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ABSTRACT

Long-Term Effects of Recession on Parenthood Gender Inequality*

This study identifies a new mechanism to account for the persistent gender differences in earnings after childbirth. Aside from women's voluntary wage cuts in pursuit of family-friendly job amenities, we claim that adverse labor market conditions at the time of childbearing widen the gender gap among parents. Employing the instrumental variable (IV) method against a large cross-sectional dataset from the US, we find that giving birth during a recession reduces mothers' earnings, whereas fathers remain mostly unaffected. The asymmetric impact of a recession at the time of childbirth persists for a long time and accounts for 30–40 percent of the after-childbirth gender gap in earnings. Unintended impacts of recession on parenthood gender gap leaves room for government intervention on women's career breaks.

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1. Introduction

Gender inequality in earnings and wage rates has been dramatically reduced globally over the last century owing to the surge in women's educational achievement and implementation of gender-oriented policies. However, median annual earnings for women remain significantly lower than that for men and show signs of a slowdown in catching up to the earnings of men even in more developed countries where gender equality in education has already been achieved (England, Levine, and Mishel, 2020).

The literature offers two major lines of explanation for the persistence of gender inequality. First, studies that are based on the theory of compensating wage differentials have ascribed the provision of lower earnings for women to the choice of occupation or firms with family-friendly amenities. Bertrand, Goldin, and Katz (2010) and Goldin (2014) point out that women seek work flexibility as a key amenity. Le Barbanchon, Rathelot, and Roulet (2021) identify gender differences in the willingness to commute as a force for the persistent gender gap.

The second line of research has identified maternal childcare as a major factor for the persistent gender gap. Angelov, Johansson, and Lindahl (2016) report the within-couple gender gap in incomes and wages after the birth of the first child in Sweden. Kleven, Landais, and Søgaard (2019) show that the arrival of children creates a long-term gender gap in earnings and that the proportion of the gender earnings gap associated with this "child penalty" has risen in Denmark. Berniell et al. (2021) find that mothers in Chile experienced a sharp decline in employment, hours, and earnings, and were more likely to work in the informal sector, whereas fathers' outcomes remain unaffected.[1]

These studies have recognized a key difference in parenting between mothers and fathers in that the former have career interruptions during their pregnancies and thereafter. Bertrand, Goldin, and Katz (2010) report that women with MBAs and children have about an eight-month deficit in labor market experience when compared with the average men with MBAs in the first 15 years following graduation. Figure 1 presents the gender difference in labor supply after

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[1] These two lines of explanation are not mutually exclusive. Mothers who choose family-friendly occupations will consider child-friendly attributes, too.

childbirth from the American Community Survey.[2] The solid line at the bottom shows the proportion of mothers who worked for 27 weeks or longer in the preceding 12 months among mothers in each of the first 18 years after their first births. Mothers work significantly less in the first year of childbirth: only 60.9 percent of mothers who gave birth to the first child in the preceding 12 months (year 0) worked for 27 weeks or longer, while 71.9 percent of childless women aged 50 years or less (horizontal line in the middle) did so. Although the labor supply of mothers is shown to increase with years after childbirth, the child effect on mother's labor supply is persistent for a long time after birth. In contrast, fathers do not experience any impact of childbirth on their labor supply (see the line at the top of Figure 1).

In the short run, mothers suffer a loss of earnings (i.e., forgone earnings) from work interruptions. They may experience a long-term loss of earnings owing to (i) loss of skills and human capital depreciation, and/or (ii) selection of more child-friendly occupations, jobs, and sectors. To test the effect of skill loss during work interruptions, several empirical studies have employed the length of time out of work as an explanatory variable and checked if it has an adverse effect on mothers' wages (Albrecht et al., 1999). Kleven, Landais, and Søgaard (2019) show that women make choices vis-à-vis their occupations, jobs, and firms once they become mothers.

Our study contributes to the literature by exploring an explicit mechanism for the long-term effect of career interruptions owing to childbirth on mothers' earnings. We hypothesize that mothers who give birth under adverse market conditions such as recessions endure long-lasting effects on earnings and employment when compared to those who give birth in a booming economy. These impacts can be an important mechanism for persistent child penalties and gender inequality as the impacts of recession are not severe for fathers. To test our hypothesis, we estimate the effects of the local unemployment rate of the year of first birth[3] on mothers' earnings until the child becomes independent, that is, in the 18-year span after childbirth, and compare these effects with those on fathers.

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[2] This figure is based on data from the American Community Surveys from 2000 to 2019, which we used for analysis. See section 3 for details.
[3] State-level unemployment rates have been used extensively in the literature as a measure of local market conditions (Schwandt and von Wachter, 2019).

Our hypothesis is premised on earlier findings on the recession effects on displaced workers' earnings. The literature on the effect of recessions on labor market outcomes has shown that the loss of a long-term job, that is, worker displacement during a recession has long-term consequences on earnings loss, market participation, hours worked, and wage rates even after the causes initially giving rise to those effects are removed. Earlier studies on job displacement effects have found long-term effects on earnings loss (Jacobson, LaLonde, and Sullivan, 1993; Topel, 1990) and employment rates (Ruhm, 1991; Walker, 2013; Yagan ,2019). Davis and von Wachter (2011) report that men lose 2.8 years of pre-displacement earnings if they are displaced when the unemployment rate exceeds 8 percent. Lachowska, Mas, and Woodbury (2020) show that displaced workers' earnings losses during the Great Recession occurred mainly because hourly wage rates fell at the time of displacement and recovered sluggishly.

Studies on market-entering graduates have also shown detrimental long-term effects of recessions on young entrants in the labor market: Adverse market conditions have long-term consequences on wages (Altonji, Kahn, and Speer, 2016), career prospects (Schwandt and von Wachter, 2019), health (Maclean, 2013; Schwandt and von Wachter, 2020), and family formation (Kondo, 2012).

These scarring effects can materialize through several channels. Market (re-)entrants during a recession are often mismatched to low-quality jobs (Oreopoulos, von Wachter, and Heisz, 2012), which can induce lower wages and slower human capital accumulation and produce negative signals to potential employers that cause less frequent upward mobility.[4] Market entrants in recessions have a higher incidence of unemployment and experience interruptions of the initial process of career progression, which produces the same impact on human capital acquisition and job mobility as does job mismatch. In a similar fashion, women returning to the labor market during a recession after childbearing may experience the damaging effects of the recession for a long time owing to unemployment and job mismatch, unlike men whose employment status is largely unaffected by having children.

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[4] Topel and Ward (1992) show that a large proportion of the wage growth in labor market careers occurs during the first 10 years of labor market experience, and that this growth is mostly driven by workers moving between employers and finding increasingly better-paying jobs. Market entrants with bad signals can lose out on these opportunities to climb job ladders.

In our estimation of the recession effects on mothers, we note a potential problem of selection on unobservables where unobserved confounders influence the timing of childbirth as well as market performance outcomes. For instance, women with higher ability may be more likely to avoid childbearing during recession because of better knowledge of market situations. On the other hand, they may bear children during recessions because of lower wages and thus smaller opportunity costs of childbearing, whereas women with lower ability are reluctant to have children during recessions because of declining household income.

To address this problem, we employ the instrumental variable (IV) approach. Our strategy builds on the fact that the actual unemployment rate at the time of market return could not be fully anticipated when a woman decided on pregnancy a year ago. As our IV pertains to a random component of the unemployment rate at market return that is not predicted in the previous year, it is unlikely to be associated with the pregnancy decision. The first-stage result of the IV regression indicates that this IV certainly accounts for our endogenous regressor.

Applying the IV method to survey data with a large sample of mothers and fathers, we find that an adverse labor market condition at first birth reduces the annual earnings of mothers for over 15 years after childbirth, but has little effect on fathers. We additionally study the recession effects on hourly wages, work status, and hours worked as components of earnings. Childbirth during a downturn reduces mothers' hourly wages and work hours from the first year after childbirth. The recession effect on maternal work status emerges only in the long run. However, the economic condition at first birth does not affect any of the components of fathers' earnings.

The rest of this paper is organized as follows. Section 2 discusses the relevant literature. Section 3 describes the data. Section 4 explains our empirical strategy and instruments. Section 5 presents the empirical results. Section 6 discusses the implications of our findings and concludes the paper.

2. Literature Review

Our work is related and contributes to several strands of the literature. First, it contributes to the literature on gender inequality (Blau and Kahn, 2017; Goldin, 2014) and on parenthood gender

gap (Angelov et al., 2016; Berniell et al., 2021; Kleven et al., 2019). It suggests another channel through which the interruptions of mothers' careers can have a longstanding impact on child penalties and the parenthood gender gap.

Our work is also related to the literature on motherhood penalties and fatherhood premiums. Studies have estimated 2 to 10 percent wage reductions after childbirth using the fixed-effects strategy to control for individual heterogeneity (Albrecht et al. 1999; Amuedo-Dorantes and Kimmel 2005; Anderson, Binder, and Krause 2002; Avellar and Smock 2003; Hotchkiss, Pitts, and Walker 2017; Kahn, García-Manglano, and Bianchi 2014; Kühhirt and Ludwig 2012; Loughran and Zissimopoulos 2009; Lundberg and Rose 2000; Taniguchi 1999; Waldfogel 1997). Recent studies (Lundborg, Plug, and Rasmussen 2017; Miller 2011) that employed the IV approach to account for the endogeneity of childbirth report an even larger adverse effect of childbearing on women's wages than the earlier studies. Our study adds to this literature with new findings that motherhood penalties can be worse based on the economic conditions at the time of childbearing, unlike fatherhood premiums.

