REBOUND OF NEVER? A LIFE COURSE APPROACH TO THE MOTHERHOOD WAGE PENALTY

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ABSTRACT

Ji Yeon Kim: Rebound or Never? A Life Course Approach to the Motherhood Wage Penalty
(Under the direction of Ted Mouw)

This paper documents the long-term consequences of motherhood on women's wages over the course of their postpartum lives. I argue that using a single number to report the average effect of childbirth on wages over the entire span of women's postpartum life masks the variation of the motherhood wage penalty over smaller increments of time. In this paper, I ask whether the wage penalty experienced by mothers increases, decreases, or remains constant over time and test if and to what extent some of the commonly cited mechanisms of the motherhood wage penalty explain the shape of the penalty over the life course. To answer these questions, this research draws from the 1979-2016 waves of the National Longitudinal Survey of Youth 1979 (NLSY79) and traces the motherhood wage penalty for over 20 years into women's postpartum lives. Using fixed effects modeling and allowing for a flexible specification of time since first childbirth, I find a curvilinear relationship between first childbirth and wages over time. The motherhood wage penalty accumulates for the first 10 to 15 years following the birth but tapers off in the later years.

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INTRODUCTION

Childbirth is a critical life event that transitions a woman into motherhood which shapes her subsequent life pathway. There is now significant evidence that birth of a child leads to a decline in women's labor force participation rate (Killewald and Zhuo 2019; Lu, Wang, and Han 2017), occupational prestige (Abendroth, Huffman, and Treas 2014; Kahn, García-Manglano, and Bianchi 2014), and earnings (Budig and England 2001; Gangl and Ziefl 2009). Among these discussions, particular attention has been given to the wage penalty. Research on the motherhood wage penalty has examined the factors that drive the penalty (Benard and Correll 2010; Budig and England 2001; Correll, Benard, and Paik 2007; Gangl and Ziefl 2009) and how the penalty varies across different socioeconomic groups and occupational characteristics (Buchmann and McDaniel 2016; Budig and Hodges 2010; England et al. 2016; Glauber 2007, 2018; Yu and Kuo 2017).

A question that has not been raised nearly as much is what happens to the penalty over the life course (Kahn et al. 2014). When the penalty is reported as some percentage decline in the hourly wages after childbirth, it implies that that amount of decrease remains constant for the rest of a woman's life. However, the motherhood wage penalty may change over time because as emphasized by life course scholars, human lives are a complex function of historical and social context, timing of life events, and individual choices made earlier in life (Elder 1994; George 1993; MacMillan and Copher 2005). Thus, using a single number to report the average effect of childbirth on wages over the entire span of women's postpartum life compared to their wages

before childbirth may misrepresent the variation of wages over smaller increments of time. Since a failure to parse out the long-term effects from the short-term effects can lead to an over- or underestimate of the penalty at different time points, a life course perspective must be adopted to better understand the motherhood wage penalty.

Acknowledging this importance, the first contribution of this paper is documenting the changes in the wage trajectories of mothers for over 20 years of their postpartum lives. Secondly, I review the methodological advances and limitations of the previous research and present an alternative approach to study the motherhood wage penalty over time. Using the data from the National Longitudinal Study of Youth (NLSY79), I model the changes in the hourly wages over mothers' postpartum lives by allowing the effect of years since first childbirth to be flexible. The third contribution of the paper is testing whether and to what extent some of the commonly cited mechanisms of the motherhood wage penalty explain the patterns of the penalty over the life course.

BACKGROUND

What Might Happen to the Motherhood Wage Penalty in the Long Run?

To understand the patterns of the motherhood wage penalty over time, it is necessary to understand why motherhood is associated with lower wages on average. If the factors that lead to an initial penalty and their effects are transitory, mothers would return to the wage trajectories that they would have otherwise been in without a child and their wages would rebound after some time elapsed. On the other hand, if motherhood is continuously associated with factors that lower their wages, it would set mothers apart from the wage paths of non-mothers after giving birth. This latter scenario implies two possible outcomes for mothers. The first is a track in which mothers continue to have a fixed amount of gap with the childless women over their life course but not fall any further behind than the amount they had started with at birth. The second is a track in which mothers not only experience a wage penalty for their entire postpartum life but an accumulation of the penalty over time. In the following section, I draw from previous research on the mechanisms of the motherhood wage penalty to hypothesize whether mothers would experience a rebound from or a persistence of the penalty as their child ages.

Past research has found that reduced worked experience and career interruptions from childbirth and care explain a substantial portion of the motherhood wage penalty (Budig and England 2001; Gangl and Ziefl 2009; Staff and Mortimer 2012). Childbirth causes at least a brief interruption from employment for most working women, and longer discontinuity for those who do not return to the labor force until their children become older (Killewald and Zhuo 2019).

Since these interruptions translate into forgone work experience, they lead to a decrease in wages for mothers when they return to the labor market. In the case of American women born between 1955 and 1964, more than half of the motherhood wage penalty was explained by work experience alone, and two-thirds of the penalty was explained away when work interruptions were also controlled for (Gangl and Ziefl 2009). Nevertheless, there is also evidence that while longer work interruptions are associated with notable declines in wages, the impact of temporary interruptions is smaller and not as long-lasting (Baum 2002; Mincer and Ofek 1982). Given that a high proportion of mothers in the U.S. do not take breaks at all from the labor market after the birth of their first child and that most women re-enter the labor market within one year of childbirth (Aisenbrey, Evertsson, and Grunow 2009), it suggests that the motherhood wage penalty may be temporary:

Hypothesis 1: The motherhood wage penalty decreases over time (rebound hypothesis).

However, several different mechanisms call into question whether the motherhood wage penalty diminishes over time. Even if mothers were to return to the labor force immediately, another relevant determining factor of wages is the characteristics of the jobs in which they return to (Stone and Lovejoy 2019). For instance, it is well known that a high proportion of women transition into part-time positions following childbirth and that part-time jobs have lower returns compared to full-time ones. (Weeden, Cha, and Bucca 2016).This relationship suggests that mothers who remain in part-time jobs for an extended time would face a continuous penalty over their lives. Research by Killewald and Zhuo (2019) demonstrated that working in part-time jobs for one's entire postpartum life is one of the five most common maternal employment patterns among American mothers who are now in their 50s. They also found that even among those who return to working full-time after childbirth, part-time employment is common during

their transition periods. These findings have important implications for the motherhood wage penalty in the long run because part-time work experience is likely to be rewarded less than full-time experience and thus would have a long-term impact on wages (Gangl and Ziefl 2009).

