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Modeling the Effect of Children on Women's Wage Distribution: A Quantile Approach

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Pooling data from the 1979-2004 waves of the NLSY and employing simultaneous quantile regression methods with year fixed effects, we test whether the size of the penalty for motherhood differs across the distribution of white women's earnings. Net of controls for labor supply, human capital, family structure and demographics, we examine variation in the size of the motherhood penalty by age of youngest child, timing of first birth, and marital status at different points in women's earnings distribution. Results indicate that the motherhood wage penalty is largest for the lowest-earners: those at the 5th and 10th quantiles of the earnings distribution. Among the lowest-earners, the motherhood penalty is larger among married and divorced women, married women whose husbands work full-time, mothers of older children, and appears unaffected by the timing of motherhood. Importantly, the larger penalty found among lower earners cannot be explained by welfare receipt. Among high-earning women, the motherhood penalty is smaller, and is smallest among women who postpone motherhood past age 30, mothers of preschoolers, and married/previously married women. The smaller penalty found at this end of the distribution cannot be attributed to having husbands with reduced work hours. Contrary to past research that emphasizes greater difficulty among professional and highly skilled women in combining work and family obligations, we find the highest earners incur the smallest penalties for motherhood.

It is now widely documented that American women experience a wage penalty for motherhood (Glauber 2007; Anderson, Binder and Krause 2003; Avellar and Smock 2003; Budig and England 2001; Waldfogel 1997) as do women in other industrialized countries (Misra, Budig, and Moller 2007; Harkness and Waldfogel 2003; Todd 2001; Waldfogel 1998). But do all mothers incur the same wage penalty? Recent research has examined differences in the motherhood penalty by educational attainment (Amuedo-Dorantes and Kimmel 2005; Anderson et al 2003; Todd 2001), by the timing of first birth (Amuedo-Dorantes and Kimmel 2005; Taniguchi 1999; Miller Unpublished), across cohorts (Avellar and Smock 2003), and between racial/ethnic groups (Glauber 2007; Budig and England 2001; Waldfogel 1997; Neumark and Korenman 1994; Hill 1979). While these factors have demonstrated variance across subgroups of women in the motherhood penalty, the question of whether the motherhood penalty varies among women at different earnings levels remains unanswered. Does earnings inequality among women shape the motherhood penalty? More precisely, does the motherhood penalty vary in size across women's earnings distribution?

To date, the standard methods employed to analyze the penalty have been unable to answer this question. Past research on the motherhood wage penalty has used a variety of regression methods to estimate the impact of children on women's average earnings, including ordinary least-squares models, fixed-effects regressions, and first-differencing approaches. What all of these methods have in common is that they estimate the size of the motherhood penalty as a mean function of the conditional distribution of earnings. Estimating the impact of children at the mean tells us little about how children may affect women at the tails of the earnings distribution, and whether highly-paid women incur smaller or larger penalties for children compared to women with lower earnings. A promising method developed in economics and other disciplines, but little used in sociology (but see Hao 2002; Hao and Naiman 2007), is the quantile regression approach, originally developed by Koenker and Bassett (1978) and elaborated for panel data by Koenker (2004). This approach enables the estimation of the motherhood penalty at different points in a conditional distribution of earnings and enables us to understand the impact of motherhood on the shape of the conditional earnings distribution:

> "Each quantile regression characterizes a particular (center or tail) point of a conditional distribution; combining different quantile regressions thus provide a more complete description of the underlying conditional distribution. This analysis is particularly useful when the conditional distribution does not have a "standard" shape, such as an asymmetric, fat-tailed, or truncated distribution." (Kuan 2004:1)

Earnings distributions are almost always skewed distributions, with extreme outliers in the upper tail. While this poses problems for standard regression analysis, quantile regression does not require a normal distribution.

Koenker (2004; 2005) extended the quantile regression method to apply to longitudinal panel data through the use of maximum penalized likelihood estimation. The development of these methods allow us to extend past research that uses fixed-effects methods to estimate the motherhood wage penalty on the conditional mean of earnings to analyzing the effect of motherhood on the conditional distribution of earnings, and test whether child penalties significantly differ by earnings quantile. Moreover, using the quantile regression approach, we test how the age of children in the home, marital status of the respondent, and respondent's age at first birth interact with the motherhood penalty to affect earnings. Our goal is to provide a more complete picture of how motherhood impacts women's earnings by examining its impact on the entire distribution of women's earnings, rather than simply the effect of motherhood at the center of the distribution.

Differences in Disadvantage: Investigating Variation in the Wage Penalty for Motherhood

Much of the earnings inequality literature in sociology is dominated by the investigation of average wage gaps between groups of workers, net of other factors. However, some scholars argue for and demonstrate the importance of comparing entire wage distributions of groups to understand shifts in average inequalities. For example, Bernhardt, Morris, and Handcock (1995) argued in 1995 that "an exclusive focus on median or average earnings levels can be seriously misleading when one analyzes inequality between two groups" (p. 323). In their in-depth analysis of the decreasing gender gap in earnings, they demonstrate that its decline from 1967 to 1987 was not due to gains women made in earnings, but due to the growing inequality among men and the related movement of men from the middle into the lowest earnings categories. Despite men's shift to lower earnings categories, by 1987 eighty percent of women had earnings below the median male earnings. This is partially related to the growing inequality in women's earnings, particularly among white women. Indeed, the white women's earnings distribution was shown to be increasingly U-shaped between highest-earnings and lowest-earnings categories. These findings can only be observed by comparing distributions of men's and women's earnings. A major contribution of this research is that it demonstrated that tracking trends at the middle (average) earnings may lead to erroneous conclusions about how two groups compare; conversely, comparing the shapes of the two group distributions gives a more accurate description of the underlying differences.

Educational Attainment, Fertility Postponement, and the Wage Penalty for Motherhood

No research to date has made comparisons of the gap between mothers and non-mothers at multiple points in the earnings distribution. However, researchers have used educational attainment as a proxy for earning capacity to examine how the motherhood penalty differs across educational groupings. Generally, this body of work has concluded that motherhood penalties are smallest among the most highly educated. Using four educational attainment groupings and running separate regression models on data from the National Longitudinal Survey of Youth (NLSY), Anderson et al (2003) document that the motherhood wage penalty differs by educational attainment. They divide women by educational attainment into high school dropouts, high school graduates, college attendees with no degrees, and college graduates. Their analyses reveal a curvilinear wage penalty for children across education: the wage penalty is largest among high school graduates, and smaller among both high school dropouts and college graduates. Similarly, Taniguchi (1999) uses the NLSY data to examine the motherhood wage penalty across the same educational attainment categories. Rather than running separate regressions, Taniguchi estimates a pooled model with interactions between number of children and education. She also finds a curvilinear effect: children boost earnings among high school dropouts, produce the highest penalties for high school graduates, with penalties becoming smaller for college attendees and then college graduates. A third study in this group, Todd (2001), uses data from the Luxembourg Income Study and finds that in the U.S. and in Canada, the motherhood wage penalty is smallest among the highly educated.

