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## Domestic Work and the Wage Penalty for Motherhood in West Germany

*Previous research suggests that household tasks prohibit women from unfolding their full earning potential by depleting their work effort and limiting their time flexibility. The present study investigated whether this relationship can explain the wage gap between mothers and nonmothers in West Germany. The empirical analysis applied fixed-effects models and used self-reported information on time use and earnings as well as monthly family and work histories from the German Socio-Economic Panel (1985–2007, N = 1,810; Wagner, Frick, & Schupp, 2007). The findings revealed that variation in reported time spent on child care and housework on a typical weekday explains part of the motherhood wage penalty, in particular for mothers of very young children. Furthermore, housework time incurred a significant wage penalty, but only for mothers. The authors concluded that policies designed to lighten women's domestic workload may aid mothers in following rewarding careers.*

The wage penalty for motherhood—that is, the negative effect of having children on

women's hourly wages—presents a major obstacle to further improvements in women's career prospects and thus to an amelioration of gender inequalities persisting in labor markets throughout the industrialized world (Budig & England, 2001; Gangl & Ziefle, 2009; Harkness & Waldfogel, 2003). As a consequence, the mechanisms driving mothers' wage disadvantages have already been the subject of much research. Even so, the motherhood penalty remained significant in most studies after controlling for women's human capital and job characteristics (Anderson, Binder, & Krause, 2003; Avellar & Smock, 2003; Budig & England; Gangl & Ziefle; Glauber, 2007; Waldfogel, 1997; Ziefle, 2004).

In the present study, we assessed whether part of the residual wage penalty results from mothers' heavy domestic workload (Baxter, Hewitt, & Haynes, 2008; Craig & Mullan, 2010), a factor whose importance has not been fully explored in the literature. Previous research has begun to demonstrate that both former involvement in family work and institutional arrangements regulating coverage and duration of maternity leave play an important role in explaining mothers' wage disadvantages (Ruhm, 1998; Waldfogel, 1998a; Ziefle, 2004); however, several theoretical arguments suggest that daily household responsibilities may continue to hamper mothers' career progress after they return to the labor market. Domestic tasks may reduce work effort (Becker, 1991, pp. 54–79), conflict with job schedules (Anderson et al., 2003), and constrain the number of feasible work tasks (Stratton, 2001). These arguments

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are underpinned by empirical research that has documented a detrimental effect of household work on earnings (Coverman, 1983; Noonan, 2001; Shirley & Wallace, 2004).

In light of this background, we expected the wage gap between mothers and childless women to narrow after accounting for individual variation in time spent on housework and child care during a typical weekday. Furthermore, mothers of toddlers should incur the largest penalties net of differences in human capital and job characteristics, because caring for young children is a particularly strenuous and inflexible task (Hill & Stafford, 1980; Kimmel & Connelly, 2007). Finally, we hypothesized that routine housework is likely to have a detrimental effect on work life and wages, in particular for mothers, because tasks associated with raising children cannot be postponed to evenings or weekends (Noonan, 2001).

In our empirical analysis, we focused on single and partnered women from West Germany. We used self-reported information on time use and earnings as well as monthly family and work histories drawn from the 1985 through 2007 waves of the German Socio-Economic Panel (SOEP). Contrary to the United States and even Scandinavia, since 1986 the German state has provided an exceptionally generous, universal maternity leave (see Henninger, Wimbauer, & Dombrowski, 2008, and Morgen & Zippel, 2003, for an overview of German family policy and its consequences for female employment). At the same time, West Germany still pales in comparison to East Germany, most of northern Europe, and France regarding the availability of public child care, in particular with respect to full-time care and prekindergarten slots. With private sector alternatives far less developed than, for instance, those in the United States, child care and associated household tasks remain for the most part in the hands of families. As in most industrialized countries, German women still perform the lion's share of unpaid work in the home, despite men's increasing participation in the last 40 years (Hook, 2006). As a consequence, women's employment—and, notably, mothers' employment—in West Germany is marked by relatively long career breaks and a low full-time participation rate. Given the German institutional setting, one would therefore expect strong wage effects of having children. A recent study indeed found the motherhood wage penalty to be much larger

in West Germany than in Britain and the United States (Gangl & Ziefle, 2009).

