in psychological traits such as the willingness to compete or bargain for wages (Azmat, Calsamiglia and Iriberri, 2016; Niederle and Vesterlund, 2007; Tungodden and Willén, 2023), differences in the willingness to trade off higher wages for other types of work amenities (Goldin and Katz, 2016; Mas and Pallais, 2017), preferences for the family-friendliness of establishments (Hotz, Johansson and Karimi, 2017), and commuting distance (Le Barbanchon, Rathelot and Roulet, 2019; Petrongolo and Ronchi, 2020). Another mechanism that has been identified is the career cost of parenthood (Adda, Dustmann and Stevens, 2017; Bertrand, Goldin and Katz, 2010; Cortés and Pan, 2023). Specifically, recent work shows that childbirth leads to significant long-term declines in earnings for mothers but not fathers (Angelov, Johansson and Lindahl, 2016; Lundborg, Plug and Rasmussen, 2017; Kuziemko et al., 2018; Kleven, Landais and Søgaard, 2019) even after accounting for the potential endogenous timing of childbirth (Bensnes, Huitfeldt and Leuven, 2020). While some of the child penalty is caused by mothers switching to more family-friendly employers, it may also stem from gender differences in preferences and opportunity costs of commuting following childbirth.

This paper studies the impact of parenthood on commuting behavior. The rationale underlying our analysis is that parenthood increases the opportunity cost of commuting, making it harder for both parents to work far from home. Since reduced willingness to commute narrows an individual's job search area, this can significantly impact their labor market outcomes. A smaller search area restricts job opportunities, increases the risk of job mismatch, and exerts downward pressure on wages due to exposure to concentrated labor markets and firm monopsony power (Dodini et al., 2020). As there are significant gender differences in the willingness to commute—in particular for mothers of young children (Le Barbanchon, Rathelot and Roulet, 2019; Petrongolo and Ronchi, 2020; Borghorst, Mulalic and van Ommeren, 2021)—this may have a considerably larger impact on mothers relative to fathers. The implication of an increased gender difference in commuting following childbirth is that mothers become systematically exposed to worse labor market conditions than fathers. This could represent a core mechanism behind the motherhood penalty.

We follow prior literature and adopt an event study design around the birth of the first child (e.g., Kleven, Landais and Søgaard, 2019). We exploit rich Norwegian register data to identify all first-time parents between 1990 and 2000. We track parents from four years before to ten years after the birth of their first child. Utilizing Microsoft's BING Distance Matrix API to measure driving distance between home and work, we examine changes in commuting distance and commuting likelihood for both mothers and fathers around the birth of their first child.

Examining the relationship between childbirth and parental commuting behavior in Norway is particularly interesting. First, while the country is seen as one of the most gender-equal in the world, with men and women having nearly identical labor market participation rates and most women returning to the workforce after childbirth, a significant and persistent gender wage gap remains (Ahrsjö, Karadakic and Rasmussen, 2023). For example, women's median annual earnings are only 75 percent of men's, women are much more likely to work part-time and in the public sector, and they face a substantial child penalty when becoming mothers (Bütikofer, Jensen and Salvanes, 2018; Riise, Willage and Willen, 2020). Additionally, the gender gap in commuting in Norway is similar to the OECD average, with little convergence between men's and women's commuting behavior over the past decade. Second, like most OECD countries, Norway has seen a sharp increase in average commuting distances, potentially intensifying the labor market effects of gender differences in commuting. From 1992 to 2014, the average daily commute increased from 13.7 km to 19.1 km for men and 8 km to 12.5 km for women (Hjorthol, Engebretsen and Uteng, 2014). Over a third of workers commute across municipal borders, with 70 percent traveling by car. Most commuters are male and employed in the private sector (see Statens vegvesen, 2019; Stangeby, 1987). Finally, Norway's rich employer-employee matched data allows us to link commuting distances, labor market concentration, and establishment characteristics to birth records dating back to the early 1980s. Combined with detailed individual-level data on employment, earnings, occupation, and family composition, this helps overcome data limitations that have constrained prior research.

Our analysis yields four key insights. First, we confirm previous findings of significant and persistent motherhood penalties in earnings and hourly wages. Second, we observe a similar pattern in commuting behavior: men's and women's commuting trends align before the birth of their first child, but they diverge afterward and remain separate for at least ten years. Third, we show that this divergence in commuting distance exposes mothers to more concentrated labor markets with fewer job opportunities and lower-quality, albeit more family-friendly, employers. This provides strong evidence of the mechanisms through which the motherhood commuting effect influences earnings and long-term labor market outcomes. Finally, we find that the size of the earnings penalty is strongly correlated with the commuting effect, suggesting that changes in mothers' commuting behavior at childbirth are closely tied to the motherhood earnings penalty documented in previous research.

This paper contributes to the extensive literature on gender differences in labor market outcomes by bridging two key strands of research. First, we augment the growing evidence on child penalties for mothers by identifying a new mechanism—commuting—through which these penalties may operate (e.g., Angelov, Johansson and Lindahl, 2016; Kleven, Landais and Søgaard, 2019; Kuziemko et al., 2018). Second, we contribute to the burgeoning literature that links gender differences in willingness to commute with the gender wage gap (Le Barbanchon, Rathelot and Roulet, 2019; Petrongolo and Ronchi, 2020). In particular, we show that childbirth generates a substantial increase in the gender gap in commuting, exposing mothers to more concentrated labor markets with fewer job opportunities and lower establishment quality. These findings have significant implications for the design of maternal protection and family policies, highlighting the strong link between transportation infrastructure and labor market outcomes.

2 Empirical Method and Data

2.1 Empirical Method

We follow the existing literature and adopt a quasi-experimental event study approach centered around the birth of the first child and estimate the following model separately for mothers and fathers (Kleven, Landais and Søgaard, 2019; Bütikofer, Jensen and Salvanes, 2018; Kuziemko et al., 2018):

$$y^g_{ist} = \alpha^g + \sum_{t=-4}^{-2} \delta^g_t D_{it} + \sum_{t=0}^{10} \delta^g_t D_{it} + \sum_k \beta^g_k A^g_{ist} + \lambda^g_s + \varepsilon^g_{ist} \;\; \forall\, g \in [m, f], \tag{1}$$

where y^g_{ist} is an outcome for individual i in calendar year s and relative time t. Relative time is relative to the child's birth; children are born when $t = 0$. The variable D_{it} is a relative time dummy, taking the value of 1 if the individual was observed in relative time t. The δ^g_t coefficients identify both relative pre-treatment trends and time-varying treatment effects of parenthood. We omit δ^g_{-1} such that all estimates are relative to the year before childbirth. The variable A^g_{ist} is a set of age dummies, allowing us to control for underlying life-cycle trends non-parametrically. Equation 1 also includes calendar year fixed effects λ^g_s, allowing us to account for any systematic shocks across years due to factors such as business cycle fluctuations and infrastructure improvements.

We compute the specific relative time t effect by re-scaling the relative time estimate in year t with predicted values of the counterfactual outcome (not entering parenthood) at the same relative time. Provided that unobserved variables influencing labor market outcomes evolve smoothly over time, these estimates can be interpreted as the effect of parenthood on the outcome relative to the year before parenthood (Kleven, Landais and Søgaard, 2019).

2.2 Norwegian Register Data

Our primary data consists of matched employer-employee registers covering all Norwegian residents from 1986 to 2010. These data provide detailed information on each individual's employer, allowing us to identify workplace and residence locations. A unique personal identifier enables us to merge this data with other administrative registers, including education, family, earnings, and social security registers. The longitudinal nature of the data allows tracking individuals over time, offering insights into labor market behaviors.

Labor earnings are defined as annual pre-tax income, including wages, self-employment income, and some taxable transfers (sick leave and parental benefits). Contracted hours are classified into three categories (0–19, 20–29, and 30+ hours per week). Using these, we estimate hourly earnings by dividing labor income by the median value in each category, assuming full-time employment at 37.5 hours per week for those working 30+ hours. The matched data provide establishment identifiers and industry affiliations, which are used to construct measures of labor market concentration, outside options, and establishment quality. Education refers to the highest level attained one year before parenthood.

We focus on individuals who became first-time parents between 1990 and 2000, utilizing a balanced panel of parents who lived in Norway for four years before and ten years after their first child's birth. Our sample is restricted to individuals with strong labor market attachment prior to parenthood, defined as continuous employment during the four years before childbirth. This restriction is necessary for analyzing commuting responses to childbirth, as it allows us to observe an employer's location and construct commuting outcomes.[1] This results in a total sample of $87,659$ first-time mothers and $110,595$ first-time fathers. Summary statistics are presented in Table A1.

We focus on two commuting measures: (i) the probability of commuting and (ii) commuting distance. We adopt Statistics Norway's definition of commuting, classifying commuters as individuals whose workplaces are in municipalities different from their

[1] This restriction differs from prior literature (e.g., Kleven, Landais and Søgaard, 2019) and accounts for the slight differences in our employment and earnings results compared to previous findings.

municipalities of residence.[2] Since commuting distance is inversely related to job satisfaction (Chatterjee et al., 2020), we use the distance between individuals' and firms' postcodes as a second commuting measure. Our data include 5,028 unique postcodes, each covering around 115 individuals, and allow us to assign distances for over 62 percent of observations. Some postcodes have been discontinued since 1980, and certain establishments lack postcodes; in these cases, we use distances from municipality center coordinates (see Figure A1). Since this measure cannot identify within-municipality commuting, we consider commuting distance only for across-municipality commuters.[3] While this measure covers suburban commuting into cities, it does not account for commuting within municipality boundaries. However, 12-58% of the workforce in major cities reside in agglomerations, making this group significant for policy considerations.

Using longitude and latitude postcode data from Bolstad (2020), we use Microsoft's BING Distance Matrix API to construct distance measures of each individual's commute. This measure is based on the distance between the center of the residence postcode and the workplace postcode. The driving distance is based on current infrastructure and assumes individuals commute by car, the predominant mode of transportation for employed individuals in the period (Statens vegvesen, 2019; Vågane, Brechan and Hjorthol, 2011; Stangeby, 1987).

We construct three measures of labor market concentration: the number of establishments, the number of jobs, and the Herfindahl-Hirschman Index of employment (HHI). Each measure captures slightly different dimensions of labor demand and helps develop a comprehensive understanding of how changes in commuting distance impact an individual's labor market opportunities and outside options.

First, we calculate the number of establishments within a year-area-industry cell employing individuals with similar education levels.[4] For example, for a construction worker in Oslo in 1995 with a high school degree, we count the number of construction establishments hiring individuals with the same education level within their local labor market. We define the local labor market by drawing a circle with the distance between residence and workplace as the radius, including all municipalities with centers within this circle.[5] Thus, an individual's commuting preference serves as a proxy for their local labor market. The geographic boundaries of the labor market vary across

[2]A few municipality mergers occurred during our analysis period. We harmonized municipalities to the 2019 structure, which includes 422 municipalities.

[3]Alternatively, we could limit the sample to firms with valid postcodes. We conduct robustness checks measuring the commuting distance across and within municipalities on a subsample of individuals, and our results are robust to these adjustments.

[4]Education is categorized into high school or less, more than high school (no BA), and at least a BA.

[5]A visual illustration of this data-driven approach is shown in Appendix Figure B1.

individuals and over time based on the distance between their workplace and residence each year.

Second, we calculate the number of newly employed individuals, including job-to-job transitions, at the year-area-industry-education level. This measure complements the first and serves as a proxy for labor market opportunities available to workers in specific industries with particular educational backgrounds.

Finally, we construct a Herfindahl-Hirschman Index of employment (HHI) at the year-area-industry-education level. To do so, we first calculate year t, area a, industry j, and education e specific employment shares for each establishment f using 2-digit industry codes (Statistics Norway, 1983). The HHI is then derived as the sum of squared employment shares across all establishments within the specified cell:

$$HHI_{jaet} = \sum_{f=1}^{N} s_{fjaet}^2 \text{ where } s = \frac{emp_{fjaet}}{\sum_{f=1}^{N} emp_{fjaet}} \tag{2}$$

The HHI ranges from 0 to 1, with 1 indicating a monopsony. Thus, the HHI measures labor demand concentration for a given industry-education group across establishments in the local labor market. The average HHI in each municipality in 1995 was significantly lower in Norway's largest cities compared to more rural areas, with notable differences across industry-education cells.

We measure establishment quality through two well-established approaches. The first is establishment size, commonly associated with quality, particularly for early-career individuals (Oreopoulos, Von Wachter and Heisz, 2012; Arellano-Bover, 2024). The second is average hourly earnings of employees; controlling for individual fixed effects, higher wages indicate greater productivity and profitability (Abowd, Kramarz and Margolis, 1999). These measures provide insights into mechanisms contributing to the motherhood penalty in earnings. Additionally, we assess firm family-friendliness by examining the share of women with children under 16 within an establishment (Hotz, Johansson and Karimi, 2017).

Each establishment quality measure is constructed using a leave-one-out approach to ensure they are unaffected by the specific individual observed, allowing abstraction from quality changes influenced by individual characteristics.

In the year before childbirth, the median establishment size was 57 employees for men and 69 for women.[6] Average hourly earnings at establishments were 216 NOK for men and 213 NOK for women.[7] A detailed overview is in Appendix B.2.

[6]This reflects the median size of establishments where individuals were employed, not the establishment size distribution, which is smaller at 8 and 10 employees for men and women, respectively.

[7]Figure B2 provides the distribution of establishment quality measures for our main commuter sample

2.3 Survey Data

We run a large-scale survey on a representative sample of Norwegians aged 25 to 50 to capture how men and women trade off commuting for different types of job amenities.[8] This survey asks respondents to make hypothetical choices between two identical jobs with different levels of specific job amenities. While the complete survey examines various job amenities, such as flexible work schedules, telecommuting, and career development, we restrict attention to the commuting time and salary trade-off comparison in this paper.

The question asks respondents to choose between a job with the same pay as their current job and a commuting time of 20 minutes and a job that pays X times more but has a commuting time of 40 minutes. Here, X represents a monetary amount calculated as a random percent, in ten-percent bins, of the salary the respondent currently earns (self-reported in the survey). The overall objective of this survey question is to understand how willing workers are to trade off commuting for salary gains across the earnings distribution. The commuting time of 20 and 40 minutes is based on the average commuting time in our registry data sample, which is 22 minutes for women and 39 minutes for men.

3 Results

We first present findings on the parenthood gap in employment and earnings. We then examine the commuting gap and supporting survey results. Finally, we explore how changes in commuting behavior affect labor market concentration and establishment characteristics and relate these to the motherhood earnings penalty.

3.1 Employment and Earnings Responses to Parenthood

Figure 1 shows event studies for the effect of childbirth on the extensive and intensive margin of labor supply.

Similar to the findings in other OECD countries, Panel 1a shows an immediate and discontinuous drop in the extensive margin of labor supply for women following childbirth. For men, there is only a modest decline. Although the immediate post-childbirth gender gap in employment (20 percentage points) shrinks over time, it remains economically meaningful even ten years after childbirth (5 percentage points).

by sex and time relative to parenthood.

[8] Summary statistics are presented in Table A2.

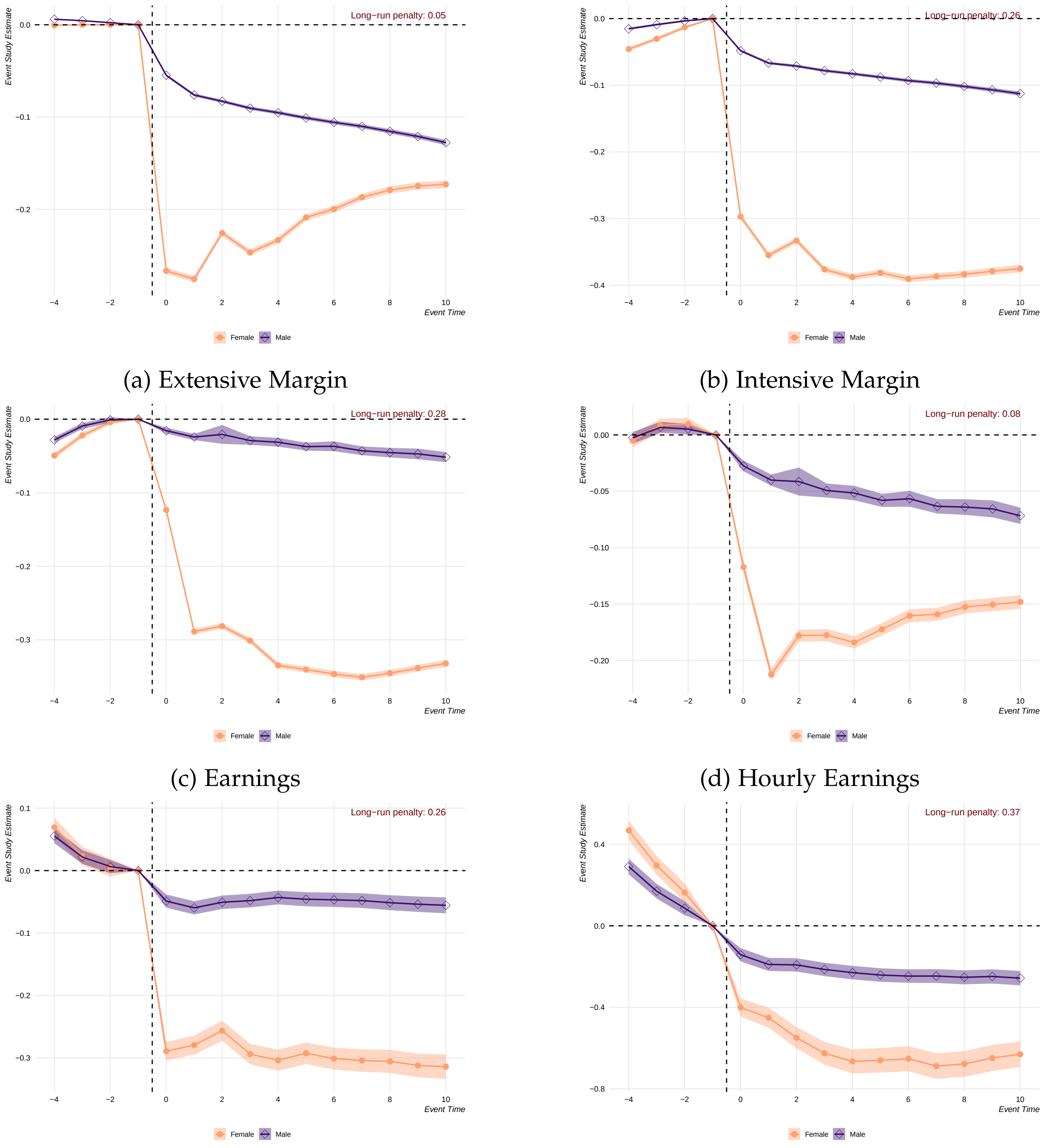
Moreover, Panel 1b reveals an immediate and discontinuous drop in the intensive margin of labor supply (hours worked) for women following childbirth, while there is very little change for men. Women reduce their hours by over 30% relative to their pre-parenthood labor supply. This emerging gap in hours persists for at least ten years, showing only minor signs of convergence.