These differences in the motherhood penalty by educational attainment are further shaped by the timing of motherhood in the lifecourse. A second set of studies examines the motherhood wage penalty, and the premium for each year of postponement of motherhood, by educational attainment. The earliest study in this group is by Taniguchi (1999) who interacted the number of children with the birth timing of the first child. Using National Longitudinal Data (NLS) and fixed-effects models, Taniguchi demonstrated that the net motherhood wage penalty was significant only for women who became mothers before the age of twenty-eight. Women who postponed motherhood after the age twenty-eight did not incur a wage penalty for children. Another study (Miller 2005) examining the impact of education and fertility delay on earnings with NLSY data found confirms the findings of Taniguchi. Miller (2005) shows that while there is a motherhood wage gap, it is smallest for college educated women who delay having their first child until after age 30. A third study in this group, also using NLSY data, is Amuedo-Dorantes and Kimmel (2005). They examine the impact of children on women's wages among female college graduates only. They find wage penalties for one child and for two or more children among women college graduates, however, these penalties are smaller among women who postpone motherhood to later ages. Net of the child penalty, they find a positive effect of postponement, increasing with each year of postponement of motherhood. The analyses of our paper also examine the impact of postponing motherhood until after age thirty.

In summary, motherhood wage penalties appear to be smaller among the highly educated and among women who delay the onset of motherhood. Highly educated women are more likely to be in demanding careers and should be among the higher paid women in the labor market. However, educational attainment is imperfectly related to earnings. Particularly at the post-secondary level, field of specialization significantly shapes the relationship between education and earnings, with women receiving greater returns for degrees in business administration, compared to social sciences, for example (Budig and Fugiero 2008; Marini and Fan 1997). Thus, using education to proxy positions in the distribution of women's earnings is an important first step, but directly estimating the size of the motherhood penalty at differing quantiles of the earnings distribution may not simply replicate findings from the educational attainment approach.

Family Structure and the Wage Penalty for Motherhood

In addition to measuring the wage penalty by the number of children a woman has, we test a measure of motherhood that incorporates the age of the youngest child. Some research finds that the age of children shapes the penalty, with younger children producing greater penalties (Anderson et al 2003; Avellar and Smock 2003). Finally, we examine how marital status shapes motherhood. Previous research has found greater penalties for married and previously married mothers, compared to never married mothers (Glauber 2007; Budig and England 2001). One obvious explanation for greater penalties among the ever married is that married mothers may have more flexibility to reduce their labor supply. However, these differences persist in models even after the inclusion of controls for hours worked, experience, and seniority. Yet it could still be the case that married women, who have greater access to a partner's earnings, are more willing to trade earnings for family friendly jobs and workplaces. If so, the employment status of a married woman's partner, and the number of hours he works, may explain part of the wage penalty. Moreover, husbands' paid employment may impact women differently depending upon how much a woman earns. Among low-earning women, having a full-time employed husband may lead to larger motherhood penalties if these women trade job amenities for wages when they can depend on their husband's employment situation. In contrast, among high-earning women, having a husband who workers *fewer* hours or not at all may lead to a smaller wage penalty for motherhood to the extent a reduced working schedule enables a husband to provide more child care. To examine the impact of husband's working schedules, we run supplemental analyses on married women only and interact husband's work hours with number of children in the home.

Other Factors Contributing to Motherhood Wage Penalty Variation

The findings of variation in the size of the child penalty across educational groupings leads us to anticipate similar variation in the penalty across the earnings distribution. The finding of larger penalties at the lower end of the educational distribution might be linked to social welfare receipt. If less skilled women are more likely to receive AFDC or TANF payments during the period of our observations, but can only receive these payments if they remain under an earnings threshold, this may lead to a larger motherhood wage penalty. This would occur if mothers purposefully kept their earnings lower in order to receive social benefits. To test this, we examine whether welfare receipt can explain a larger penalty at the lower end of the earnings distribution.

A few recent studies examine whether the wage penalty for motherhood varies by race and ethnicity, but the findings have been inconsistent. Newsome and Dodoo (2002) demonstrate that the motherhood wage penalty increased from 1980 to 1990 among African-American women. Yet their findings contradict those of Glauber (2007) who finds consistent motherhood penalties among white women, no penalties among Latinas, and occasional penalties among black women, depending upon marital status and number of children. Finally, Budig and England (2001) tested for differences in the motherhood penalty between Latinas, African-American, and white women, finding smaller penalties for Latinas and also for black women with three or more children. In studies comparing African-American and white women, Waldfogel (1997), Neumark and Korenman (1994), and Hill (1979) found smaller penalties for African-American women, while Anderson et al (2003) found few differences in the wage penalty, with the exception that white women receive larger penalties for adolescents. Given the complex and inconsistent findings on racial differences in the motherhood penalty, and given the complexity of our current analysis, we limit our current analysis to white women.

Other factors that partially explain the motherhood wage penalty are well documented and include human capital and labor supply measures; occupational, industrial, and job characteristics; current family structure and spousal characteristics; and unmeasured heterogeneity (Anderson et al 2003; Budig and England 2001; Waldfogel 1998). Previous studies have reduced unmeasured heterogeneity through person- and year-fixed-effects models and our research extends this tradition. Because we lack employer data, we are unable to test the extent to which employer discrimination explains the wage penalty for motherhood, though past work finds evidence of such discrimination (Correll, Benard, and Paik 2007).

Data

Our analyses pool the 1979- 2004 waves of the National Longitudinal Survey of Youth (NLSY), a national probability sample of individuals. The respondents were interviewed annually up to the 1994 survey and were interviewed bi-annually thereafter. The initial survey took place when respondents were aged 14- 21. In 2004, the ages of respondents range from 39 to 46. We limit the sample to women who are employed and have valid data on all variables used in our analyses. This results in 36,361 observations where person-years are the units of analysis (16,934 person-years for mothers and 19,427 person-years for non-mothers).

Variable Measurement

The dependent variable is the natural logarithm of hourly wage in the respondent's current job at the time of the survey.[1] We top and bottom code hourly wages at $1 and $200.[2] The primary independent variable is the total number of children reported by the respondent as of the interview date.[3] In addition to estimating the effects of number of children in the home on earnings, we also use alternate specifications for motherhood. In supplementary analyses we measure motherhood using dummy variables indicating a mother with a preschool child at home, a mother of all older children, with non-mother as the reference category. We also test whether

[1] We replicated models using annual earnings. Effects were much larger, but the consistent pattern of lower earning women incurring larger penaltyies for motherhood was robust in all models.