#### PREFERENCES, LABOR MARKET BEHAVIOR, AND DISCRIMINATION

Previous empirical studies of the motherhood wage penalty have focused primarily on three factors on the supply side: (a) lower motivation or career orientation of mothers (see Budig & England, 2001, for a discussion), (b) deficits in human capital resulting from career breaks after childbirth (Mincer & Ofek, 1982), and (c) mothers trading higher earnings for work conditions that help them combine work and family after reentry into the labor market (Becker, 1991). To assess the explanatory power of these factors, models to estimate the motherhood penalty have included measures of education, work experience, job tenure, number and duration of employment breaks, and a variety of job characteristics. Fixed-effects (FE) regression models have been used to control for time-constant, unobserved preferences.

Nonetheless, a residual effect of the number of children on hourly wages remained in most studies. For the United States, Waldfogel (1997) analyzed data of the National Longitudinal Survey of Young Women for the period 1968 through 1988. After controlling for education, work experience, and part-time employment, she found a wage penalty of 4% for mothers with one child and of 12% for those with two or more children. In the same data, accounting for type of industry and financial resources outside the labor market reduced the effect to 3% and 5.5%, respectively (Anderson et al., 2003). The analysis of more recent U.S. data from the National Longitudinal Survey of Youth (NLSY79) from 1982 to 1993 still yielded a wage penalty on the order of 4% per child, even after controlling for a large number of job characteristics (Budig & England, 2001). Avellar and Smock (2003) compared the penalty across birth cohorts, using National Longitudinal Survey of Young Women and NLSY79 data covering the period 1975 through 1998. The results showed no decline in the unexplained effect in the United States. In several Scandinavian countries, on the contrary, differences in human capital and type of job seem sufficient to explain the motherhood wage penalty. After controlling for education, work experience, and time out of the labor market,

no significant wage effects of having children appeared in Denmark from 1980 to 1995 (Datta Gupta & Smith, 2002) or in Sweden in the early 1990s (Albrecht, Edin, Sundström, & Vroman, 1999). A recent Norwegian study using firm-level employer–employee data (Petersen, Penner, & Høgsnes, 2010) reported a wage penalty of merely 0.6% for mothers with one child and 1.4% for those with two or more children in the period 1990 through 1996 after accounting for firm, occupation, and exact job unit. These relatively small motherhood penalties may result from institutional settings particular to the Scandinavian welfare state that combines maternity leave of moderate duration with a high level of state-subsidized child care (Waldfoegel, 1998b).

Comparative research has shown that the introduction of short maternity leave periods in the United States and Great Britain may mitigate the wage loss at reentry into the labor force (Waldfoegel, 1998a). Nevertheless, Baum (2002) still found a remaining wage penalty of 2.4% in the NLSY79 data after controlling for the duration of maternity leave. For Germany, Ziefle (2004) analyzed the motherhood penalty with SOEP data from 1984 to 1999. She reported a significant motherhood penalty of 1% per child after including controls for occupation and industry, as well as the cumulative duration of employment breaks. In this study, the adverse effects of long career breaks became obvious. According to Ziefle's estimates, German women incurred a wage loss of 4.8% for each year of maternity leave. Given that the maximum duration of maternity leave was extended to 3 years in 1992, this result implies strong negative policy effects on mothers' careers.

In contrast to Ziefle (2004), a recent comparative study (Gangl & Ziefle, 2009) showed that only women in Britain and the United States face significant wage losses after family-related work interruptions (defined as time out of the labor force while the youngest child was younger than age 6), whereas in West Germany these employment breaks were not associated with a decline in wages. Nevertheless, West German mothers incurred by far the largest wage penalty after accounting for the aforementioned factors on the supply side. Gangl and Ziefle hypothesized that German employers may discriminate against mothers in order to compensate for the costs of long maternity leave periods. In fact, scholars have

referred to discrimination to explain the residual motherhood wage penalty in the United States as well (e.g., Budig & England, 2001; Correll, Benard, & Paik, 2007). Nevertheless, attributing the residual wage effects of motherhood entirely to discrimination may be inadequate, because empirical research to date has not fully explored the role of women's increased domestic workload after childbirth (Baxter et al., 2008; Craig & Mullan, 2010).