In addition to transition into part-time jobs and the possibility of its long-term effects, mobility into jobs with mother-friendly characteristics is another mechanism which suggests that the motherhood wage penalty may persist or even accrue over time (Stone and Lovejoy 2019). Mother-friendly job characteristics such as predictable work hours and flexible schedules are characteristics that allow mothers to bear the responsibility of work and parenting more compatibly (Budig and England 2001; England et al. 1988). However, as a trade-off to these characteristics, these jobs tend to have lower prestige and wages. If occupational adjustments made in response to childbirth constrain mothers from career development that childless women of otherwise similar characteristics achieve, this would affect their wage trajectories as well. Since the occupational status gap between the mothers and non-mothers are found to increase over time following the birth of a first child (Abendroth et al. 2014), this literature suggests that mothers who transition into a job that is lower in prestige following a childbirth may not only experience an immediate penalty but also an accumulation of the penalty in the long run.

Lastly, even brief career interruptions and temporary transition into part-time or low prestige jobs may have scarring effects if they signal things beyond forgone work experience to the employers (Weisshaar 2018). A recent audit study by Weisshaar (2018) on career interruptions found that although all employment lapses decreased the chances of being hired for prospective returning employees, opting out for childcare was more heavily penalized than lapses from job displacement. Findings from her survey experiment suggest that this is likely due to bias about the reliability and commitment levels of mothers. These findings imply that it is not

just the forgone work experience that the mothers are being penalized for but their violation of ideal worker norms (Correll et al. 2007; Ridgeway and Correll 2004). A similar process of discrimination can take place for mothers who initially transition into part-time jobs or other jobs with mother-friendly characteristics during the early phase of the motherhood. If interruptions and job transitions made in the early stage of motherhood lead to discrimination that impede mothers from re-entry or promotion into the types of occupations that have high wages (Fuller 2018), mothers would experience a cumulative career penalty from childbirth. Taken together, I arrive at the following hypothesis:

> Hypothesis 2: The motherhood wage penalty increases over time (cumulative disadvantage hypothesis)

Methodological Advances in the Study of the Motherhood Wage Penalty

[Eq. 1] $ln(Wage) = \beta_0 + \beta_1 Parity + \gamma Z + \varepsilon$

[Eq. 2] $ln(Wage_{it}) = \beta_0 + \beta_1 Parity_{it} + \gamma Z_{it} + u_i + v_{it}$

In reporting the penalty and investigating the mechanisms, much of the studies on the motherhood wage penalty have employed large datasets with OLS or fixed effects models. The first equation is a typical OLS model that estimates the effect of each additional child on the natural log of wages controlling for a set of human capital and job-related covariates (Z). Since the coefficient for parity (β_1) represents the effect of an additional child on women's wages net of other factors that are included in the model, it presents the penalty experienced by mothers compared to their childless counterparts. One major concern about using this OLS model, however, is the issue of selectivity. If mothers and childless women differ on unobserved

characteristics that are associated with wages such as career ambition or work effort in ways that favor non-mothers, this model would overstate the true effect of children on wages.

Fixed effects models handle this problem by removing the unobserved individual characteristics that are stable over time (u_i). Using longitudinal data that has years ($_t$) nested within persons ($_i$), fixed effects models subtract the individual mean of a variable from each of the person-year observations (Eq. 2), and present how a change in an explanatory variable from its within person mean is associated with a change in the outcome variable from the mean, averaged across all person-year observations. As a result, all time constant characteristics, including those that are unobserved and not part of the model, are eliminated. In sum, fixed effects models are concerned with changes within persons unlike OLS models in which the estimation of the effect of a variable is based on a cross-comparison of individuals. This implies that individuals whose values for a variable which do not change over time are excluded in calculation of the effect of that specific variable on the outcome because all of their person-year observations would have no variation from their individual means. For instance, women who have only one child throughout the entire survey would not contribute to the calculation of the effect that the number of children has on wages because the number of children they had had at every wave would be equal to their average across the waves.

A good demonstration of how the estimates of the penalty depends on the model types is provided by (Waldfogel 1997) using the National Longitudinal Study of Young Women. Her results from the OLS model shows a smaller effect of children on wages when using a single wave compared to a pooled cross section of multiple waves. In addition, although the results from the OLS and fixed effects models are similar, the penalty was found to be slightly larger in the pooled OLS models. These findings support that there are at least some unobserved

differences between mothers and childless women that lead to an overestimate of the penalty in OLS models.

Although fixed effects models provide a clear improvement, it still frames the effect of children to be constant over time, failing to consider how the penalty may vary over the course of women's lives. Since the coefficient for the child term in a fixed effects model represents an average deviation of women's wages from their individual means after childbirth, it does not recognize that the child penalty for each subsequent year after birth may differ from the previous year. Thus, a different approach is needed to provide a more nuanced understanding of the motherhood wage penalty.

Past Research on the Motherhood Wage Penalty Over the Life Course

While a few studies have looked at the long-term motherhood wage penalty beyond the short-term costs, overall, their results are inconclusive. Some studies found an attenuation of the penalty over time (Kahn et al. 2014; Sigle-Rushton and Waldfogel 2007), while others found it to be static (Loughran and Zissimopoulos 2009). It is difficult to compare the results from these previous studies, however, because the data and methods employed by each study differs from one another. In the following section, I review and compare the methods and findings from previous studies on the motherhood wage penalty in the long run.

One of the first attempts to study the long-term consequences of motherhood was made by Sigle-Rushton and Waldfogel (2007) using cross sectional data on 8 different countries. Using pooled cross-sectional data to run OLS, Sigle-Rushton and Waldfogel used the resulting regression parameters to simulate the future earnings of young women based on the earnings of older women with similar characteristics. Their findings for the United States demonstrate that

there is a gradual contraction in the gap between mothers and childless women over their life course, and that the two groups reach near convergence by their mid-40s. While these results suggest that motherhood wage penalty is not so persistent, there are several concerns to their methodological approach. Since their findings are based on simulated future earnings of young women that are predicted using the earnings of older women with similar education and child history but no other characteristics such as work experience or job tenure, they may not be very accurate. Moreover, given the evolving labor market context and values and policies associated with work and family, the experiences of young women at older ages may vastly differ from the predicted.

Another study employed longitudinal data and person-fixed effects models to track the effect of children on women's wages over time. Contrary to the findings by Sigle-Rushton and Waldfogel, Loughran and Zissimopoulos (2009) found the motherhood wage penalty to be constant over time when they used time since birth to capture the effect of children on wage growth. However, it is possible that the true effect of children on wage growth is concealed by using years since the birth of children as a continuous variable, assuming that the effect is linear. If the effect of each subsequent year since childbirth is distinct such that it is positive in some years and negative in others, they may on average counterbalance, and the effect at different time points would not be captured.