Figure 1 also presents event study plots for annual earnings (Panel 1c), confirming results from existing literature: men's and women's earnings trend similarly before childbirth but diverge sharply afterward. Specifically, women experience a sudden drop in earnings at parenthood, while men do not. This gap persists for ten years, resulting in a long-run penalty of approximately 28%.[9] Compared to non-Scandinavian countries, Norwegian women experience a slightly smaller penalty than women in the US and the UK, and a much smaller penalty than women in Australia and Germany (Kleven et al., 2019). This difference is usually attributed to differences in gender norms and housework expectations.

Panel 1d shows a similar trend for hourly earnings, though the long-term gender gap is smaller (about six percentage points).[10] This suggests that the drop in female earnings after childbirth is not solely due to fewer hours worked or labor market exit but also reflects lower earnings, even when hours are held constant. This aligns with previous research, highlighting that both extensive and intensive margin effects contribute to the child penalty in earnings, especially in Scandinavian countries with high female labor force participation (Kleven et al., 2019; Bütikofer, Jensen and Salvanes, 2018).

[9] This aligns closely with findings by Andresen and Nix (2022) who find a long-run penalty of approximately 24% for Norway.

[10] The penalty is similar if we restrict the sample to individuals who are employed throughout the sample period (Figure A3).



(a) Extensive Margin

(b) Intensive Margin

(c) Earnings

(d) Hourly Earnings

(e) $\mathbb{P}$(Commuting)

(f) Commuting Distance

Figure 1: Labor Supply, Earnings and Commuting Relative to Parenthood

Note: The figure shows estimated event time coefficients from Equation 1, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for men and women, with shaded areas representing 95% confidence intervals (robust standard errors). The sample includes individuals who became first-time parents between 1990 and 2010 and were continuously employed before childbirth. Long-run penalties, shown in the top-right of each panel, represent the male-female difference at $t = 10$. Intensive margin employment is categorized into 0, 10, 25, and 37.5 hours per week.

3.2 Commuting Behavior in Response to Parenthood

One potential explanation for the motherhood penalty is differential changes in job amenity preferences, such as commuting, between men and women following childbirth. To disentangle the commuting effect of childbirth, Figure 1 shows event study results for the probability of commuting (Panel 1e) and commuting distance (Panel 1f).

The probability of commuting (Panel 1e) trends similarly for men and women before childbirth but diverges sharply afterward. Female commuting experiences a significant drop of approximately 30 percentage points at parenthood, while men see a minimal decline of around five percentage points. These gender differences persist throughout our ten-year post-childbirth period. While the commuting effect is partly explained by the extensive margin labor supply effect shown in Figure 1, long-run gender gaps in commuting also exist for individuals employed throughout the entire period (Table A3). Thus, the commuting effect is not solely a mechanical consequence of changes in extensive margin employment.

Panel 1f estimates the gender-specific parenthood effect on commuting distance. Women reduce their commuting distance before childbirth at a slightly higher rate than men, indicating different pre-trends. This difference is particularly evident in the year leading up to childbirth, which often aligns with conception and pregnancy. However, during the year of child birth, commuting distance drops significantly for both genders, with mothers experiencing a much more substantial decline than fathers. This gap remains throughout the ten-year post-childbirth period and cannot solely be attributed to minor pre-trend differences.[11]

Based on the pre-birth average commuting distance, we estimate a commuting time reduction of about 10 km for men and 19 km for women. Regular speed limits in urban areas and agglomerations would imply about 12— and 22-minute reductions for men and women. While the commuting distance effect partly reflects changes in labor supply, similar patterns are observed among employed individuals throughout the analysis period. Comparing the long-run distance penalties in Figures 1 and A3, the drop in commuting for always-employed mothers is one-third of the size of the total effect, implying a sizable commuting effect *not* driven by changes in labor supply. It is also important to remember that always-employed mothers represent a select sample of career-oriented women, meaning that this likely represents a lower bound.[12]

[11] These differences between mothers and fathers are primarily driven by gender rather than pre-childbirth primary or secondary earner status (Appendix Figure D2).

[12] We also verify that the commuting distance effects are not sensitive to top coding by dropping or replacing vast commuting distances in various ways. This ensures that our findings are not influenced by a small number of outliers (Appendix Figure A4).

To understand the commuting dynamics—whether mothers are moving to jobs closer to home or relocating closer to their jobs—, we study individuals who were commuting before their first child and stopped commuting within two years of the birth.[13] Among still-employed mothers who were commuting before their first child and stopped commuting within two years after childbirth, 45 percent changed their residence municipality, while 60 percent changed their workplace municipality. In comparison, 45 percent of fathers changed their residence municipality, and 50 percent changed their workplace municipality. The changes in commuting behavior in Figure 1 are primarily driven by individuals shifting their workplaces closer to their residences.

In addition to the evidence in Figure 1, our survey results suggest a change in the way women and men trade off commuting against earnings after becoming parents. Utilizing the survey data presented in Section 2, we run the following regression to examine differences in willingness to commute:

$$y_i = \alpha + \beta_1 \text{Female}_i + \beta_2 \cdot (\gamma_i \times \text{Male}_i) + \beta_3 \cdot (\gamma_i \times \text{Female}_i) + \tau X_i + \varepsilon_i \qquad (3)$$

where y_i is a dummy variable equal to one if individual i selected a salary increase of γ percent in exchange for a doubling in commuting time.[14] *Male* and *Female* are dummy variables equal to one if a person is male and female, respectively. The variable γ_i is the continuous threshold variable, randomized across individuals. Equation 3 also includes a vector of control variables: residence county, baseline commuting time, level of education, and the monthly salary of an individual.[15]

The results from estimating Equation 3 are presented in Table 1. First, women are significantly less likely than men to accept an increased commute for higher monetary compensation. Second, both genders are less likely to choose increased commute time for a higher monetary payoff when children are present. Childless men (women) are approximately 13 (17) percentage points more likely to accept a doubling of commuting time compared to those with children. The reduction in the likelihood of opting for a longer commute for higher compensation is statistically and economically significant, with a greater impact on women than men. Third, the interaction of gender dummies with the threshold variables shows no significant differences in responsiveness to commuting changes based on monetary compensation between men and women. That is, men and women do not differ in their responsiveness to commuting changes as a func-

[13] Note that a non-negligible share of individuals who stopped commuting after childbirth is no longer employed. Two years after childbirth, this share is 28 percent among women and 16 percent among men.

[14] In Figure A5 we provide results for the share of men and women choosing a salary increase of γ percent in exchange for a doubling in commuting time for each of the different γ threshold values. The graph indicates a general gender difference but no significant difference in the trend of the fitted lines.

[15] All control variables are balanced across the randomized threshold γ.

tion of the monetary compensation they receive. Still, their willingness to commute differs, conditional on their income.

Table 1: Survey Results: Commuting Preferences

Model:	All (1)	No Children (2)	With Children (3)	Child (Age $\leq$ 6) (4)	Child (Age > 6) (5)
Constant	0.385***	0.451***	0.325***	0.261*	0.326***
	(0.038)	(0.059)	(0.050)	(0.145)	(0.055)
Female	-0.103***	-0.076**	-0.122***	-0.160**	-0.108***
	(0.022)	(0.033)	(0.029)	(0.063)	(0.033)
Threshold $\times$ Male	0.007***	0.006***	0.007***	0.008***	0.007***
	(0.0004)	(0.0006)	(0.0005)	(0.001)	(0.0006)
Threshold $\times$ Female	0.008***	0.007***	0.008***	0.011***	0.008***
	(0.0003)	(0.0005)	(0.0005)	(0.001)	(0.0005)
Fit statistics					
Observations	10,008	4,210	5,798	1,188	4,610
R^2	0.104	0.092	0.118	0.170	0.113
Adjusted R^2	0.102	0.088	0.115	0.155	0.109

Note: The table presents results from estimating Equation 3 for different sample specifications. The full sample consists of 10,008 representative Norwegians in the age range 25 to 50 who where individually surveyed about their labor market preferences and conditions during late June 2021. Column one includes the full sample, column two only individuals without children, column three those with at least one child, column four only individuals with children below age seven and column five includes individuals with children above age six. Significance thresholds: ***: 0.01, **: 0.05, *: 0.1.

The patterns in Figure 1 and Table 1 might reflect actual or constrained choices. Although we cannot perfectly distinguish between these two mechanisms, we find suggestive evidence that constraints play an important role. First, Columns (4) and (5) in Table 1 show that parents with young children have a higher willingness to pay for shorter commuting times than parents with older children. Given that parents with younger and older children have similar commuting preferences (1) but parents with younger children are more constrained, this suggests that constraints are an important factor. Second, we compare families with grandparents who live close by to families with grandparents who live far away (Figure A6). Long-run gender differences in commuting and labor market outcomes are significantly larger for families with grandparents who live far away. Assuming that grandparents might reduce constraints, these findings suggest that constraints are partly responsible for our effects.

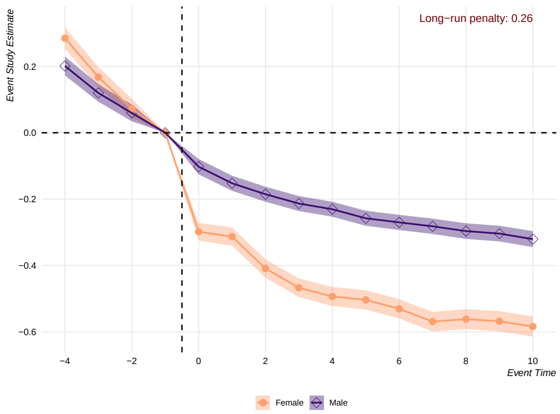
Overall, our results suggest that women are restricting their local labor markets to a much smaller geographic area after childbirth relative to men. This may mechanically result in females facing a more concentrated market with fewer job options, reducing the probability of finding high-paying jobs, high-quality firm matches, and moving up the career ladder. To examine this in detail, Figure 2 provides estimates for the three concentration measures discussed in Section 2: the number of establishments, the number of jobs, and the HHI. We measure changes in labor market opportunities based on observed changes in commuting distances. This might underestimate workers' job opportunities. In the Online Appendix, we provide an analysis that is not based on observed changes and demonstrates that women's average changes in commuting distances lead to a more considerable change in labor market opportunities for women.

In Panel 2a, we examine the effect of parenthood on the number of establishments. Similar to the commuting distance effect, the number of establishments evolves similarly for men and women prior to parenthood and then drops abruptly for both. The drop is significantly larger for women. This means that the outside options available to mothers decline more than for fathers following parenthood. For example, five years post-childbirth, mothers have experienced a 50% reduction in the number of potential establishments where they can work, while the reduction is 25% for fathers. These reductions correspond to 250 fewer potential establishments for the average women and 108 fewer establishments for the average men relative to the year prior to parenthood.

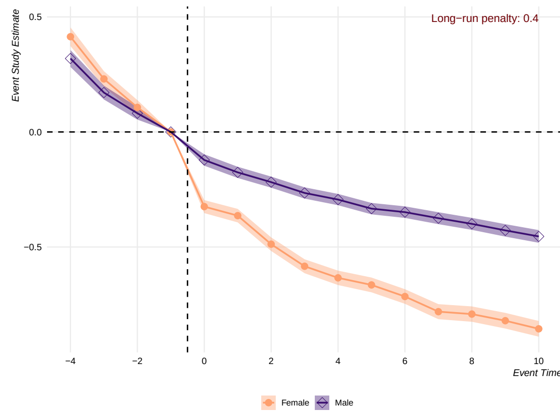
In Panel 2b, we examine the effect of parenthood on the number of job positions that were filled within the individual's industry-education-area cell. There is an abrupt and immediate reduction in the number of positions within the local labor market for women and a much smaller drop for men. This result mirrors the gender-specific effect on the number of establishments shown in Panel 2a. Five years after childbirth, women have experienced a significantly larger reduction in potential positions filled in their education-industry-area cell. There is no indication that the gender-specific effects converge over time.

Event study results for the HHI are shown in Panel 2c. Labor market concentration evolves similarly for men and women before childbirth, and we observe a substantial divergence in the gender-specific HHIs after birth. Hence, women are exposed to much more concentrated labor markets than men. Ten years after childbirth, women are exposed to a labor market concentration 18 percentage points greater than men. This effect is comparable to moving from the median to the 40th percentile of labor market concentration in our main sample. Dodini et al. (2020) estimate that a 10 percentage point decline in the HHI generates a negative wage effect of 9,298 NOK. In our case, this corresponds to a concentration penalty of 16,736 NOK in annual earnings for women or a 5% reduction relative to the pre-parenthood mean.[16]

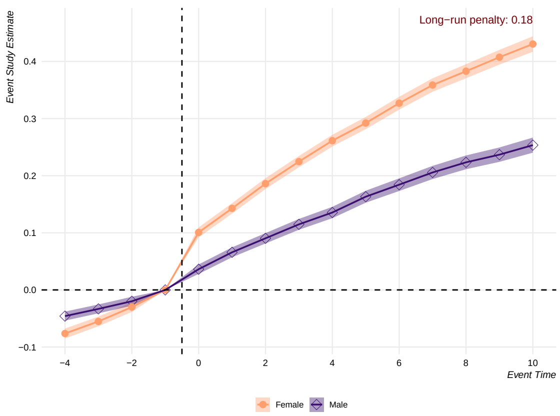
[16]Note that we allow industry to vary over time for these measures. Appendix Figure A7 documents that keeping the industry code fixed at the value two years before childbirth (t=-2) results in a slightly larger long-term penalty. Hence, industry changes post-birth are not driving the effects we measure above.



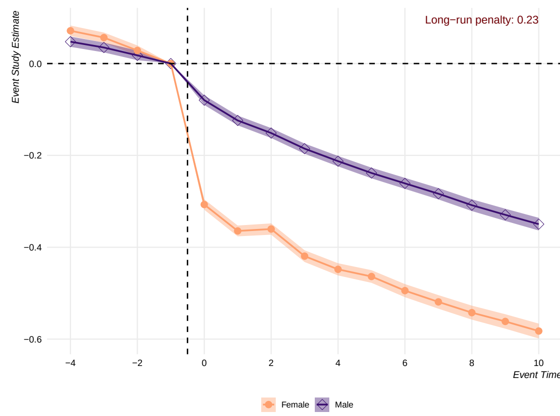
(a) Number of Establishments



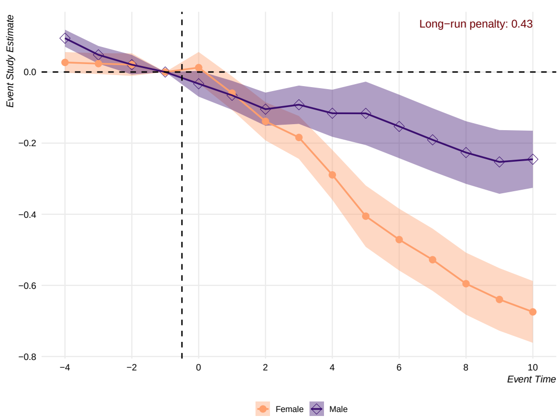
(b) Number of Positions



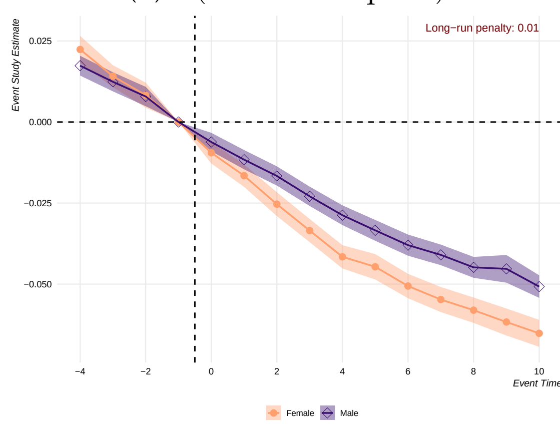
(c) Herfindahl-Hirschman Index



(d) $\mathbb{P}$(Urban Workplace)



(e) Establishment Size



(f) Average Hourly Earnings

Figure 2: Labor Market Conditions Relative to Parenthood

Note: The figure shows the estimated coefficients of the event time dummies as a fraction of the predicted outcome, when omitting the contribution from event dummies in each year relative to the birth of the first child. Coefficients are estimated separately for men and women, and the regressions include industry-fixed effects. The shaded areas indicate the 95% confidence band using robust standard errors. The samples include men and women who became first-time parents between 1990 and 2010, whom we observe four years prior and ten years after childbirth, and who were continuously employed in the years prior to childbirth. Municipalities defined as urban are the following (ordered by size): Oslo, Bergen, Trondheim, Stavanger, Fredrikstad, Drammen, Kristiansand, Tromsø, Bodø, and Hamar.

A significant portion of the decline in labor market concentration is due to women's reduced likelihood of working in urban municipalities (see Panel 2d), which offer more jobs, more establishments, and a lower labor market concentration (Dodini et al., 2020). These results indicate that parenthood alters mothers' commuting behavior and negatively impacts their labor market opportunities, suggesting an additional pathway for the child penalty.

3.3 Parenthood, Establishment Quality, and Family Amenities

Changes in commuting may also affect the quality of job opportunities for mothers and fathers through two primary channels. First, the overall reduction in the number of jobs and establishments could result in fewer high-quality matches. Second, increasing labor market concentration could enhance employers' bargaining power over employees, potentially leading to decreased workplace quality. The effects discussed in this subsection should be interpreted as the total aggregate impact of these two channels.