Another stream of the literature related to our study centers on the persistent impact of labor market entry in a recession. Kahn (2010) finds that college graduates have a large and negative recession effect on wages for over two decades after college. Altonji et al. (2016) find a disproportionately large reduction in the early-career earnings of college graduates who entered the labor market during the Great Recession. Schwandt and von Wachter (2019) show persistent earnings and wage reduction for young entrants during a recession, especially among the less advantaged ones. Long-term effects of initial labor market conditions have been observed in the US and other countries (Raaum and Røed (2006) for Norway; Genda, Kondo, and Ohta (2010) for Japan; Oreopoulos et al. (2012) for Canada; Choi, Choi, and Son (2020) for Korea)[5]. Our study advances the literature by investigating the long-term recession effect on another group: women returning to the labor market after giving birth.

There are several differences between graduating in a recession and having a child during a downturn because women who give birth in a recession can be influenced by their prenatal

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[5] Cockx and Ghirelli (2016) provide an overview of the literature on losses in employment and earnings experienced by those entering the labor market during an economic downturn.

careers and families, unlike young graduates. For example, women who worked before childbirth may return to their previous employers owing to federally mandated job protection, which mitigates the recession effect. If the unemployment shock hits the husband, women may have to increase their labor supply even after childbirth. A recession can be more detrimental to mothers because increased family responsibilities after having a child make the maternal labor supply more inelastic than the labor supply of recent graduates who have not yet formed their families.

Our estimation is based on the common specification used in this literature, especially that in Schwandt and von Wachter (2019). We use repeated cross sections of mothers from the American Community Survey (ACS) who had their first children between 1982 and 2018. As noted in Schwandt and von Wachter (2019), the advantage of using cross-sectional data is the large sample size for the precision of the estimation result. It is particularly advantageous to use ACS for our study because the data provide information on the birth year and place of the first child through the mother–child link, whereas studies on the recession effects on college graduates that use repeated cross-sectional data (for example, Schwandt and von Wachter 2019) must use the state of current residence to proxy the state of labor market entry.

The effect of labor market re-entry on market performance has been investigated in the literature across different groups of workers. Card and Cardoso (2012) find a significantly positive and long-lasting impact of military service on the wages of Portuguese men with primary education when they returned to the labor market. Bingley, Lundborg, and Lyk-Jensen (2020) find a negative average effect of peacetime military service on earnings in Denmark. Another group of re-entrants studied were criminals. Kling (2006) shows that time in prison improved labor market outcomes after release in Florida and California. Mueller-Smith, Michael (2015) reports that incarceration worsened labor market outcomes in Texas. Bhuller et al. (2020) report that Norwegians not working before incarceration had increased their participation in employment programs and raised their future employment and earnings, while previously employed individuals experienced lasting negative employment effects. Our work investigates the effect of re-entry on mothers.

Broadly, our paper contributes to the large body of studies on hysteresis that examine the long-lasting effects of temporary shocks such as short-term policies (Allcott and Rogers 2014; Saez, Schoefer, and Seim 2021), recession shocks (Yagan 2019), and trade shocks (Autor et al.

2014) even after the original cause is removed. We identify earnings and employment hysteresis among mothers returning during a recession.

Beyond our contribution to the literature with new findings, we also provide a novel set of instruments to address the crucial empirical challenge of endogenous fertility timing. We exploit the fact that the realized unemployment rate a mother faces in the year of childbirth comprises a component that was not expected while planning a family owing to a year's gap between conception and delivery. We construct an unexpected local unemployment shock for the year of childbirth by estimating the deviations in unemployment rates from the expected level a year ago.

3. Data

The data are drawn from the ACS between 2000 and 2019. The major advantage of the ACS is that, along with its large sample size, it provides enough information to identify the years and places of women's first births. The ACS data provide a family interrelationship variable indicating the link between a parent and child, which we use to match children aged under 19 years to their mothers and fathers. We consider the birth year and location of the eldest child among those matched to a parent as the year and place of a parent's first birth. The annual unemployment rates in the states of first birth are obtained from the US Bureau of Labor statistics.

We explore the recession effects on the annual earnings of women and men. We investigate the effects on three margins of earnings: hourly wages, work status, and work hours. Work status indicates whether a woman works for pay or not. Work hours are the number of usual hours worked per week. We include paid and self-employed workers in constructing these labor supply variables. Annual earnings are the total pretax labor income, and hourly wages are computed from the yearly salary income, weeks worked in the preceding 12 months, and usual hours worked per week. The annual earnings and hourly wages are valued in 2015 US dollars.

Table 1 presents the summary statistics of mothers and fathers' characteristics and labor market outcomes for the regression sample. As many as 77 percent (81 percent) of the sample are white mothers (fathers), whereas 10 percent (7 percent) are black mothers (fathers). Further, 35 percent of the mothers have at least a bachelor's degree, whereas 13 percent are educated beyond

a 4-year college degree. The average level of fathers' education is about the same as that of mothers. Mothers and fathers with over 16 years of education are, as expected, older, more likely to be white, and had their first births at an older age than those with less education. The state unemployment rate at first childbirth for highly educated and white parents is lower than that for less educated and nonwhite parents. This suggests that there may be unobserved confounding factors like ability that affect childbirth timing. The average age of the first child is approximately 10 years.

Panel III in Table 1 shows descriptive statistics of maternal and paternal labor market outcomes. As many as 77 percent of highly educated mothers work, whereas 65 percent of mothers with lower education have jobs. The difference in work status between white and nonwhite mothers is smaller than that by education level. The fathers' employment rate is higher than that of mothers. Over 90 percent of highly educated and white fathers are employed, and 87 percent of low-educated fathers work, which is higher than the average employment rate for mothers with higher education. Working mothers work for 36 hours, and fathers work 8.7 hours longer than mothers. Highly educated parents are likely to work longer than their less-educated counterparts. Mothers and fathers earn USD 28,495 and USD 65,056, respectively, each year. The substantial gender earnings gap is driven by differences in employment, working hours, and hourly wages. Mothers and fathers with higher education earn USD 46,491 and USD 106,790 a year, respectively, more than twice the income of their counterparts. The hourly wage gap between mothers and fathers is smaller than the earnings gap because it is restricted to working persons. Finally, the income differences between white and nonwhite parents are smaller than the differences by education level.

4. Empirical Specification

To estimate the long-term effect of the labor market condition on returning mothers, we use the following regression specification:

$$y_{ist} = \sum_{k=1}^{18} I[t - B = k](\alpha_k UR_{SB} + \delta_k) + X'_{ist}\beta + \gamma_B + \gamma_s + \gamma_t + \gamma_b + \varepsilon_{ist} \tag{1}$$

where y_{ist} denotes the annual earnings for woman i residing in state s in calendar year t, who gave birth to her first child in state S in year B. The annual earnings of those not working are considered zero. In addition, we consider three labor market outcome variables for our analysis: Hourly wages, work status, and work hours, where work status is a dummy variable and the other two are continuous ones. Hourly wages and hours worked are defined only for workers.

Our key regressor UR_{SB} denotes the unemployment rate in state S and year B of woman i's first childbirth. $I[\cdot]$ is an indicator function that is one when years elapsed after childbirth $(t - B)$ is equal to k ($k = 1, 2, \ldots 18$). α_k's are our main parameters that show how strongly the market condition at return has lingering effects on women in the k-th year after childbirth. We consider the time span of 18 years after childbirth during which children are dependents.

Following Kleven et al. (2019), we estimate level effects instead of using log values to keep nonparticipants' earnings at zero. The effects in percentage are calculated by dividing the estimated level effects by the predicted outcome in the k-th year after childbirth: $\hat{\alpha}_k / E[\hat{y}_{ist}|k]$. The predicted outcome is the fitted value obtained from a regression specification after omitting the contribution of the local unemployment rate:

$$\hat{y}_{ist} = \sum_{k=1}^{18} I[t - B = k]\hat{\delta}_k + X'_{ist}\hat{\beta} + \hat{\gamma}_B + \hat{\gamma}_s + \hat{\gamma}_t + \hat{\gamma}_b. \qquad (2)$$

Vector X_{ist} includes control variables like dummy variables for educational attainment (less than high school, high school, some college, bachelor's degree, master's degree or more), years of potential labor market experience in a cubic form,[6] and dummy variables for race and ethnicity (white, black, Hispanic, and others). All these covariates are included because they have been extensively used in the literature as determinants that can influence labor market performance and thus reduce the standard error of the estimated parameter for the key regressor. Parameters γ_B, γ_s, γ_t, and γ_b pertain to fixed effects for childbirth year, state of current residence, calendar year, and a woman's birth year, respectively.[7] ε_{ist} is an error term clustered at the level of childbearing year by state. We use the same specification for fathers.

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[6] The number of years of potential experience is calculated by the current year minus the commonly expected graduation year for her highest degree.

[7] Owing to multicollinearity, it is not feasible to simultaneously include all three sets of dummy variables for childbirth years, years elapsed after childbirth, and calendar years. We thus excluded one extra calendar year dummy as well as the first calendar year dummy.

One of the greatest challenges in estimating a causal relationship pertains to the unobserved confounding or selection on unobservables where such unobservables are correlated with the treatment and outcome variables so that they induce selection bias. In our analysis, it is possible that more capable women with knowledge of market situations could do better in avoiding adverse market conditions at the time of returning after childbirth, which biased our estimates of α_k to overestimate the long-term adverse effects of a recession. On the other hand, more capable women may bear children during recessions because of lower wages and thus smaller opportunity costs of childbearing. In the latter case, our estimates of α_k can underestimate the recession effects.

To address this, we employ the IV method. We assume that the unemployment rate of state S in year t (UR_{St}) is a function of its anticipated and unanticipated components (ε_{St}), and $\varepsilon_{St} = (UR_{St} - UR_{St-1}) - E(UR_{St} - UR_{St-1}) = \Delta_{St} - E(\Delta_{St})$, where E is the expectation operator. We estimate the expected unemployment gap between two consecutive years, $E(\Delta_{St})$, from the linear regression of Δ_{St} on Δ_{St-1}, which implies that women form adaptive expectations of the next-year unemployment rate. As ε_{St} pertains to an unexpected development in the labor market, the part of the variation of the unemployment rate captured by it will be exogenous and thus utilized as an instrument.