A more recent study coupled fixed effects models with event studies to document a more detailed picture of the long-term penalty by reporting the effects of children at each successive year after birth. Unlike other studies that also employ time since an event as an explanatory variable, event studies are unique in including each time point as a dummy variable in the model with time at which the event took place as the reference category. The advantage of this

approach is that it allows the effect of each year since the event to vary, which is assumed to be constant when using a continuous time variable. Using fixed effects models and an event study around the birth of the first child, Chung and colleagues (2017) found that women experience the largest decrease in their earnings one year after the first birth but gradually recover over the next ten years.

Despite its advantages in providing a more precise picture of the motherhood penalty by presenting the variation in the penalty each year following childbirth, there are several limitations to this study. One limitation is that it fails to account for subsequent childbirths following the first, and thus, it is not possible to distinguish whether the effect of years since the first birth is due to the effects of the first or later births. Additionally, this study includes women who are out of the labor force in the sample and sets their wages as zero; consequently, the results likely overestimate the penalty in the earlier years following childbirth when mothers are temporally out of the labor market.

A different methodological approach to examining the long-term consequences of motherhood on earnings is examining how mothers fare compare to non-mothers at different ages. Using the NLSY, Kahn, García-Manglano, and Bianchi (2014) compares the wage trajectories of mothers and childless women from their 20s to 50s. They use age decades and parity interactions to trace the changing effect of parity as women age. They found that mothers experience the greatest wage penalty in their 30s relative to their childless women counterparts but narrow the gap by their 40s. While these findings are similar to the findings by Sigle-Rushton and Waldfogel (2007), Kahn and colleagues found that this was not true for mothers with more than two children. Mothers with three or more children experienced an additional disadvantage later in their lives as they continued to fall behind childless women into their 40s

and 50s. The benefit of this approach over event studies is that the comparison group at each stage of life is much more evident. It clearly shows how the earnings penalty experienced by mothers relative to the non-mothers at each age decade is different.

However, by collapsing the age categories into so few categories, the heterogeneity in the penalty across more detailed age groups is lost. If the wage penalty experienced by mothers in their early 20s differs vastly from those in their late 20s, for instance, this detail would be missed by the aggregation of age groups. It is also concerning that women are combined into a single category based on their age decade and the number of children regardless of the amount of time elapsed since each birth. Consequently, it is not possible to determine whether their findings on the long-term consequences are a result of timing of the childbirth or time since birth. For example, for two women in their 30s with one child, a considerable amount of time would have elapsed for a woman who had her child in her early 20s. On the other hand, not much time would have elapsed since the childbirth for another woman who have given birth in her 30s. In this way, despite a significance difference in the amount of time elapsed since childbirth, the two women will be assumed to be in the same group.

METHODS

Data

The data for this study comes from the 1979-2016 waves of the National Longitudinal Survey of Youth 1979 (NLSY79). NLSY79 is a panel study that began in 1979 with a nationally representative sample of Americans between the ages of 14 to 22. Respondents were interviewed annually until 1994 and biennially thereafter. Since it is one of the few longitudinal studies with detailed information about respondents' employment history and childbirth, it is widely used to study the motherhood wage penalty in the United States. NLSY79 is particularly well-suited for this research because studying the long-term consequences of motherhood requires a panel data that spans enough time to capture the labor market behaviors and outcomes of women before and after childbirth until they reach the end of their childbearing years. Since so few births are given by women over the ages of 45 (Pew Research Center 2018) and because all respondents in the sample had reached their 50s in the latest round of the survey, most women in the sample should have completed their fertility.

Sample

I use two different samples in my analyses. The first set of my analyses restricts the sample to cases in which the number of children at the time of the interview is none or one to assess the effect of first child over time while making sure that the effects are not confounded by

subsequent children. The next set of analyses expands the sample to include cases in which the number of children is less than or equal to 3. Besides the restriction on the number of children, the sample selection criteria are identical for both samples and as follows. I exclude military and low-income white oversamples who are not followed in the later years of the NLSY1979. I further exclude female respondents who are working less than one hour per week or have zero wages. Finally, I also exclude individuals who had their children at ages younger than 15.

In modeling how changes in the motherhood status and employment characteristics are associated with change in wages over women's life course, I use person fixed-effects models in which the unit of analysis is person-years. For years in which the respondent reported multiple jobs, I used their current or most recent job, and for those with more than one current or most recent job, I used the job with the highest hourly wages. Since fixed-effects analysis requires at least two observations per person, all respondents who participate in the survey for less than two waves are also excluded from the analyses. The resulting final analytic sample includes 4,736 individuals and 79,582 person-year observations for the extended sample and 4,313 individuals and 48,850 person-year observations for the sample restricted to one or no child.

Measures

Dependent Variable

The dependent variable of this study is the natural log of hourly wages adjusted for inflation using the 2016 CPI factor from the U.S Bureau of Labor Statistics. I restrict my analysis to cases in which wages are greater than $1 and less than or equal to $300 after the inflation adjustment. For those who hold multiple jobs between two interviews, I use their wages from their most recent job reported as of the survey date.

Explanatory Variables

The key independent variables are parity and time since childbirth. Parity is a time-varying variable that is equal to the total number of births a respondent has had at the time of the interview. In the full analytic sample, over half of the women had two or more children over the survey rounds and 73% of women had at least one child. I include parity as a categorical variable in all of my models as previous studies have found the effect of each child to be distinct (Kahn et al. 2014).

To investigate the penalty associated with motherhood over time, I use years since childbirth calculated using the interview dates and date of births from the NLSY's child history data. Since the exact dates of neither the interviews nor the births are provided by the NLSY, I took the first day of the reported month and year of each event to identify the week they had taken place. The weeks are continuously numbered, starting from the first week of January 1979, and ending in the last week of December 2016. For instance, for an interview that is reported to have taken place in March 2010, I assume it to have taken place in the first week of March of that year, which would correspond to the 1680^{th} week. After identifying the exact week of the interview and childbirths in this way, I subtract the week of the childbirth from the interview to estimate the number of weeks elapsed since each childbirth as closely as possible and divide by 52 to convert them into years. For any years in which women are childless, I assign a 0 to indicate that no time has elapsed since birth.

The coefficient for the time since childbirth represents the estimated effect of the child on wages in subsequent years after the birth, and when combined with the constant effect of the child, they represent the total effect of the child at a particular time point over women's life course. These variables not only allow for a comparison of the wage differences between

mothers and childless women over time but also a comparison of mothers with different number of years elapsed since birth.

Controls

Based on the findings from the previous literature, I control for respondents' age and its squared term, education, full-time work status, tenure, years of full-time and part-time work experience and their squared terms. I use years of education to classify respondents' education into the following categories: less than high school, high school graduate, some college and college graduate and beyond. I consider weekly work hours greater than or equal to 35 as working full-time. Using the reported start and stop dates of jobs, I calculate actual labor market experience and tenure by cumulatively summing up the weeks in which the respondents were employed and the weeks they had worked for a particular employer, respectively. By excluding all weeks that the respondent was out of the labor force or unemployed in calculation of both variables, work-interruptions are indirectly taken into account.