[2] We use top and bottom codes to minimize the effects of extreme outliers. However, we verified that our use of these top/bottom codes does not alter the distribution of earnings. Less than 3% of observations had earnings above $200 per hour, thus the same observations remain in the top 5th of the distribution regardless of the top code procedure. We also ran models without these top/bottom codes and results were robust.

[3] We tested an alternate measure with dummy variables for one child, two children, and three or more children, (no children as the reference category). We found monotonic increases in the motherhood penalty with these measures, results were robust, and we decided to use the more efficient measure of number of children in all models.

the effects of motherhood vary by the timing of motherhood in the lifecourse. To do so, we create a dummy variable indicating postponement of first birth until the age of 30 or older. We interact this indicator with number of children to examine how timing of motherhood influences the child penalty. To examine whether children affect women's earnings differently depending on their marital status, some models include interactions between marital status categories and number of children. We measure marital status, with dummy variables indicating currently married, currently divorced (and not remarried)[4], with never-married serving as the reference category.

Remaining independent variables include human capital, labor supply, and demographic characteristics. Human capital measures include education (measured as highest grade completed in most models), years of total work experience, and years of seniority (experience with current employer). These measures cover the respondent's work history from 1979. In addition, we include the total number of jobs ever worked to control for the affect of job turnover on the respondents' income. We also include a dummy variable indicating current school enrollment. We also have multiple measures for labor supply. We control for the number of annual weeks worked, number of weekly hours, and a squared term for weekly hours.

Demographic variables include age of respondent, racial/ethnic group, and dummies for urban and rural areas and for the southern, north central, and northeastern, with the northwest as the reference category. We also include the unemployment rate of the respondent's county.

Statistical Models

To analyze the penalty at differing points in the income distribution, we use a semi-parametric regression approach known as quantile regression (Koenker 2005). Past research on the motherhood wage penalty has used elaborations of the classical least-squares regression on

[4] Divorced also includes widows, which number too few cases to analyze separately with this young sample.

the conditional mean, producing averaged estimates of the wage penalty. In contrast, quantile regression enables simultaneous estimation of the motherhood penalty at various percentage points of the earnings distribution. This approach allows us to test whether the wage penalty for motherhood significantly differs among women at different points in the wage distribution. We analyze the following seven quantiles: the lowest fifth (.05), tenth (.1), the lowest quartile (.25), the median (.5), the top quartile (.75), the top tenth (.9), and the top fifth of the income distribution (.95). A simplified model for quantile regression can be expressed as follows (Koenker and Bassett 1978; Bunchinsky 1998): Let (y_i,x_i), i=1,…,n, be a sample from some population where x_i is a K x 1 vector of regressors,

$$(1)\quad y_i = x_i^{'}\beta_\theta + u_\theta, \quad Quant_\theta(y_i \mid x_i) = x_i^{'}\beta_\theta, \quad Quant_\theta(u_{\theta i} \mid x_i) = 0$$

Where $Quant_\theta(y_i| x_i)$ denotes the conditional quantile of y_i, conditional on the regressor vector | x_i. The Linear model for the θ^{th} quantile solves the following minimization to obtain β:

$$(2)\quad \min \frac{1}{n}\left\{ \sum_{i:y_i \geq x_i^{'}\beta_\theta} \theta \mid y_i - x_i^{'}\beta_\theta \mid + \sum_{i:y_i \geq x_i^{'}\beta_\theta} (1-\theta) \mid y_i - x_i^{'}\beta_\theta \mid \right\}$$

The dependent variable, Y, is the natural logarithm of hourly earnings. We use the logarithmic transformation to enable comparison of effects across the wage distribution. For example, compared to workers at the 5th quantile, the dollar amount difference between mothers and non-mothers at the 95th quantile is a larger number because the baseline earnings at the 95th quantile is much higher. However, as a proportion of earnings at a given quantile, the effect of motherhood may be larger at the 5th quantile (despite the smaller dollar value). Logarithmic transformation enables a comparisons of these proportionate effects across the earnings distribution, whereas using untransformed earnings would misleadingly show a larger effect (dollar-wise) of motherhood at the higher quantiles. We use a post-estimation linear combination of estimators technique to test whether the coefficients generated at specified quantiles are significantly different from one another. This enables us to identify whether the motherhood wage penalty is significantly larger or smaller between paired quantiles that are adjusted by control variables in the model.

Koenker (2004; 2005) extended the quantile regression method to apply to longitudinal panel data through the use of maximum penalized likelihood estimation. As previously stated, because we have multiple time-point observations for each respondent structured into person-years data, we fix effects across time and individuals by demeaning all variables used in our analyses. To do this, we calculate each person's mean value across the number of years they appear in the data, and subtract that mean from each year's value. To deal with the potential autocorrelation of the error term resulting from multiple observations for each respondent, we obtain estimates of the standard errors by bootstrapping the residuals of the quantile regression. As developed for quantile regression by Gould (1992) and Hahn (1995), bootstrapping estimates the entire variance-covariance matrix of the estimators and corrects for heteroskedasticity. In table A1 in the appendix and in analyses not shown, we compared results obtained from median quantile regression models with those obtained from two-way fixed-effect models on the conditional mean.[5] Table A1 in the appendix gives these results for the fixed effects and quantile methods for the full model. Because the fixed-effects regression estimates the effect of children on the conditional mean, while quantile regression estimates this effect on the conditional median, we expected some small differences in the size of coefficients. If there is any tendency in the differences between estimating the effects of children on the conditional mean versus the conditional median as presented in table A1, it appears that child penalties are less likely to be significant in the quantile models. However, the sizes of coefficients are similar between the two

[5] Complete results for all variables are available upon request.

approaches, and the directions of the relationships are consistent. Overall, these comparative results from different models verify that our coefficients are unbiased in the quantile model, and we are confident that the quantile regression method provides a valid portrait of the effects of motherhood across the income distribution with pooled person-year data.

We begin our analysis by fitting four analytical models including a baseline model incorporating number of children a woman has and her age. The second model adds to the measures in model 1 current marital status and demographic controls (race/ethnicity, region of country, residential population density, and respondent's county's unemployment rate). The third model includes measures in model two plus labor supply indicators: usual weekly hours worked, a squared term for usual hours, annual weeks worked, and number of jobs ever held. The fourth model includes measures in model three, and adds human capital measures, such as highest grade completed, years of experience, years of seniority (experience with current employer), and school enrollment status. This staged approach enables us to examine how the motherhood penalty changes as we introduce sets of theoretically and empirically relevant variables that past research have found to partially explain the wage penalty for motherhood.