Our idea for the instrument exploits a year gap between conception and delivery, which implies that the unemployment rate materialized at the time of childbirth reflects an unexpected exogenous shock. In practice, we use a predicted value of ε_{St} ($\widehat{\varepsilon_{St}}$) in linear and quadratic forms as our instruments because UR_{St} can be approximated with them through the Taylor series expansion, and this set of instruments shows a much stronger first stage than the case with the linear term alone. Since our key regressor is interacted with the dummies for years elapsed after childbirth, both instruments interacted with those dummies are included in our IV regression.

To determine whether our instruments are strongly correlated with the state unemployment rates, we first regress UR_{St} on $\widehat{\varepsilon_{St}}$ and $\widehat{\varepsilon_{St}}^2$ with state and year fixed effects using the complete sample of state unemployment rates from 1982 through 2018 which includes 1,924 observations. The results in the first column of Table 2 show that the instruments significantly increase the state unemployment rates and that the quadratic term is more strongly correlated with the unemployment rate than the linear term. The F-statistic for the significance of instruments in the

first-stage regression is 58.27, and far exceeds 10, which is a critical value for weak instruments when there is one endogenous regressor (Stock, Wright, and Yogo 2002).

The other columns in Table 2 show how strongly the instruments are correlated with the state unemployment rates at first births in our regression samples of earnings, wages, and work status and hours for mothers and fathers. We regress the state unemployment rate at first birth on the set of instruments with all covariates in the baseline specification and clustered standard errors. The estimates and F-statistics from the six regression samples[8] indicate that these IVs are not weak instruments. The F-statistics in the first-stage regression from the regression samples with only the linear term of the predicted value $\widehat{\varepsilon_{St}}$ included are 4.43– 4.77, which are less than the critical value of 10. Therefore, we use the predicted value in the linear and quadratic forms as our instruments instead of using the linear term alone.

5. Results

5.1 Gender Gap over the Years Since Birth

Before discussing the results, we present the unconditional gender gap in earnings and its components between mothers and fathers by years elapsed since first birth. Panel A in Figure 2 shows the earnings gap as the ratio of the average earnings of mothers to that of fathers. Mothers earn less than half the fathers' earnings throughout the 18-year period after first birth. Maternal earnings decline from 43.7 percent in the first year to 41.3 percent of the income for men in the fourth year and begin to increase five years after giving birth when the child enters kindergarten. This increase in women's relative earnings is driven by improvements in their work status (see Panel B in Figure 2). While less than 70 percent of mothers work until the fourth year after childbearing, the percentage of working mothers increases gradually, reaching over 80 percent of male employment.

The hourly wage rate of working mothers tends to decrease over the years since childbirth in contrast with increasing employment rate relative to fathers who had their first birth in the same

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[8] As the samples for earnings and work status are identical for mothers and fathers, we have six rather than eight regression samples.

year. This implies that relatively lower-wage women are slower to return to work after the first birth. The hourly wage rate of mothers working the year following that of childbirth is 83 percent of that of fathers, but decreases to 67 percent in the 15th year after giving birth as mothers' employment rate recovers above 80 percent of male employment. Work hours of employed mothers have increased modestly, accounting for over 80 percent of men's hours for the 18-year span.

5.2 Baseline Regression Results

Table 3 shows the effects of the state unemployment rate at first childbirth on earnings and three other labor market outcomes in the first 18 years after childbirth, estimated from the IV regression. Panels A to D in Table 3 show the values of the coefficients associated with the unemployment rate for years elapsed since birth k (k = 1, 2, …18), which are estimated from equation (1) for the full sample of mothers and fathers with annual earnings, hourly wage, and work status and hours as the dependent variables, respectively. Table 3 shows the effect of the unemployment rate in percentage, which is derived from the estimated coefficient divided by the income level.

Panel A in Table 3 shows that the estimated coefficients associated with the unemployment rate are significantly negative in most of the first 15 years after the first birth for women. Thus, women who gave birth to their first child during a recession endured lower earnings than their counterparts who gave birth during an economic boom and this harmful effect of an economic downturn at first birth persists for 15 years after childbirth for mothers. However, for men, the coefficient associated with the unemployment rate is not significant for the first year and the coefficients are negative significantly only for a few years afterwards. The recession effect for men vanishes by the seventh year after childbirth, which implies that adverse economic conditions at first birth are less damaging for men than for women.

Further, a percentage point increase in the local unemployment rate at first birth reduces women's earnings by 1.12−3.49 percent in the first 15 years after childbirth. It decreases men's earnings by 0.85−1.16 percent in the first 6 years. During the first 15 years after childbirth, the

adverse recession effects are more marked for women when compared to men.[9] This finding indicates that the observed parenthood gender gap can be attributed in part to the uneven effects of recession on mothers and fathers.

Studies show that motherhood penalties account for 2 to 10 percent wage reductions (see references in section 2). In addition to this average effect, our results show that mothers returning to the market after childbirth at the trough in the business cycle experience an additional 4.8 percent earnings reduction in the first year after childbirth when compared to those returning at a peak in the business cycle.[10] This negative recession effect on earnings in the first year after childbirth indicates that the postpartum work experience gap between women returning in a recession and those not (as the former return to the labor market later) cannot account for all recession effects on earnings. By contrast, fatherhood is associated with a wage premium (Yu and Hara, 2021), and there is no significant recession effect in the first year after childbirth.

The asymmetric recession effects on mothers and fathers over the life cycle can exacerbate the gender earnings gap. Mothers who have their first child in a recession receive significantly reduced earnings in the following year whereas fathers who have their first child in a recession are hardly affected, which will further increase the gender gap between them in comparison to their counterparts who have their first birth during a peak in the business cycle. The gender earnings gap among parents who have their first birth during an economic downturn widens more in the long term as unlucky fathers catch up on their earnings to the level of their lucky counterparts rather quickly and unlucky mothers experience longer impacts.

Panel B reveals that adverse economic conditions at first birth have harmful effects on women's hourly wages as well. The magnitude of adverse impacts on hourly wages for women is even greater than that on earnings: A percentage point increase in the local unemployment rate at first birth reduces returning mothers' wages by 3.84 percent in the first year after childbirth, more than twice the magnitude of the earnings effect. This huge damaging effect of a recession at first birth is reported to persist for seven years after childbirth, and the negative effects for women are

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[9] This persistent earnings effect is comparable to the findings in other studies that investigated the effect of the unemployment rate at graduation on later earnings (Schwandt and von Wachter, 2019).

[10] The calculation of this additional earnings reduction is based on the point estimate in Table 3.A (-0.0159) and the typical difference in the unemployment rate by 3 percentage points between a peak and a trough in the business cycle.

intermittently observed even beyond ten years postpartum. By contrast, men who have their first children in a bad economy do not experience wage reduction at all.

According to Panel C in Table 3, women and men who give birth in a tough economic condition are not affected in terms of labor market participation in the first ten years after childbirth. The results show that a recession at childbirth had an impact on labor market participation for women at least after ten years, which may corroborate the finding that mothers experience lowered wages in earlier years after childbirth in a recession and that the effect disappears thereafter as some mothers opt to leave the market. This aligns with Bertrand, Goldin, and Katz (2010) who noted that there was almost no decline in labor force participation after childbirth among MBA mothers.

Finally, Panel D in Table 3 shows that the adverse labor market conditions in the year of first childbirth reduce the work hours for employed mothers in the short run, but the disadvantage disappears in five years. Entering fatherhood during a recession hardly affects men's work hours.

Taken together, the recession effect on women's earnings in the first 15 years after childbirth would have been mainly driven by a decrease in work hours and hourly wages of working women. The long-term effect on earnings after ten years since first birth would have been because of mothers leaving the labor market. Entering fatherhood during a recession reduces the earnings of men in the short run. However, we do not find significant impacts independently on men's hourly wage, employment, and work hours, even until the first six years when their earnings decline.

5.3 Heterogeneous Responses

Studies in the literature on motherhood penalties have revealed that motherhood penalties can vary based on the demographic characteristics of women (e.g., Anderson et al., 2002; Loughran and Zissimopoulos, 2009; Pal and Waldfogel, 2016). In Tables 4 and 5, we employ the IV method and examine how the recession effects on parents' earnings vary by educational and racial groups, respectively.

Table 4 shows that the adverse effect of a recession on earnings is similar between mothers with less and more education, but the impact on less-educated mothers is larger and persists longer

than that on more-educated mothers: A percentage point increase in the unemployment rate at first birth lowers the annual earnings of mothers with less (more) education in the following year by 1.80 (1.27) percent, and the adverse effect lasts for 16 (12) years after childbirth.

Adverse labor market conditions at childbirth are less detrimental to the earnings of fathers at both education levels. Fathers with college degrees or higher are hardly affected by economic fluctuations at the time of their first births. The recession effect on less-educated fathers and mothers is similar in the first two years after childbirth, but the damaging effect for less-educated fathers becomes small and insignificant more quickly than for mothers.

Panel B in Table 4 shows a stark contrast in hourly wages between mothers with different educational levels: less-educated mothers who give birth in a downturn experience wage reduction for the entire 18-year span by 1.5−6.2 percent whereas more-educated mothers take virtually no impact from economic conditions at first birth. Thus, the persistent recession effects on mothers' wages reported in Table 3 can be attributed to the effects on less-educated mothers and exacerbate the wage inequality among women.

Panels C and D in Table 4 show that the recession effects on work status and hours experienced by mothers shown in Table 3 are because of those effects on less-educated mothers. Both educational groups of fathers do not experience any effect on work status and hours as well as on wages from economic conditions at first birth.