Analytic Technique

In all of my analyses, I use weighted fixed effects models to predict the natural log of wages since they have a clear advantage over the OLS in estimating the effects of motherhood as previously noted. In the first part of my analyses which use the sample restricted to one or no child, I allow the effect of years since first childbirth to be completely flexible by assessing the effect of each year following the birth on hourly wages to vary relative to all years prior to birth. The purpose of this analysis is to capture any variations across the years after birth that may have been missed by earlier studies by not incorporating the time component in the model or using a continuous time since child variable. Results from this model will provide a better understanding

of the patterns of the motherhood wage penalty over the life course by reporting the penalty at different time points in life. After gleaning an understanding of the general patterns of the motherhood wage penalty over time in this way, I use higher-order polynomials of time since first childbirth in my subsequent analyses to allow for a flexible specification while avoiding overspecification. Analyses on the extended sample which include all women with less than four children follow a similar procedure. However, instead of using years since first child, I use years since last child at the time of the interview.

RESULTS

Descriptive Statistics

Table 1 shows descriptive statistics by years since first childbirth and age at the time of the interview in groups for the sample restricted to cases in which the number of children is less than two. Statistics across the rows show how women within the same age group vary in each of the displayed characteristics by the amount of time that has elapsed since their first childbirth. The column for zero displays characteristics of women who do not have a child at the time of the interview. It should be noted that in some of the cells, some woman may be included multiple times due to collapsing of the years since first childbirth. Also, some of the cells representing a combination of young age groups and high years since childbirth, and older age groups and low years since childbirth are empty or very low in sample sizes.

The empty cells for the teen mothers reflect that there is no teen mother in the sample for whom more than five years has elapsed since their childbirth. Among teens, there is little difference between the childless women and mothers in their key work characteristics. The mean hourly wages for both groups are about $10 and they both have less than a year of work experience and job tenure. One characteristic in which the two groups notably differ from is their full-time work status. About 39% of the teen mothers are working full-time while 27% of childless women do. These descriptive results suggest that teen mothers do not face a motherhood wage penalty and that they are more likely to be working full-time compared to the childless teens.

For women in their 20s, the cells for 16 years and after first childbirth are empty. However, it is still possible to compare the characteristics across groups for whom more or less time has elapsed since the birth using the remaining cells. In terms of wages, there is not much difference between women who gave their first births earlier or later and on average, they are paid $13 hourly. Childless women in this group, on the other hand, are paid $2 more on average. While these descriptive results show some evidence of the motherhood wage penalty, it does not suggest that the penalty changes over the life course. Turning to full-time work status, approximately 71% of mothers whose child is 5 years old or younger in the sample is employed full-time and this rate is the lowest among all women in their 20s. For childless women, the proportion is 76%, and for women whom more than 5 years have elapsed since their child's birth, the proportion is even higher. This suggests that during the early years of motherhood, women are more likely to be working part-time compared to childless women but as their child gets older, they are not any more likely to do so. Contrary to what would be expected from the findings from the previous literature, years of full-time work experience and job tenure are actually higher among mothers than non-mothers and this is especially the case for mothers of older children.

For women in their 30s and beyond, the patterns of hourly wages after birth over time are very similar. Even though mean hourly wages is higher among higher age groups, within each age decade groups, it is consistently found that mothers for whom less than 5 years have elapsed since birth actually have higher average wages than those of childless women. It is also consistent that mothers for whom 6 or more years have elapsed since birth have lower wages than their childless counterparts and the wage gap is larger for women in their later years of motherhood. For instance, among women in their 30s, the mean hourly wages decline from

$22.37 to $18.26 to $16.45 for mothers who gave their birth 1 to 5 years ago, 6 to 10 years ago, and 11 to 15 years, respectively. This suggests that the motherhood wage penalty is not constant over the life course and that the penalty grows over time. However, because descriptive results from Table 1 are a display of averages of characteristics of women collapsed into broad age and years since first birth categories and do not take unobserved heterogeneity into account, results from fixed effects regression are needed for a more precise assessment.

Multivariate Fixed Effects Regression Results

What do the results from the fixed effects analyses suggest about the motherhood wage penalty over time? I find some support for the cumulative disadvantage hypothesis. I begin my analyses by estimating the effect of time since first childbirth on the log of hourly wages to be completely flexible by including each year since birth as a separate variable in the model while controlling for the time-constant effect of the child, age and its squared term (See Appendix). For each of the year since birth variables, I use two years and prior to birth as the reference category because in the year prior to birth, a woman may have already made labor market decisions in anticipation of birth. Therefore, the coefficients for each of the year since birth variable represent the change in hourly wages at n^{th} year since birth relative to two years and prior to birth.

For ease of interpretation, Fig. 1 is a graphical representation of the results from the completely flexible model. The effect of the first child at a particular time point is calculated by adding the constant effect of a child and the additional effect a child has at time t. The patterns of results suggest clear evidence of dynamism in the motherhood wage penalty over the 25 years of time since the first child. There is an initial 7% drop in wages at the time of birth (t=0), and the penalty grows for the next 10 years before tapering off. Mothers experience some rebound in the later years but continue to experience a penalty. I also considered the possibility that the results

are different when the effects are predicted relative to 1 year and prior to birth or 3 years and prior but found similar patterns regardless of the reference category. However, because the analyses of the effects of the first child over time is limited by low statistical power when using over 20 variables for each year since birth, I use time since first birth as a single continuous variable for my subsequent analyses.

Table 2 displays the results from three different models estimating the motherhood wage penalty over the life course. I first evaluate the effect of the first child, controlling for age and its squared terms and find a 10% penalty (Model 1). Because the first model lacks a time component, it assumes the motherhood wage penalty is fixed for women's entire lives. In the second model, I add in a continuous time since first child variable to evaluate the effect of the child over time. As expected, the constant effect of the first child on wages reduces to 8.6%, and I find a 0.4% additional decline in wages every year after the child is born. According to this model, mothers are expected to experience a 9% penalty a year after the birth, 12.6% after 10 years, and 14.6% after 15 years. In this way, while Model 2 no longer assumes the penalty to be constant, it still assumes it to be linear.

However, because at least some rebound was found in the earlier model that uses a flexible specification of time, I add in a squared term for the years since first child to Model 2 in the next model (Model 3) to investigate to what extent the results change. Including a squared term, in fact, resulted in the baseline child penalty to drop to 5% while the additional yearly penalty of the child increased from 0.4% to 1.8%. The coefficient for the squared term is small but positive suggesting that time since first childbirth has a curvilinear relationship with hourly wages. The negative coefficient for the child and time since child terms, and a positive coefficient of the squared term, in combination, suggest that the pattern of the motherhood wage

penalty over time is concave up. That is, mothers experience an initial decline in wages following their first childbirth but after a while they experience some rebound. To visually demonstrate the three different models in Table 2, Fig. 2 displays three corresponding graphs that show what the motherhood wage penalty would look like for a hypothetical woman who gave birth at age 26 according to each model. In summary, consistent with the point estimates from Fig. 1, the analyses using years since first child and its squared term show support for the cumulative disadvantage hypothesis.