Panel 2e of Figure 2 shows that the establishment size declines in response to parenthood for both genders. Women experience a larger drop, generating a long-term establishment size gap of 43 percentage points. This is important because larger firms have been shown to offer better on-the-job training (Lynch and Black, 1998), apprenticeship training in larger firms has been shown to protect workers from unemployment later in life (Müller and Neubäumer, 2018), and increased firm size is associated with higher lifetime earnings (Arellano-Bover, 2024). Therefore, the parenthood-induced gender gap in establishment size may be an important pathway through which the child penalty operates.

Second, we consider the average hourly earnings at the establishment—a function of firm profitability, productivity, worker value-added, and rent-sharing propensity (Abowd, Kramarz and Margolis, 1999).

Panel 2f demonstrates no significant differential trend in the average hourly earnings at the establishment prior to parenthood. Following parenthood, both men and women experience a drop, which is considerably larger for women, generating a long-run gap of 1%. Taking the mother's pre-parenthood average hourly establishment earnings as a base, the long-run gap in the establishment's average hourly earnings corresponds to a salary reduction of around 13 NOK per hour or approximately $25,000$ NOK annually for a full-time worker.

These results demonstrate that the quality of the establishments that men and women work at declines sharply at the onset of parenthood. However, these declines are more prominent for women, and this pattern is robust to focusing only on always-employed individuals. Thus, not only do the gender-specific parenthood effects on commuting result in a reduction in outside options and increased exposure to concentrated markets, but they also widen the gender gaps in terms of the quality of the employers.

Nevertheless, the overall reduction in establishment quality measures above might be due to preferences for shorter commutes and a higher demand for family-friendly employers; both meant to accommodate the increased demand for household work that comes with childbirth (see Hotz, Johansson and Karimi, 2017). We use the share of women with children below 16 years in an individual's plant as a measure of work-place family friendliness, and we document in Appendix Figure A8 that the long-term parenthood-induced gap is significant; women are much more likely to remain or move to family-friendly firms relative to men. However, since we observe strong suggestive evidence of constraints playing an important role in the post-parenthood employment choices of mothers (Section 3.2), we believe that the estimated effect most likely implies a welfare reduction for these women.

Table 2: Child Penalty by Quintile of Commute (Distance) Penalty

	Bottom Quintile of Commute Penalty	**Top Quintile of Commute Penalty**	**Difference**
	(1)	**(2)**	**(3)**
Earnings Penalty	0.220	0.267	0.047
Hours Worked Penalty	0.138	0.169	0.031
Herfindahl Hirschman Index Penalty	0.302	0.399	0.097
Number of Establishments Penalty	0.004	0.138	0.133

Notes: The table presents the child penalty measured as the average difference in event-study estimates obtained from Equation 1 between men and women in the post-period minus the average difference between estimates of men and women in the pre-period, which directly follows Kleven (2022). The definition of the child penalty can be written as follows: Child Penalty $= \mathbb{E}[P_t^m - P_t^f | t \geq 0] - \mathbb{E}[P_t^m - P_t^f | t < 0]$. Column (1) presents results for the child penalty for individuals with a distance penalty in the bottom quintile of their respective sex. Column (2) presents analogous child penalties for the top quintile. Column (3) presents the difference.

A limitation of our study is that we only observe commutes across municipalities. Hence, our results are based on commuting in agglomerations around cities and rural areas. Appendix Figure A9 presents the main results separately for individuals who lived in cities and individuals who only lived in agglomerations around cities and rural areas (pre-birth). While the post-birth decrease in earnings of women is similar for both groups, travel distance decreases much less, and the change in the HHI index is much larger for women in the cities.[17] These results suggest that commuters inside and outside city borders face a child penalty in commuting and earnings.

3.4 Commuting Gap and Earnings Penalty

How much of the child penalty can be attributed to the changing labor market conditions induced by the commuting effect found in this paper? Even though we cannot directly link the commuting impact to the earnings penalty, we provide suggestive evidence of their connection.

First, we examine whether the earnings penalty is more prominent for individuals who experience a larger commuting effect. We divide individuals into (gender-specific) quintiles of the predicted parenthood commuting penalty and re-estimate our main results for individuals in the top and the bottom quintiles (Table 2). Individuals who experienced the smallest predicted commuting effect also experienced fewer adverse job opportunity effects, smaller adverse establishment quality effects, a smaller change in labor market concentration, and a significantly smaller child earnings penalty.

Second, we show that women who commuted before the birth of their first child have a larger earnings drop post-birth than women who did not commute before (Appendix Figure A10). Although the estimated differences may appear small, they exceed the estimated return to an additional half year of education and accumulate to more than 124,000 NOK over a decade (see, e.g., Card, 1999). While commuting is an endogenous stratification variable, and the results should be interpreted cautiously, they provide additional evidence of the link between commuting and earnings.

Third, we analyze whether the earnings penalty for commuters differs by their pre-birth labor market opportunities. We measure job market opportunities using the number of establishments within an individual's revealed commuting distance for each individual in the pre-period. This allows us to compare individuals with similar numbers of potential employers in the pre-period. We analyze earnings penalties for non-commuters and commuters in the top and bottom deciles of pre-parenthood job opportunities. Among individuals with low job market opportunities, the non-commuters have a significantly higher earnings penalty. In contrast, for individuals with high job market opportunities, there is almost no difference in the respective earnings penalties (Appendix Figure A11). This means that people who commute to obtain the same level of job opportunities as non-commuters have a larger earnings penalty.

[17] Travel distances in cities and rural areas do not translate 1:1 into travel time, as traffic is much slower in cities. Hence, differences in the travel time penalty for women in and outside cities might be smaller than Appendix Figure A9 suggests.

Taken together, these findings suggest that commuting plays a meaningful role in shaping the post-childbirth earnings penalty. To clarify the mechanisms underlying this relationship, we distinguish between two channels. First, some women adjust their job search patterns after childbirth and accept lower-paid jobs closer to home (extensive margin). Second, non-commuting jobs themselves may offer lower pay—potentially due to greater flexibility, fewer career advancement opportunities, or reduced bargaining scope—resulting in a persistent earnings gap even conditional on commuting status (intensive margin). To better understand how commuting contributes to the post-childbirth earnings penalty, we decompose the commuting-related component into these two channels.

To implement this, we classify women into three groups based on commuting behavior before and after childbirth: (1) those who always commute, (2) those who commute before but do not commute after childbirth, and (3) those who never commute.[18]

We define the total commuting-related penalty as the earnings difference between women who always commute and those who stop commuting after childbirth. The intensive margin component is the earnings gap between women who always commute and women who never commute. The extensive margin is then the residual—the difference between the total penalty and the intensive component:

$$\underbrace{\text{Total effect}}_{\text{Always}-\text{Stoppers}=0.12} = \underbrace{\text{Extensive Margin}}_{\text{Residual}=0.07} + \underbrace{\text{Intensive Margin}}_{\text{Always}-\text{Never}=0.05} \tag{4}$$

These estimates are based on the earnings differentials observed ten years after childbirth, as reported in Appendix Table A4, Panel C.[19] The decomposition implies that approximately 60% of the commuting-related child penalty arises from changes in the extensive margin, while the remaining 40% reflects changes on the intensive margin. Panels A and B in Appendix Table A4 show that the extensive margin plays an even larger role two and five years after childbirth.

Overall, these findings highlight that both extensive and intensive margins of commuting behavior are associated with post-childbirth earnings penalties. However, we emphasize that this is a descriptive exercise, and commuting choices are endogenous. The resulting estimates should therefore be interpreted with appropriate caution.

[18] A very small number of women begin commuting after childbirth; we exclude them from the decomposition. This has no impact on the result.

[19] While the decomposition focuses on variation within women, the overall gender gap in Figure 1 (–0.28) can be recovered by taking the difference between the weighted average penalties across commuting groups for women and for men, using the group-specific estimates and population shares shown in Panel C of Appendix Table A4.

4 Conclusion

We advance the motherhood penalty literature by investigating whether parenthood generates gender differences in commuting behavior and if this explains why the motherhood penalty exists. Leveraging administrative data and a quasi-experimental event study approach, we document that the large wage drops mothers face after childbirth coincide with a sharp decline in commuting probability.

First, we document large reductions in earnings for women relative to men after childbirth. Second, we show a sharp drop in female commuting probability at the onset of parenthood; no such drop is observed among men. Third, we show that the commuting gap leads mothers to face a more concentrated labor market with fewer job options and a sharp decline in establishment quality. We link our findings to the motherhood earnings penalty by examining earnings penalties as a function of the commuting effect, analyzing post-birth earnings drops for commuting and non-commuting women, and stratifying our sample by pre-birth labor market opportunities and commuting behavior.

Our study highlights the need to address commuting behavior to mitigate the motherhood penalty. Policymakers might explore flexible work arrangements, improve public transportation, and provide affordable childcare to support mothers in accessing better job opportunities and navigating commuting challenges.

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Appendix

A Additional Figures and Tables

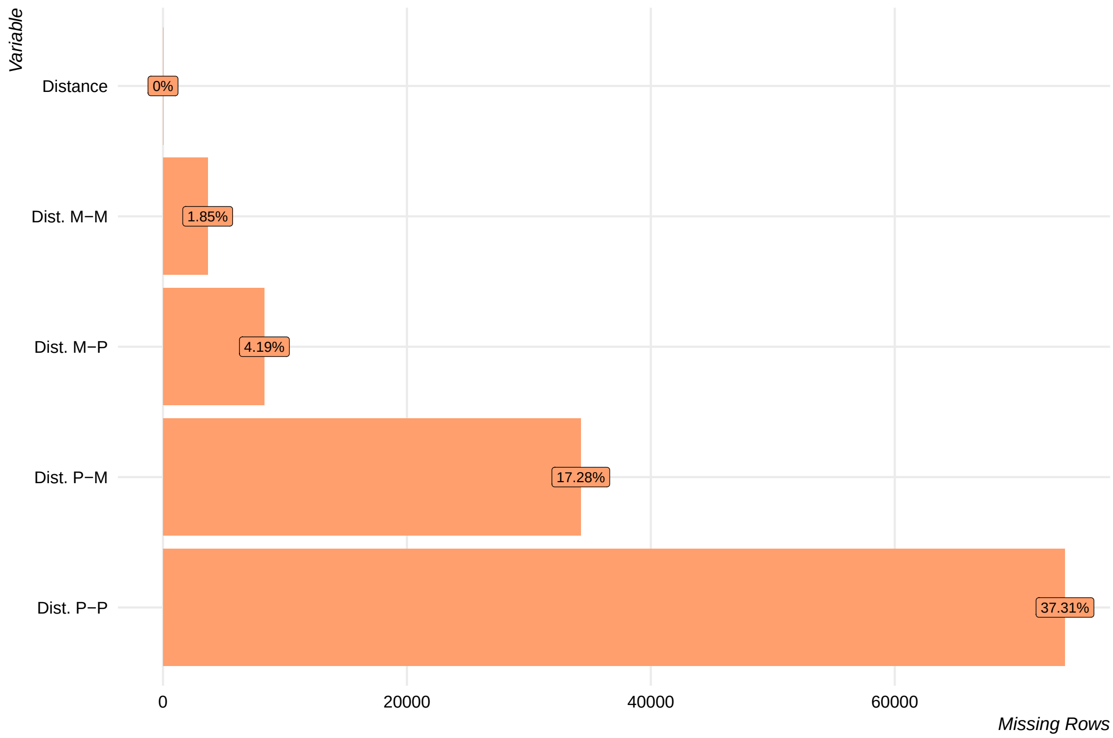


Figure A1: Distance Assignment

Note: The figure shows the share of missing distance values for different combination of postcodes and municipalities in the period prior to childbirth ($t = -1$). Dist. M-M indicates the share of missing values for distances constructed where workplace and resident municipality are available. Dist. M-P indicates workplace municipality to residence postcode, Dist. P-M indicates workplace postcode and residence municipality and Dist. P-P indicates postcode to postcode distances.

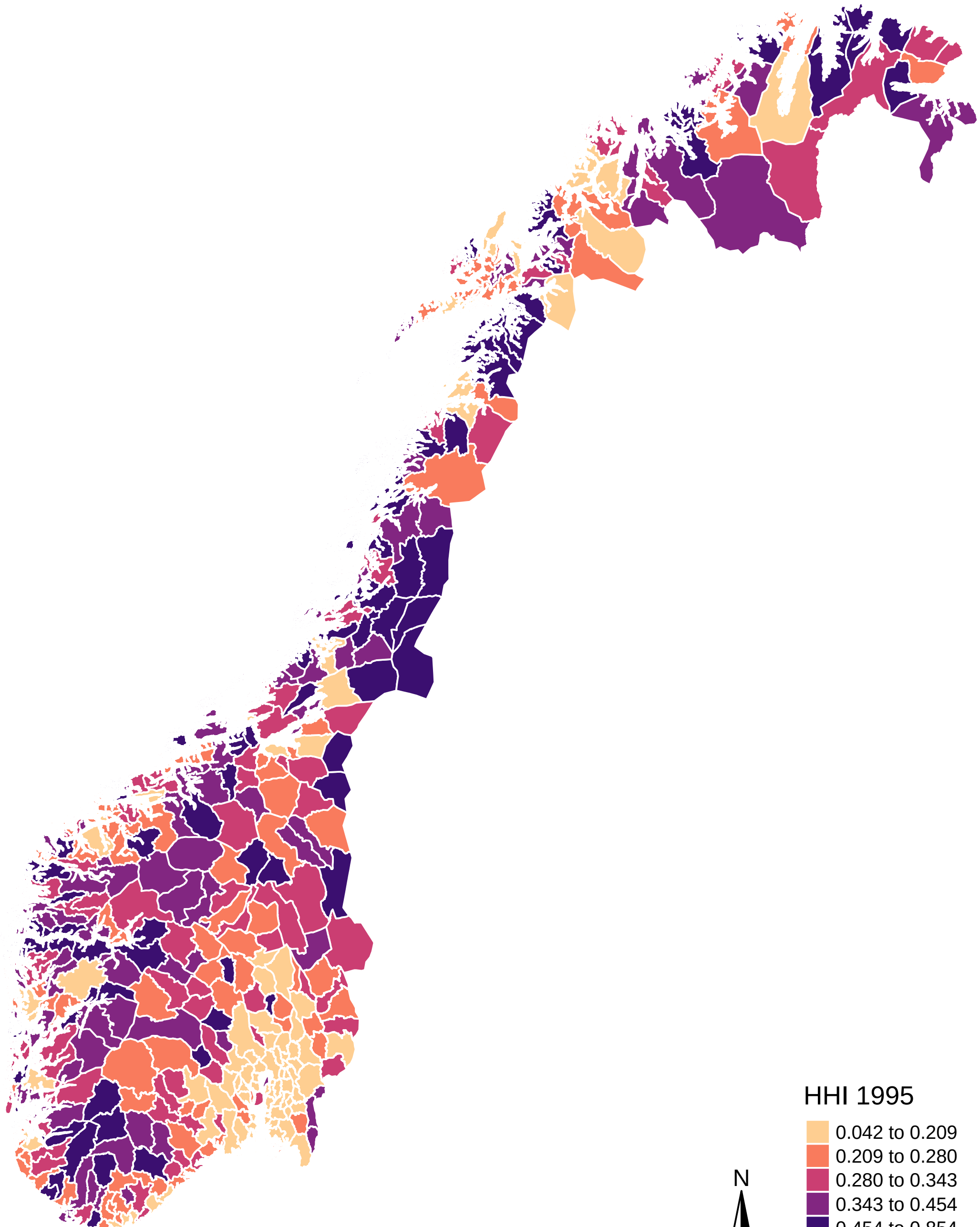


Figure A2: Herfindahl-Hirschman Index in 1995

Note: Average Herfindahl-Hirschman Index in 1995 in each municipality. The HHI is calculated based on the main commuter sample using the actual commuting distance of individuals to define the local labor market (see Figure B1). It includes all individuals who became first-time parents between 1990 and 2010 who were employed at least eight out of 15 years in the 15 years around childbirth.