Table 5 compares the effects of having a first child during a recession between white and nonwhite parents. White mothers face more pronounced effects of having children during a recession on their earnings than nonwhite mothers. A percentage point increase in the local unemployment rate at first birth reduces the earnings of white mothers by 1.9 percent in the following year, and the 1–3 percent earnings reduction lasts for 12 years. The decrease in white women's income is driven by reduced work hours and wage rates of working mothers rather than by lowered market participation. White mothers who give birth during a lousy economy receive lower hourly wages for the first seven years and work shorter hours for eight years. The harmful effect on earnings for nonwhite mothers remains even 15 years after giving birth, but there are many periods in which no significant effect is observed, including the first four years after childbirth.

The recession effect on earnings for white fathers is generally absent over the 18-year period, which contrasts with the result for white mothers. The recession effect is more detrimental for nonwhite fathers than nonwhite mothers until five years after giving birth. Nonwhite fathers experience a 1.4−2.5 percent reduction in their earnings for seven years, with a percentage point increase in the unemployment rate when entering fatherhood.

5.4 Decomposition

In this section, we decompose the parenthood gender gap in earnings after childbirth into recession-related gender disparity and the residual. Our findings, that is, having children during a bad economy is more damaging for women than men, suggest that the gender gap can widen owing to unmanageable economic conditions at the time of childbearing beyond the transmission mechanisms of child penalties for mothers that are mentioned in the literature, such as occupation or firm choices for family-friendly amenities. To quantify the significance of the recession effect on the gender gap among parents, we compute the extent to which the aggregate gender difference in earnings after entering parenthood is attributable to economic conditions at childbirth.

We define the mean gender gap in the kth year after first birth as the difference between the average earnings for men and women divided by the average earnings for men. Using equation (1), we decompose the predicted gender earnings gap in the kth year after childbirth into the part that is attributed to different recession effects on men and women and the amount that can be explained by other factors, including all fixed effects denoted in equation (1).

$$\frac{E[\hat{Y}_k^m|k]-E[\hat{Y}_k^w|k]}{E[\hat{Y}_k^m|k]} = \frac{\hat{\delta}_k^m - \hat{\delta}_k^w}{E[\hat{Y}_k^m|k]} + \frac{(\hat{\alpha}_k^m - \hat{\alpha}_k^w)E[UR_{SB}^m|k]}{E[\hat{Y}_k^m|k]} + \frac{\hat{\alpha}_k^w\{E[UR_{SB}^m|k]-E[UR_{SB}^w|k]\}}{E[\hat{Y}_k^m|k]} + \frac{\hat{e}_k^m - \hat{e}_k^w}{E[\hat{Y}_k^m|k]} \quad (3)$$

where $\hat{e}_k^g = E[X_{ist}^g]'\hat{\beta} + \hat{\gamma}_B^g + \hat{\gamma}_s^g + \hat{\gamma}_t^g + \hat{\gamma}_b^g$. $\hat{Y}_{ist}^g$ is the predicted earnings of gender g, and m and w denote men and women, respectively. Among the first three terms on the right-hand side, which indicate what can be attributed to economic conditions while giving birth, the first two terms represent the differential induced by gender-dependent recession effects, and the third term represents the difference in the local unemployment rates at childbearing by gender. As there is little difference in the average unemployment rates between fathers and mothers in all 18 years since first birth, the third term is close to zero.

Figure 3 presents all the components in our decomposition exercise. The line that Point A (B) is on shows a locus of predicted earnings of mothers (fathers) with varying unemployment rates at childbirth on the horizontal axis. Point A (B) corresponds to the predicted average earnings for mothers (fathers) with the assumption that mothers and fathers have the same unemployment rate at first birth on average. Therefore, the gender difference in earnings is equal to the distance between Points B and A. The gap between Points D and A pertains to the first term in equation (3) and the distance between Points C and D represents the second term in equation (3). The gap between Points B and C is thus the earnings gap which cannot be explained by the recession effect.

Table 6 shows our decomposition results. The first two columns are the mean predicted earnings of mothers and fathers for 18 years after childbirth, which correspond to the heights of Point A and B, respectively. The next column denotes the predicted gender gap in earnings, corresponding to the left-hand side value of equation (3) or the distance between Points B and A in Figure 3. The last column reports the gender gap that can be explained by the different impacts of giving birth during a recession−the sum of the first three terms on the right-hand side of equation (3) or the distance between Points C and A−with its share in the gender gap in parentheses.

The table shows that the predicted earnings gap between mothers and fathers remains stable just below 0.6 for 18 years since first birth. Around 0.2 of this gap is a difference that could have been reduced if the unemployment rate at childbirth had the same effect on mothers' earnings as it had on fathers'. In other words, 26.3-40.1 percent of the predicted gender gap is attributed to economic conditions at childbirth and their gender-differentiated impacts. The explained gap persists for 18 years without an evident decline, consistent with the finding that the adverse recession effects on maternal earnings last for 15 years without converging.

6. Concluding Remarks

Studies have attributed the persistent gender gap in earnings to child penalties and suggested potential transmission mechanisms through which child penalties can materialize. For example, Blau and Kahn (2017) and Kleven et al. (2019) pointed out that child penalties are driven by women voluntarily selecting into family-friendly occupations or firms with lower wages as compensating wage differentials.

Given that mothers tend to have career interruptions after childbirth, we presented another mechanism for child penalties that yields more harm to the economic performance of women than that of men. We argued that child penalties can result from asymmetric impacts of adverse economic conditions at childbirth on mothers: Mothers who return to work after giving birth during a recession endure long-lasting effects on earnings, while fathers who do not experience career interruptions are largely unaffected by having children during a recession. To empirically test our hypothesis, we applied the IV approach to the large repeated cross-sectional data.

We found that mothers experience asymmetrically damaging impacts. Women who give birth to their first child during a recession endure lower earnings than their counterparts who give birth during an economic boom, and this adverse effect for mothers is more pronounced and lasts longer than that for fathers. Adverse economic conditions at first births have detrimental effects on women's hourly wages and reduce the work hours for employed mothers in the short run, indicating the recession effect on women's earnings after childbirth seems to be mainly driven by a decrease in work hours and hourly wages of working women. However, there were no recession effects for working fathers on their work hours and wages even in the short run.

This indicates that the asymmetric recession effects on mothers against fathers enlarge the gender earnings gap among parents. In our decomposition analysis, we find that the heterogeneous recession impact can account for about 30 to 40 percent of the observed parenthood gender gap in earnings.

In Blau and Kahn (2017) and Kleven et al. (2019), the parenthood gender gap arises from the fact that mothers intentionally trade off market benefits such as high wage and full-time work for time to care for children. This type of gender gap is thus driven by rational decisions within a household and does not leave much room for gender policies. By contrast, career breaks can have long-term and unintended effects on mothers who give birth during a recession, and therefore gender inequality, even if mothers want to fully engage in the labor market after childbirth. In this case of gender inequality, there is a rationale for government intervention on women's career breaks.

In terms of methodological perspectives, our study addresses two important issues raised in the literature: (i) unobserved confounding and (ii) the common practice of proxying the state of

market entry with the state of current residence in the use of repeated cross-sectional data. For the first issue, we found the proper IV for the endogenous unemployment rates at first birth exploiting a year gap between conception and delivery. For the second issue, we used the mother–child link in the ACS data to accurately identify the birth state of the first child.

Our study leaves a number of issues unaddressed that we would like to take on in future work. First, we did not investigate how long a woman was on leave before and after first childbirth because of the lack of information in the data. We were unable to study the heterogeneous effects of a recession by the length of maternity leave. If human capital depreciates with time away from the workforce, the adverse recession effects can be more severe for mothers with longer maternity leave.

Second, our study did not inquire into the varied effects of a recession on mothers who returned to former jobs after childbirth versus those who switched jobs. It is possible that the latter group experiences more pronounced effects owing to a higher probability of job mismatch during a recession. However, the estimation of the heterogeneous effects will be challenging because we may have a problem of sample selection between the two groups.

Third, it may be interesting to see whether the effect of the local unemployment rate during a recession differs from its effect during an expansion. For example, the effect may be pronounced during a recession but not during an expansion because job mismatch may be prevalent in a recession, but job overmatch may not be so widespread in an expansion.

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Table 1. Summary Statistics
A. Mothers

| | Full sample | | Mother's years of schooling | | | | Maternal race | | | |
| | | | <16 years | | 16+ years | | White | | Nonwhite | |
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
I. Maternal Characteristics										
Age	37.82	8.20	36.55	8.42	40.17	7.20	38.18	8.12	36.56	8.33
White	0.77	0.42	0.75	0.43	0.82	0.39	1.00	0.00	0.00	0.00
Black	0.10	0.30	0.12	0.33	0.06	0.24	0.00	0.00	0.45	0.50
Nonwhite Hispanic	0.05	0.23	0.07	0.26	0.02	0.14	0.00	0.00	0.24	0.42
Less than high school	0.09	0.28	0.13	0.34	0.00	0.00	0.07	0.26	0.14	0.35
High school	0.46	0.50	0.70	0.46	0.00	0.00	0.45	0.50	0.49	0.50
Some college	0.11	0.31	0.16	0.37	0.00	0.00	0.11	0.31	0.09	0.29
BA	0.22	0.42	0.00	0.00	0.64	0.48	0.24	0.43	0.17	0.38
Advanced degree	0.13	0.33	0.00	0.00	0.36	0.48	0.13	0.34	0.11	0.31
II. Characteristics of first children										
Mother's age at first birth	27.37	6.27	25.86	6.28	30.20	5.20	27.66	6.15	26.38	6.58
Child's age	10.44	5.18	10.70	5.15	9.97	5.22	10.52	5.18	10.18	5.17
State unemployment rate in childbirth year	5.80	1.81	5.82	1.80	5.77	1.83	5.74	1.79	6.01	1.87
III. Maternal labor market outcomes										
Annual earnings	28495	41407	18856	24195	46491	57666	28926	42046	27021	39109
Hourly wage	24.24	111.2	17.86	65.72	34.81	159.8	24.63	110.0	22.91	115.3
Work status (= 1 if working)	0.69	0.46	0.65	0.48	0.77	0.42	0.69	0.46	0.67	0.47
Work hours	36.03	11.77	35.48	11.28	36.93	12.48	35.71	12.01	37.14	10.82
Observations	4,685,874		3,051,528		1,634,346		3,624,344		1,061,530	

Notes: This table presents the sample means and standard deviations of mothers' demographic characteristics, first-child characteristics, and mothers' labor market outcomes in the full sample and by education and race. While the full sample includes mothers whose first child was less than 19 years of age at the time of survey, work hours and hourly wages are defined only for working mothers. Annual earnings include zero earnings and income variables are valued in 2015 US dollars.

