



A Review of the Motherhood Wage Penalty in the United States

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Abstract

On average, mothers earn lower wages than childless women. This well-established finding is referred to as the “motherhood penalty.” In this review, we summarize the main theoretical explanations for the motherhood penalty, and briefly discuss which theories have received empirical support. We evaluate research that explores variation in the motherhood penalty by important demographic and job-related characteristics. Additionally, we highlight recent methodological advances used to estimate the penalty. The review concludes with suggestions for future research in this area.

Introduction

On average, mothers earn lower wages than childless women. This well-established finding is referred to as the “motherhood penalty.” Although study results vary depending on the time period covered, sample, and analytic technique used, the gross motherhood wage penalty is typically estimated to be between 5 and 10 percent per child. Differences in work history and current work hours account for much of the gap in pay between mothers and non-mothers, but a substantial portion is typically left unexplained. The residual motherhood penalty is often attributed to possible unobserved differences between mothers and non-mothers, such as work effort, productivity or commitment. Employer discrimination against mothers may also be an explanation for the residual penalty.

Since the majority of women in the United States become mothers, and most mothers are employed,¹ any price associated with motherhood will affect most women and influence overall gender inequality in pay (Budig and England 2001). In fact, many scholars of gender inequality now believe that motherhood is the critical factor behind the remaining gender wage gap (England 2005; Waldfogel 1998). In this paper, we review and summarize the theories and empirical findings on the motherhood penalty. For the sake of brevity and simplicity, we limit this review to studies using data from the United States.

This review has four sections. First, we summarize the main theoretical explanations for the motherhood penalty, and briefly discuss which theories have received empirical support. Second, we evaluate research that explores variation in the motherhood penalty by important demographic and job-related characteristics. Third, we highlight recent methodological advances used to estimate the motherhood penalty. The review concludes with suggestions for future research in this area.

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Theoretical explanations for the motherhood penalty

Researchers have posited a number of theoretical explanations for the motherhood penalty. While the precise magnitude of the penalty and the mechanisms driving it are not fully agreed upon, five theories dominate the literature: human capital, work effort, job characteristics/compensating differentials, employer discrimination, and selection. These theories are usually tested using a multi-step process. First, researchers estimate regression models that predict the natural log of wages for a sample of working women as a function of motherhood status. Second, variables are added to the regression model in a step-wise fashion in order to see if they explain away the negative relationship between motherhood and wages. Finally, since it is not possible to test directly a theory such as employer discrimination using survey data, indirect tests for such theories are carried out by examining whether a residual motherhood penalty exists after controlling for all theoretically relevant observed variables. In this section, we discuss each of the proposed theories in turn, and discuss the amount of support (or lack of support) each has received in the empirical literature.

Human capital

Human capital theory suggests that mothers' wages are lower than childless women's wages because mothers invest less in market human capital (Becker 1985). Mothers spend more time out of the labor force to raise children, resulting in overall lower levels of work experience. Work experience affects wages via on-the-job training and tenure with employer, both of which make workers more productive. In addition to having less work experience and tenure, mothers are more likely to work part-time than non-mothers, and part-time work generally pays less on an hourly basis compared to full-time work (Blank 1990). Job-protected maternity leave is one family policy that may encourage mothers' post-birth return to the labor market and employer continuity, and thus positively impact general and firm-specific work experience. On the contrary, access to extended maternity leave could plausibly lead to longer work interruptions, and thus lower levels of general work experience (Waldfogel 1998).

Most motherhood penalty studies test the human capital explanation by controlling for measures of education, work experience, tenure, time out of the labor market, and current work status (part-time versus full-time). Although these measures explain a large portion of the motherhood penalty (typically about 50 percent, depending on the study), an unexplained portion customarily remains (e.g., Anderson et al. 2003; Budig and England 2001). Some research further finds that access to maternity leave may mitigate the pay penalty associated with motherhood, via its impact on women's tenure and work experience (Waldfogel 1997b), although cross-national research suggests that extended paid maternity leaves may exacerbate the motherhood pay penalty by discouraging post-birth maternal employment (Pettit and Hook 2005).