### *Domestic Work and Women's Wages*

Several theoretical arguments suggest that the time and effort devoted to raising children and maintaining the home affect women's wages. The most prominent argument posits that strenuous domestic work depletes a woman's energy and thus causes distraction and exhaustion on the job (Becker, 1991, pp. 54–79). In an early cross-sectional study, Bielby and Bielby (1988) examined self-reported measures of work effort of women and men in the 1973 and 1977 Quality of Employment Surveys (QES). Their results suggested no negative association between child care or housework hours and work effort; nevertheless, caring for preschool children reduced women's reported effort. A replication study with Swiss data (Engelhardt & Jann, 2004) revealed a negative impact of child care on work effort, but no effect of housework hours. Moreover, the effect of child care turned nonsignificant after job characteristics were taken into account.

Nonetheless, other studies repeatedly have found a negative association between domestic work and earnings. In a small cross-sectional sample drawn from the 1977 QES, each hour of domestic work per week reduced women's weekly income by 0.5% (Coverman, 1983). In a similar but more recent sample from the 1996 Indiana QES, 1 hour of child care and housework per week were associated with a 0.6% and a 1% drop in annual earnings, respectively (Shirley & Wallace, 2004). Noonan (2001) used two waves of the National Survey of Families and Households and estimated FE models of hourly wages on housework hours to control for unobserved heterogeneity. She found a negative wage effect of traditionally female household tasks (i.e., cooking, doing laundry, and cleaning) of 0.5% per weekly hour. Strikingly, the effect of children on wages was

not statistically significant in any of these three studies after including housework measures in the models.

These findings indicate that there might be mechanisms by which family life interferes with work that were neglected by Becker's (1991) concept of work effort. According to Greenhaus and Beutell (1985), work-family conflict may not only be the only result of the strain associated with the obligations of family roles; inflexible schedules in both domains also may cause time pressures. On one hand, daily family responsibilities are likely to make it difficult to work inflexible or odd hours (Anderson et al., 2003; Bonke, Datta Gupta, & Smith, 2005). Anderson et al. concluded that inflexible working hours and not reduced work effort caused the residual wage penalty, because in their analyses medium-skilled mothers, who faced the most rigid working hours on average, suffered the strongest disadvantages. On the other hand, time constraints resulting from household tasks may keep mothers from participating in work-related training activities or from fulfilling job tasks involving travel (Stratton, 2001).

Interestingly, Noonan (2001) found that only housework traditionally performed by women had a negative impact on wages: Domestic tasks typically done by men (i.e., maintenance work) did not significantly affect wages in her study. The findings were similar for men and women. Noonan concluded that routine housework is much less time flexible than men's domestic work, which, in most cases, can easily be moved to the weekend so it does not interfere with work life.

### *The Present Study*

If the arguments outlined above hold true, then individual variation in child care and housework hours should explain part of the residual motherhood penalty found in most countries, including the United States and Germany. Little is known about the role of current involvement in family work with regard to the wage penalty for motherhood, because empirical studies have not shown how the effect of having children on wages changes after accounting for women's time in domestic work. In the present study, we addressed this issue by adding self-reported time spent on housework and child care during a typical weekday to regression models commonly

used to estimate the motherhood wage penalty. If the domestic workload after childbirth is an important contributing factor, then the effect of motherhood on wages should decline as a consequence.

Moreover, the residual motherhood penalty should be strongest for mothers of younger children, because providing care for younger children sets a particularly strict schedule and is most energy intensive (Hill & Stafford, 1980; Kimmel & Connelly, 2007). Of course, disadvantages of mothers due to career breaks and (repeated) job changes are likely to accumulate as the children grow older, resulting in larger overall wage penalties due to having older children (Budig & Hodges, 2010, pp. 720f.). Once differences in job type and industry are controlled for, in addition to education and work experience, the wage penalty in the United States in fact seems to decline with the age of the children (Anderson et al., 2003). In our analysis, we used an observation window of up to 20 years to assess changes in the size of the wage penalty as children grow older.