Mechanisms of the Motherhood Wage Penalty Over Time

Next, I move on to test if the mechanisms that were found to explain the motherhood wage penalty in previous studies explain the patterns of the motherhood wage penalty over time as well. Each of the models in Table 3 adds in one or a set of possible mechanism variables to Model 3 of Table 2. I chose to do this instead of nesting the models in order to test out the effect of each mechanism at a time. It is still challenging to precisely assess how each of the mechanism variables mediate the relationship between the first child and hourly wages over time because the coefficients for the first birth and time since first birth and its squared term must be considered as a whole. Nonetheless, analyses show that while controlling for education, full-time status, tenure, and work experience results in varying levels of changes to the coefficients of first birth, time since first birth and its squared term, the changes are small and do not change the signs of the three coefficients. This suggests that the general pattern of the effect of first child remains the same after controlling for each of the mechanisms individually.

In Model 5, I include all of the variables that were individually tested in Models 1 to 4 and find that there is a more noticeable change to the magnitude of the effects of all of the

variables related to first birth compared to results from the model without any of the mechanism variables (Table 2, Model 3). Holding all covariates constant, the fixed penalty from first birth decreased from 4.9% to 4% and time since first birth from 1.8% to 0.8%. In addition, however, the coefficient for the squared term for time since first birth decreased from 0.0005 to 0.0003. Figure 4 provides graphs of the motherhood wage penalty over time net of each set of controls to visualize the suggested patterns of the penalty according to each of the models. These results once again confirm that even though the commonly cited mechanisms of the motherhood wage penalty individually explain at least some portion of the penalty, they do not explain the patterns of the penalty over women's postpartum lives.

Results from the Extended Sample

The results presented thus far have used the sample restricted to cases in which a woman has had one or no child at the time of the interview to protect the effect of a first child over time from being confounded by the effect of subsequent children. As a result, even though women who had more than one child throughout the NLSY79 interviews were not excluded entirely, they were only in my sample until before the birth of their second child. However, because a substantial number of women had a second or third child in the NLSY79 sample, I assess the effect of childbirth over the life course with caution using the extended sample. Table 4 presents the results from models predicting the motherhood wage penalty over the life course using the extended sample. In these models, I control for first, second and third child separately, and use years since last birth to assess the effect of the most recent child over time. Similar to the findings discussed earlier, the effect of each child and years since last birth are negative and significant, while the squared term for years since last birth is positive and significant (Model 3).

These results confirm that the effect of a child on wages do exacerbate over time but taper off in the later years of motherhood.

CONCLUSION AND DISCUSSION

Despite a significant body of research on the motherhood wage penalty, few studies have examined the variations in the penalty over the life course. In this study, I show that the level of the motherhood wage penalty is not constant over mothers' postpartum lives. Mothers experience a decline in their hourly wages immediately following the birth of their first child and the penalty accrues for the next 10 to 15 years of motherhood. These findings call to attention that averaging the motherhood wage penalty across the entire postpartum life conceals the changes in the penalty over time and leads to an inaccurate and incomplete understanding of the penalty. Methodologically, this research underscores the advantage of including the time component to models estimating the penalty and allowing for a flexible specification of time since childbirth in particular.

To further examine factors that might explain why the penalty accumulates over time, I also tested the effects of some of the common predictors of the motherhood wage penalty based on prior research. I found that while education, work experience, job tenure and full-time work status explain some of the penalty, none of these factors individually explain the shape of the penalty over the life course. It is possible that occupational changes made upon return to work following a childbirth explain why mothers experience this type of a cumulative penalty (Abendroth et al. 2014; Stone and Lovejoy 2019). The average number of jobs held by women between the ages of 25 to 34 is reported as 2.4 and 2.9 for ages 35 and 44 (Bureau of Labor Statistics 2017). This suggest that it is not uncommon for women to change jobs at least once or

twice at the ages in which a majority of women become mothers. If women pursue new career paths upon becoming mothers (Moen 2005), future research would benefit from studying the intragenerational occupational mobility of women with a focus on childbirth as a life event.

Heterogeneity across different groups in the patterns of the motherhood wage penalty over the life course is also possible. The results from this research demonstrates an average pattern of the motherhood wage penalty over time. Even though person fixed effects models are employed in this study, the effects of a child and time elapsed since birth on hourly wages is averaged across all individuals after extracting the effects for each person. Given the evidence on the differences in the extent of the average motherhood wage penalty across populations (England et al. 2016; Glauber 2007, 2018; Herr 2015), this may also be the case for the patterns of the penalty over the life course. There may be variations in the shape of the penalty by characteristics at the time of the birth such as age, education, income percentiles and job characteristics since the impact of life transitions is likely to be dependent on the characteristics at the transition (Elder 1994). It is possible that some women diverge from the average pattern of the motherhood wage penalty and experience a quick and complete rebound over their life course.

Recent research have responded to the need to studying long-term maternal employment patterns (Damaske and Frech 2016; García-Manglano 2015; Killewald and Zhuo 2019; Lu et al. 2017). This research emphasizes the importance of taking a life course approach to understanding the motherhood wage penalty as well. Childbirth is a life event but motherhood is a persistent status that has a continuous effect on one's life trajectory. Even though findings from this research reveal that mothers experience a cumulative penalty, future research is needed to better understand the sources of this pattern and variations across groups

TABLES AND FIGURES

Table 1. Descriptive Statistics for Women with One or No Child by Years Since First Childbirth

		Years Since First Childbirth						
		0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	Over 25
Teens	Hourly wages ($)	10.13	10.36	-	-	-	-	-
		(5.88)	(5.32)	-	-	-	-	-
	% Working full-time	32.9	51.8	-	-	-	-	-
	Full-time work experience	0.27	0.39	-	-	-	-	-
		(0.50)	(0.57)	-	-	-	-	-
	Job tenure	0.73	0.60	-	-	-	-	-
		(0.70)	(0.63)	-	-	-	-	-
	% College graduate	0.00	0.00	-	-	-	-	-
	N	5,350	411	0	0	0	0	0
20s	Hourly wages ($)	15.02	13.77	13.12	13.74	-	-	-
		(8.82)	(8.81)	(6.35)	(10.96)	-	-	-
	% Working full-time	75.6	70.8	78.2	80.7	-	-	-
	Full-time work experience	2.70	2.97	3.33	4.75	-	-	-
		(2.41)	(2.57)	(2.59)	(3.18)	-	-	-
	Job tenure	1.99	2.11	2.22	3.03	-	-	-
		(2.03)	(2.29)	(2.32)	(2.92)	-	-	-
	% College graduate	22.64	10.81	4.26	5.56	-	-	-
	N	18,100	5,077	1,785	270	0	0	0
30s	Hourly wages ($)	21.68	22.37	18.26	16.45	16.34	15.66	-
		(16.02)	(16.49)	(11.81)	(13.01)	(13.46)	(7.15)	-