Other studies explain the entire motherhood penalty after accounting for measures of human capital (e.g., Gangl and Ziefle 2009; Hill 1979; Korenman and Neumark 1992; Lundberg and Rose 2000; Staff and Mortimer 2012). These conflicting results may be attributable to differences in data, sample, and method. Additionally, studies that attribute more of the motherhood penalty to human capital differences typically include more detailed measures of work experience, such as number of job changes and years of on-the-job training, in their models.

Effort

A second supply-side explanation for the motherhood wage penalty is the effort hypothesis. This theory was originally proposed by Becker (1985) and begins with the assumption that all individuals have a fixed endowment of effort to spend on various activities. Since mothers have more responsibility for housework and childcare than other workers (i.e., childless women and men), they are theorized to spend more of their effort at home and thus have less for work. Mothers' depleted energy and effort levels will translate into lower productivity at work, which leads to lower wages, all else constant.

Most quantitative surveys have no way of objectively measuring work effort. Some researchers have utilized data with respondents' self-reported work effort to test whether a relationship exists between gender, parental status and work effort. Kmec (2011) is one of the most recent studies of this type. Based on a sample of full-time workers age 35 and older, she estimates regression models predicting work effort as a function of individual- and job-level characteristics. Findings reveal no difference in work effort between mothers and childless women. One limitation of studies like this one, which uses self-reported effort measures, is that if mothers are more likely than non-mothers to inflate their reports of work effort because they measure their work effort against their competing responsibilities (e.g., child care), the estimates of effort may be biased. Also, there is no link made between self-reported work effort, and productivity, performance, or earnings.

Some researchers have attempted to test the effort hypothesis by limiting their sample to workers who are unaffected by employer discrimination, and then attributing any remaining motherhood penalty to mothers' lower levels of work effort. For example, Kalist (2008) studies the motherhood penalty using panel data on professional female golfers, and finds that becoming a mother decreases productivity, as measured by players' golf scores. He states, "because earnings on the LPGA are determined strictly by merit and relative performance, it is not possible that these findings result from discrimination" (p. 234). Instead, Kalist suggests that mothers' lower levels of productivity are due, in part, to lower levels of energy devoted to practicing and playing golf.

Other studies have suggested alternative indirect ways of assessing the effort hypothesis. Anderson et al. (2003) find that Black and White women face the same motherhood penalty, and suggest this is a pattern in step with the work effort story. They also use "age of children" as a proxy for work effort, suggesting that young children sap more effort away from mothers than older children. Their results show that the motherhood wage penalty diminishes as children get older, consistent with the work effort explanation (Anderson et al. 2003, p. 284).

Job characteristics

A third explanation for the motherhood penalty is that mothers accept lower wages in return for more flexible and accommodating jobs. Compared to childless women, mothers are theorized to choose, or be channeled into, jobs that demand less effort (see above), have flexible hours (or a standard shift with little overtime), a location near (or at) home, and limited out-of-town travel. These job characteristics are supposedly sought after by mothers in order to more effectively integrate childcare and housework responsibilities with paid work (Becker 1985). According to the theory of compensating differentials, jobs with these types of "attractive" characteristics offer lower wages, all else constant (Filer 1985).

Budig and England (2001) control for mother-friendly job characteristics (e.g., commuting time, amount of effort demanded at work), but these variables do not explain away the motherhood penalty. Others have tried to assess directly the connection between having flexible work practices and wages. In a study of mothers only, Glass (2004) finds that professional and managerial mothers who use flexible work arrangements experience lower wage growth. Glass' research further suggests that the negative relationship between work-family policy use and wage growth is not due to compensating differentials. Instead, she suggests that employers may perceive mothers who use flexible arrangements as less committed and dedicated employees, and, as a result, give them smaller raises and fewer promotions than mothers who do not use these arrangements.

Amuedo-Dorantes and Kimmel (2008) also address the role of compensating differentials in explaining the motherhood wage gap in their study using data from the 1979 National Longitudinal Survey of Youth (NLSY79). They find that after accounting for having employment-based health insurance, the motherhood wage gap is no longer evident. Amuedo-Dorantes and Kimmel (2008) conclude that the motherhood wage gap originates, in part, from "a negative compensating wage differential arising from a relative preference on the part of mothers for an important component of non-wage compensation, namely, health insurance coverage" (p. 19).