B. Fathers

| | Full sample | | Father's years of schooling | | | | Paternal race | | | |
| | | | <16 years | | 16+ years | | White | | Nonwhite | |
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
I. Paternal characteristics										
Age	40.55	8.42	39.46	8.62	42.55	7.64	40.72	8.36	39.79	8.66
White	0.81	0.39	0.80	0.40	0.84	0.36	1.00	0.00	0.00	0.00
Black	0.07	0.25	0.08	0.27	0.04	0.21	0.00	0.00	0.37	0.48
Nonwhite Hispanic	0.05	0.22	0.07	0.25	0.01	0.12	0.00	0.00	0.27	0.44
Less than high school	0.10	0.30	0.16	0.37	0.00	0.00	0.09	0.28	0.17	0.37
High school	0.46	0.50	0.72	0.45	0.00	0.00	0.46	0.50	0.47	0.50
Some college	0.08	0.27	0.13	0.33	0.00	0.00	0.08	0.28	0.07	0.25
BA	0.21	0.41	0.00	0.00	0.61	0.49	0.23	0.42	0.16	0.37
Advanced degree	0.14	0.34	0.00	0.00	0.39	0.49	0.14	0.35	0.14	0.34
II. Characteristics of first children										
Father's age at first birth	30.11	6.78	28.84	6.95	32.45	5.78	30.20	6.66	29.72	7.28
Child's age	10.44	5.17	10.63	5.13	10.10	5.23	10.53	5.17	10.07	5.15
State unemployment rate in childbirth year	5.78	1.80	5.79	1.80	5.77	1.81	5.73	1.78	6.01	1.87
III. Paternal labor market outcomes										
Annual earnings	65056	76471	42477	41579	106790	103812	68131	78775	51709	63841
Hourly wage	34.6	112.6	24.6	79.1	51.7	152.2	35.6	121.6	30.1	57.7
Work status (= 1 if working)	0.90	0.31	0.87	0.34	0.95	0.22	0.91	0.29	0.85	0.36
Work hours	44.69	10.79	43.99	11.01	45.91	10.27	45.11	10.74	42.79	10.79
Observations	3,815,793		2,476,131		1,339,662		3,101,342		714,451	

Notes: This table presents the sample means and standard deviations of fathers' demographic characteristics, first-child characteristics, and fathers' labor market outcomes in the full sample as well as by education and race. While the full sample includes fathers whose first child was less than 19 years of age at the time of survey, work hours and hourly wages are defined only for working fathers. Annual earnings include zero earnings and income variables are valued in 2015 US dollars.

Table 2. First-Stage Results for the IV Regression

Dependent variable: State-level unemployment rate

	State-year-level sample	Women's regression sample for			Men's regression sample for		
		Earnings/ Work status	Wage	Work hours	Earnings/ Work status	Wage	Work hours
$\widehat{\varepsilon_{St}}$	0.152***	0.111	0.114*	0.114*	0.110	0.112*	0.112*
	(0.044)	(0.068)	(0.067)	(0.067)	(0.067)	(0.067)	(0.067)
$\widehat{\varepsilon_{St}^2}$	0.245***	0.273***	0.269***	0.270***	0.270***	0.268***	0.268***
	(0.029)	(0.030)	(0.030)	(0.030)	(0.029)	(0.029)	(0.029)
F-stat	58.27	55.51	56.17	56.31	58.73	60.35	59.69
N	1,924	4,685,874	3,378,995	3,569,346	3,815,793	3,353,393	3,596,049

Notes: $\widehat{\varepsilon_{St}}$ is the predicted value of ε_{St}, where $\varepsilon_{St} = (UR_{St} - UR_{St-1}) - E(UR_{St} - UR_{St-1}) = \Delta_{St} - E(\Delta_{St})$, and $E(\Delta_{St})$ is predicted from the regression of Δ_{St} on Δ_{St-1}. We regress the state unemployment rates on the set of instruments using the various samples, and this table shows their coefficient estimates. The result using the sample of state-year-level unemployment rates from 1982 through 2018 is in the first column where state and year fixed effects are included. Standard errors are clustered by state. The regression is weighted by the state's population size. The next six columns show the results using the samples of mothers and fathers excluding the missing variables of our outcome variables: annual earnings, work status, work hours, and hourly wages. The regressions include individual characteristics and fixed effects for years elapsed after childbirth, childbirth year, state of residence, calendar year, and an individual's birth year.

Table 3. Effects of State Unemployment Rate at First Birth on Parents' Labor Market Outcomes

A. Annual earnings

Years since first birth (k)	Women		Men	
	b_k^{women}	se	b_k^{men}	se
1	-0.0159***	(0.005)	-0.0067	(0.004)
2	-0.0133**	(0.005)	-0.0088*	(0.005)
3	-0.0173***	(0.006)	-0.0062	(0.005)
4	-0.0112**	(0.005)	-0.0085**	(0.004)
5	-0.0191***	(0.005)	-0.0104**	(0.004)
6	-0.0166***	(0.005)	-0.0116***	(0.004)
7	-0.0144***	(0.005)	-0.0052	(0.004)
8	-0.0152**	(0.006)	-0.0058	(0.004)
9	-0.0147**	(0.007)	-0.0080*	(0.004)
10	-0.0164***	(0.005)	-0.0058	(0.004)
11	-0.0115	(0.010)	0.0048	(0.011)
12	-0.0349***	(0.009)	-0.0100	(0.009)
13	-0.0113	(0.009)	-0.0025	(0.008)
14	-0.0119*	(0.006)	0.0023	(0.006)
15	-0.0130**	(0.006)	-0.0038	(0.005)
16	-0.0090	(0.009)	0.0055	(0.012)
17	-0.0036	(0.005)	-0.0101*	(0.005)
18	0.0004	(0.006)	-0.0011	(0.006)

B. Hourly wages

Years since first birth (k)	Women		Men	
	b_k^{women}	se	b_k^{men}	se
1	-0.0384**	(0.017)	0.0003	(0.007)
2	-0.0198**	(0.010)	0.0010	(0.008)
3	-0.0368***	(0.014)	-0.0034	(0.008)
4	-0.0216**	(0.010)	-0.0009	(0.008)
5	-0.0275***	(0.010)	-0.0104	(0.010)
6	-0.0313***	(0.012)	-0.0117	(0.007)
7	-0.0234**	(0.011)	0.0000	(0.007)
8	-0.0151	(0.010)	-0.0006	(0.007)
9	-0.0173	(0.011)	-0.0049	(0.010)
10	-0.0355*	(0.019)	-0.0217	(0.016)
11	-0.1163	(0.091)	-0.0473*	(0.026)
12	-0.1434	(0.125)	-0.0188	(0.022)
13	-0.0706	(0.079)	-0.0193	(0.017)

Years since first birth (k)				
14	-0.0430	(0.039)	-0.0068	(0.012)
15	-0.0654**	(0.030)	-0.0264	(0.020)
16	-0.0447	(0.029)	0.0043	(0.012)
17	-0.0586**	(0.029)	-0.0096	(0.010)
18	-0.0405	(0.029)	-0.0133	(0.013)

C. Work status

	Women		Men	
Years since first birth (k)	b_k^{women}	se	b_k^{men}	se
1	-0.0046	(0.003)	0.0001	(0.001)
2	-0.0013	(0.003)	-0.0003	(0.001)
3	-0.0014	(0.003)	0.0020	(0.001)
4	0.0012	(0.003)	-0.0007	(0.001)
5	-0.0026	(0.003)	0.0013	(0.001)
6	-0.0031	(0.003)	-0.0003	(0.001)
7	-0.0038	(0.004)	0.0018	(0.001)
8	-0.0021	(0.003)	0.0024*	(0.001)
9	-0.0027	(0.004)	0.0012	(0.002)
10	-0.0035	(0.003)	0.0033***	(0.001)
11	-0.0096*	(0.006)	-0.0022	(0.004)
12	-0.0153***	(0.005)	-0.0050	(0.003)
13	-0.0099**	(0.005)	-0.0049*	(0.003)
14	-0.0098***	(0.004)	-0.0047	(0.004)
15	-0.0101***	(0.004)	-0.0033	(0.002)
16	-0.0058*	(0.003)	-0.0029	(0.002)
17	-0.0074**	(0.003)	-0.0015	(0.002)
18	-0.0058	(0.004)	-0.0001	(0.003)

D. Work hours

	Women		Men	
Years since first birth (k)	b_k^{women}	se	b_k^{men}	se
1	-0.0049***	(0.001)	0.0007	(0.001)
2	-0.0046***	(0.001)	-0.0004	(0.001)
3	-0.0018	(0.002)	0.0005	(0.001)
4	-0.0029**	(0.001)	-0.0002	(0.001)
5	-0.0030*	(0.002)	0.0004	(0.001)
6	-0.0013	(0.001)	0.0001	(0.001)
7	-0.0016	(0.001)	0.0010	(0.001)
8	-0.0030**	(0.001)	0.0003	(0.001)
9	-0.0026	(0.002)	-0.0006	(0.001)
10	-0.0011	(0.001)	-0.0016	(0.001)
11	0.0014	(0.003)	-0.0003	(0.003)

12	0.0010	(0.002)	0.0009	(0.002)
13	0.0012	(0.002)	-0.0020	(0.002)
14	-0.0018	(0.002)	-0.0013	(0.002)
15	0.0015	(0.002)	-0.0031	(0.003)
16	0.0013	(0.003)	-0.0013	(0.002)
17	0.0036**	(0.002)	0.0003	(0.001)
18	0.0025	(0.002)	-0.0006	(0.002)

Notes: The tables show the IV coefficient estimates associated with the state unemployment rate at first birth for the first 18 years after childbirth as a percentage of the counterfactual outcome in the corresponding years since first birth. While the effects on earnings and work status are estimated including mothers and fathers whose first child was less than 19 years of age at the time of survey, regardless of work status, the regression samples for work hours and hourly wages are restricted to working mothers and fathers. The standard errors are clustered at the childbirth year by state.