	% Working full-time	86.3	75.0	80.2	79.8	80.5	84.0	-
	Full-time work experience	8.83	8.51	8.31	7.72	8.66	10.29	-
		(4.11)	(3.77)	(4.30)	(4.72)	(5.09)	(6.20)	-
	Job tenure	4.93	4.88	4.50	4.20	4.49	5.89	-
		(4.50)	(4.20)	(4.31)	(4.15)	(4.59)	(5.52)	-
	% College graduate	38.02	38.96	19.39	9.25	6.74	8.51	-
	N	5,586	1,617	1,186	1,092	519	94	0
40s	Hourly wages ($)	24.86	26.52	26.33	26.44	22.16	18.92	17.34
		(19.06)	(27.65)	(20.55)	(22.45)	(18.08)	(12.55)	(11.99)
	% Working full-time	84.4	73.8	79.2	79.8	83.5	81.9	80.9
	Full-time work experience	16.79	14.88	16.00	15.62	15.33	14.52	15.96
		(6.59)	(6.10)	(5.65)	(6.40)	(6.84)	(7.10)	(7.54)
	Job tenure	8.51	7.13	8.41	8.30	7.75	7.00	8.77
		(7.47)	(6.01)	(7.12)	(7.01)	(6.97)	(6.77)	(7.73)
	% College graduate	39.10	40.98	43.65	34.75	22.05	11.67	10.40
	N	2,455	122	307	495	635	574	404
50s	Hourly wages ($)	25.28	-	30.15	25.36	26.01	24.82	20.02
		(21.82)	-	(30.84)	(15.26)	(16.58)	(17.20)	(13.03)
	% Working full-time	77.9	-	81.3	77.4	79.1	84.5	82.5
	Full-time work experience	23.04	-	21.50	22.70	22.09	22.18	21.97
		(8.39)	-	(7.32)	(6.90)	(7.44)	(8.07)	(8.60)
	Job tenure	11.66	-	6.36	10.04	11.95	11.83	11.03
		(9.91)	-	(7.96)	(9.17)	(9.75)	(9.68)	(9.52)
	% College graduate	46.49	-	-	46.43	46.43	35.81	20.66
	N	1,381	0	16	84	196	310	784

Table 2. Fixed Effects Models Predicting the Natural Log of Hourly Wages for Women with One or No Child

	(1) model1	(2) model2	(3) model3
1st birth	-0.102***	-0.0863***	-0.0495***
	(0.0126)	(0.0121)	(0.0118)
Age	0.112***	0.111***	0.115***
	(0.00302)	(0.00301)	(0.00318)
Age^2	-0.00125***	-0.00121***	-0.00127***
	(4.07e-05)	(4.22e-05)	(4.48e-05)
Years since 1st birth		-0.00403***	-0.0178***
		(0.00138)	(0.00261)
Years since 1st $birth^2$			0.000491***
			(7.83e-05)
Constant	0.614***	0.630***	0.576***
	(0.0495)	(0.0489)	(0.0510)
Observations	48,850	48,850	48,850
R-squared	0.246	0.247	0.249
Number of id	4,313	4,313	4,313

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Fixed Effects Models Predicting the Natural Log of Hourly Wages for Women with One or No Child Net of Controls

	(1) model1	(2) model2	(3) model3	(4) model4	(5) model5
1st birth	-0.0489***	-0.0326***	-0.0521***	-0.0486***	-0.0402***
	(0.0117)	(0.0118)	(0.0116)	(0.0117)	(0.0114)
Age	0.0928***	0.103***	0.111***	0.0865***	0.0547***
	(0.00342)	(0.00323)	(0.00311)	(0.00495)	(0.00505)
Age^2	-0.00102***	-0.00111***	-0.00129***	-0.00121***	-0.000776***
	(4.70e-05)	(4.49e-05)	(4.34e-05)	(6.21e-05)	(6.30e-05)
Years since 1st birth	-0.0116***	-0.0163***	-0.0167***	-0.0158***	-0.00783***
	(0.00265)	(0.00257)	(0.00251)	(0.00249)	(0.00251)
Years since 1st $birth^2$	0.000350***	0.000430***	0.000465***	0.000468***	0.000253***
	(8.13e-05)	(7.68e-05)	(7.38e-05)	(7.27e-05)	(7.42e-05)
Education					
High school graduate	0.0576***				0.0784***
	(0.0159)				(0.0168)
Some college	0.0424**				0.102***
	(0.0199)				(0.0211)
College graduate and beyond	0.380***				0.444***
	(0.0264)				(0.0283)
Full-time		0.127***			0.0620***
		(0.00945)			(0.00901)
Tenure			0.0177***		0.0140***
			(0.00116)		(0.00134)
Full-time experience				0.0416***	0.0341***
				(0.00369)	(0.00380)
Full-time $experience^2$				-0.000406***	-0.000522***
				(8.64e-05)	(8.50e-05)

Part-time experience				0.0173***	0.00552
				(0.00594)	(0.00545)
Part-time experience^2				-0.000113	-3.19e-05
				(0.000148)	(0.000137)
Constant	0.842***	0.682***	0.640***	1.069***	1.397***
	(0.0506)	(0.0503)	(0.0737)	(0.0723)	(0.0743)
Observations	48,850	48,850	48,850	48,850	48,850
R-squared	0.274	0.260	0.265	0.263	0.302
Number of id	4,313	4,313	4,313	4,313	4,313

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample is restricted to parity less than 2.