Employer discrimination

A "demand-side" explanation for the motherhood penalty is employer discrimination. Economists distinguish between two types of discrimination by employers: statistical (Phelps 1972) and taste (Becker 1957). In the case of motherhood and employment, statistical discrimination occurs when employers perceive childless women to be more productive, on average, than mothers and thus treat *all* childless women and *all* mothers differently as a result of this assumption. Taste discrimination refers to the notion that employers (or co-workers or customers) favor childless women over mothers, not because they perceive mothers to be less productive, but because they simply prefer working with childless women. Despite the differences in these two types of discrimination, both taste discrimination and group stereotyping result in similar outcomes: women who differ *only* with respect to their parental status will be treated differently by employers.

Quantitative survey studies attempt to test for employer discrimination against mothers by controlling for individual- and job-level characteristics in models predicting wages; any residual difference in wages between mothers and non-mothers is then attributed to potential employer discrimination. These studies are unable to conclude definitively that discrimination exists, however, because the association between motherhood and wages may be attributable to some other group difference that is not measured in the survey data and is related to pay, such as productivity or work commitment.

Audit studies measure employer discrimination directly by presenting volunteer subjects or real-world employers with resumes from fictitious job applicants who are comparable in all respects except for one characteristic (e.g., parental status). A number of such studies have found that mothers are judged to be less competent than childless women (e.g., see Correll et al. 2007; Cuddy et al. 2004; Heilman and Okimoto 2008). A study by Correll et al. (2007) is one of the most comprehensive studies of this type, showing that study subjects were less likely to hire, and offered lower starting salaries to, mothers compared to non-mothers. These findings were mirrored in their employer audit study, in which mothers were significantly less likely to receive a call-back for an interview compared to an equally qualified childless woman.

Selection

A final explanation for the motherhood penalty is selection. Before childbirth, women who become mothers may differ from non-mothers in certain ways that are related to workplace productivity (e.g., motivation, work commitment) and thus earnings. Many studies attempt to control for unobserved heterogeneity in these characteristics using fixed-effects models, which eliminate between-person variation (observed or unobserved) that remains stable over time. Most research finds that unobserved group differences explain some, but not all, of the motherhood penalty.

An alternative type of selection that could account for the negative association between children and women's wages is endogenous fertility. That is, women may decide to have children if/when their careers are going badly or when their wages are low. In order to determine whether this type of selection exists, one would need to examine women's earnings before and after childbirth. Lundberg and Rose (2000) use longitudinal data from the Panel Study of Income Dynamics to do just this, and find support for the selection argument: mothers earn less than non-mothers prior to the birth of the first child (p. 701).

Heterogeneity in the motherhood penalty

While early analyses of the motherhood penalty focused on estimating average effects, more recent literature has focused on heterogeneity in the penalty by factors such as age, race, marital status, number of children, education level, and so forth. In this section, we discuss some of the key findings from this research. These studies are important because they help shed light on the mechanisms producing the motherhood penalty.

Age at first birth and postponement

Many researchers have considered whether mother's age at first birth moderates the motherhood penalty. This research has its basis in the wage growth model of Mincer (1974). Women who postpone a first birth have more time to accumulate human capital, including work experience, prior to childbirth. Given the typical wage growth profile, mothers who have their first child at an older age will have higher wages if and when they take a childcare-related work interruption compared to mothers who have their first child at a younger age. This should improve the market position of older first-time mothers upon return to the labor force (Mincer 1974).

The empirical evidence suggests that postponing the first birth reduces the magnitude of the motherhood penalty. Taniguchi (1999) finds that women who have their first birth after age 28 experience no wage penalty, while younger mothers face penalties between 2.5 percent and 4 percent per child. The lack of a penalty for older first-time mothers is also shown in Amuedo-Dorantes and Kimmel's (2005) work wherein they find that women who have their first child after age 30 earn about the same as their childless counterparts. In addition, these women earn 7 percent more than mothers who have their first birth before age 30.

Other research also indicates a clear earnings benefit to delaying first childbirth. Miller (2011) finds that each year of delayed motherhood increases career earnings (cumulative earnings between ages 21 and 34) by 9 percent and average wage rates by 3 percent, resulting in a smaller motherhood penalty for older women. Herr (2011) obtains smaller estimates than Miller (2011) for each year of delay, although she uses entry into the labor

force as the starting point for her analysis rather than age 21. Herr's (2011) results indicate that each year of delay in first childbirth is associated with 1.5 percent to 3 percent higher wages at the 20-year, post-labor market entry point.