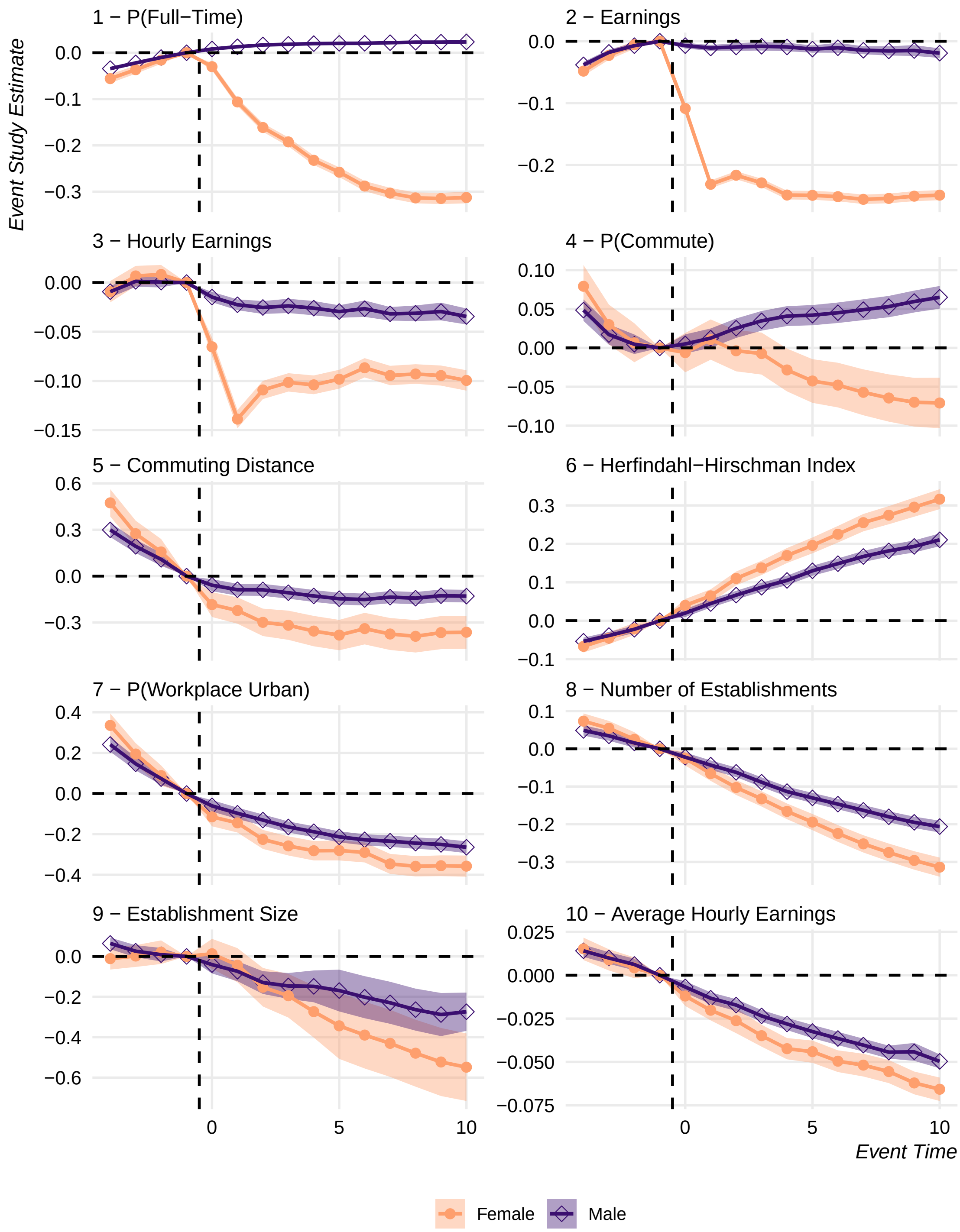
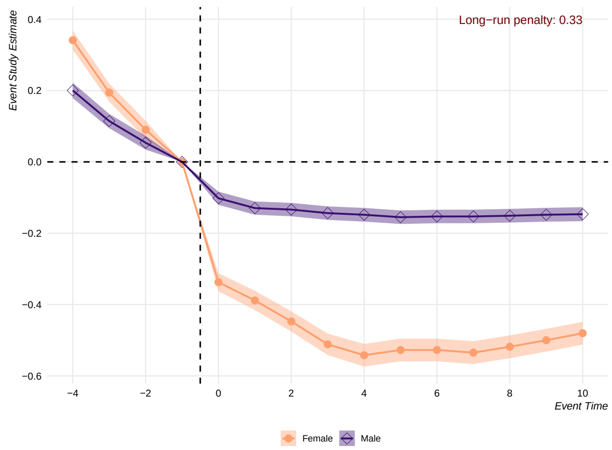
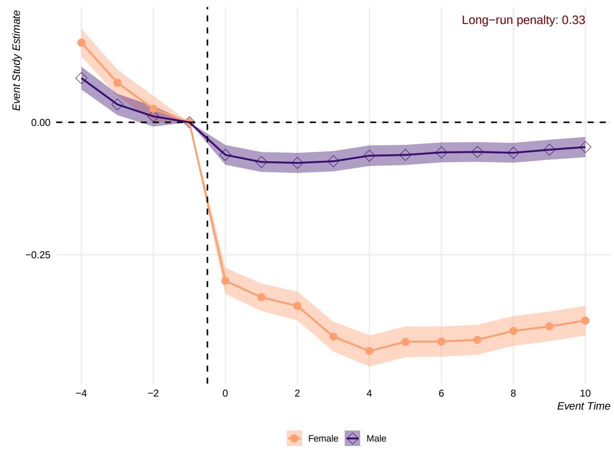


Figure A3: Always Employed Sample

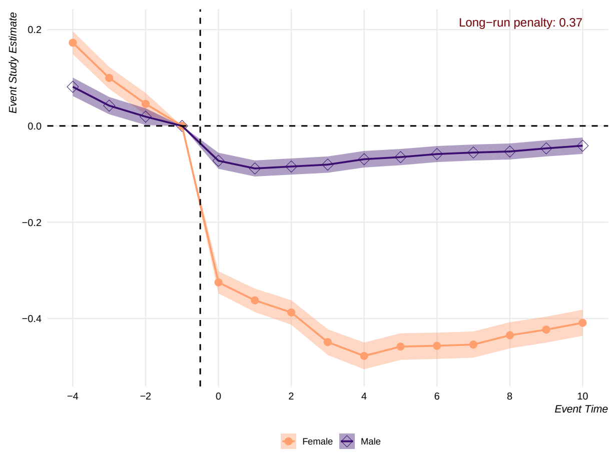
Note: The figure shows the estimated coefficients from Equation 1, as a fraction of the predicted outcome, when omitting the contribution from event dummies in each year relative to the birth of the first child. The figure presents results for a sample of first-time mothers ($N = 26,109$) and first-time fathers ($N = 74,037$) employed throughout the 15 years surrounding childbirth. Each panel presents results for a different outcome separately for men and women.



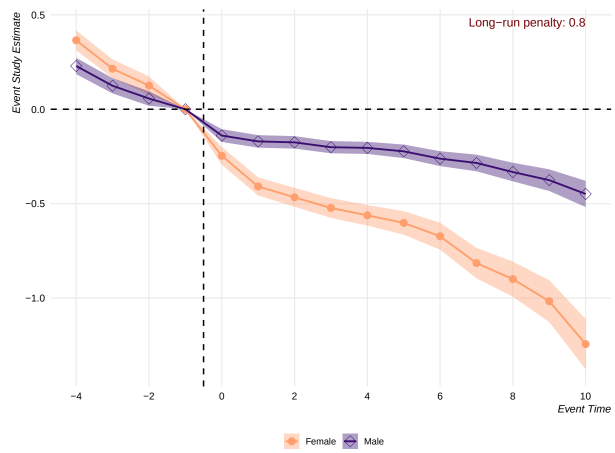
(a) Large Distances Top Coded



(b) Large Distances Dropped



(c) Large Distances Replaced



(d) Postcode to Postcode Distance

Figure A4: Sensitivity of Distance Results to Alternative Distance Measures

Note: The figure shows the estimated coefficients of the event time dummies as a fraction of the predicted outcome, when omitting the contribution from event dummies in each year relative to the birth of the first child. Coefficients are estimated separately for men and women for our main sample specification. The shaded areas indicate the 95% confidence band using robust standard errors. Panel (a) shows results when top coding all distances above 200 km to 200 km, panel (b) shows results when dropping distances above 200 km, panel (c) provides results where we replace distances above 200 km with the average gender and time-to-treatment specific distance and panel (d) shows results for the distance measure based on distances where we measure postcode to postcode commuting distances.

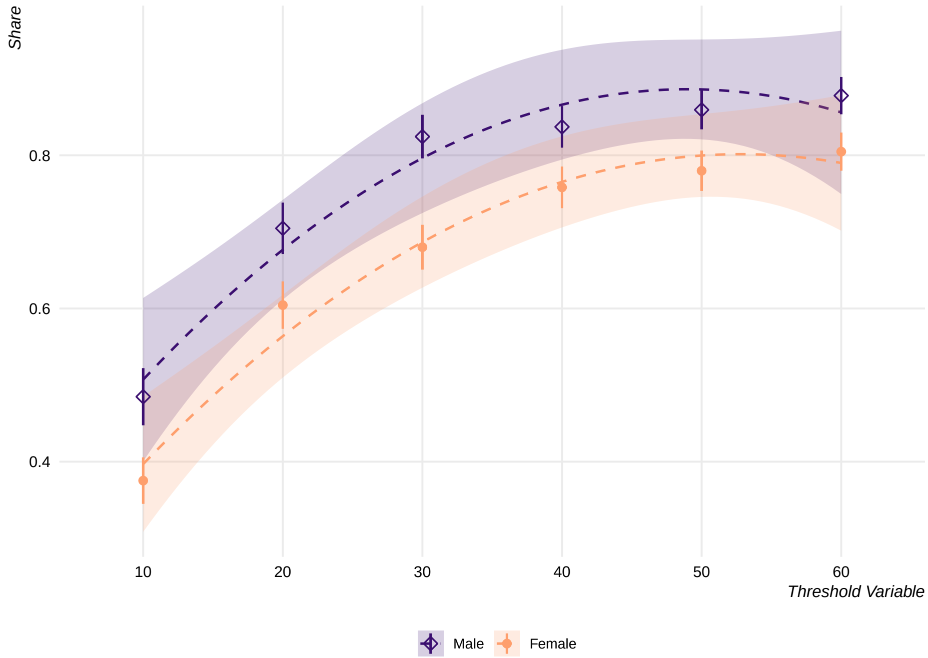
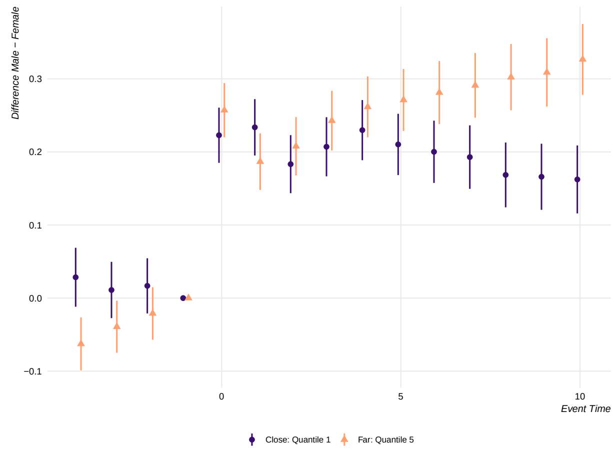
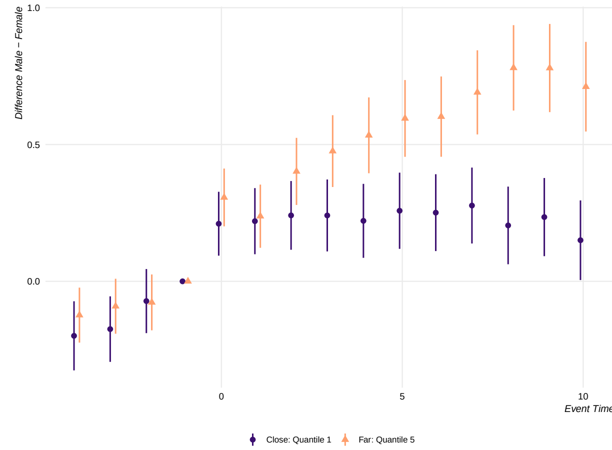


Figure A5: Survey Results: Willingness to Commute

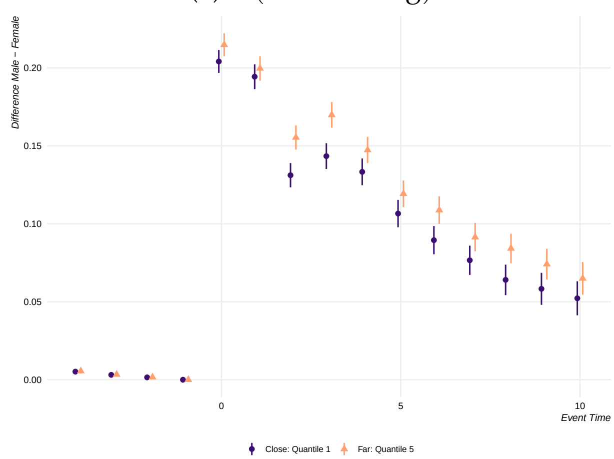
Note: The figure separately shows the share of men (purple diamond shapes) and women (orange point shapes) choosing to select position two in a question referring to the trade-off between a salary increase and doubling of the commuting distance. The shares were obtained by regressing a dummy variable equal to one if a person chooses to position two on the full set of threshold dummies $\gamma \in [10, 20, 30, 40, 50, 60]$ separately for men and women. The 95 % confidence intervals are based on robust standards. Fitted lines are regression lines of second-order polynomials through the shares estimates.



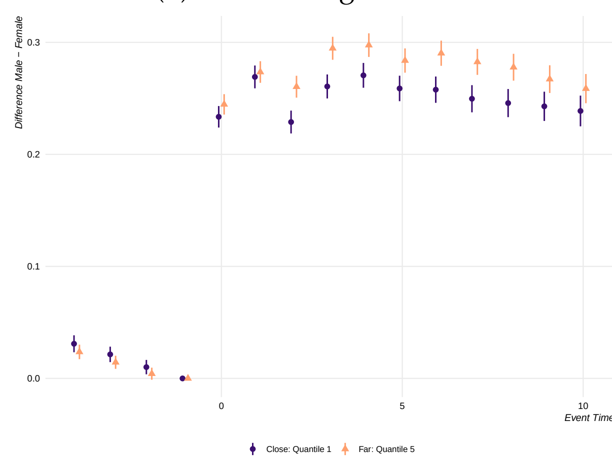
(a) $\mathbb{P}$(Commuting)



(b) Commuting Distance



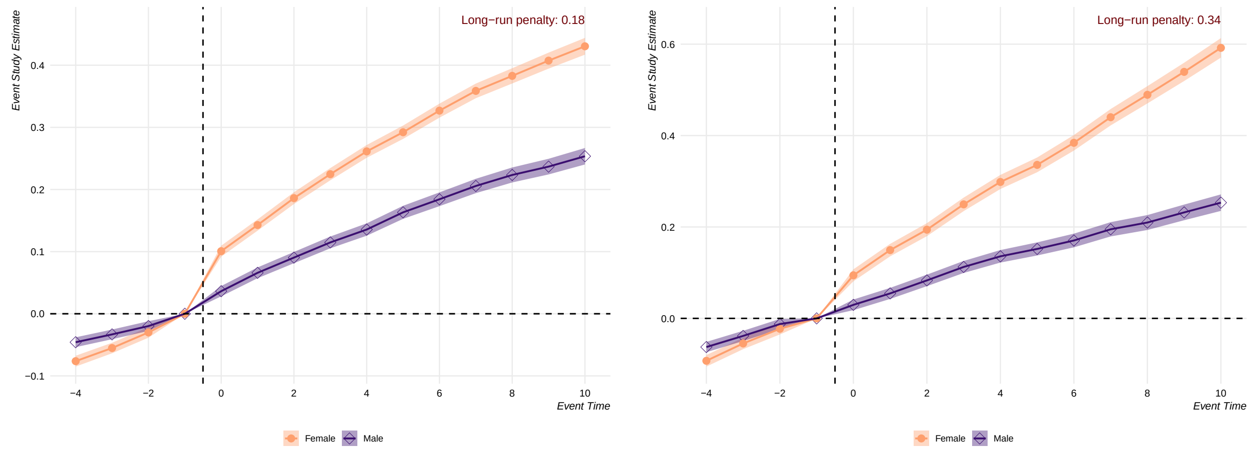
(c) Extensive Margin



(d) Intensive Margin

Figure A6: Commuting and Labor Market Outcomes by Distance to Grandparents

Note: The figure depicts differences in the estimated event-time coefficients (from Equation 1) between men and women. Each panel displays the differences for individuals in two groups: those in the bottom quintile of distance to grandparents (Close: Quintile 1) and those whose grandparents live furthest away (Far: Quintile 5) before the onset of parenthood. Coefficients are estimated separately for men and women, with 95% confidence intervals shown as error bars (using robust standard errors).



(a) HHI - Industry Varies

(b) HHI - Industry Fixed

Figure A7: Sensitivity of HHI Responses to Changes in Industry Affiliation

Note: The figure shows estimated event time coefficients from Equation 1, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for men and women, with shaded areas representing 95% confidence intervals (robust standard errors). The left panel shows the change in the HHI for men and women in response to parenthood when allowing industry codes to vary over time. The right panel shows HHI responses, when fixing the industry code of an individual at $t = -2$. Long-run penalties, shown in the top-right of each panel, represent the male-female difference at $t = 10$.

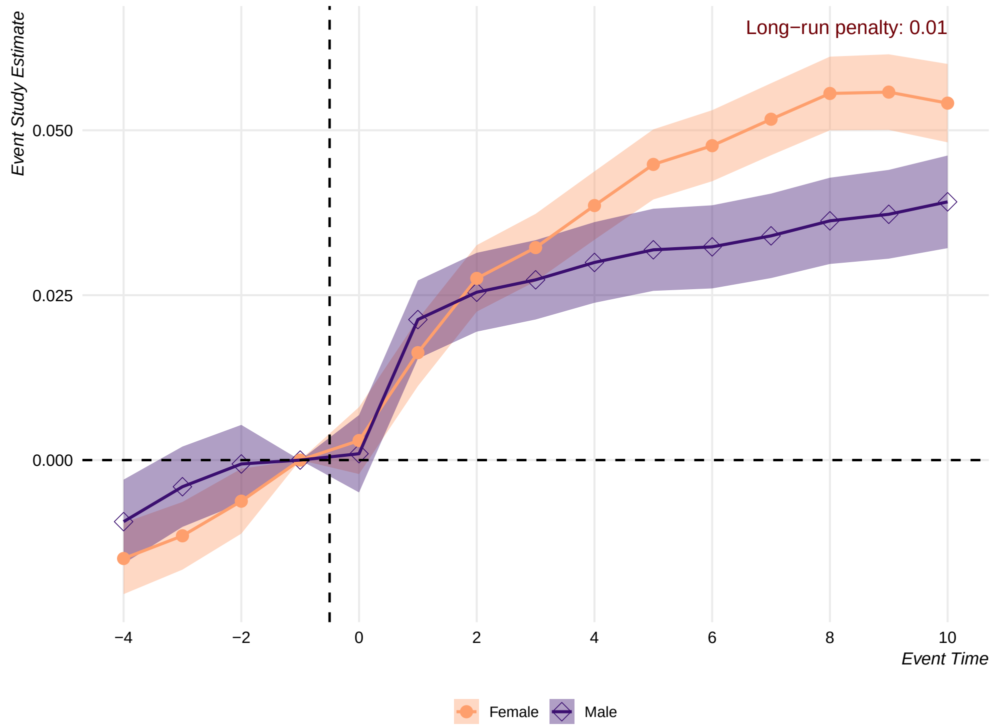
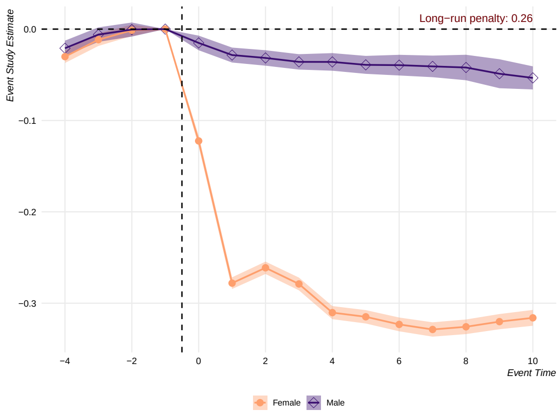
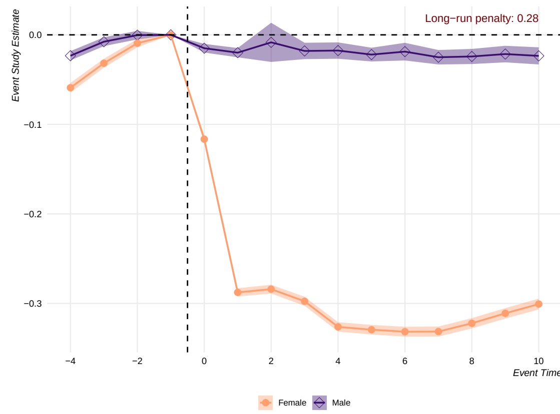


Figure A8: Parenthood Effect and the Share of Mothers with Young Children in Establishment

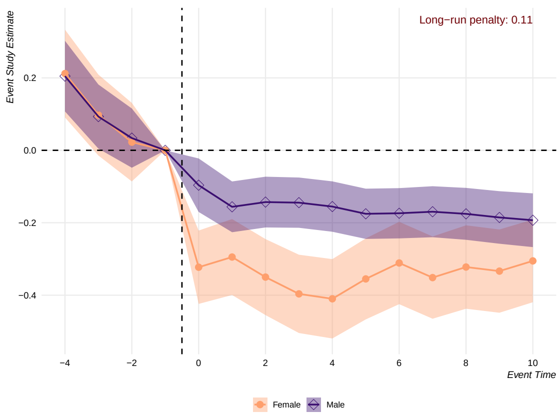
Note: The figure shows the estimated coefficients from Equation 1, as a fraction of the predicted outcome, when omitting the contribution from event dummies in each year relative to the birth of the first child. The figure presents results for the effect of parenthood on the share of mothers with children under the age of 16 within an individual's establishment.