Last, for mothers, housework may have a particularly adverse effect on wages, whereas for childless women household tasks may pose no career obstacle. Similar to maintenance work usually done by men, for which no association with wages was found (Noonan, 2001), in the absence of children it may be possible to postpone routine household tasks to evenings or weekends so that they do not interfere with one's work life. To evaluate this hypothesis, our analyses included time spent on both routine housework and maintenance work. In addition, we investigated whether the effect of reported routine housework hours on hourly wages depends on the presence of children.

To estimate the motherhood wage penalty, we compared the wage trajectories of initially childless women who became mothers during the observation period with those of women who remained childless. We also controlled for changes in relationship status because of its high correlation with fertility, time use, and wages. In accordance with previous research (Budig & England, 2001; Budig & Hodges, 2010; Gangl & Ziefle, 2009; Ziefle, 2004), we used education, work experience, and tenure with the current employer to capture differences in human capital. To control for diverging job choices of mothers and nonmothers, we included measures of working hours, occupational prestige, and

firm size, as well as variables indicating self-employment, employment in the public sector, and participation in vocational training. Employment histories that correlate with family formation and career outcomes are measured by the number of past employer changes as well as the cumulative duration of employment breaks in connection with maternity leave and with being a homemaker.

## METHOD

### *Data*

We used waves 1985 through 2007 of the SOEP (Wagner, Frick, & Schupp, 2007), a survey of nationally representative households that has been conducted annually since 1984 (mainly by means of computer-assisted personal interviews). The data contain information about household members' labor market characteristics at the time of the interview as well as on their family and work histories from age 16 onward. In contrast to most large-scale panel surveys, the SOEP contains respondents' reported time use, including hours of housework and child care on a typical weekday. Therefore, it is well suited to address the questions raised in this article.

The focus of our analysis on women during their childbearing years led us to exclude all but the 1960 through 1974 birth cohorts (17,078 women, 72.2% of female respondents from 1985 to 2007). From the remaining 6,583 women, we deleted 1,422 (21.9%) living in the area of the former East Germany, because high rates of the provision of public child care might mitigate the impact of motherhood on the domestic workload of women and thus distort the results of our analyses. By considering only observations from years in which women were working at least 1 hour per week we further reduced the sample by 926 (17.9%), leaving 4,235 employed West German women who ranged in age from 16 to 47. The deletion of observations with missing data resulted in the loss of 705 (16.6%) of these women. Additionally, we further dropped observations with implausible values (e.g., childless women with maternity leave experience) and those belonging to the upper and lower 0.5 percentiles of the wage distribution (i.e., hourly wages above €45.23 [~64.22 USD] or below €2.20 [~3.12 USD]), thus losing 59 (1.4%) and 20 (0.5%)

more women, respectively. To analyze how motherhood affects women's wages, we also excluded women who had already been mothers in the year with the first valid observation (1,412 women, 32.9%) and those who provided only one observation (249 women, 5.9%). Hence, we were able to analyze data from 1,810 women, who were observed for 7.6 years on average, yielding a total of 13,843 individual-years.

Compared with the full sample of 4,235 employed West German women in their childbearing years, women in the final sample were slightly younger and more often single. Mainly because of the restriction to initially childless women, there were also fewer mothers in the final sample, especially those with two or more children. As a consequence, the proportion of women working full time was higher, whereas average child care and housework hours, as well as the mean duration of employment breaks, fell short of those in the full sample.

In Table 1 we provide descriptive statistics for the final sample regarding the real hourly wage and the explanatory variables. The "Mothers" column refers to observations from 622 women who became mothers, whereas the "Nonmothers" column includes data from the 1,188 women in our sample who remained childless. There were 456 mothers who were observed while they had one child and 339 mothers who were observed with two or more children. Finally, the sample included 173 mothers who were observed first with one child and again, later, with two or more children. Because mothers remained in the sample for 10 years on average, and thus roughly 3.5 years longer than nonmothers, they provided nearly as many individual-years. Of the 6,238 individual-years provided by mothers, 2,696 years were prebirth observations. Furthermore, there were 1,801 postbirth observations from mothers with one child and 1,741 individual-years from mothers with two or more children. We should note that the prospective design of the SOEP and the resulting attrition among respondents may have led women who had children after they had dropped out of the sample to be included in the "Nonmothers" group.