By contrast, a small amount of evidence indicates either no apparent age or postponement effects, or that earlier childbearing may have long-term wage benefits. For instance, Budig and Hodges (2010) find no difference in the motherhood penalty for women who postpone a first birth past age 30 compared to those who have their first child before age 30. One reason their results conflict with other studies may be because they include more work-related controls as well as a measure of spousal earnings in their model. In addition, although Herr (2011) finds benefits to delay, she estimates that most women (but not college graduates) would have higher long-run wages if they had their first child before entry to the labor force. However, Herr's study is unique in this literature because the "timing" variable in her analysis is time in the labor force, not age. Although the literature leans toward the position that postponement of first birth past age 30 may be beneficial, the evidence suggests that fertility timing relative to labor market entry may also matter.

Spacing of children

Just as researchers study the effect of childbirth timing on the magnitude of the motherhood penalty, so too does it make sense to consider the role of birth spacing. For biological reasons, childbirth timing and spacing are linked. As such, the effects of timing and spacing may be confounded in existing estimates of the motherhood penalty for women with more than one child.

Very close spacing of children may reduce a mother's available work effort, discourage human capital accumulation, increase the likelihood of taking a job with compensating differentials, or be viewed unfavorably by an employer. Yet, women who space their children very far apart may be more likely to have a second birth on the basis of characteristics that are negatively associated with labor force outcomes, such as an unemployment spell (Gough 2012). Therefore, we might expect to see larger wage penalties at the extremes of the birth spacing distribution than in the middle.

The relationship between birth spacing and the motherhood penalty is a complex and relatively understudied issue. Only three papers have examined this issue in recent literature. Peltola (2004) and Troske and Voicu (2012) both use data from the NLSY79 to explore the relationship between birth spacing and women's return to work after childbirth. Peltola (2004) estimates that women with shorter birth intervals will return to work more quickly than women with longer birth intervals, but longer birth intervals reduce the risk of entering low-hours (≤ 20) part-time work. Since short work interruptions minimize the loss of human capital associated with wage growth, but part-time work status is negatively associated with wages (Peltola 2004), the overall effect of birth spacing on wages is unclear.

Conversely, Troske and Voicu (2012) find that the negative effect of a second child on labor force participation weakens as the number of years between the first and second births increases. However, as the length of time between the first and second births increases, the negative effect of the second birth on the likelihood of working full-time increases, and the effect on the likelihood of working part-time switches from negative to positive. Finally, Gough (2012) also uses data from NLSY79, along with a dynamic potential outcomes framework, and finds minimal evidence that spacing is associated with the motherhood penalty by midlife. However, she finds some evidence of heterogeneity by education and age at first birth, pointing to a need for further research.

Marital status

In addition to considering age and spacing, researchers have investigated whether the motherhood penalty varies as a function of marital status. Married mothers may have a greater ability to specialize in homemaking and childrearing than unmarried mothers because they can rely on their husbands' income. As a result, married mothers may be more likely to take time out of the labor force than unmarried mothers; likewise, employers may view married mothers as less committed to work compared to unmarried mothers. Supporting this contention, some researchers have found a higher motherhood wage penalty for married mothers than unmarried mothers (Budig and England 2001; Budig and Hodges 2010). Yet, other researchers have found no differences in the motherhood wage penalty by marital status (Killewald and Gough 2012; Taniguchi 1999; Wilde et al. 2010). One possible explanation for this discrepancy is that papers which find no difference by marital status account for possible non-linearities in wage growth over time, which might be correlated with both marriage and motherhood.

Education

Education may also moderate the motherhood penalty in a number of ways. For example, highly educated women are more likely to work in jobs with greater autonomy. Higher levels of autonomy may allow women to better respond to motherhood by providing them flexibility in determining when (e.g. flex schedules) and where (e.g. telecommuting) they perform their paid work (Anderson et al. 2003). In this way, highly educated women may be able to more effectively combine work and family, and thus maintain a high level of work commitment and productivity. Additionally, highly educated women have more family income, on average, than less educated women. They can use these resources to purchase high-quality childcare and thus reduce work-family conflict. Finally, highly educated women may also experience a smaller motherhood penalty because, on average, they have their first child at an older age compared to women with less education. At older ages, employees' wage trajectories have "flattened out" and so mothers having children at older ages may have less to lose in terms of wage growth.