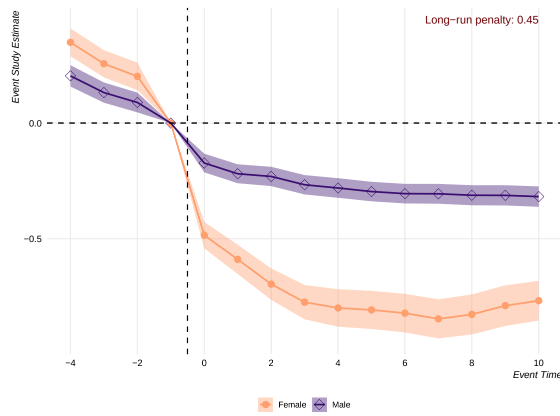
(a) Earnings - Urban



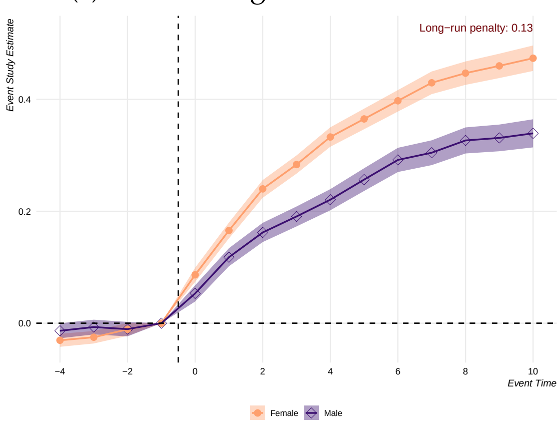
(b) Earnings - Rural



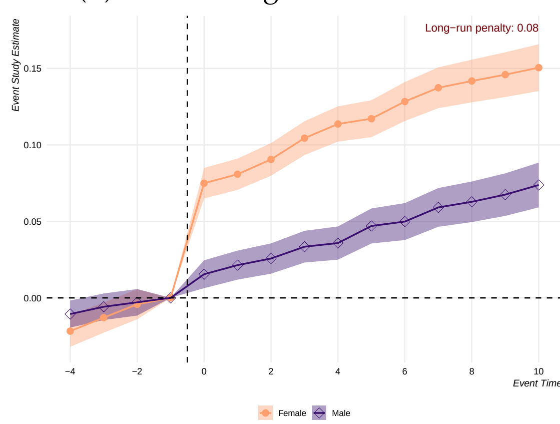
(c) Commuting Distance - Urban



(d) Commuting Distance - Rural



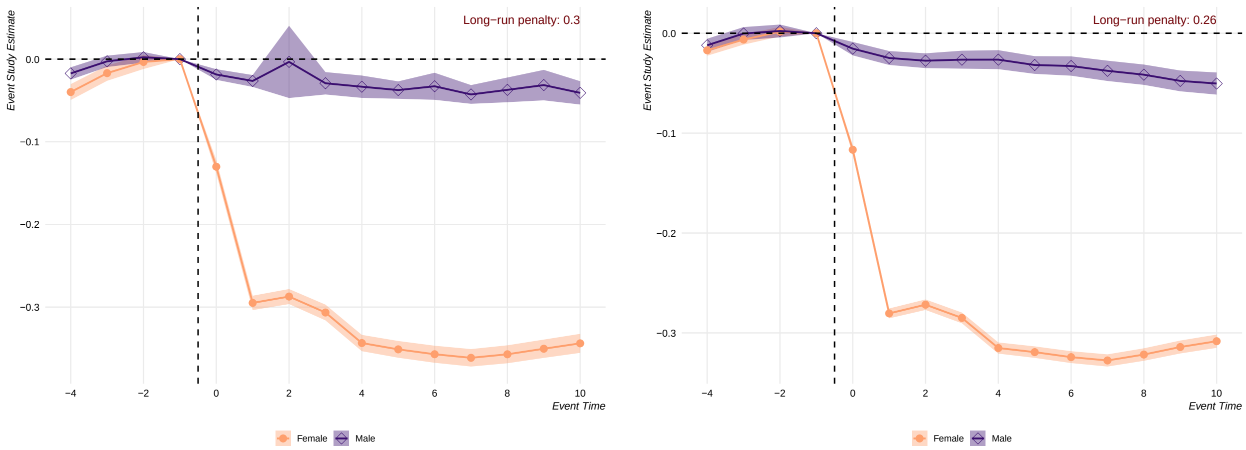
(e) HHI - Urban



(f) HHI - Rural

Figure A9: Urban and Rural Differences in Parenthood Effects

Note: The figure shows estimated event time coefficients from Equation 1, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for men and women, with shaded areas representing 95% confidence intervals (robust standard errors). The urban sample includes individuals who lived continuously in an urban municipality in the years prior to childbirth (N=58,804). In contrast, the urban sample is restricted to individuals who continuously lived in areas outside of urban municipalities prior to parenthood (N=112,296). Long-run penalties, shown in the top-right of each panel, represent the male-female difference at $t = 10$.

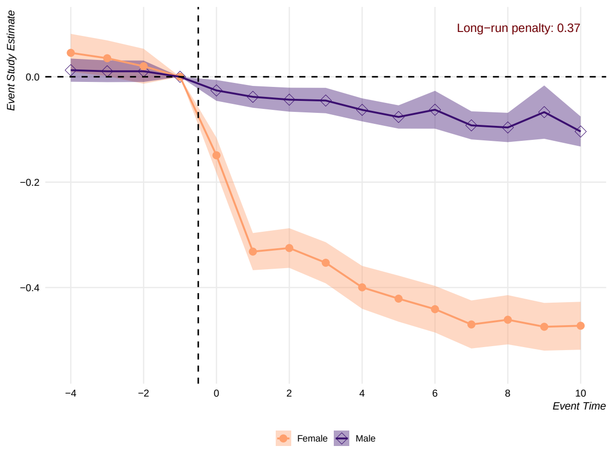


(a) Earnings - Commuters

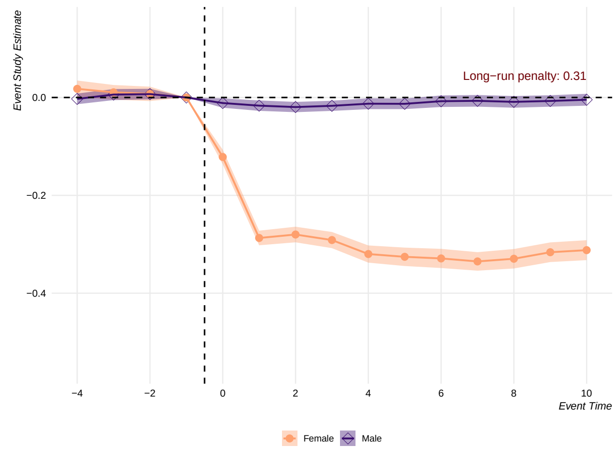
(b) Earnings - Non-Commuters

Figure A10: Earnings Penalty for Pre-Period Commuters and Non-Commuters

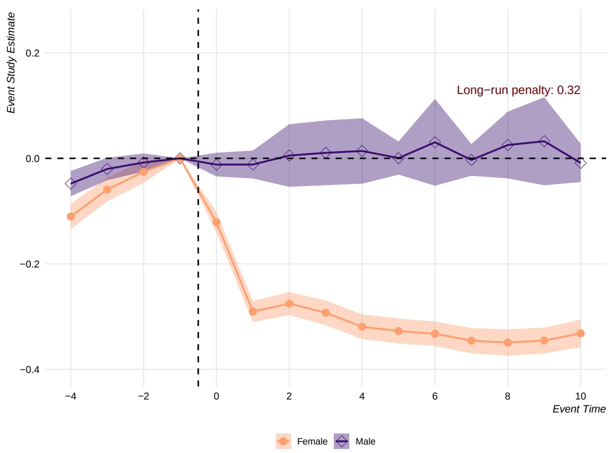
Note: The figure shows estimated event time coefficients from Equation 1, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for men and women, with shaded areas representing 95% confidence intervals (robust standard errors). The commuter sample includes individuals who commuted between municipalities in all four years prior to parenthood (N = 45,034), while the non-commuter sample is restricted to individuals who did not commute in any year prior to the birth of the first child (N = 91,838). Long-run penalties, shown in the top-right of each panel, represent the male-female difference at $t = 10$.



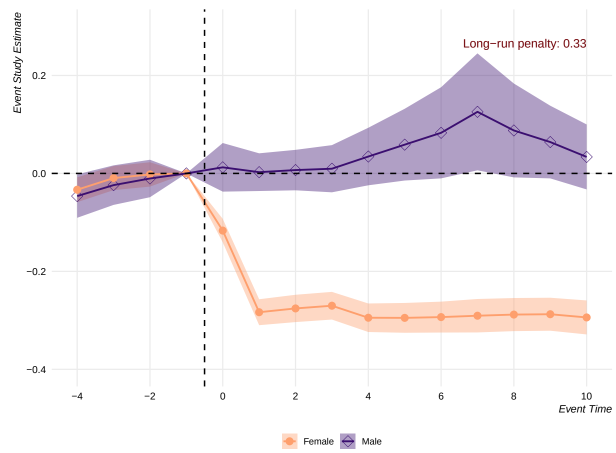
(a) Earnings - Commuters (Bottom Decile)



(b) Earnings - Non-Commuters (Bottom Decile)



(c) Earnings - Commuters (Top Decile)



(d) Earnings - Non-Commuters (Top Decile)

Figure A11: Earnings Responses by Pre-Period Commuting and Job-Opportunities

Note: The figure shows estimated event time coefficients from Equation 1, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for men and women, with shaded areas representing 95% confidence intervals (robust standard errors). The commuter sample includes individuals who commuted between municipalities in all four years prior to parenthood, while the non-commuter sample is restricted to individuals who did not commute in any year prior to the birth of the first child. Individuals were further stratified by the decile of a number of potential job opportunities they had in the pre-parenthood period. Long-run penalties, shown in the top-right of each panel, represent the male-female difference at $t = 10$.

Table A1: Summary Statistics: Main Sample

	Mean	SD	Min	Median	Max
Panel A: Women (N = 87,659)					
Annual Earnings (1,000 NOK)	311.73	113.45	0.92	300.72	4798.23
Hourly Earnings	189.50	99.99	0.54	165.19	2454.02
Hours Worked	34.11	8.15	10.00	37.50	37.50
Employment	1.00	0.00	1.00	1.00	1.00
Public Sector Employment	0.41	0.49	0.00	0.00	1.00
Age	27.92	4.16	19	27.00	48
Years of Education	12.31	2.55	0	12.00	20
Commuting	0.34	0.47	0.00	0.00	1.00
Distance (km)	28.65	128.16	0.00	0.00	2412.09
HHI	0.15	0.15	0.00	0.11	1.00
Full Time Share	0.71	0.25	0.00	0.77	1.00
Average Hourly Earnings at Plant	213.75	71.99	2.09	206.93	4987.22
Residence Urban	0.40	0.49	0.00	0.00	1.00
Workplace Urban	0.49	0.50	0.00	0.00	1.00
Panel B: Men (N =110,595)					
Annual Earnings (1,000 NOK)	396.40	193.84	0.16	367.66	26044.81
Hourly Earnings	218.41	125.00	0.08	193.25	13320.45
Hours Worked	36.07	5.71	10.00	37.50	37.50
Employment	1.00	0.00	1.00	1.00	1.00
Public Sector Employment	0.16	0.37	0.00	0.00	1.00
Age	29.71	4.71	19	29.00	64
Years of Education	11.93	2.77	0	12.00	20
Commuting	0.40	0.49	0.00	0.00	1.00
Distance (km)	40.53	155.08	0.00	0.00	2494.71
HHI	0.17	0.17	0.00	0.11	1.00
Full Time Share	0.86	0.20	0.00	0.94	1.00
Average Hourly Earnings at Plant	216.23	72.73	1.02	204.99	6393.20
Residence Urban	0.35	0.48	0.00	0.00	1.00
Workplace Urban	0.42	0.49	0.00	0.00	1.00

Note: The table presents summary statistics for first-time parents, women (Panel A) and men (Panel B), in the year prior to their first child. The sample includes all men and women who became first-time parents between 1990 and 2000, whom we observe four years prior to and ten years after childbirth, and who are employed at least seven out of 15 years.

Table A2: Summary Statistics: Survey

	Mean	SD	Min	Median	Max
Male	0.42	0.49	0	0.00	1
Any Child	0.58	0.49	0	1.00	1
Cohabiting	0.67	0.47	0	1.00	1
Primary School	0.03	0.16	0	0.00	1
High-School	0.18	0.38	0	0.00	1
Vocational School	0.16	0.37	0	0.00	1
Bachelor	0.29	0.46	0	0.00	1
Master	0.33	0.47	0	0.00	1
Other	0.01	0.10	0	0.00	1
Threshold	3.50	1.71	1	3.00	6
Age	38.27	7.64	25	39.00	60
Monthly Salary	32.71	14.58	3.00	30.00	150.00
Commuting Time	23.28	29.51	1.00	15.00	180.00

Note: The table presents summary statistics for the full sample of surveyed individuals ($N = 10,008$). Monthly salaries are reported in 1,000 NOK. The variables presented are a subset and only variables used in the analysis for this article.

Table A3: Child Penalty Overview

	Main	**Main** $t \leq 5$	**Always Employed**
Average Hourly Earnings	0.01	0.01	0.01
Commuting Distance	0.48	0.45	0.28
Earnings	0.26	0.24	0.22
Establishment Size	0.19	0.07	0.11
Herfindahl-Hirschman Index	-0.14	-0.12	-0.07
Hourly Earnings	0.11	0.13	0.08
Hours Worked	0.27	0.27	0.10
Number of Establishments	0.28	0.26	0.12
P(Commute)	0.25	0.24	0.09
P(Workplace Urban)	0.24	0.24	0.08

Note: The table presents the overall child penalty for different outcome variables and sample specifications by following the procedure presented in Equation **??**. The second column uses our main sample, the third column also uses the main sample but only for relative time periods $t \leq 5$ and the last column is computed on estimates from the always employed sample.

Table A4: Commuting Penalties by Group and Timing

Group	Est. Female	Est. Male	% Female	% Male	Penalty
Panel A: $t = 2$					
Non-Commute to Commute	-0.2503	0.0043	8.23	10.27	0.2547
Commute to Non-Commute	-0.3447	0.0011	15.26	11.25	0.3457
Commute to Commute	-0.2468	-0.0127	18.59	28.55	0.2341
Non-Commute to Non-Commute	-0.2803	-0.0342	57.92	49.93	0.2461
Panel B: $t = 5$					
Non-Commute to Commute	-0.3035	-0.0053	10.46	13.68	0.2982
Commute to Non-Commute	-0.4183	-0.0704	17.42	13.55	0.3479
Commute to Commute	-0.2893	-0.0195	16.43	26.25	0.2698
Non-Commute to Non-Commute	-0.3360	-0.0444	55.69	46.51	0.2917
Panel C: $t = 10$					
Non-Commute to Commute	-0.2954	-0.0178	12.22	16.14	0.2777
Commute to Non-Commute	-0.4057	-0.0896	18.18	15.36	0.3162
Commute to Commute	-0.2809	-0.0153	15.67	24.45	0.2655
Non-Commute to Non-Commute	-0.3265	-0.0691	53.94	44.06	0.2574

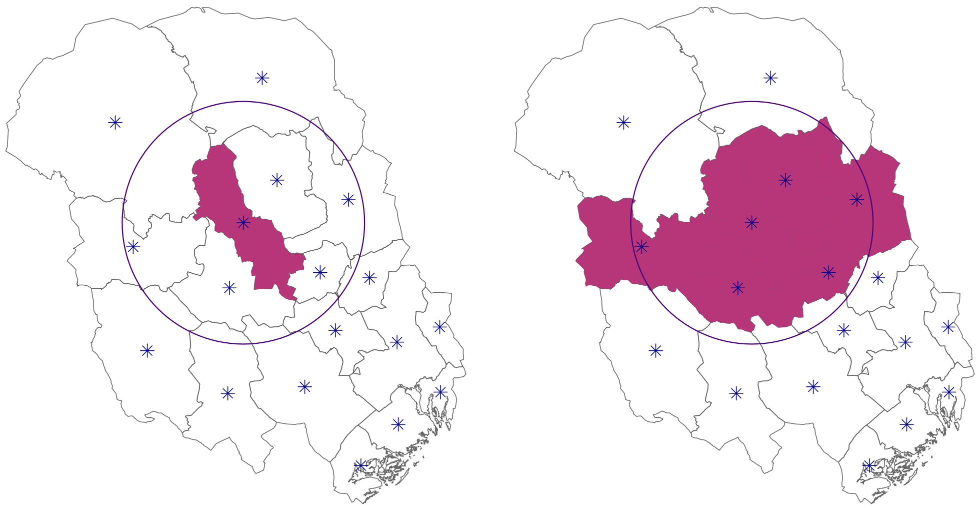
Notes: The table provides an overview of the commute penalty for individuals in different groups. In panel A we show commute penalties two years post birth of the first child for men and women for individuals who did not commute in $t = -1$ and commuted in $t = 2$, those who commuted in $t = -1$ and did not commute in $t = 2$, those who remained commuters and non-commuters respectively. Panel B and C show the same for the comparison between $t = -1$ and $t = 5$, as well as $t = 10$ respectively. Column 1 indicates the group, column 2 the female earnings reduction relative to the year before childbirth, column 3 the corresponding male estimate, column 4 and 5 show the share of each group among women (% Female) and men (% Male).