Table 4. Effects of State Unemployment Rate at First Birth on Parents' Labor Market Outcomes by Education

A. Annual earnings

Years since first birth	Years of schooling < 16				Years of schooling ≧ 16			
	Women		Men		Women		Men	
1	-0.0180***	(0.006)	-0.0102**	(0.005)	-0.0127*	(0.007)	-0.0054	(0.005)
2	-0.0127**	(0.006)	-0.0139***	(0.005)	-0.0098	(0.007)	-0.0031	(0.006)
3	-0.0166**	(0.007)	-0.0077	(0.005)	-0.0120*	(0.007)	-0.0037	(0.006)
4	-0.0166***	(0.005)	-0.0098**	(0.005)	0.0001	(0.007)	-0.0065	(0.006)
5	-0.0141***	(0.005)	-0.0062	(0.005)	-0.0171**	(0.007)	-0.0124**	(0.005)
6	-0.0130***	(0.005)	-0.0086*	(0.004)	-0.0128**	(0.006)	-0.0120**	(0.006)
7	-0.0093	(0.006)	-0.0025	(0.006)	-0.0114*	(0.006)	-0.0053	(0.006)
8	-0.0094	(0.006)	-0.0033	(0.006)	-0.0132**	(0.007)	-0.0062	(0.006)
9	-0.0134*	(0.007)	-0.0044	(0.005)	-0.0099	(0.008)	-0.0078	(0.006)
10	-0.0118*	(0.006)	-0.0038	(0.004)	-0.0136**	(0.007)	-0.0043	(0.006)
11	0.0036	(0.010)	-0.0001	(0.010)	-0.0189	(0.014)	0.0152	(0.021)
12	-0.033***	(0.011)	-0.0096	(0.009)	-0.0314**	(0.014)	-0.0044	(0.012)
13	-0.0028	(0.012)	0.0067	(0.010)	-0.0118	(0.012)	-0.0057	(0.012)
14	-0.0153**	(0.007)	-0.0048	(0.009)	-0.0036	(0.012)	0.0119	(0.009)
15	-0.0229***	(0.008)	-0.0153**	(0.007)	0.0000	(0.011)	0.0068	(0.009)
16	-0.0180*	(0.010)	-0.004	(0.009)	0.0035	(0.019)	0.0176	(0.019)
17	-0.0054	(0.006)	-0.0018	(0.006)	-0.0015	(0.009)	-0.0183**	(0.008)
18	-0.0039	(0.008)	0.002	(0.007)	0.0072	(0.010)	-0.0094	(0.010)
N	3,051,528		2,476,131		1,634,346		1,339,662	

B. Hourly wages

Years since first birth	Years of schooling < 16				Years of schooling ≧ 16			
	Women		Men		Women		Men	
1	-0.0425***	(0.016)	0.0007	(0.011)	-0.0331	(0.029)	0.0000	(0.009)
2	-0.0245**	(0.012)	-0.0011	(0.012)	-0.0147	(0.016)	0.0063	(0.009)
3	-0.0491**	(0.025)	-0.0091	(0.012)	-0.0254	(0.018)	0.0040	(0.009)
4	-0.0153*	(0.009)	-0.0069	(0.011)	-0.0305	(0.024)	0.0068	(0.009)
5	-0.0201**	(0.009)	-0.0281	(0.019)	-0.0382	(0.023)	0.0083	(0.009)
6	-0.0212**	(0.011)	-0.0188*	(0.011)	-0.0412*	(0.022)	-0.0029	(0.008)

7	-0.0165	(0.010)	-0.0002	(0.011)	-0.0278	(0.022)	0.0020	(0.008)
8	-0.0179*	(0.009)	0.0021	(0.012)	-0.0147	(0.018)	-0.0010	(0.007)
9	-0.0174*	(0.010)	-0.0092	(0.010)	-0.0203	(0.020)	0.0010	(0.015)
10	-0.0261***	(0.009)	-0.0167	(0.011)	-0.0505	(0.044)	-0.0222	(0.028)
11	-0.0200	(0.032)	-0.0661	(0.046)	-0.2248	(0.200)	-0.0221	(0.025)
12	-0.0299	(0.044)	-0.0447	(0.039)	-0.297	(0.294)	0.0123	(0.017)
13	-0.0339	(0.074)	-0.0263	(0.024)	-0.1287	(0.162)	-0.0063	(0.021)
14	-0.0276	(0.025)	-0.0161	(0.016)	-0.0803	(0.105)	0.0075	(0.018)
15	-0.0599**	(0.023)	-0.0506	(0.034)	-0.0916	(0.081)	0.0027	(0.018)
16	-0.0617**	(0.027)	-0.0085	(0.013)	-0.0352	(0.072)	0.0228	(0.021)
17	-0.0582***	(0.020)	0.0038	(0.013)	-0.0651	(0.073)	-0.0230*	(0.014)
18	-0.0379*	(0.021)	-0.0225	(0.020)	-0.0543	(0.071)	-0.0054	(0.015)
N	2,107,239		2,110,941		1,271,756		1,242,452	

C. Work status

Years since first birth	Years of schooling < 16				Years of schooling ≧ 16			
	Women		Men		Women		Men	
1	-0.0036	(0.004)	0.0004	(0.002)	-0.0038	(0.003)	-0.0007	(0.001)
2	-0.0005	(0.004)	-0.0001	(0.002)	0.0003	(0.003)	-0.0009	(0.002)
3	0.0000	(0.004)	0.0037*	(0.002)	-0.0018	(0.004)	-0.001	(0.001)
4	0.0029	(0.004)	-0.0002	(0.002)	0.0017	(0.004)	-0.0013	(0.001)
5	-0.0002	(0.004)	0.0027	(0.002)	-0.004	(0.004)	-0.0012	(0.001)
6	-0.0036	(0.004)	0.0002	(0.002)	-0.0002	(0.003)	-0.0011	(0.001)
7	-0.004	(0.005)	0.0027	(0.002)	-0.001	(0.003)	0.0000	(0.001)
8	-0.0003	(0.004)	0.004**	(0.002)	-0.0032	(0.003)	-0.0006	(0.001)
9	-0.0026	(0.004)	0.0022	(0.002)	-0.0014	(0.004)	-0.0009	(0.001)
10	-0.0021	(0.004)	0.0062***	(0.002)	-0.0047	(0.003)	-0.0020	(0.001)
11	-0.0103	(0.007)	-0.0011	(0.004)	-0.0079	(0.007)	-0.0042	(0.004)
12	-0.0177***	(0.007)	-0.0016	(0.004)	-0.0088	(0.006)	-0.0121**	(0.005)
13	-0.0091	(0.006)	-0.0061*	(0.003)	-0.0096	(0.006)	-0.0027	(0.004)
14	-0.0086*	(0.004)	-0.0078	(0.005)	-0.0111**	(0.005)	0.0031	(0.003)
15	-0.012**	(0.005)	-0.004	(0.003)	-0.0038	(0.006)	-0.0013	(0.002)
16	-0.0055	(0.005)	0.0002	(0.003)	-0.0055	(0.006)	-0.0095***	(0.004)
17	-0.007*	(0.004)	0.0004	(0.003)	-0.0068	(0.005)	-0.0047**	(0.002)
18	-0.0081*	(0.004)	0.0019	(0.003)	0.0052	(0.005)	-0.0028	(0.002)
N	3,051,528		2,476,131		1,634,346		1,339,662	

D. Work hours

Years since first birth	Years of schooling < 16				Years of schooling ≥ 16			
	Women		Men		Women		Men	
1	-0.0058***	(0.002)	0.0002	(0.001)	-0.0026	(0.002)	0.0011	(0.002)
2	-0.0045***	(0.001)	-0.0012	(0.001)	-0.0037*	(0.002)	0.0007	(0.001)
3	-0.0020	(0.002)	0.0011	(0.001)	-0.0006	(0.002)	-0.0006	(0.002)
4	-0.0033**	(0.001)	-0.0009	(0.001)	-0.0001	(0.002)	0.0009	(0.001)
5	-0.0026	(0.002)	0.0009	(0.001)	-0.0019	(0.002)	-0.0007	(0.002)
6	0.0005	(0.002)	0.0002	(0.001)	-0.0027	(0.002)	-0.0002	(0.001)
7	-0.0008	(0.002)	0.0010	(0.001)	-0.0012	(0.002)	0.0008	(0.001)
8	-0.0008	(0.001)	0.0007	(0.001)	-0.0049**	(0.002)	-0.0007	(0.001)
9	-0.0021	(0.002)	-0.0006	(0.001)	-0.0021	(0.002)	-0.0007	(0.002)
10	0.0017	(0.002)	-0.0015	(0.001)	-0.0041**	(0.002)	-0.0021	(0.001)
11	0.0048	(0.003)	-0.0019	(0.003)	-0.0046	(0.004)	0.0032	(0.005)
12	0.0013	(0.003)	0.0008	(0.003)	0.0018	(0.005)	0.0005	(0.003)
13	0.001	(0.003)	-0.0023	(0.003)	0.0035	(0.005)	-0.0017	(0.003)
14	-0.0004	(0.002)	-0.0030	(0.002)	-0.0045	(0.003)	0.0026	(0.003)
15	0.0011	(0.003)	-0.0049	(0.003)	0.0037	(0.004)	0.0004	(0.003)
16	0.0021	(0.004)	-0.0011	(0.002)	0.0000	(0.003)	-0.0017	(0.003)
17	0.0033	(0.002)	0.0006	(0.002)	0.0052*	(0.003)	-0.0002	(0.002)
18	0.0026	(0.002)	-0.0006	(0.002)	0.0040	(0.004)	-0.0007	(0.003)
N	2,229,486		2,289,823		1,339,860		1,306,226	

Notes: The tables show the IV coefficient estimates associated with the state unemployment rate at first birth for the first 18 years after childbirth as a percentage of the counterfactual outcome in the corresponding years since first birth by education. While the effects on earnings and work status are estimated including mothers and fathers whose first child was less than 19 years of age at the time of survey, regardless of work status, the regression samples for work hours and hourly wages are restricted to working mothers and fathers. The standard errors are clustered at the childbirth year by state.