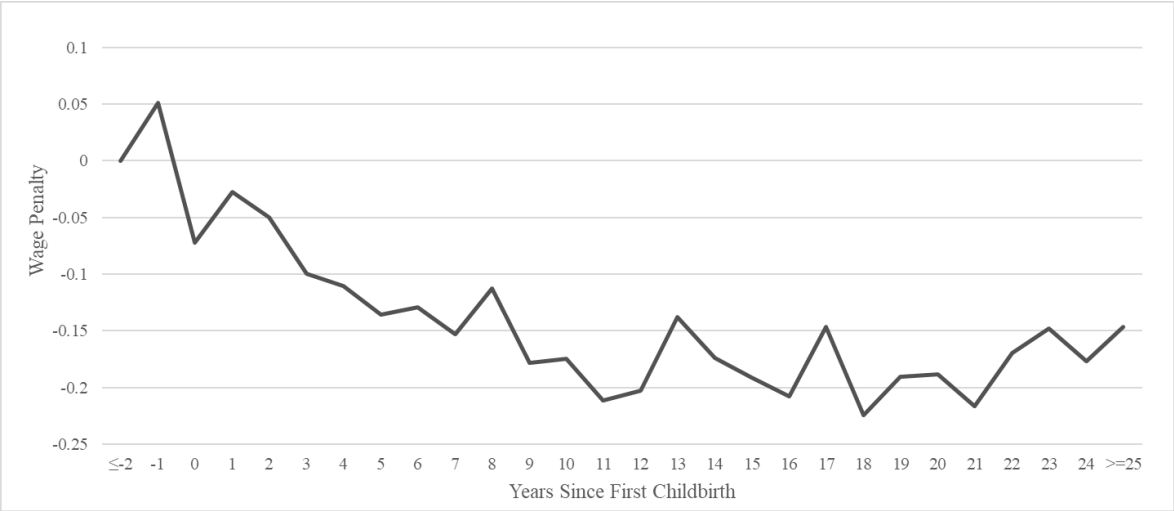
Table 4. Fixed Effects Models Predicting the Natural Log of Hourly Wages for Women with Less than 4 Children

	(1) model1	(2) model2	(3) model3	(4) model4
Parity				
1st birth	-0.0630***	-0.0572***	-0.0326***	-0.0324***
	(0.0119)	(0.0119)	(0.0118)	(0.0110)
2nd birth	-0.185***	-0.178***	-0.143***	-0.0934***
	(0.0162)	(0.0161)	(0.0159)	(0.0148)
3rd birth	-0.257***	-0.251***	-0.209***	-0.113***
	(0.0241)	(0.0239)	(0.0237)	(0.0230)
Age	0.0952***	0.0937***	0.0989***	0.0456***
	(0.00245)	(0.00242)	(0.00264)	(0.00356)
Age^2	-0.00100***	-0.000965***	-0.00104***	-0.000635***
	(3.10e-05)	(3.30e-05)	(3.64e-05)	(4.51e-05)
Years since 1st birth		-0.00278**	-0.0128***	-0.00309**
		(0.00109)	(0.00163)	(0.00156)
Years since 1st $birth^2$			0.000377***	0.000140***
			(5.03e-05)	(4.83e-05)
Education				
High school graduate				0.0680***
				(0.0151)
Some College				0.134***
				(0.0191)
College graduate and beyond				0.481***
				(0.0253)
Full-time				0.0615***
				(0.00766)

Tenure				0.0149***
				(0.000907)
Full-time experience				0.0326***
				(0.00264)
Full-time experience^2				-0.000538***
				(5.61e-05)
Part-time experience				0.00664*
				(0.00364)
Part-time experience^2				-9.77e-05
				(9.96e-05)
Constant	0.858***	0.871***	0.791***	1.515***
	(0.0408)	(0.0401)	(0.0431)	(0.0528)
Observations	79,582	79,582	79,582	79,582
R-squared	0.212	0.213	0.215	0.274
Number of id	4,736	4,736	4,736	4,736

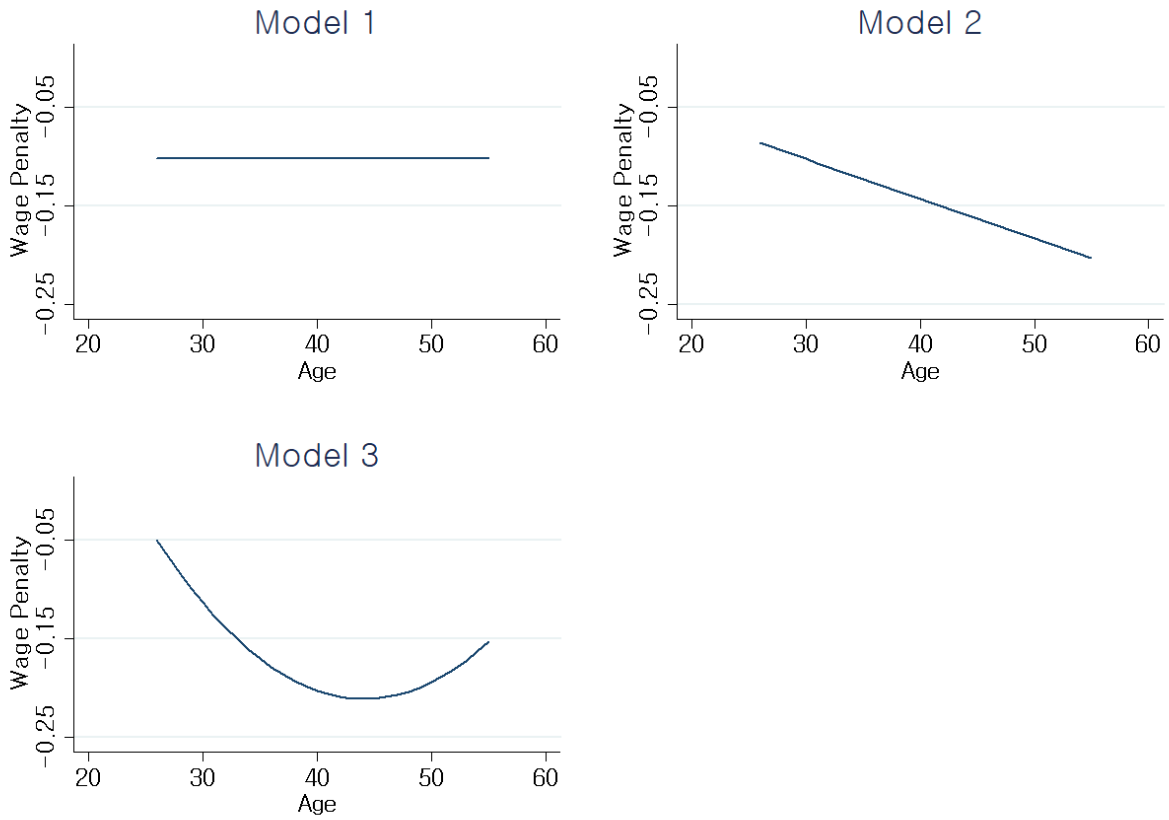
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Fig. 1. The Motherhood Wage Penalty Over the Life Course