B Data and Definitions

B.1 Labor Market Opportunities and Concentration

To examine if the change in commuting behavior has an impact on the job opportunities of workers, we construct three measures of labor market concentration: the number of establishments, the number of jobs, and the Herfindahl-Hirschman Index (HHI). Each of these measures captures slightly different dimensions of labor demand and helps us develop a comprehensive understanding of how changes in commuting distance impact an individual's labor market opportunities and outside options.

The first measure we focus on is the number of establishments that employ workers of similar types. Specifically, we calculate the number of establishments within a year-area-industry cell where individuals with a similar level of education are used. Education is categorized into three groups: high school or less (less than 12 years of education), more than high school (but no Bachelor's degree, 12 to 14 years of education), and at least a Bachelor's degree (15 or more years of education). We include the education and industry dimensions since prior work has shown that industry alone is an imperfect measure for labor market concentration Dodini et al. (2020). A hypothetical example would be someone who lived in Oslo in 1995, works in construction, and has a high school degree. For this worker, we would count the number of establishments in the construction industry that employ individuals with a high school degree and are located in the worker's local labor market. To define an individual's local labor market, we draw a circle between the individual's place of residence and workplace, letting the distance between the workplace and the place of residence act as the circle's radius. All municipalities with centers that fall inside this circle are considered to belong to the individual's local labor market. A visual illustration of this data-driven local labor market assignment approach is provided in Figure B1. In other words, we use an individual's revealed commuting preference as a proxy for the individual's local labor market. The geographic boundaries of the labor market will, therefore, vary across individuals and time depending on the distance between the individual's workplace and place of residence in that year. Hence, this measure provides information on how much employer concentration the individual faces in her labor market. This provides a helpful proxy for the concentration of labor demand.



(a) Commuting Radius (b) Individual-Specific LLM

Figure B1: Illustration of Individual-Specific Local Labor Markets (LLM)

Note: The figure shows how local labor markets are constructed using the revealed commuting behavior of individuals. The radius around the highlighted area in Panel B1a indicates the observed commuting distance. All municipalities whose administrative municipality center (blue marked stars) falls within this radius are then counted towards the individual's local labor market in the particular year. This is indicated by the highlighted area in Panel B1b.

Second, we focus on the number of jobs. We calculate the number of newly employed individuals, including job-to-job transitions, at the year-area-industry-education level. This measure complements the above measure and is a proxy for the labor market opportunities available to workers in a specific industry with a particular educational degree. Finally, we construct an HHI at the year-area-industry-education level. We construct the HHI by first calculating year t, area a, industry j, and education e specific employment shares for each establishment f. We use 2-digit industry codes. These shares are then used to construct the HHI as the sum of squared employment shares across all establishments within a year-area-industry-education cell:

$$HHI_{jaet} = \sum_{f=1}^{N} s_{fjaet}^{2} \text{ where } s = \frac{emp_{fjaet}}{\sum_{f=1}^{N} emp_{fjaet}} \tag{5}$$

The HHI ranges from 0 to 1, where 1 indicates a single monopsonistic establishment in the market. Hence, the HHI measures the concentration of labor demand for a given industry-education group across establishments in the local labor market. Figure A2 shows the average HHI in each municipality in 1995. The figure shows that concentration in the largest cities of Norway is much lower than that in more rural parts of the country. There are also differences across industry-education cells. Note that we allow industry to vary over time for these measures. Appendix Figure A7 documents that keeping the industry code fixed at the value two years before childbirth (t=-2) results in a slightly larger long-term penalty. Hence, industry changes post-birth are not driving the effects we measure above.

B.2 Establishment Quality

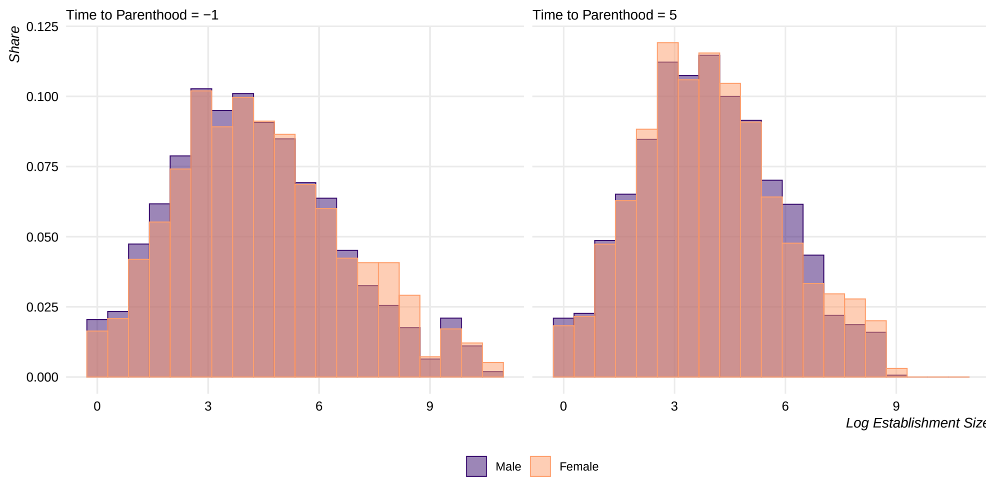
Besides changes in labor supply and skill mismatch, establishment quality is an additional pathway through which parenthood potentially alters earnings differently for men and women after they become parents for the first time. Women might switch to more family-friendly establishments, but these firms impede career progression and ultimately hinder climbing the career ladder (Hotz, Johansson and Karimi, 2017). We analyze how parenthood impacts the establishment's quality. Through a lower willingness to commute and an increased burden for childcare, women have a) fewer outside options and b) the options they might have are of lower quality, resulting in a disproportionate reduction of establishment quality for women after the onset of parenthood.

We present results using two different measures of establishment quality, which have been suggested in the previous literature (see, e.g. Dustmann et al., 2020). The first measure is establishment size. Establishment size has been used extensively to measure establishment quality, particularly for individuals in the early stages of their careers. Oreopoulos, Von Wachter and Heisz (2012) show that individuals starting their careers at larger employers suffer from fewer negative labor market consequences in comparison to those who start at smaller firms. Additionally, larger firms are associated with higher wages and better training resulting in improved opportunities for career and earnings progression (Arellano-Bover, 2024). The second measure used is the average hourly earnings of individuals at the establishment. Establishments paying higher wages, controlling for person fixed effects, have been shown to be more productive, more profitable, and more professional-labor intensive in the context of France (Abowd, Kramarz and Margolis, 1999).

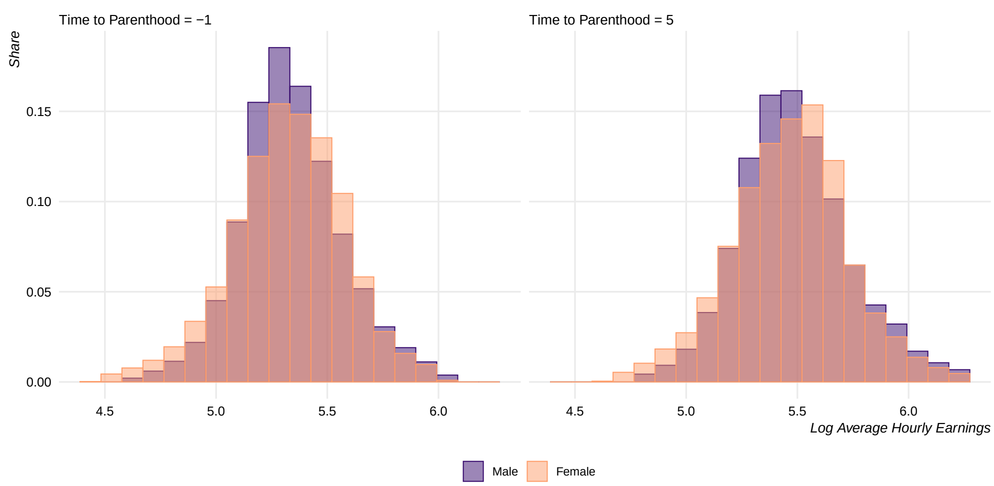
All establishment quality measures are constructed from the linked employer-employee data available between 1986 and 2010. We condition this sample on individuals with non-zero hourly earnings and who have non-missing establishment identifiers as well as reported hours worked.[20] The average hourly earnings are then constructed from annual earnings data divided by the number of weeks and hours of work. This is only an approximation of actual hourly earnings, but due to data limitations, it is the best

[20]Hours are reported only in three broad categories which we approximate with 10, 25, and 37.5 hours of work per week.

measure of hourly earnings we can provide consistently for the sample. Establishment size is simply defined as the number of employees at a given establishment.



(a) Establishment Size



(b) Log Average Hourly Earnings

Figure B2: Distribution of Establishment Quality Measures by Sex and Time to Parenthood

Note: The figure plots the distribution of two establishment quality measures in our main sample separately for men and women in the period $t = -1$ and $t = 5$. Each measure is plotted separately for the year $t = -1$ and $t = 5$ and by the sex of the parent. Panel a shows the natural logarithm of establishment size, and panel b, the logarithm of the average hourly wage in the company, winsorized to exclude the top one and bottom percentile of the average hourly wage distribution.

To construct the establishment quality measures, we follow a leave-out mean approach, which ensures that we construct average hourly earnings and establishment size net of the impact of the particular individual herself. This will take care of sensitivity for cases where the number of individuals within an establishment is small and allows us to abstract from changes in establishment quality due to changes in labor market characteristics of the individual whose establishment quality we want to observe. In Figure B2, we present the distributions of establishment quality measures for our main sample separately by time relative to parenthood and sex. To conveniently plot the distributions, the establishment size variable and average hourly earnings within an establishment are transformed using the natural logarithm. We additionally winsorize the top and bottom percentiles of the distribution for the average hourly earnings mainly for ease of visualization.[21] The main difference in the distributions comes from differences between men and women, rather than differences due to the time relative to parenthood. Importantly, establishment measures are plotted for all individuals in the respective period $t = -1$ and $t = 5$, particularly for our measure of establishment size, which suggests a large average establishment size. When plotting the distribution of establishment size for unique establishments only, it becomes apparent that the median size is much smaller than suggested by Figure B2 Panel B2a. In Figure B3, we plot the distribution of the size of unique establishments for men and women for 1995.

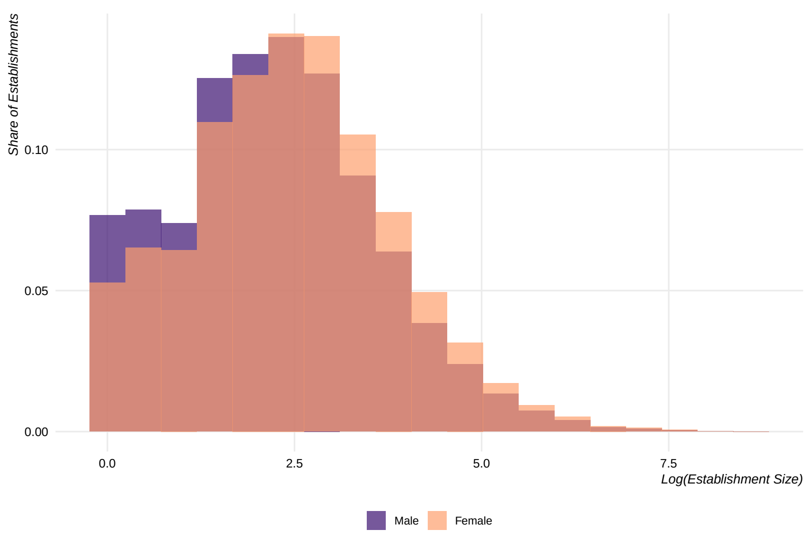


Figure B3: Distribution of Establishment Size for Unique Establishments in 1995

Note: The figure presents the distribution of the natural logarithm of establishments size of all unique establishments in our sample for the year 1995, separately for men and women.

In addition to workplace quality, we measure the workplace's family friendliness. We follow Hotz, Johansson and Karimi (2017) and Kleven, Landais and Søgaard (2019)

[21]The right tail of the hourly wage distribution is relatively long because we are constructing hourly earnings from annual earnings data. This income variable includes incomes from self-employment and governmental transfers. Particularly the first income source can be substantial and result in very large hourly earnings.

and proxy family friendliness by the share of women with children below 16 years in an individual's plant. The average share of female co-workers with children under the age of 16 in the year prior to childbirth is 36% for men and 37% for women. Five years post childbirth this number increases to 39% for men and 41% for women on average. We also plotted the distribution of the share of female co-workers with children under the age of 16 in Figure B4.

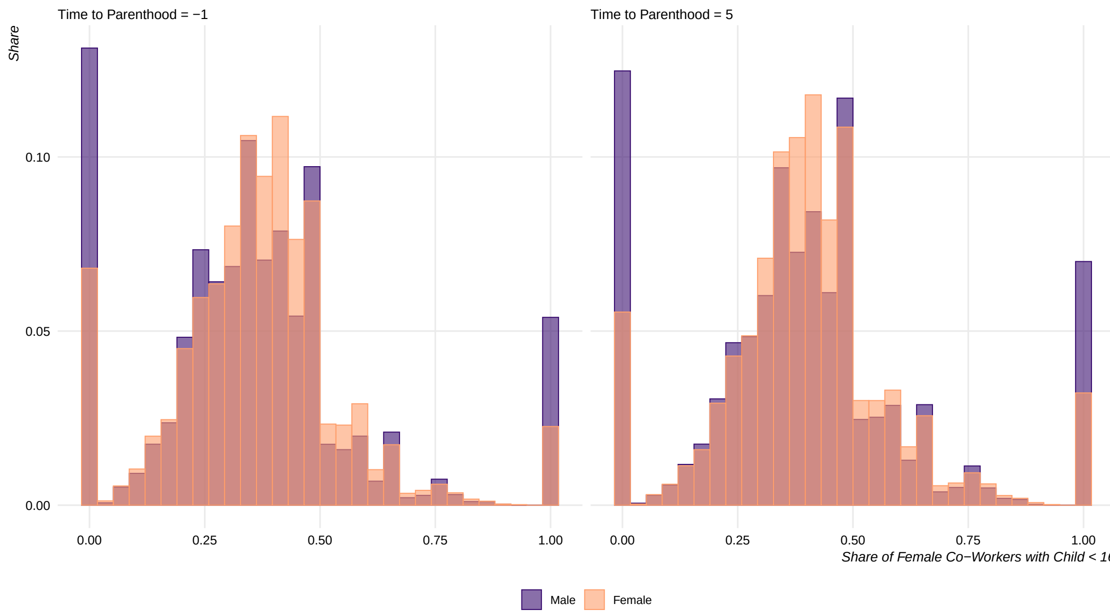


Figure B4: Distribution of Share of Female Co-Workers with Children Under Age of 16 by Sex and Time to Parenthood

Note: The figure plots the distribution of the share of female co-workers with children under the age of 16 separately for men and women and by time relative to parenthood.

C Commuting in Norway

The main commuting measures in this article rely on commuting across municipality borders. Due to limitations in accessing exact workplace locations, we use this proxy to estimate commuting probability and distance. In this appendix, we provide an overview of commuting behavior in Norway using two datasets: the 1991-1992 Norwegian Travel Habit Survey (Reisevaneundersøkelsen) and our main sample constructed from Norwegian administrative data registers.

C.1 Travel Habit Survey 1991 - 1992

The Travel Habit Survey is conducted by the Institute of Transport Economics in Oslo to assess and plan national and local transportation needs in Norway. Phone interviews were carried out throughout the year to account for seasonal variations in travel behavior. The survey includes a representative cross-section of the Norwegian population and is accessible via the Norwegian Agency for Shared Services in Education and Research (Sikt). For detailed information on the survey and its methodology, please refer to the study documentation (Institute of Transport Economics et al., 2022).

Table C1: Transport Habit Survey 1991-1992: Summary Statistics

	Unique	Missing Pct.	Mean	SD	Min	Median	Max
Age	81	0	43.63	18.26	13.00	42.00	99.00
Female	2	0	0.51	0.50	0.00	1.00	1.00
City Municipality	2	0	0.49	0.50	0.00	0.00	1.00
Employed	2	0	0.64	0.48	0.00	1.00	1.00
Work Hours per Week	77	36	37.62	17.79	0.00	38.00	99.00
Distance	131	49	12.00	35.98	0.00	5.00	850.00

Note: The table presents summary statistics for key variables for 6,000 repondents from the Transport Habit Survey 1991-1992.

In Table C1, we provide an overview of key variables from the survey. Respondents range in age from 13 to 99 years, with a balanced gender distribution (50% female). About 60% of respondents report being employed for at least one hour per week. The average commuting distance is 12 km, including both within and across municipality commutes. Additionally, 49% of respondents live in "city municipalities," defined as administrative units with more than 5,000 inhabitants that feature urban settlements with trade, service functions, and concentrated development—this definition differs from our "urban municipality" classification in the main paper.

Focusing on the 60% of respondents who are employed, Figure C1 shows the distribution of commuting distances for men and women. Employed men commute significantly further than women, with average distances of 15 km and 9 km, respectively.