Table 5. Effects of State Unemployment Rate at the Time of First Birth on Parents' Labor Market Outcomes by Race

A. Annual earnings

Years since first birth	Nonwhite				White			
	Women		Men		Women		Men	
1	-0.0015	(0.009)	-0.0242***	(0.009)	-0.0191***	(0.006)	-0.0034	(0.005)
2	-0.0095	(0.008)	-0.0146	(0.009)	-0.0138**	(0.007)	-0.0076	(0.005)
3	-0.0093	(0.008)	-0.0074	(0.008)	-0.0199***	(0.007)	-0.0066	(0.005)
4	-0.0085	(0.009)	-0.0254***	(0.008)	-0.0126*	(0.007)	-0.0051	(0.005)
5	-0.0186**	(0.008)	-0.0198***	(0.008)	-0.0197***	(0.006)	-0.0085*	(0.004)
6	-0.0224***	(0.008)	-0.0217***	(0.007)	-0.0153***	(0.006)	-0.0097**	(0.005)
7	-0.0116*	(0.007)	-0.0144*	(0.008)	-0.016***	(0.006)	-0.0031	(0.005)
8	-0.0099	(0.009)	-0.0095	(0.009)	-0.0177***	(0.006)	-0.0053	(0.005)
9	-0.0156	(0.012)	-0.0167	(0.010)	-0.0147*	(0.008)	-0.0064	(0.004)
10	-0.0231***	(0.008)	-0.0032	(0.009)	-0.0143**	(0.006)	-0.0069	(0.004)
11	-0.0087	(0.016)	-0.0104	(0.016)	-0.0144	(0.012)	0.0072	(0.013)
12	-0.048***	(0.018)	-0.0197	(0.019)	-0.0311***	(0.011)	-0.0072	(0.009)
13	-0.0164	(0.017)	0.0152	(0.018)	-0.0103	(0.010)	-0.0042	(0.009)
14	-0.0118	(0.013)	-0.0001	(0.012)	-0.0119	(0.009)	0.0035	(0.006)
15	-0.031***	(0.011)	-0.0027	(0.012)	-0.006	(0.008)	-0.0031	(0.006)
16	0.0029	(0.025)	-0.0043	(0.020)	-0.0115	(0.009)	0.0078	(0.012)
17	-0.011	(0.014)	-0.0224*	(0.012)	-0.0014	(0.006)	-0.0073	(0.005)
18	-0.0104	(0.012)	0.0009	(0.014)	0.0034	(0.007)	0.0003	(0.006)
N	1,061,530		714,451		3,624,344		3,101,342	

B. Hourly wages

Years since first birth	Nonwhite				White			
	Women		Men		Women		Men	
1	-0.0186	(0.014)	-0.0196	(0.016)	-0.0455**	(0.022)	0.0044	(0.008)
2	-0.0155	(0.018)	-0.0059	(0.014)	-0.0227*	(0.012)	0.0023	(0.009)
3	-0.0626	(0.040)	-0.0091	(0.013)	-0.0295**	(0.012)	-0.0033	(0.009)
4	-0.0111	(0.013)	-0.0117	(0.013)	-0.0258*	(0.014)	0.0007	(0.008)
5	-0.0239	(0.015)	-0.0071	(0.015)	-0.0299**	(0.014)	-0.0116	(0.011)
6	-0.0071	(0.017)	-0.0279*	(0.015)	-0.0400***	(0.015)	-0.0085	(0.008)

7	-0.0109	(0.015)	-0.014	(0.013)	-0.0301*	(0.016)	0.0026	(0.008)
8	-0.0161	(0.015)	-0.0086	(0.015)	-0.0177	(0.013)	-0.0001	(0.008)
9	-0.0276	(0.022)	-0.0152	(0.016)	-0.0164	(0.012)	-0.0036	(0.012)
10	-0.0262	(0.017)	-0.0057	(0.012)	-0.0384	(0.024)	-0.027	(0.019)
11	0.0315	(0.054)	0.0079	(0.029)	-0.1676	(0.120)	-0.0585*	(0.031)
12	0.017	(0.082)	-0.0107	(0.023)	-0.1976	(0.163)	-0.0193	(0.026)
13	-0.0034	(0.046)	-0.0212	(0.032)	-0.0925	(0.102)	-0.0188	(0.018)
14	-0.0015	(0.035)	0.0058	(0.017)	-0.0605	(0.051)	-0.0094	(0.014)
15	0.0037	(0.044)	-0.0064	(0.016)	-0.0931**	(0.040)	-0.0296	(0.024)
16	0.0202	(0.037)	-0.0053	(0.022)	-0.0622*	(0.035)	0.0059	(0.013)
17	-0.0345	(0.022)	0.0304	(0.026)	-0.0663*	(0.039)	-0.0151	(0.010)
18	0.0189	(0.037)	0.0167	(0.027)	-0.0587	(0.038)	-0.0167	(0.014)
N	767,073		614,455		2,611,922		2,738,938	

C. Work status

Years since first birth	Nonwhite				White			
	Women		Men		Women		Men	
1	-0.0020	(0.006)	-0.0022	(0.004)	-0.0044	(0.003)	0.0008	(0.001)
2	-0.0013	(0.005)	-0.0026	(0.004)	-0.0005	(0.004)	0.0003	(0.002)
3	0.0034	(0.005)	0.0023	(0.003)	-0.0028	(0.003)	0.0019	(0.001)
4	0.0034	(0.005)	-0.0011	(0.003)	0.0007	(0.003)	-0.0006	(0.001)
5	-0.0022	(0.006)	0.0005	(0.004)	-0.0028	(0.003)	0.0015	(0.001)
6	-0.0069	(0.005)	-0.0003	(0.003)	-0.0018	(0.003)	-0.0002	(0.001)
7	-0.0021	(0.007)	0.0002	(0.004)	-0.0044	(0.003)	0.0023*	(0.001)
8	0.0013	(0.007)	0.0018	(0.004)	-0.0034	(0.003)	0.0026*	(0.001)
9	-0.0097	(0.007)	0.0003	(0.004)	0.0000	(0.004)	0.0014	(0.002)
10	-0.0041	(0.007)	0.0008	(0.003)	-0.0034	(0.003)	0.004***	(0.001)
11	-0.0272***	(0.010)	-0.0048	(0.009)	-0.0039	(0.006)	-0.0016	(0.003)
12	-0.0203**	(0.010)	-0.0025	(0.009)	-0.0135**	(0.005)	-0.0056*	(0.003)
13	-0.0059	(0.009)	0.0007	(0.007)	-0.0109*	(0.006)	-0.0062**	(0.003)
14	-0.0141*	(0.008)	-0.0164*	(0.010)	-0.0076	(0.005)	-0.0013	(0.003)
15	-0.0255***	(0.008)	-0.0102*	(0.006)	-0.0035	(0.004)	-0.0011	(0.003)
16	-0.0084	(0.008)	-0.0149**	(0.007)	-0.005	(0.004)	-0.0008	(0.002)
17	-0.0114	(0.007)	-0.0071	(0.008)	-0.006**	(0.003)	-0.0002	(0.002)
18	-0.0168**	(0.007)	0.0041	(0.008)	-0.0023	(0.004)	-0.0010	(0.003)
N	1,061,530		714,451		3,624,344		3,101,342	