We next examine whether the age of children alters the motherhood wage penalty by estimating gross and full models where we measure motherhood with a set of dummy variables indicating age of youngest child. We then examine whether the age of the mother at the time of her first birth interacts with the child penalty. Our final analysis further investigates the variation of the penalty by marital status. Here we create statistical interactions between married and previously married and the number of children.

Results

Table 1 presents unadjusted means and standard deviations for all variables used in the analyses, separately for mothers and childless observations. T-tests for significant differences in paired means were used to test for differences between mothers and childless observations. Survey weights are not used due to the person-year structure of the data. As a group, childless observations are at younger ages than observations of mothers -- the mean age of childless observations is 25.6 and while the mean age of observations of mothers is 32.1. Due to this difference in age, corresponding differences are expected and observed between mother person-years and childless person-years in current family status, human capital, and job characteristics measures. Childless observations are more likely to live in urban areas and in the northeastern region of the U.S. Mothers have, on average, 1.8 children and roughly twenty-six percent of the mother person-years have a preschool child in the home. More than seventy-five percent of mothers are currently married.

What are the effects of children on earnings? Table 2 shows the effect of each additional child on women's ln hourly earnings from simultaneous quantile fixed-effects regression models with bootstrapped standard errors. The child penalties are estimated at the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th} quantiles for all model specifications. Figure 1 shows these penalties graphically for the gross model and for the fully specified model. Starting with a gross child penalty model that controls only for age of respondent, we find that the child penalty is -11.5 percent per child for women at th 5^{th} quantile of earnings, and becomes significantly smaller in a monotonic pattern (-7 percent at the 10^{th} quantile to -2 percent at the 95^{th} quantile) as we move across the earnings distribution. This pattern of lower earning women incurring larger penalties for children persists as we add sets of theoretically relevant variables to the model. Adding family structure and demographic characteristics in model 2 *increases* the child penalty at all quantiles, indicating that marital status and local labor market conditions boost mothers' earnings (controlling for these factors thereby increases the child penalty). Adding labor supply variables in model 3 decreases the penalty for the median and lowest earners, but increases the penalties among the top quantiles of the earnings distribution. This demonstrates that mothers or women with more children are working fewer hours and weeks, compared to childless women and women with fewer children at the lower end of the earnings distribution. However, among high-earning women, mothers/women with more children appear to be working more hours and weeks compared to childless women/women with fewer children. In contrast, human capital measures added in model 4 explain the largest portion of the motherhood wage penalty among the median to highest quantile earners, but do little to explain the penalty among the lowest earners. Adding human capital measures reduces the penalty by 40% at the 25th and 50th quantiles, and explains over 50 percent of the penalty at the 75th, 90th and 95th quantiles. Thus, mothers in the upper half of the earnings distribution incur wage penalties largely due to lost experience surrounding childbearing. However, lost experience explains virtually none of the much larger remaining penalty among women at the 5th and 10th quantiles of the earnings distribution. These women experience significant penalties of 10 and 5 percent per child, respectively, and these penalties are larger than penalties experienced at any other point in the earnings distribution. In summary, table 2 reveals four major findings: 1) that there is a wage penalty for motherhood across the wage distribution that persists with the addition of control variables; 2) reduced working hours among the lowest earners accounts for a significant portion of this penalty; 3) lost experience accounts for half of the penalty among women in the upper 50 percent of the wage distribution; and 4) women with the least to lose are losing the most—the motherhood penalty is significantly larger among women in the lowest 5th and 10th quantiles of the earnings distribution.

In table 3 we present results from gross and fully-specified models for the child penalty, however we use a different measurement of motherhood that accounts for the age of the youngest child. Past research shows that the women's labor supply decreases the most when they have a preschool child and rebounds as children become school age (Leibowitz and Klerman 1995). Although some work shows that the motherhood penalty does not vary by the age of the youngest child (Budig and England 2001) other studies find greater penalties for small children (Anderson et al 2003). In table 3 we divide mothers into those whose youngest child is 5 years old or younger from mothers whose children are all older than 5 years. Both the gross and full models shown in table 3 clearly show that the motherhood penalty is largest among women with older, not younger, children. The sole exception is women whose earnings are at the 5th quantile; here, the penalty for younger children is larger for that of older children, and this persists when all control variables are included. Looking at the gross model, there is a significant penalty for mothers of preschoolers only at the 5th and 10th quantiles, while the total penalty experienced by mothers of all older children ranges from 12 percent to 26 percent, with the highest penalties again found in the lowest quantile of the earnings distribution. When control variables are included, these penalties change drastically. Figure 2 shows the penalties for the fully specified model in graphic form. First, significant motherhood penalties emerge among mothers with preschool children at all quantiles: yet again, women at the lowest quantiles incur the largest penalties for small children of 19 and 8 percent. The penalty for older children decreases across quantiles until the 75th quantile, where it appears to rise slightly. However, significance tests show that penalties across the 50th, 75th, 90th, and 95th quantiles are not significantly different. Secondly, significant penalties persist for older children, though they are much reduced with the inclusion of control variables. In the fully specified models, women at the median and 75th

quantiles of the earnings distribution incur relatively smaller (6 percent) older child penalties compared to the lowest earning (15 to 9 percent) and highest earning (11 percent) women. In analyses not shown, we sequentially added sets of control variables to the initial model and found again that the single variable that explains the largest portion of the motherhood penalty is years of experience.

Why do we find that the motherhood penalties are generally larger for mothers of older, compared to younger children (with the exception of the 5^{th} quantile)? Because we are using dummy variables to indicate motherhood in this equation, we decided to test whether mothers of older kids simply had more children in the home compared to mothers with at least one younger child. In analyses not shown, we added total number of children in the home to control for this. Our results were robust: there were small wage penalties in the full model for younger children, but there were significantly larger penalties for mothers of all older children, with the largest penalties incurred at the lowest quantiles of the earnings distribution. Other factors might account for the larger penalty experienced by mothers of all older children. It is possible that there is greater selectivity into employment among mothers of very young children, and only employed person-years are included in this analysis. If mothers with greater career ambitions constitute a larger share of mothers who are employed when children are young, compared to mothers who are employed when children are older, this positive selectivity may reduce the child penalty experienced among mothers of younger children. Indeed, Budig (2003) found that while younger children pulled women out of the labor market, older children increased women's likelihoods of part-time and full-time employment, indicating greater selectivity among mothers of younger children in terms of entering the labor force. However, we are using person- and year-fixed effects models, which should reduce this unmeasured heterogeneity and selectivity. A stronger argument regarding why mothers of older children might experience a larger penalty than mothers of younger children could be that motherhood penalties are accrued over time. A woman with a young child likely has fewer years between the birth of that child and its potential effects on her wage, thus she may have not had enough time for a large wage gap to emerge between. A mother of all older children has likely been experiencing the effects of reduced human capital, lowered productivity, and/or employer discrimination against mothers for a longer period, increasing the wage penalty over time. In sum, results in table 3 and figure 2 show greater penalties for mothers of older children, and these penalties are significantly larger among the highest and lowest earning women at the 5th and 95th quantiles.