Conversely, some researchers suggest that the motherhood penalty may increase with educational attainment because highly-educated women are more likely to work in managerial and professional jobs that require high levels of overall work commitment (Anderson et al. 2003; Wilde et al. 2010). These demanding all-or-nothing jobs may be *more* difficult to combine with motherhood, even if they do offer more flexibility and autonomy. Employers may also be reluctant to hire mothers into these types of jobs out of concern that job demands will conflict with home demands. Finally, because highly educated women are more likely to be married and have higher-earning spouses than women with less education, they may be more likely to cut back on labor supply post-birth, resulting in a larger earnings penalty.

Empirical research on the variation in the motherhood penalty by education is mixed. Some research finds a smaller (or no) penalty for highly educated women (Amuedo-Dorantes and Kimmel 2005; Taniguchi 1999), whereas other research find a *larger* penalty for highly educated women (Waldfogel 1997a; Wilde et al. 2010). Loughran and Zissimopoulos (2009) and Budig and England (2001) find no variation in the motherhood penalty by educational attainment, and Anderson et al. (2003) find a non-monotonic relationship between education and the motherhood penalty, with medium-skilled women facing the highest penalty and high school dropouts and college-educated women facing significantly

smaller penalties. Herr (2011) and Miller (2011) both find that college graduates achieve higher returns to delaying motherhood compared to women with less education. Next, we highlight the specific findings of a few of these studies.

Amuedo-Dorantes and Kimmel (2005) find a motherhood *premium* for women with college degrees. More specifically, they show that wages of college-educated mothers are 3.5 percent higher than those of college-educated non-mothers. They further find that college-educated mothers who postpone a first birth past age 30 earn 16 percent more than their similarly educated counterparts who remain childless, and 12.5 percent more than college-educated mothers who have their first child before age 30.

Conversely, Wilde et al. (2010) find that women with high skill levels experience a *larger* penalty from motherhood than women with low skill levels. Results show that low-skill women face a one-time 6 percent reduction in pay after first birth, whereas high-skill women face an 8 percent reduction in pay during the first five years after a first birth, and this penalty expands to 24 percent over the decade following the first birth (Wilde et al. 2010, p. 17). The authors also find that although low-skill women give up 10–14 percent of lifetime earnings to have a child, high-skill women give up twice that amount – almost 21–33 percent of lifetime earnings. The authors show that the difference in the motherhood penalty by skill level is due, in part, to variation in the shape of the wage trajectories; the wages of low-skill women are lower and rise more slowly than the wages of high-skill women, even before motherhood. Thus, low-skill women have “less to lose” in terms of earnings and earnings growth when they do have children.

The contradictory results across these studies may be due to differences in time period studied, analytic technique employed, and types of controls included in the analyses. For example, some studies include measures of “timing of return to work” and “age at first childbirth” whereas others do not. Since these variables are associated with both education and wages, regression results will likely be sensitive to their inclusion.

Earnings

Similar to research exploring the variation in the motherhood penalty by education, Budig and Hodges (2010) explore heterogeneity in the penalty across the earnings distribution for White women. The authors find a motherhood *bonus* for married women in the top 10 percent of the earnings distribution, and the largest (proportionately) penalty for women at the low end of the earnings distribution. Budig and Hodges (2010) also find that the mechanisms responsible for the motherhood penalty vary significantly by earnings level. For example, human capital explains a significant portion of the motherhood penalty among the highest earners but very little among those with low earnings. The major limitation to their study is the exclusion of Black and Latino women due to significant differences in the shape of women’s earnings distributions across race.

Race and ethnicity

A number of researchers have theorized that the motherhood penalty may vary by race and ethnicity. Racial-ethnic differences in work behavior and family support networks may be a source of these differences and employers’ stereotypes of mothers also likely vary by a woman’s racial-ethnic group and thus contribute to variation in the motherhood penalty by race-ethnic group.