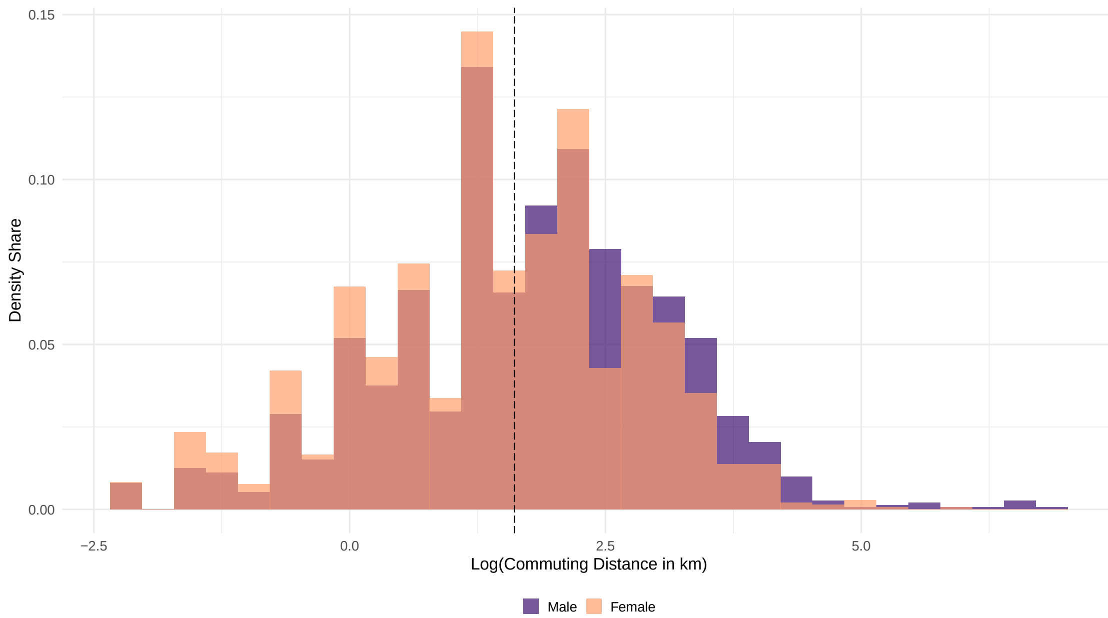


Figure C1: Distribution of Commuting Distance by Sex

Note: The figure shows the distribution of the log commuting distance for individuals reporting at least one hour of paid work per week in the survey interview separately for men and women. The vertical dashed line indicates the national median commuting distance among all individuals in the employed sample, which corresponds to 5 km.

Focusing on the commuting differences between men and women across Norwegian counties, we can see dramatic geographic variation in gender gaps in commuting. Figure C2 shows the gender differences in the median commuting distance between men and women across the 19 Norwegian counties. Overall, men commute more in almost all counties, including Oslo, which is the only county that is also a self-contained municipality. Reported commuting distances are generally smaller in northern Norway, such as Finnmark and Troms, where gender gaps in median commuting distance are not as pronounced. The most considerable difference in median commuting distance is found in Akershus, where men commute significantly more than in any other part of the county.

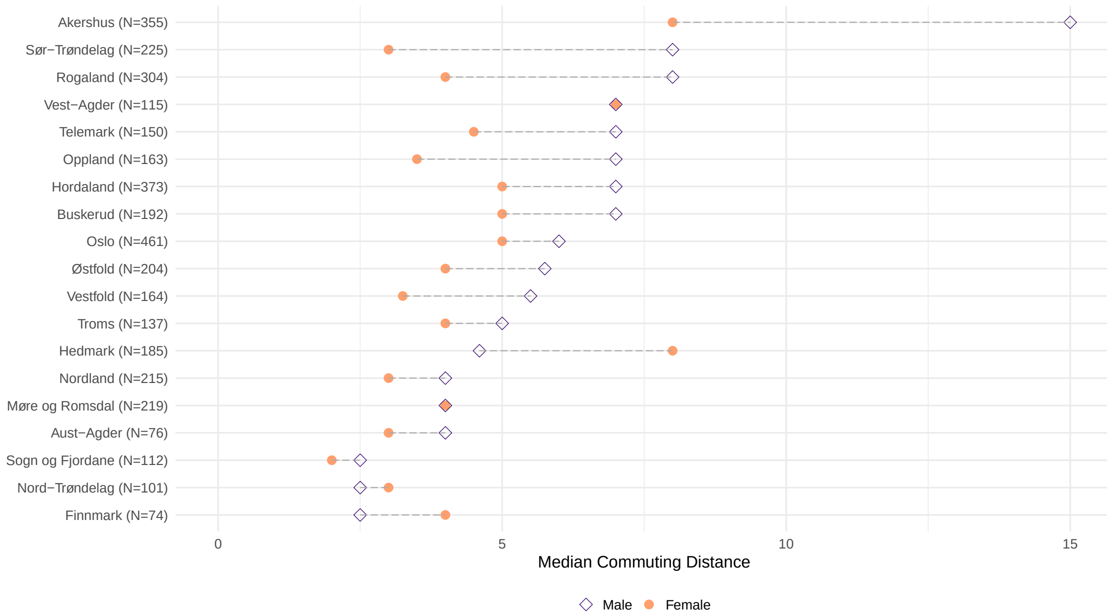


Figure C2: Median Commuting Distance by County and Sex

Note: The figure shows the median commuting distance for individuals reporting at least one hour of paid work per week in the survey interview separately for men and women by county. The number of observations by county is reported in parentheses on the y-axis.

In our paper, we measure commuting distances using driving distances obtained from the Microsoft BING Matrix API, arguing that driving distances accurately reflect commuting behavior at the time. This is supported by data on the dominant modes of transport. Figure C3 shows that for commutes of 5 km or more (above the median), cars were the primary mode of transport, followed by public transportation (buses, trams, subways, and trains). Walking and cycling were rare for longer commutes. Even for shorter commutes under 5 km, cars remained the most common mode (over 30%), with walking and cycling following behind and minimal use of public transport. Overall, automobile use was the dominant commuting method in Norway in the early 1990s.

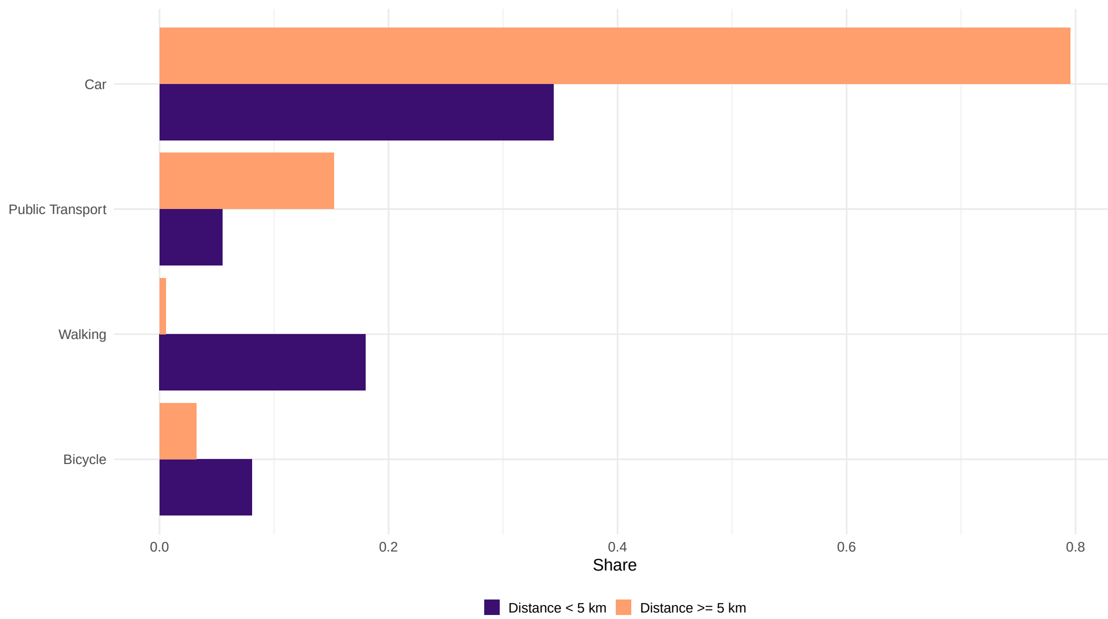


Figure C3: Share of Individuals by Mode of Transportation

Note: The figure plots the share of employed individuals by mode of transportation separately for individuals commuting more than 5 km and those commuting less than 5 km on an average work day. The sample is obtained using the Travel Habit Survey 1991-1992. Individuals without a reported commuting distance have been assigned zero commuting distance and are included in the group commuting less than 5 km.

The final insight from the Norwegian Travel Habit Survey focuses on commuting behavior in Oslo, the only municipality in the survey that is explicitly identified as an urban area. While median commuting distances in Oslo are similar to other regions in Norway, there is notably less variation in how far individuals commute. The median male worker in Oslo commutes 6 km (5 km for females), while the average distances are 8.27 km for men and 8.03 km for women. In contrast, across all other Norwegian counties, the median commuting distance is nearly the same, but the average distance is much higher—15.63 km for men and 9.25 km for women. Despite being an urban area, car usage remains the predominant mode of transportation in Oslo, followed by public transportation, with only about 18% of individuals walking or cycling to work (see Figure C4).

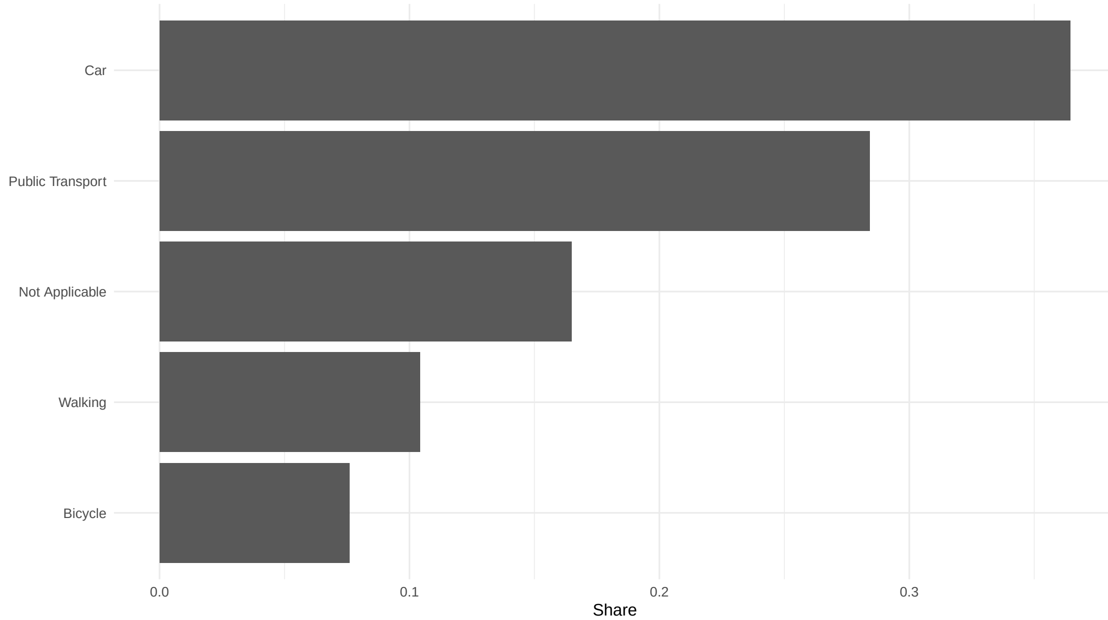


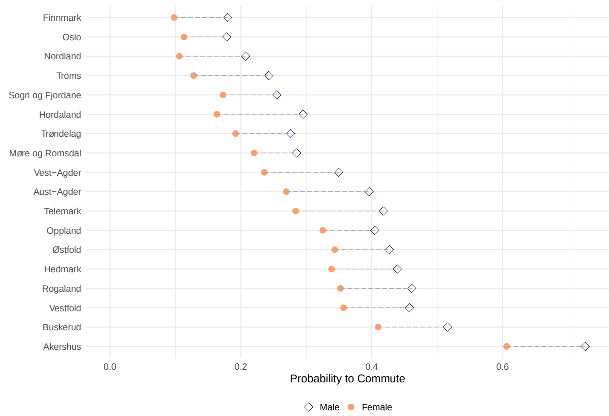
Figure C4: Share of Individuals by Mode of Transportation in Oslo

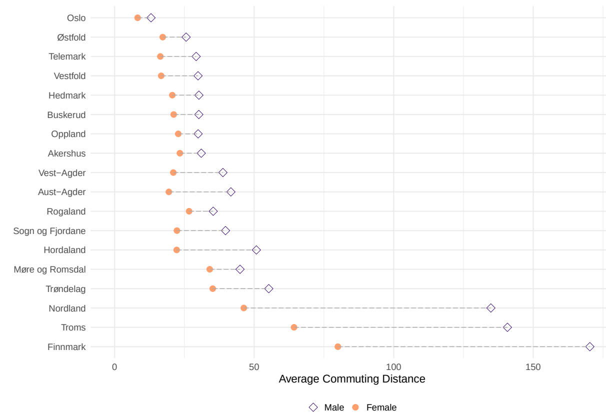
Note: The figure plots the share of employed individuals by mode of transportation for individuals in Oslo municipality. The sample is obtained using the Travel Habit Survey 1991-1992.

C.2 Commuting in the Main Sample

This subsection provides an overview of commuting behavior in our main sample. Our commuting measure identifies individuals who commute between different municipalities, with non-commuters likely traveling within their municipality. The previous subsection highlighted how transportation modes vary between Oslo and the rest of Norway.

Figure C5 presents commuting patterns for first-time parents in 1995. Panel C5a shows the probability of commuting by county, revealing two main patterns: (i) men are more likely to commute than women across all counties, and (ii) commuting across municipality borders is more common in southeastern Norway around Oslo than in the less densely populated north and west. Panel C5b illustrates that longer commuting distances are more frequent in the west and especially in northern Norway, where the gender gap in commuting distance is also the largest. In contrast, average commuting distances are shorter and gender differences smaller in southern and eastern Norway, closer to the capital.





(a) Probability to Commute

(b) Commuting Distance

Figure C5: Commuting Probability and Distance by County and Sex

Note: The figure plots commuting probabilities (Panel C5a) and average commuting distances (Panel C5b) by county and sex for the year 1995 of individuals in our main sample of first-time parents.

There is a clear distinction between areas with a high share of commuters and those with longer commuting distances. Figure C7 illustrates the relationship between commuting patterns in our main sample and both population density (inhabitants per square kilometer) and municipality size.

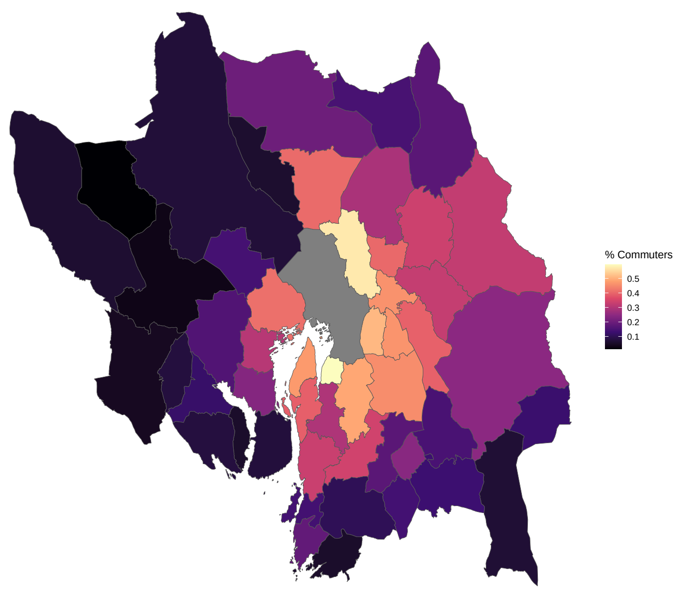
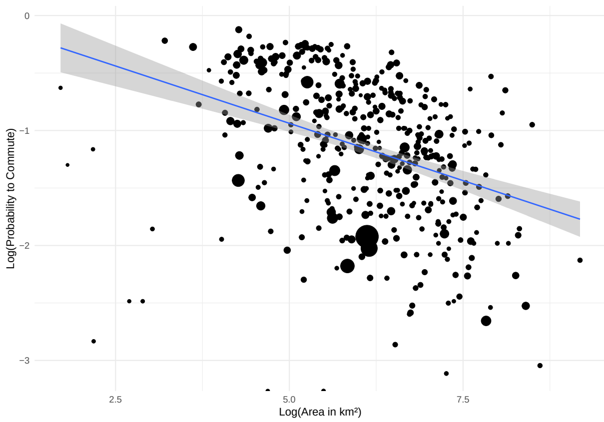


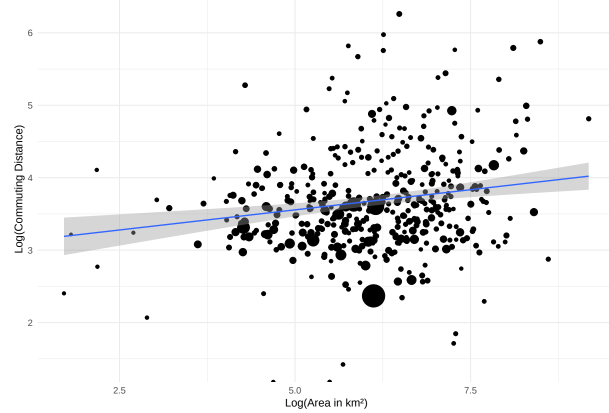
Figure C6: Share of Individuals Commuting into Oslo by Municipality in 1995

Note: The figure plots the share of employed individuals commuting into Oslo municipality for work by Municipality for the year 1995. Darker colors indicate a lower share of employed individuals commuting into Oslo, while lighter colors indicate higher shares. The grey polygon defines Oslo municipality.

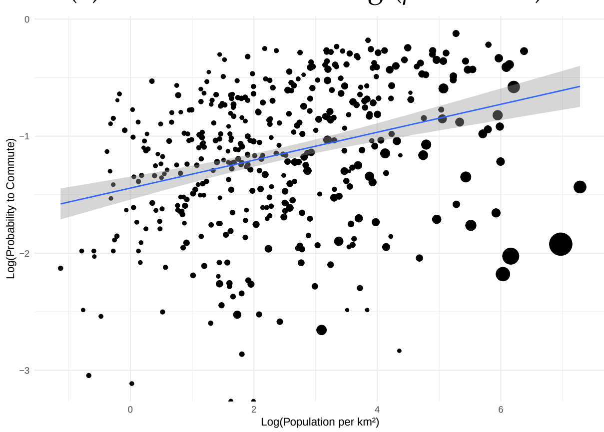
Larger municipalities tend to have a lower share of individuals commuting across municipal borders (Panel C7a), while average commuting distances are significantly longer in these areas (Panel C7b). This pattern aligns with our cross-municipality commuting definition. In larger municipalities, more residents live farther from the municipal border, reducing the likelihood of being classified as commuters. However, when individuals do commute across municipalities, they typically travel longer distances due to the larger geographic size of their home municipality.