We also wondered whether the timing of motherhood could shape the size of the wage penalty. Do women who postpone fertility until they reach age 30 incur different motherhood penalties compared with women who bear children at earlier ages? Table 4 offers evidence that the answer varies based on the earnings distribution, and figure 3 presents the effects for the full model in graphic form. For most women, the answer is no: for women in the 75th quantile and below, the motherhood penalty does not vary by the mother's age at the first birth. Moreover, it remains significantly largest for women at the 5th quantile of earnings and decreases across quantiles. However, in the extreme upper tail of the earnings distribution, the story is different: while becoming a mother before the age of 30 years results in a 3 percent penalty per child at the 90th and 95th quantiles, in contrast, becoming a mother after the age of 30 is associated with a wage *bonu*s in these top two quantiles. Late motherhood is associated with a 2 percent per child wage bonus at the 90th quantile and a 4.6 percent wage bonus at the 95th quantile. While surprising, these findings are consistent with those of Taniguchi (1999), Miller (2005), and Amuedo-Dorantes and Kimmel (2005) all of whom found wage penalties for early motherhood that were strongest among the least educated, while no motherhood penalties for postponed motherhood. Amuedo-Dorantes and Kimmel further found wage premia associated with postponed motherhood among the highly educated.

Table 5 and figure 4 show the effects of number of children on earnings separately by marital status from the fully specified model (with all controls). Among the never married, we find a significant wage penalty for motherhood across all quantiles, but that is five times as large at the lowest earnings quantile (5^{th}) compared to 25^{th} and higher quantiles. Among married and previously married women, we find a significant motherhood penalty of 20 to 25 percent per child at the 5^{th} quantile, followed by a declining penalty of 10 to 12 percent at the 10^{th} quantile, 3 to 5 percent at the 25^{th} quantile, and 2 percent per child at the median and 75^{th} quantiles (note that the motherhood penalty does not vary by marital status at the median). In contrast, at the 90^{th} and 95^{th} earnings quantiles we do not find a wage penalty for motherhood among married or previously married women. Indeed, we again see wage *bonuses* for partnered motherhood of 4 to 10 percent per child at the 90^{th} and 95^{th} quantiles the earnings distribution. That we find larger motherhood penalties among currently married and previously women at the bottom half of the distribution is consistent with findings from past research (Glauber 2007; Budig and England 2001). A husband's earnings may enable mothers to temporarily opt out of the labor force or choose more family-friendly jobs with the sacrifice of higher wages. If such an exchange is made, it may have effects that persist even after the marriage has ended. Conversely, never married women are very likely to have been the sole or main breadwinner in their families, in addition to mothering. The reliance of children on never-married mothers' earnings only increases the pressure for their labor market participation. However, the findings of wage premia at the 90^{th} and 95^{th} quantiles indicates that previous wage penalty research has not fully captured the extent of variation among married and previously married women. We considered whether women at the top end of the earnings distribution might be more likely to have husbands who were more available to provide child care, thus alleviating women of the challenge of balancing work and family responsibilities while simultaneously increasing pressure for the woman to be the breadwinner for the family. To investigate whether high-earning women were more likely to be following a breadwinner-caregiver model with reversed gender roles, in supplementary analyses we interacted husband's work hours with number of children to see how the mother penalty/bonus varied. To do so, we created dummy variables indicating a non-employed husband, a part-time employed husband, and a full-time employed husband, with no husband being the reference category. We did not find evidence that the child bonus for women at the 90th and 95th quantiles was greater among those with non-employed or part-time employed husbands. In sum, table 5 and figure 4 show greater penalties for married women at the lower end of the earnings distribution, while married and previously married women at the highest earning women at the 90th and 95th quantiles receive bonuses for motherhood.

The consistent finding that women at the lowest position in the earnings distribution incur the largest wage penalty for motherhood also merited further investigation. To test whether this larger penalty was linked to pressures on mothers at this earnings level to keep earnings low in order to continue to receive social welfare payments (AFDC or TANF), we interacted a measure of social welfare receipt with number of children. In these supplemental analyses, we did not find evidence that low-earning women receiving social welfare differed in terms of the child penalty from low-earning women not receiving welfare payments.

Discussion

The major contribution of our study was to investigate whether the well-documented wage penalty for motherhood, previously estimated at the conditional mean of wages, varied in size across women's earnings distribution. To do so we utilized a relatively new method developed in economics to estimate the motherhood wage penalty at the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th} quantiles of the earnings distribution. The weight of evidence from our analyses of the motherhood penalty and its interaction with other factors reveals that the motherhood gap is largest among the lowest paid women, net of controls. While adding cumulative sets of theoretically derived control variables reduces the wage penalty for motherhood, and the reduction in experience associated with motherhood accounts for much of the wage penalty, these controls do the least to explain the penalty among the lowest earning women. In supplemental analyses we confirmed that this larger penalty incurred among the lowest paid is not due to their attempts to keep wages low enough to receive social welfare. Receipt of AFDC and TANF payments is not linked with variation in the size of the motherhood penalty.

It is well documented that women located on the lower end of the earnings distribution experience difficulty combining work and family obligations. These jobs typically entail the fewest benefits (health, life, and sick time), the closest supervision, and the least autonomy in setting the pace and intensity of work. In past work one of us (Budig 2006) argues that low-paying non-professional work drives mothers into self-employment arrangements in an attempt to balance work and family demands. Indeed, when we analyze the motherhood penalty by age of the youngest child, we see that mothers of preschoolers incur a penalty that is almost 4 times as great at the lowest quantile of earnings, compared to higher quantiles. Yet the same pattern does not appear for mothers of older children. This again speaks to the difficulty of combining high family responsibilities with work responsibilities in low-paid jobs. A final finding supporting this argument is that we see labor supply accounts for significantly more of the motherhood wage penalty at the lowest quantile, indicating women with low-wage jobs are more likely to reduce work hours to accommodate motherhood. According to our results, these women can least afford a large wage penalty given their already low wages.