Overall, most studies exploring racial-ethnic differences find that wage penalties associated with motherhood are larger for Whites compared to non-Whites. Most of these

studies compare White women and Black women, and show that White mothers pay a larger wage penalty than Black mothers (Glauber 2007; Hill 1979; Neumark and Korenman 1994; Waldfogel 1997a). There are a few exceptions to this general finding. Budig and England (2001) find that the difference between Black women and White women exists only for mothers with more than two children, and Anderson et al. (2003) find race differences only among mothers of adolescents. In their experimental research exploring the motherhood penalty at the point of hiring, Correll et al. (2007) find that the motherhood penalty is similar in magnitude for both White and Black mothers.

Studies on Asians and Latinos are less prevalent, but, again, typically find smaller wage penalties among non-White mothers. Budig and England (2001) find that Latinas experience smaller penalties than White women. Similarly, Glauber (2007) finds that Whites pay a higher motherhood penalty than Latinas, and, in fact, Latinas do not pay a motherhood wage penalty at all, regardless of their marital status and family size.

Due to small sample sizes, few studies have examined Asian American or Asian women as a separate group. Greenman's (2011) research is one of the only studies to do so; using a sample of women scientists and engineers, she finds that Asian American women are less likely than White women to reduce labor force participation or hours of work after becoming mothers. She does not estimate the wage penalty associated with motherhood specifically, but her results suggest that the motherhood penalty would be smaller for Asian American women compared to White women. In line with this work, Torres Stone et al.'s (2006) shows that children are not related to Filipina or Asian-Indian women's earnings, but are negatively associated with non-Hispanic White women's earnings.

Sexual orientation

A small number of studies have examined whether the motherhood penalty is dependent on sexual orientation. These studies allow researchers to test potential employer discrimination in an alternative way. For example, it is possible that employers *perceive* lesbian mothers to have greater work commitment than heterosexual mothers and reward them accordingly. Conversely, employers may be more likely to discriminate against lesbian mothers because of their stigmatized sexual orientation. Because most large-scale representative data sets do not collect information on sexual orientation, this topic has been under-studied.

Baumle (2009) is one of the only studies to date to test whether the motherhood penalty varies by sexual orientation. Using data from the 2000 U.S. Census, Baumle finds that the motherhood penalty is limited to heterosexual women and that lesbian mothers experience a motherhood *premium*. More specifically, partnered lesbian mothers earn 20 percent more than those without children, whereas married heterosexual mothers earn 4 percent less than their childless counterparts.

One limitation of the Census data used in the Baumle (2009) study is that questions on sexual orientation are only asked of respondents who are *partnered* (cohabiting or married), and so single mothers are not included in this analysis. Furthermore, the Census does not collect data on work history (part- and full-time work experience, tenure at current employer) and so these important control variables are not included in the analysis. More definitive research, using large nationally representative data with adequate controls, is needed to further understand this important topic.

Methodological advances

The past couple of decades have witnessed a number of methodological advances or innovations in research on the motherhood penalty. Since Hill's (1979) landmark article drew attention to the motherhood penalty, researchers have mainly relied upon ordinary least squares (OLS), fixed effects, and first-differencing to estimate the motherhood penalty. Each of these methods has strengths and weaknesses that researchers readily acknowledge, but all attempt to get closer to a true *causal* effect of motherhood on wages. Fixed-effects models improve on OLS by removing bias arising from time-invariant omitted variables. These models control for unobserved individual characteristics that do not change over time but could influence both fertility and wages. Researchers have also augmented fixed-effects models to estimate annual wage growth between interviews, while controlling for individual differences (Korenman and Neumark 1992; Loughran and Zissimopoulos 2009). They do this by taking the first-difference of wages as the outcome variable in the fixed-effects model, where the first-difference is equal to wages at time t minus wages in the previous period, $t-1$. Both methods improve on OLS by eliminating certain types of bias.