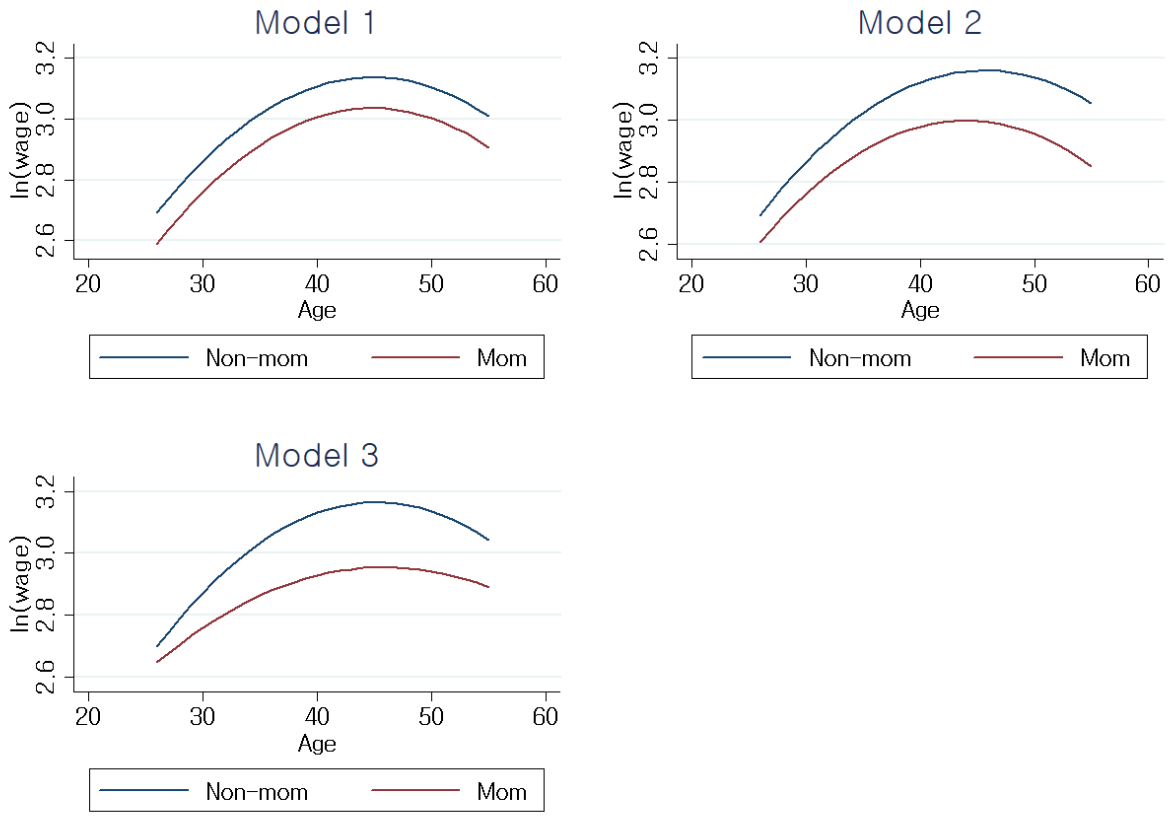
Notes: Sample is restricted to parity less than 2.

Fig. 2. Model Comparisons of the Life Course Estimates of the Motherhood Wage Penalty



Notes: Sample is restricted to parity less than 2. Models corresponds to Table 2.

Fig. 3. Life Course Wage Trajectories Comparison of a Non-mom vs. Mom by Model Types



Notes: Sample is restricted to parity less than 2. Models corresponds to Table 2.

APPENDIX

Table 5. Fixed Effects Models Predicting the Natural Log of Hourly Wages for Women with One or No Child

	(1) model1
1st birth	-0.0852*
	(0.0508)
Age	0.113***
	(0.00329)
Age^2	-0.00124***
	(4.54e-05)
Years Since 1st Birth	
-1	0.0508***
	(0.0132)
0	0.0130
	(0.0140)
1	0.0575
	(0.0526)
2	0.0350
	(0.0531)
3	-0.0144
	(0.0531)
4	-0.0253
	(0.0546)
5	-0.0508
	(0.0547)
6	-0.0440
	(0.0560)
7	-0.0678
	(0.0569)
8	-0.0275
	(0.0560)
9	-0.0934
	(0.0576)
10	-0.0892
	(0.0593)
11	-0.126**
	(0.0589)
12	-0.118**
	(0.0589)
13	-0.0526

	(0.0606)
14	-0.0887
	(0.0679)
15	-0.106*
	(0.0628)
16	-0.123*
	(0.0686)
17	-0.0612
	(0.0616)
18	-0.139**
	(0.0659)
19	-0.105
	(0.0676)
20	-0.103
	(0.0653)
21	-0.131*
	(0.0709)
22	-0.0846
	(0.0642)
23	-0.0626
	(0.0652)
24	-0.0919
	(0.0759)
25	-0.0615
	(0.0656)
Constant	0.599***
	(0.0525)
Observations	48,850
Number of id	4,313
R-squared	0.250

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Fixed Effects Models Predicting the Natural Log of Women's Hourly Wages for Women with Less than 4 Children

	(1) model1	(2) model2	(3) model3	(4) model4
Parity				
1st birth	-0.0630***	-0.0414***	-0.0137	-0.0177
	(0.0119)	(0.0119)	(0.0116)	(0.0109)
2nd birth	-0.185***	-0.162***	-0.101***	-0.0873***
	(0.0162)	(0.0167)	(0.0175)	(0.0165)
3rd birth	-0.257***	-0.256***	-0.168***	-0.122***
	(0.0241)	(0.0261)	(0.0278)	(0.0267)
Age	0.0952***	0.0954***	0.101***	0.0471***
	(0.00245)	(0.00243)	(0.00269)	(0.00363)
Age2	-0.00100***	-0.000983***	-0.00107***	-0.000653***
	(3.10e-05)	(3.32e-05)	(3.71e-05)	(4.65e-05)
Years since birth				
1st birth		-0.00720***	-0.0172***	-0.00590***
		(0.00137)	(0.00195)	(0.00187)
1st birth^2			0.000358***	0.000105**
			(5.20e-05)	(5.11e-05)
2nd birth		0.00540***	0.00335**	0.00390***
		(0.00131)	(0.00132)	(0.00121)
3rd birth		0.00201	0.000221	0.000217
		(0.00148)	(0.00151)	(0.00142)
Education				
High school graduate				0.0645***
				(0.0151)
Some College				0.130***

				(0.0192)
College graduate and beyond				0.474***
				(0.0254)
Full-time				0.0603***
				(0.00765)
Tenure				0.0148***
				(0.000910)
Full-time experience				0.0323***
				(0.00262)
Full-time experience^2				-0.000523***
				(5.62e-05)
Part-time experience				0.00663*
				(0.00366)
Part-time experience^2				-0.000101
				(0.000101)
Constant	0.858***	0.844***	0.755***	1.494***
	(0.0408)	(0.0403)	(0.0437)	(0.0535)
Observations	79,582	79,582	79,582	79,582
R-squared	0.212	0.214	0.216	0.274
Number of id	4,736	4,736	4,736	4,736

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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