Although the fundamental pattern of motherhood penalties among highly paid women persists, we find occasional and surprising wage premiums certain subgroups of high-earning women: 1) those who postpone motherhood and 2) those who are married or previously married. To examine whether high-earning married mothers are following a breadwinner model with reversed gender roles, we examined whether the effects of motherhood varied by the intensity of the husband's work hours. We found no evidence that high-earning married women were receiving wage premiums for motherhood due to having more care-giving spouses; if anything, it appeared that high-earning women with fully employed husbands were the most likely to receive a motherhood premium. We do not have strong arguments to explain this motherhood bonus phenomenon for high-earning married and post-poned childbearing mothers. It could be that these women are positively selected in ways not captured in our models. As Moen, Waismel-Manor, and Sweet (2003) found in their investigation of dual-earner couples, individuals do not always play a zero-sum game in terms of trading off success at work for success at home. Rather they find evidence of a "synergy in domain success [that] results in overall successful living" (Moen, Waismel-Manor, and Sweet 2003:134). At the risk of reifying a "supermom" image, we argue that more research is needed to unpack these motherhood wage premia for subgroups of highly successful women.

Beyond these instances of motherhood premiums for some subgroups of high-earning women, our analyses still consistently show smaller motherhood penalties for the highest paid workers. Indeed, our analysis contradicts recent arguments about the speed-up of demands in professional careers and how this makes motherhood even less compatible with work, compared to non-professional careers. While we have ruled out arguments regarding social welfare receipt and spousal care-giving availability as explanations for this asymmetrical penalty across women's earnings distribution, more research is needed to unpack the mechanisms producing this variation. Our major contribution in this analysis has been to demonstrate that not all mothers incur the same wage penalties for children and that the mothers who can least afford to lose wages are the ones incurring the largest penalties. These findings are new and could only be discerned by utilizing a methodology that analyzes the entire distribution of wages and how it is shaped by motherhood, rather than relying on estimating the motherhood penalty at the center of the earnings distribution. We hope that the application of quantile regression gains greater usefulness in examining variation in effects for a wider variety of sociological questions.

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Table 1: Descriptive Statistics by Motherhood Status: Means, Standard Deviations, and t-tests

Independent Variables	Mothers	Childless Women
	N=16,934	N=19,427
Family Structure		
Number of Children	1.84	--
	(0.87)	
Mother of at Least One Child < 6 yrs	0.26	--
	(0.44)	
Mother of All Older Children > 5 yrs	0.21	--
	(0.41)	
Currently Married	0.76***	0.32***
	(0.43)	(0.46)
Currently Divorced	0.19***	0.10***
	(0.40)	(0.29)
Never Married	0.05***	0.59***
	(0.21)	(0.49)
Human Capital & Labor Supply		
Current School Enrollment	0.05***	0.18***
	(0.21)	(0.38)
Years of Seniority	4.14***	2.57***
	(4.44)	(3.10)
Years of Experience	9.79***	6.16***
	(5.82)	(4.77)
Usual Weekly Hours	34.89***	36.30***
	(11.80)	(11.56)
Number of Jobs Ever Held	7.98***	6.57***
	(4.88)	(4.70)
Annual Weeks Worked	43.94***	45.54***
	(14.37)	(11.84)
Job Characteristics		
Hourly Wage	9.96***	8.00***
	(9.06)	(7.23)
Demographic		
Age	32.10***	25.64***
	(6.56)	(5.72)
Inner City Residence	0.06***	0.13***
	(0.24)	(0.34)
Suburban Residence	0.65***	0.62***
	(0.48)	(0.49)
Rural Residence	0.29***	0.25***
	(0.45)	(0.43)
Southern Region	0.34***	0.31***
	(0.47)	(0.46)
Northeastern Region	0.17***	0.23***
	(0.37)	(0.42)
North-central Region	0.32***	0.28***
	(0.48)	(0.45)
Western Region	0.17	0.17
	(0.37)	(0.38)
County Unemployment Rate	2.74***	2.98**
	(0.95)	(1.06)

Notes: ** is $p \leq 0.05$; *** is $p \leq 0.01$.

Table 2: Effect of Number of Children on Women's Ln Hourly Earnings from Fixed-Effects Quantile Regression Models with Bootstrapped Standard Errors [a]

Quantile	**.05**	**.10**	**.25**	**.50**	**.75**	**.90**	**.95**
	Coeffic (SE)	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**
Model 1: Gross[b]	**-.115** (.013)**	**-.074** (.009)**	**-.045** (.005)**	-.036** (.002)	-.034** (.005)	-.032** (.007)	-.023** (.008)
Model 2: + Demographics and Family Structure[c]	**-.141** (.017)**	**-.105** (.008)**	**-.069** (.005)**	-.054** (.003)	-.052** (.004)	**-.041** (.006)**	**-.027** (.01)**
Model 3: + Labor Supply[d]	**-.103** (.009)**	**-.068** (.007)**	-.046** (.003)	-.038** (.004)	-.041** (.005)	-.043** (.005)	-.047** (.009)
Model 4: + Human Capital	**-.103** (.015)**	**-.053** (.007)**	-.029** (.004)	-.021** (.004)	-.025** (.004)	-.025** (.005)	-.022* (.01)

Notes: * is p≤ 0.05; ** is p ≤ 0.01. [a] Bolded numbers indicate coefficients significantly differ from other coefficients within the same model at different quantiles. [b] Gross model includes number of children and age of respondent. [c] Model 2 includes measures in model 1, plus current marital status and demographic controls (region of country, population density, county unemployment rate). [d] Model 3 includes measures in model 2 plus usual weekly hours, hours squared, annual weeks worked, and number of jobs ever held. [e] Model 4 includes measures in model 3, plus highest grade completed, years of experience, years of seniority, enrollment status.

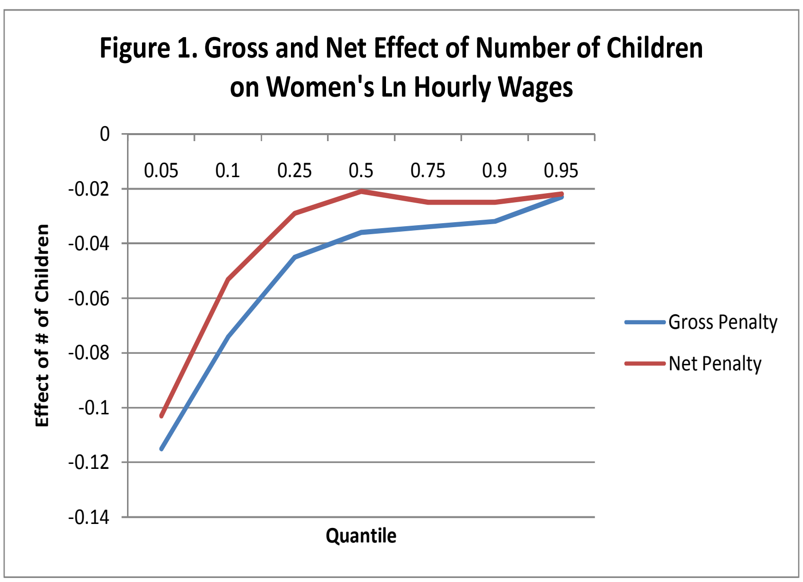

Table 3. Effect of Motherhood by Age of Youngest Child on Women's Ln Hourly Earnings from Fixed-Effects Quantile Regression Models with Bootstrapped Standard Errors [a]