Recently, a number of researchers have employed more sophisticated methods, with varying degrees of success. Miller (2011) employs an instrumental variable approach to instrument for a woman's age at first birth. Identifying the true causal effect of motherhood delay on earnings is difficult because the relationship between the two variables may be due to reverse causality or joint determination. In studies like Miller's (2011), instrumental variables help to better identify causal effects by exploiting biological variation in motherhood timing among women whose preferred age at first birth is assumed to be similar. Miller's instruments include whether the first pregnancy ended in miscarriage, whether conception of the first child occurred while using contraception, and the elapsed time from the first conception attempt to the first birth. Although she notes possible limitations to the instruments, other researchers, such as Wilde et al. (2010) have questioned the validity of the instruments on a number of grounds. For example, miscarriages are often not reported, women who experience a miscarriage may live in communities with unobservable characteristics that influence both the likelihood of miscarriage and wages, and reported miscarriages may not be exogenous to wages (Wilde et al. 2010, p;.13).²

Another approach to deal with the plausible endogeneity between women's earnings and number of children is to use the occurrence of twins in the first birth, as it is an exogenous and unplanned event. Jacobsen et al. (1999) employ this approach to examine the impact of number of children on married women's earnings. Using data from the 1970 and 1980 PUMS, they find a significant short-run negative impact of number of children on women's earnings. Although this research is creative in its use of twins as an instrumental variable, there are some limitations to this approach. One concern is that the occurrence of twins may not be random. For example, women who use *in vitro* fertilization (IVF) to become pregnant are more likely to have twins than women who become pregnant without medical intervention. Both the ability to pay for IVF and the strong desire for children may be correlated with women's labor market outcomes. Older women are also more likely to have twins and to have higher wages at the time of the birth, as discussed previously. Finally, using twins as a natural experiment requires some strong assumptions about how individuals assess the cost of children, their time in leisure, and their time in the labor market (Rosenzweig and Wolpin 2000).

Previous research has typically focused on wage penalties of motherhood in the context of wage levels. Yet, recent studies have expanded to estimate the motherhood penalty as it pertains to wage growth (Loughran and Zissimopoulos 2009; Miller 2011; Wilde et al. 2010). The argument here is that wages may not decline instantaneously after a birth because many mothers return to their pre-birth employers and jobs, but wage growth may be depressed as it depends heavily on employers' perception of workers' effort (Wilde et al. 2010). For example, if an employer perceives (correctly or not) that a mother is less work committed after having a child, she may be less likely to receive a job promotion, and thus her wages may grow at a slower rate compared to a childless woman's wages (Wilde et al. 2010). Results on wage growth are mixed, but generally suggest that women's wage growth slows significantly after having children. The exception is research by Loughran and Zissimopoulos (2009), which finds that children affect women's wage levels but not wage growth.

Innovations in measurements are also seen in recent literature. Rather than studying heterogeneity in the motherhood penalty by education level, Wilde et al. (2010) examine heterogeneity by skill level as measured by the Armed Forces Qualification Test (AFQT) score. Using the AFQT score instead of education level is advantageous because not all high-skilled individuals receive higher education, and some low-skilled individuals receive more education than might be otherwise expected.

Timing of first birth has also been redefined. Typically, when researchers study the effect of timing of first birth on the motherhood penalty, they conceptualize timing in terms of mother's absolute age. Herr (2011) reconceptualizes the issue by moving the focus away from the woman's age and instead toward the woman's entry into the labor force. In doing so, she finds that most women would actually benefit most in the long run financially if they had their first child before they entered the labor force, which is relatively uncommon. These new operationalizations of conceptual measures provide important insights into explanations for the motherhood penalty.

Future research

The motherhood penalty is a continuing concern for advocates of gender equality in the work place because the majority of empirical evidence points to persistent disadvantages for mothers compared with non-mothers, and mothers continue to constitute a large fraction of the labor force. To better understand the causes and magnitude of the motherhood penalty, researchers have tested a wide variety of theories and employed increasingly sophisticated methodological strategies. Yet, considerable work still remains.

Going forward, researchers should continue to work to better determine the causal mechanisms linking motherhood status and wages. Many studies use longitudinal designs which importantly control for fixed unobserved characteristics, but they cannot control for varying unobserved characteristics. For instance, it is possible that women's work commitment and productivity decline after becoming mothers and/or when they have additional children. Assuming that work commitment and productivity are positively associated with wages, this could be an important explanation for the wage gap based on motherhood status. Unfortunately, longitudinal data sets of U.S. women do not collect measures of either of these variables, and so only studies using proxies have been conducted (see Noonan et al. 2012).