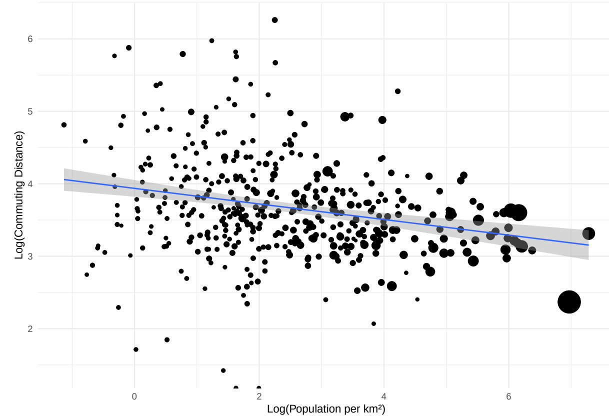
(a) Area vs. Commuting ($\beta = -0.19$)



(b) Area vs. Distance ($\beta = 0.11$)



(c) Pop. Density vs. Commuting ($\beta = 0.11$)



(d) Pop. Density vs. Distance ($\beta = -0.1$)

Figure C7: Commuting/Distance versus Population Density/Area

Note: The figure provides scatter plots for the relationship of the share of commuters/average commuting distance with the area of a municipality or its population density measured using the population per square kilometer. Commuting measures were constructed using our main sample for 1995, and area and density measures were constructed using the entire population of Norway in 1995. The size of the dots corresponds to the municipality's population size, and the β reported in the Panel title reports simple OLS coefficients between the relationships of the depicted variables. OLS coefficients are not weighted by population.

Our commuting definition does not capture all commuters—for example, individuals living and working within Oslo are not considered commuters. Despite this limitation, 1.34 times more individuals lived in the Oslo labor market but outside the municipality of Oslo, indicating a substantial pool of potential commuters in the surrounding agglomeration. Figure C6 shows the share of employed individuals commuting into Oslo from the broader Oslo labor market.

Examining the relationship between population density (measured as population per square kilometer) and commuting patterns, we find a positive correlation between higher population density and the share of individuals commuting across municipal borders (Panel C7c). Conversely, higher population density is associated with shorter average commuting distances across municipalities (Panel C7d). These patterns likely reflect the higher degree of connectivity and proximity between densely populated and smaller areas in southeastern Norway.

C.3 Labor Market Opportunities

We measure labor market opportunities using observed commuting distances, which may underestimate true opportunities. To account for this, we calculate labor market measures for all employed individuals in Norway across different commuting radii, segmented by education, industry, and municipality of residence. Using 1995 data (the midpoint of our sample), we compute weighted averages of these measures, with weights based on the number of employees in each cell. This approach offers a detailed snapshot of labor market characteristics at varying commuting distances. The results of this exercise are reported in Table **??**.

Table C2: Labor Market Outcomes at Different Commuting Distances in 1995

	180-day	**1-Year**	**2-Year**	**3-Year**
HHI	-0.006			
	(0.020)			
Observations	4,456,173			
R^2	0.118			
Dependent variable mean	0.077			
F-test (1st stage), hhi_ctype_npi	4,774.645			

Notes: The table provides summary statistics of labor market outcomes at different commuting distances measured using driving distances between municipality centers. Labor market outcomes were constructed at the education, industry and municipality cell adjusted for the respective commuting distances and refer to the year 1995. The aggregated statistics are then obtained as weighted averages where we weight labor market outcomes by the number of individuals in each cell.

Using the estimated commuting distance penalties and pre-parenthood average commuting distances, we calculate the average reduction in commuting distances in our sample. Table C3 summarizes these reductions for men and women five and ten years after childbirth.

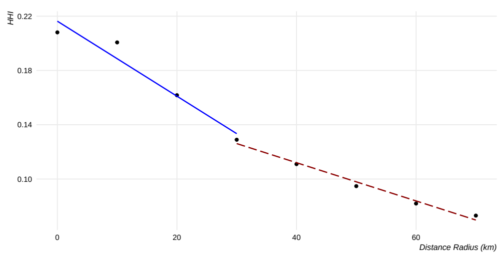
Table C3: Commuting Distance Penalty and Average Distance Reduction

	Male	**Female**
Penalty $(t = 5)$	-0.24	-0.66
Penalty $(t = 10)$	-0.26	-0.63
Average Distance $(t = (-1))$	40.53	28.65
Distance $(t = 5)$	30.80	9.74
Distance Reduction $(t = (-1))$ to $(t = 5)$	-9.73	-18.91
Distance $(t = 10)$	29.9	10.6
Distance Reduction $(t = (-1))$ to $(t = 10)$	-10.63	-18.05

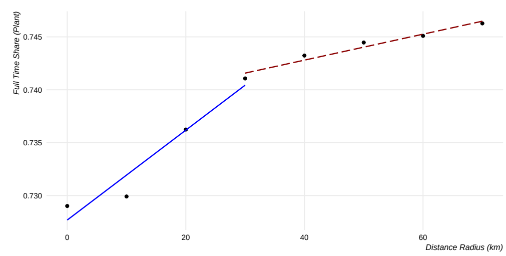
Notes: The table provides summary statistics of commuting penalties for men and women constructed from average pre-parenthood commuting distances in our main sample.

Our findings show that the average male in our sample reduces commuting distance from 41 km to 30 km between t = -1 and t = 10, a decline of 11 km. According to Table **??**, this shift corresponds to an increase in the average HHI from 0.11 to 0.13, reflecting an 18% rise in labor market concentration. For women, commuting distances drop from 29 km to 19 km over the same period, leading to a more pronounced HHI increase from 0.13 to 0.20—a 54% rise in labor market concentration.

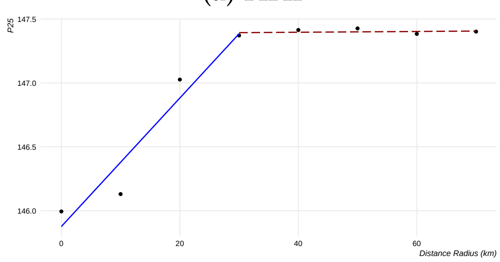
The results also indicate that reductions in firm quality measures are notably larger at shorter commuting radii. These sharper declines, particularly among women, highlight that the labor market impacts of reduced commuting are more significant within smaller geographic areas, as illustrated in Figure C8a.



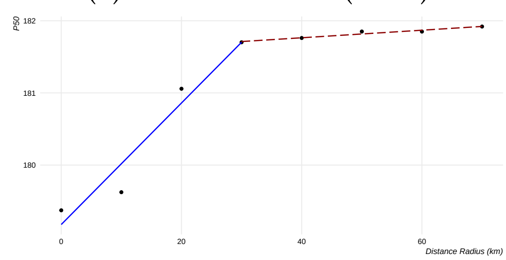
(a) HHI



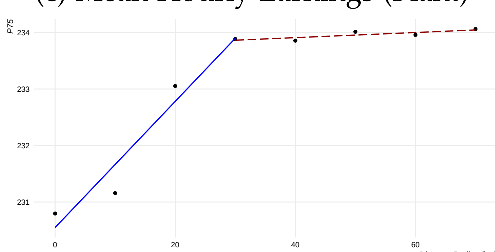
(b) Full Time Share (Plant)



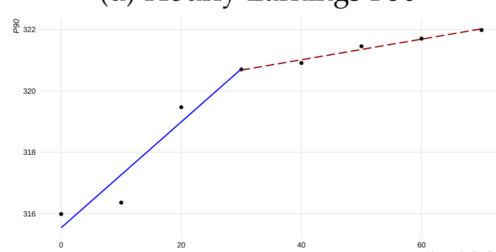
(c) Mean Hourly Earnings (Plant)



(d) Hourly Earnings P50



(e) Hourly Earnings P75



(f) Hourly Earnings P90

Figure C8: Labor Market Outcomes at Different Commuting Distances in 1995

Note: The figure provides summary statistics of labor market outcomes at different commuting distances measured using driving distances between municipality centers. Labor market outcomes were constructed at the education, industry, and municipality cells adjusted for the respective commuting distances and referred to 1995. The aggregated statistics are then obtained as weighted averages where we weight labor market outcomes by the number of individuals in each cell. We added separate linearly fitted lines for the outcomes between distances 0km to 30km and for the outcomes between distances 30km to 70km.

D Primary and Secondary Earners

To assess whether the estimated results reflect pre-birth household specialization rather than gender, we examine earnings and commuting gaps between primary and secondary earners.

We calculate each individual's average annual earnings in the pre-childbirth period ($t = [-4, -2]$) alongside their spouse's earnings over the same period. From these values, we derive each individual's earnings share within the household before childbirth. Figure D1 presents the distribution of household earnings shares for our main sample.

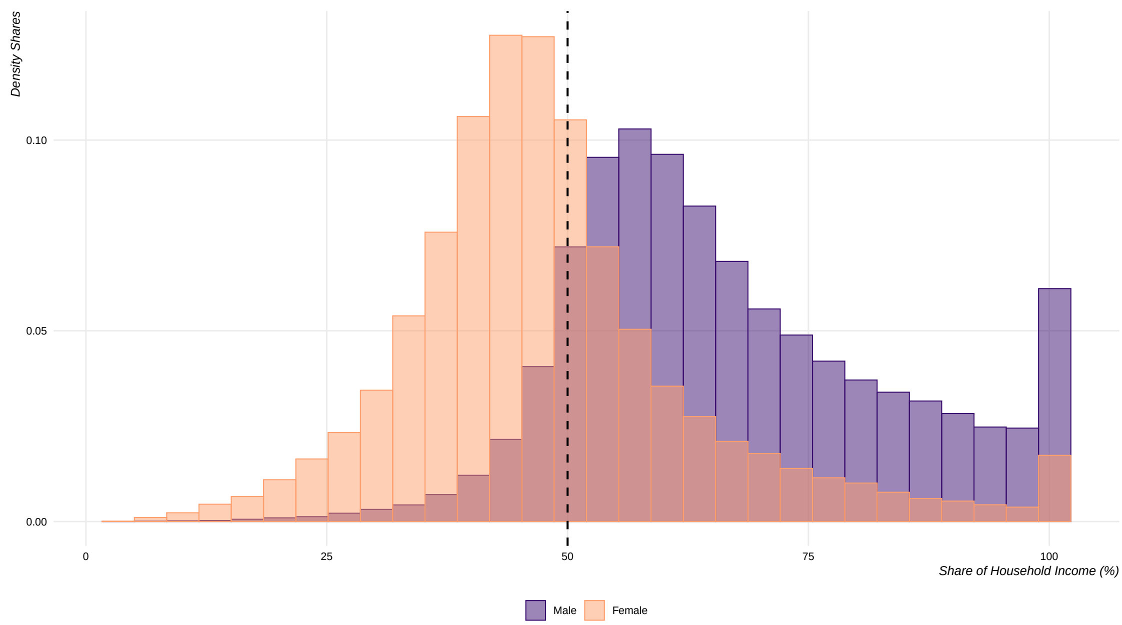


Figure D1: Distribution of the Share of Household Income by Gender

Note: The figure shows the distribution of the share of household income each individual contributes to in the pre-period. The measure is constructed as the fraction of the average annual earnings of the individual in the pre-period ($t = [-4, -2]$) over the sum of the spousal average annual earnings and the average annual earnings of the individual in the pre-period. The distribution is provided separately for men and women.

We classify individuals into two groups based on their household earnings share: primary earners (contributing $\geq 50\%$ of household earnings before childbirth) and secondary earners (contributing $< 50\%$). A small subset of individuals without an identifiable spouse is excluded from the analysis.

Table D1 shows the sample sizes for each group by gender, highlighting that men are significantly more likely to be primary earners than women.

	Male	**Female**
$<$ 50% (Secondary)	13,353	54,403
$\geq$ 50% (Primary)	97,234	30,338

Table D1: Number of Individuals by Primary/Secondary Earner Category by Sex

Next, we estimate our main event-study specification separately for primary and secondary earners, allowing us to compare long-run earnings penalties across earning roles and assess how these align with the gender-based disparities presented in the paper. However, since men are significantly more likely to be primary earners than women, this comparison is inherently influenced by the gender differences documented in our main analysis.

Table D2: Long-Run Earnings/Commuting Penalty Differences

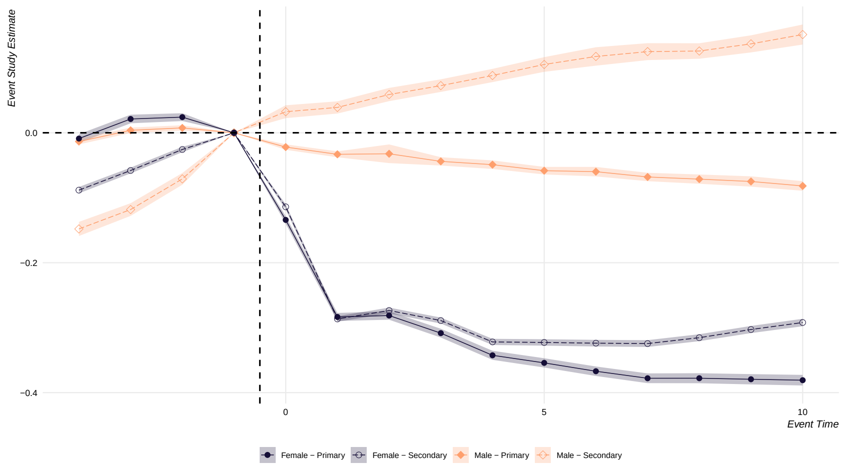
	Male vs. Female	**Primary vs Secondary**
Earnings	0.28	0.07
$\mathbb{P}$(Commuting)	0.26	0.15
Distance	0.37	0.21

Notes: The table provides an overview over differences in the long-run ($t = 10$) parenthood penalty for different outcomes and comparison groups. Male vs. Female indicates the difference between the long-run penalty for men minus the long-run penalty of women. Positive values indicate a bigger decline in the outcome in response to parenthood for women. The comparison primary versus secondary refers to the difference in the long-run penalty between primary earners and secondary earners. Positive value indicate a larger decline in the outcome relative to pre-parenthood for the secondary earner group.

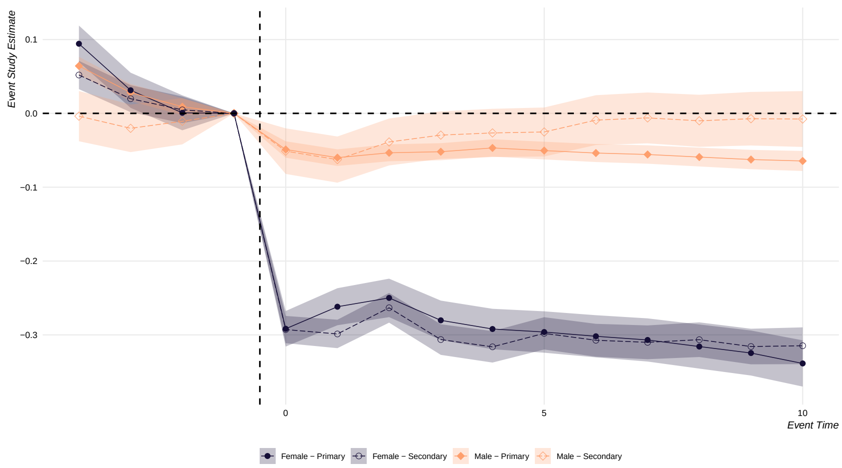
Table D2 shows that long-run earnings penalties vary more by gender than by earning role, with the gender-based earnings gap being 400% larger than the gap between primary and secondary earners. This suggests that gender, rather than breadwinner status, primarily drives our main estimates.

When estimating the event study separately for primary-earner men, primary-earner women, secondary-earner men, and secondary-earner women, the patterns in earnings, commuting, and commuting distance remain consistent with our main results. Panel D2a of Figure D2 presents event-study estimates for annual earnings, Panel D2b shows estimates for the probability of commuting, and Panel D2c reports estimates for commuting distance.

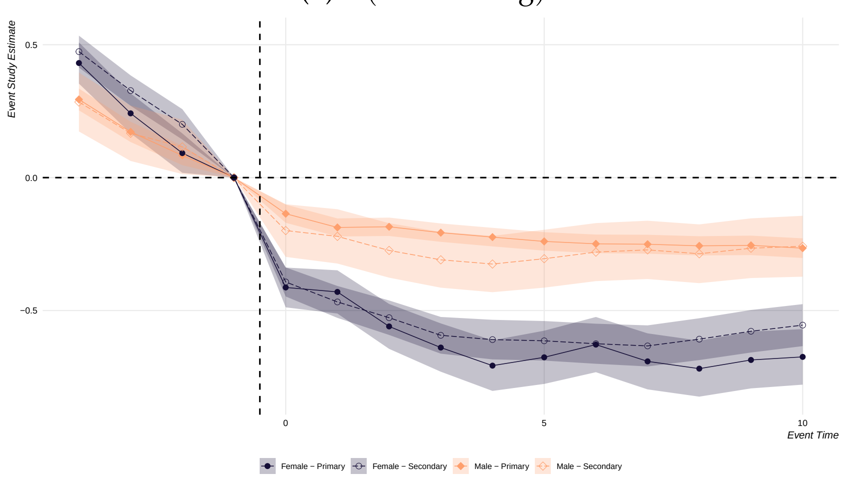
Earnings penalties are consistently larger for women than for men, regardless of breadwinner status. This pattern extends to the probability of commuting and commuting distance, where gender differences remain substantial. While gender differences in commuting behavior (Panel D2b) and commuting distance (Panel D2c) are nearly identical between primary and secondary earners, within-gender differences between these groups are small and oftentimes not economically meaningful.



(a) Annual Earnings



(b) $\mathbb{P}$(Commuting)



(c) Commuting Distance

Figure D2: Earnings/Commuting Responses for Primary versus Secondary Earners

Note: The figure shows estimated event time coefficients, expressed as a fraction of predicted outcomes, excluding event dummies for each year relative to the birth of the first child. Coefficients are estimated separately for primary and secondary earners. Shaded areas representing 95% confidence intervals (robust standard errors). Each panel focuses on a different outcome.