Quantile	.05	.10	.25	.50	.75	.90	.95
	Coeffic (SE)	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**
Model 1: Gross [b]							
Mom of Preschooler(s)	**-.106** (.024)**	**-.037* (.02)**	.0002 (.008)	-.006 (.007)	-.01 (.005)	-0.005 (.014)	0.02 (.019)
Mom of Older Child(ren)	**-.259** (.029)**	**-.20** (.013)**	-.133** (.01)	-.12** (.007)	-.117** (.009)	-0.12** (.013)	-0.13** (.026)
Model 4: Full [c]							
Mom of Preschooler(s)	**-.186** (.032)**	**-0.08** (.015)**	-.034** (.01)	-0.017** (.007)	-.025** (.009)	-0.028* (.013)	-0.043* (.02)
Mom of Older Child(ren)	**-.153** (.038)**	-0.093** (.022)	-.079** (.01)	-0.064** (.007)	-.068** (.012)	-0.087** (.017)	-0.113** (.025)

Notes: * is p≤ 0.05; ** is p ≤ 0.01. [a] Bolded numbers indicate coefficients significantly differ from other coefficients within the same model at different quantiles. [b] See notes for model 1 in table 2. [c] See notes for model 4 in table 2.

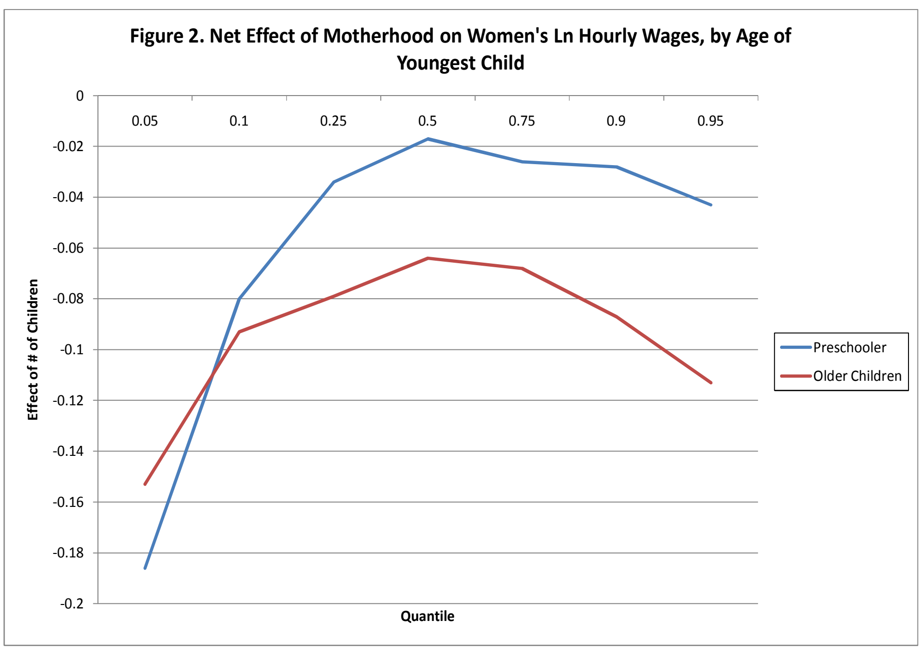

Table 4. Effect of Number of Children on Women's Ln Hourly Earnings by Age of Mother at First Birth from Simultaneous Quantile Regression Models with Bootstrapped Standard Errors [a]

Quantile	**.05**	**.10**	**.25**	**.50**	**.75**	**.90**	**.95**
	Coeffic (SE)	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**
Model 4: Full [b]							
1st Birth Before Age 30	**-.110** (.014)**	**-0.056** (0.008)**	-.028** (.006)	-0.022** (0.004)	-.01** (.004)	-0.031** (.006)	-0.027* (.011)
1st Birth Age 30 or Older	-.110**	-0.056**	**-.028****	**-0.022****	**-.01****	.019**	.046**

Notes: * is p≤ 0.05; ** is p ≤ 0.01. [a] Bolded numbers indicate coefficients significantly differ from other coefficients within the same model at different quantiles. [b] See notes for model 1 in table 2. [c] See notes for model 4 in table 2.