Furthermore, more attention should be paid to measuring workplace productivity. How could productivity be better measured, whether in surveys or case studies? What individual and employer traits are associated with a worker's productivity? Knowing more

about productivity in the workplace will help researchers gain leverage in understanding the factors that underlie the residual motherhood penalty once work history and other factors are controlled.

Do mothers trade flexibility for pay? This question is difficult to test because many longitudinal data sets with large samples (National Longitudinal Surveys, Survey of Income and Program Participation) do not have detailed questions on policy use. Some examples of questions that could be asked of workers include: Who decides when you come to and leave work? Is it possible to take a day off from work without loss of pay/use of vacation time? Is it possible to make personal phone calls during the work day?

One way that motherhood is theorized to affect wages is via increased housework and childcare duties, and resulting lower energy and effort available for paid work. We are aware of two studies that have tested the housework-work effort explanation for the motherhood penalty – one using Canadian data (Phipps et al. 2001) and one using German data (Kühhirt and Ludwig 2012). Both studies find that the negative impact of children on wages remains significant, but is noticeably reduced, when time spent in housework is controlled for in the regression models. Researchers have not tested whether the extra domestic responsibilities associated with motherhood accounts for a portion of the motherhood penalty among U.S. women, but related work has found a negative effect of housework on U.S. women's wages (Hersch and Stratton 1997; Noonan 2001). Future research should explore the role of time spent in housework and childcare as an explanation for the motherhood penalty in the U.S.

Most studies find that a large portion of the motherhood wage penalty is explained away via differences in work history. Given this finding, it is important for researchers to investigate questions such as: Why do some mothers take little or no time away from the labor market and others take substantial breaks? Why and how do work interruptions depress wages? Are skills actually depreciating during periods away from the labor market? Or do employers simply view women with resume “gaps” due to childrearing as particularly ineffective workers? The theories reviewed earlier in this paper offer indications of what the answers to these questions may be, but without empirical analyses, it is impossible to know for certain.

Finally, research should continue to use innovative identification strategies to model the effect of children on women's wages. The majority of current research on the motherhood penalty examines women working in different establishments. Since the distribution of wages differs across establishment, the estimated effect of having a child, or taking a break from work, may be biased because it is in part capturing the effect of working in a given establishment. Intra-establishment data allows researchers to control for unobserved establishment-specific heterogeneity (Beblo et al. 2009). Some recent European studies have used establishment-level data to estimate the motherhood penalty in Norway (Petersen, Penner, and Hogsnes 2010) and Germany (Beblo et al. 2009). Although this approach demands data which is difficult to procure, the results could shed considerable insight into the relationship between motherhood and earnings.

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Short Biographies

Margaret Gough's research is located at the intersection of sociology of the family and social stratification; she has co-authored papers in these areas for *Journal of Marriage and Family*, *Demography*, and *Social Science Research*. Current research involves empirical research on family formation and labor market outcomes, and the effects of unemployment and the Great Recession on family health and well-being. She holds a postdoctoral fellowship from the American Sociological Association and National Science Foundation at Harvard University. She holds a BA in Social Welfare and Sociology from the University of California, Berkeley, and an MA in Statistics and PhD in Sociology from the University of Michigan, Ann Arbor.

Mary Noonan's research explores the relationship between gender, family responsibilities, and work outcomes; she has authored or co-authored papers in these areas for *American Sociological Review*, *Journal of Marriage and Family*, *Social Forces*, and *Social Science Research*. Current research investigates the use of family-friendly policies on employees' work hours and earnings. Noonan is an Associate Professor in the Department of Sociology at the University of Iowa. She holds a BA in Mathematics from Boston College, and a MPP and PhD in Sociology from the University of Michigan, Ann Arbor.

Notes

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¹ In 2008, 82 percent of women in the United States aged 40–44 had given birth, and nearly three-quarters of women with children under the age of 18 were employed (Dye 2010).

² Additionally, contraceptive failure may be a problematic instrument because the use of contraception varies based on a number of characteristics that could also influence women's labor force outcomes, including feelings of self-determination, a woman's information, and her perceived cost of childbearing. Furthermore, many unwanted pregnancies end in abortion and are therefore not observed as childbirths (Wilde et al. 2010, p. 14).

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