D. Work hours

| Years since first birth	Nonwhite				White			
	Women		Men		Women		Men	
1	-0.0016	(0.003)	-0.0044*	(0.003)	-0.0061***	(0.002)	0.0019	(0.001)
2	-0.0039	(0.003)	-0.0008	(0.002)	-0.0047***	(0.001)	-0.0004	(0.001)
3	-0.0009	(0.002)	-0.0022	(0.002)	-0.0021	(0.002)	0.0011	(0.001)
4	-0.0028	(0.002)	-0.0024	(0.002)	-0.0031**	(0.002)	0.0002	(0.001)
5	-0.0019	(0.002)	-0.0008	(0.002)	-0.0035*	(0.002)	0.0006	(0.001)
6	-0.0004	(0.002)	-0.0008	(0.002)	-0.0018	(0.002)	0.0002	(0.001)
7	-0.0017	(0.002)	-0.0015	(0.002)	-0.0018	(0.002)	0.0015	(0.001)
8	0.0002	(0.002)	-0.0010	(0.002)	-0.0043***	(0.002)	0.0005	(0.001)
9	-0.0008	(0.002)	-0.0008	(0.002)	-0.0034	(0.002)	-0.0005	(0.001)
10	0.0017	(0.002)	-0.0024	(0.002)	-0.0023	(0.002)	-0.0014	(0.001)
11	0.0034	(0.005)	-0.0032	(0.005)	0.0005	(0.003)	0.0003	(0.003)
12	0.0047	(0.005)	-0.0002	(0.005)	-0.0005	(0.003)	0.0011	(0.003)
13	0.0146**	(0.006)	0.0005	(0.005)	-0.0039	(0.003)	-0.0026	(0.002)
14	0.0020	(0.003)	-0.003	(0.003)	-0.0037*	(0.002)	-0.0009	(0.002)
15	0.0015	(0.004)	-0.0026	(0.005)	0.0013	(0.002)	-0.0033	(0.003)
16	0.0000	(0.005)	-0.0025	(0.005)	0.0016	(0.003)	-0.0011	(0.002)
17	0.0071**	(0.004)	-0.0037	(0.004)	0.0026	(0.002)	0.0012	(0.001)
18	0.0020	(0.004)	-0.0043	(0.004)	0.0026	(0.002)	0.0001	(0.002)
N	798,327		650,858		2,771,019		2,945,191	

Notes: The tables show that the IV coefficient estimates associated with the state unemployment rate at first birth for the first 18 years after childbirth as a percentage of the counterfactual outcome in the corresponding years since first birth by race. While the effects on earnings and work status are estimated including mothers and fathers whose first child was less than 19 years of age at the time of survey, regardless of work status, the regression samples for work hours and hourly wages are restricted to working mothers and fathers. The standard errors are clustered at the childbirth year by state.

Table 6. Decomposition of the Gender Earnings Gap

Years since first birth	Predicted annual earnings		Gender gap	Explained gap
	Women	Men		
1	23,347	53,099	0.560	0.197 (0.352)
2	23,435	54,437	0.569	0.201 (0.353)
3	24,040	56,092	0.571	0.190 (0.332)
4	24,034	57,577	0.583	0.208 (0.356)
5	24,670	58,483	0.578	0.208 (0.359)
6	25,132	59,515	0.578	0.210 (0.363)
7	25,504	60,151	0.576	0.184 (0.319)
8	25,863	61,126	0.577	0.193 (0.334)
9	26,541	61,500	0.568	0.190 (0.334)
10	26,936	62,267	0.567	0.183 (0.322)
11	27,345	62,772	0.564	0.149 (0.263)
12	27,885	62,982	0.557	0.193 (0.346)
13	28,286	63,733	0.556	0.176 (0.317)
14	28,782	64,328	0.553	0.163 (0.295)
15	29,257	65,312	0.552	0.185 (0.336)
16	29,975	67,299	0.555	0.168 (0.302)
17	30,128	67,520	0.554	0.222 (0.401)
18	28,963	62,404	0.536	0.181 (0.338)

Notes: The table shows the decomposition results. The predicted earnings are the average fitted values in the corresponding years since first birth, computed with the coefficient estimates in equation (1). "Gender gap" is the difference in the predicted earnings between men and women divided by men's average earnings for each year after first birth. "Explained gap" indicates how much of the gender gap is driven by the gender-differentiated impacts of the local unemployment rates when giving birth, which corresponds to the first three terms in equation (3). The figures in parentheses are the percentages of the explained gap to gender gap.

Figure 1. Share of Mothers Who Worked for 27 Weeks or More in the Last 12 Months
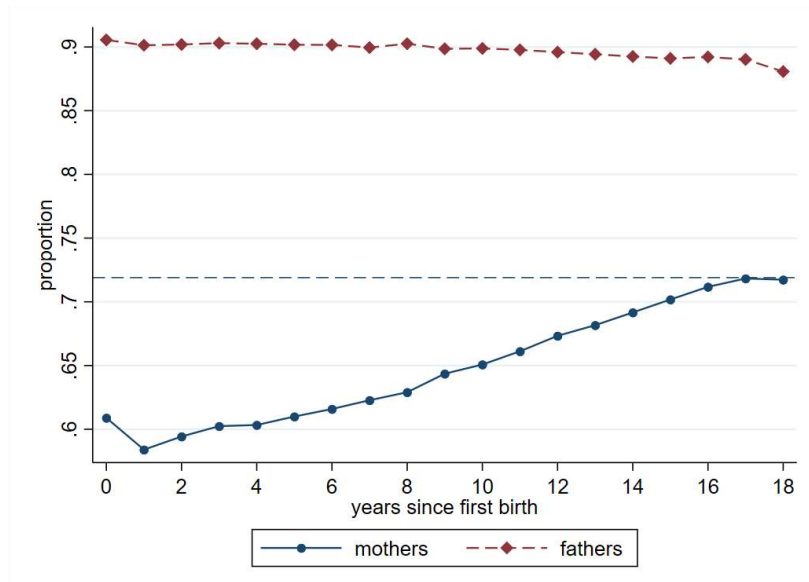
Notes: The solid line at the bottom of this figure shows the proportion of mothers who worked for 27 weeks or more (more than six months) in the last 12 months in each of the first 18 years after first birth. For example, 60.9 percent of mothers who gave birth to the first child in the last 12 months (shown as year 0) worked for 27 weeks or more in that period. The dashed line at the top of this figure pertains to the same proportion among fathers. The horizontal line in the middle shows the average share of women who worked for 27 weeks or more in the last 12 months among those women aged 50 years or less with no child. The average share is 0.719.

Data source: ACS 2000–2019 (see Section 3 for details)

Figure 2. Unconditional Gender Gap over Years Since First Birth

A. Annual earnings

B. Wage, work status, and work hours
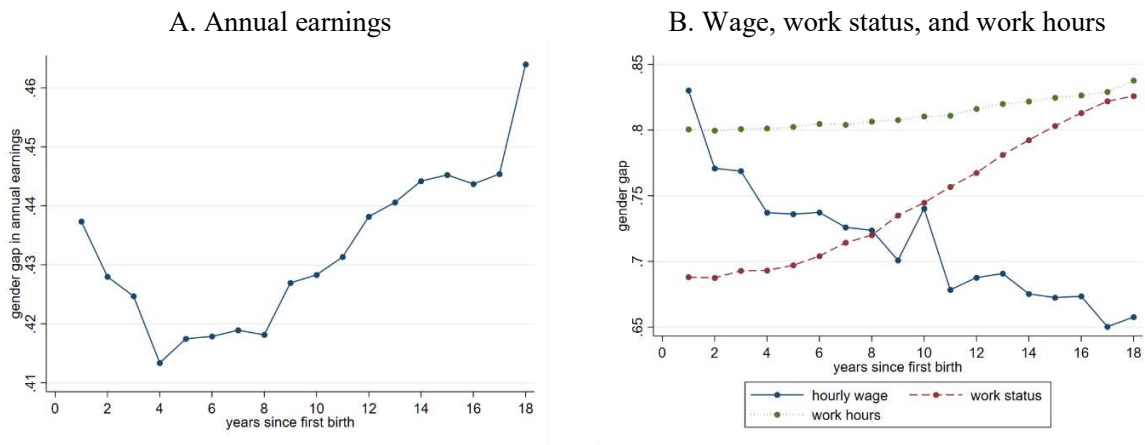
Notes: Panel A shows the gender earnings gap between mothers and fathers, and Panel B shows the gap in hourly wages, work status, and working hours by years elapsed since first birth. Annual earnings include zero earnings and the other outcomes are defined only for working persons. The unconditional gender gap refers to the ratio of the average outcomes of mothers to fathers in each indicated year after first birth.

Figure 3. Decomposition of the Gender Gap
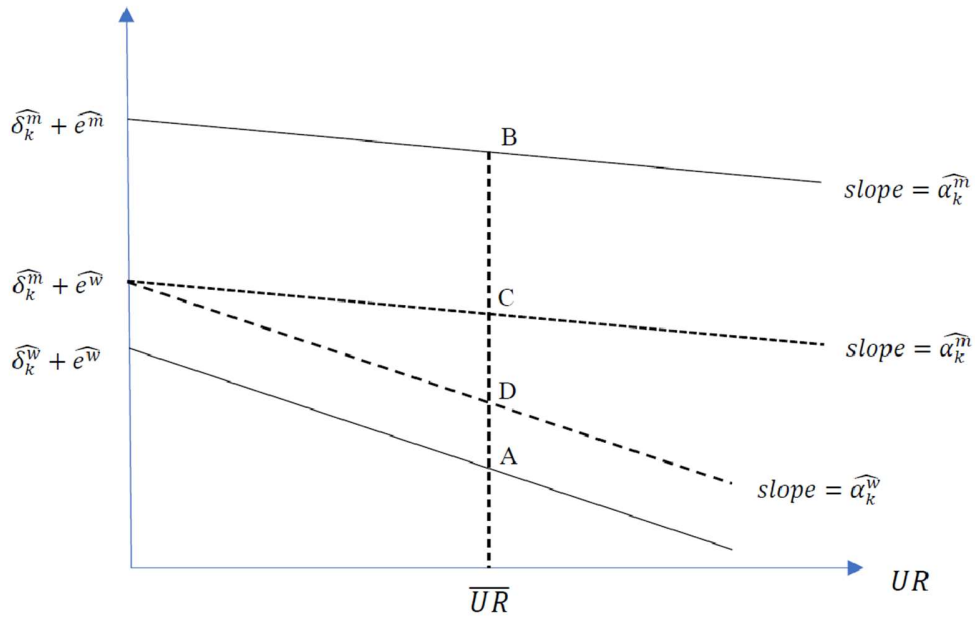
Notes: The figure depicts all components of the predicted gender gap. Points A and B denote the predicted earnings for mothers and fathers, respectively, when the unemployment rate at first birth is $\overline{UR}$. See Section 5.4 for a detailed description of each component.