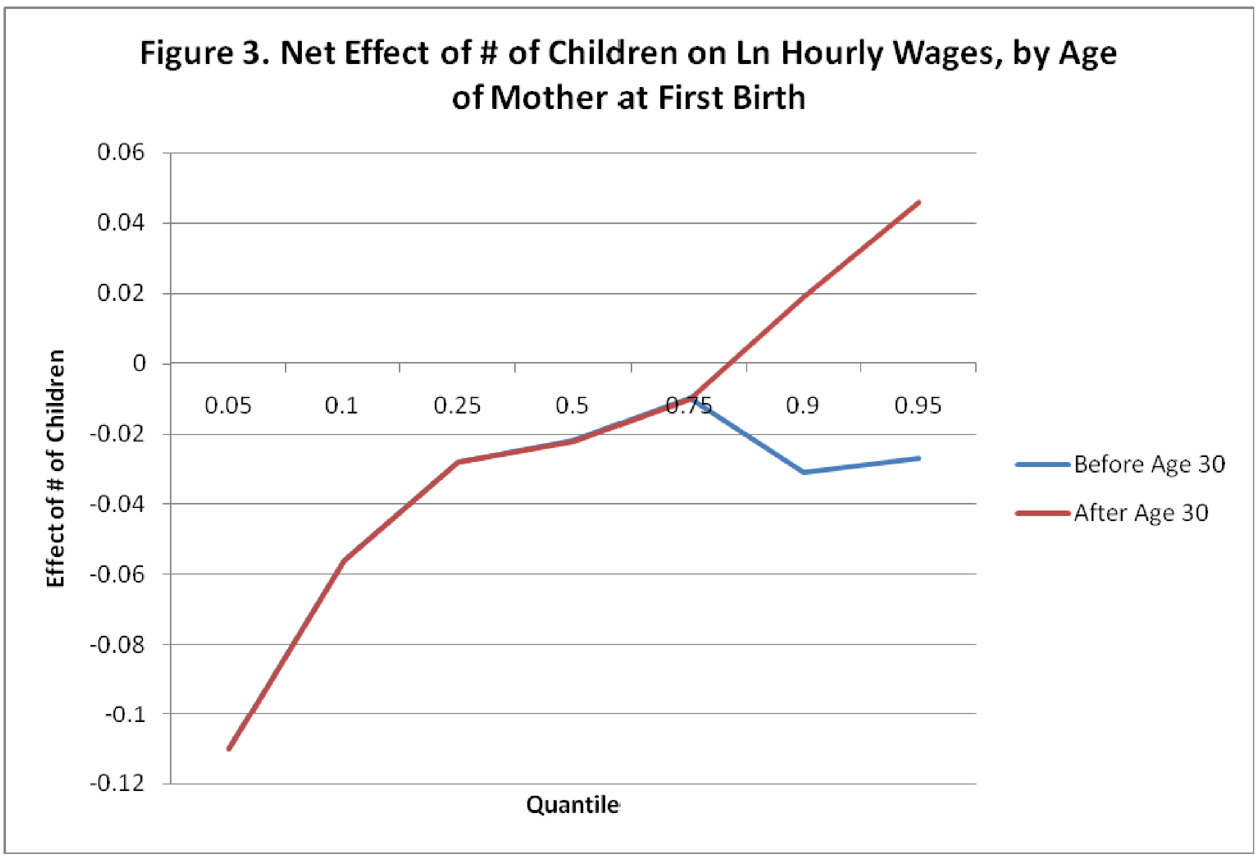

Table 5. Effect of Number of Children on Women's Ln Hourly Earnings by Marital Status from Simultaneous Quantile Regression Models with Bootstrapped Standard Errors [a]

Quantile	.05	.10	.25	.50	.75	.90	.95
	Coeffic (SE)	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**	**Coeffic (SE)**
Model 4: Full [b]							
Never Married	**-.103** (.018)**	**-0.054** (.011)**	-.028** (.005)	-0.022** (.004)	-.025** (.004)	-0.026** (.005)	-0.028* (.008)
Married	**-.252****	**-0.129****	**-.028****	**-0.022****	**-.01****	**0.041****	**0.102***
Divorced/Separated	**-.201***	**-0.106****	**-.053****	-0.022**	-.025**	**0.041****	**0.102***

Notes: * is p≤ 0.05; ** is p ≤ 0.01. [a] Bolded numbers indicate coefficients significantly differ from other coefficients within the same model at different quantiles. [b] See notes for model 1 in table 2. [c] See notes for model 4 in table 2.

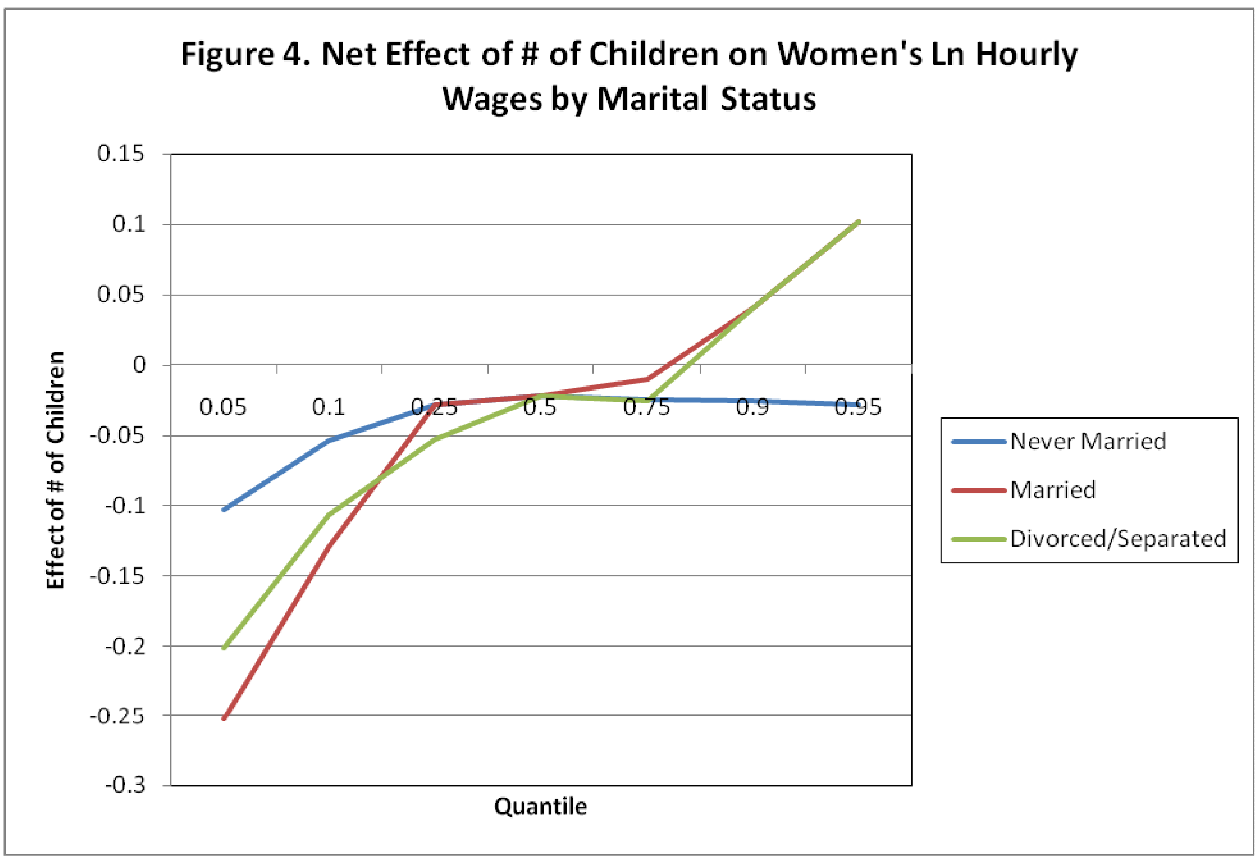

Table A1. Effects of Children on Women's Ln Earnings from Fixed-Effects Regression Models on the Conditional Mean and Conditional Median

	Person- and Year-Fixed Effects on Conditional Mean	Person- and Year-Fixed Effects Regression on Conditional Median, Bootstrapped SEs
Full Model: # of Children	-0.018**	-0.021
	(0.003)	(0.032)
Full Model: # Child by Age of Youngest		
Preschooler	-0.018**	-0.017**
Older Child	-0.026**	-0.064**
	(0.004)	(0.007)
Full Model: Postponement		
1st Birth Before Age 30	-0.021**	-0.022**
	(0.003)	(0.004)
1st Birth Age 30 or Older	0.004	0.022**
Full Model: By Marital Status		
Never Married	0.018**	-0.022
	(0.005)	(0.003)
Married	-0.013**	-0.022**
Divorced/Separated	-0.009	-0.022**

Notes: * is p≤ 0.05; ** is p ≤ 0.01.