Taking into account the whole observation period, mothers earned merely €0.25 (~0.36 USD) per hour less than nonmothers. More obvious discrepancies emerged regarding time use and employment breaks. Even including their prebirth observations, mothers reported

Table 1. *Women's Characteristics by Motherhood Status: Descriptive Statistics*

Variable	Mothers		Nonmothers		<i>p</i> Δ <sup>a</sup>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Deflated hourly wage (€) <sup>b</sup>	11.39	5.26	11.64	5.60	.01
One child	0.29	0.45			
Two or more children	0.28	0.45			
Family responsibilities					
Reported daily child care (hours)	3.55	4.99	0.03	0.35	.00
Reported daily housework (hours)	3.11	1.79	2.19	1.32	.00
Reported daily maintenance (hours)	0.44	0.69	0.29	0.66	.00
Maternity leave (years)	1.17	1.54			
Homemaker (years)	0.61	1.51	0.07	0.54	.00
Job-related variables					
No. changes of employer	1.83	1.68	1.23	1.45	.00
Full-time employment (>35 hours)	0.52	0.50	0.87	0.34	.00
Part-time employment (16–35 hours)	0.32	0.47	0.10	0.31	.00
Marginal employment (<16 hours)	0.16	0.37	0.03	0.16	.00
Self-employed	0.03	0.17	0.02	0.15	.00
Public sector	0.27	0.44	0.29	0.45	.02
Occupational prestige score (SIOPS)	42.82	11.41	43.93	11.34	.00
Currently in vocational training	0.05	0.21	0.10	0.30	.00
Firm with ≤ 20 employees	0.35	0.48	0.30	0.46	.00
Firm with 21–200 employees	0.24	0.43	0.25	0.43	.46
Firm with 201–2000 employees	0.19	0.39	0.22	0.41	.00
Firm with >2,000 employees	0.21	0.41	0.23	0.42	.03
Human capital					
Work experience, full time (years)	6.06	4.27	7.27	6.26	.00
Work experience, part time (years)	2.53	3.54	0.77	2.07	.00
Job tenure (years)	5.51	5.33	5.44	5.33	.45
Education (years)	11.84	2.38	12.27	2.62	.00
Control variables					
Never-married single	0.19	0.39	0.46	0.50	.00
Cohabiting	0.13	0.34	0.22	0.42	.00
Married	0.62	0.49	0.26	0.44	.00
Separated, divorced, or widowed	0.05	0.22	0.05	0.22	.91
Age	30.89	6.76	29.37	6.85	.00
<i>N</i> individuals		622		1,189	
<i>N</i> individual-years		6,238		7,605	

Note: Values are rounded. Nonmothers include women who may have had children after sample participation. SIOPS = Treiman's (1977) Standard International Occupational Prestige Score.

<sup>a</sup>From a two-tailed *t* test. <sup>b</sup>As of September 4, 2011, €1.00 = 1.42 USD.

almost 4 hours of routine housework and child care per day, roughly 2 hours more than nonmothers. Mothers' previous employment breaks amounted to almost 2 years, whereas nonmothers rarely interrupted their careers for family reasons. Despite statistical significance, there was only a small difference between mothers and nonmothers regarding reported time spent doing maintenance work.

With respect to job-related characteristics, we observed that motherhood was associated with a pronounced cut in working hours. Whereas 87% of nonmothers worked full time, 48% of mothers were either employed part time or held a marginal job. The prestige of jobs held by mothers was also slightly lower than that of those held by childless women. Moreover, most mothers worked in small firms, with 20 or fewer

employees, where wages are typically lower than in bigger firms. Women without children were distributed more equally among the different firm sizes.

We also noted differences between mothers and nonmothers in terms of human capital. Although mothers, on average, were 1.5 years older than women without children, they gathered 1 year less of full-time work experience. Additionally, mothers had 2.5 years of part-time work experience, whereas childless women spent less than 1 year in part-time employment. Mothers also attained less formal education than nonmothers.

Last, mothers were married in more than 60% of the observations, compared with only 26% of the observations provided by women without children. The latter were predominantly never-married singles. Because sexual orientation could not be determined for all SOEP respondents, both the mothers and nonmothers possibly included lesbians.

### *Measures*

The dependent variable of this study was the natural logarithm of the deflated gross hourly wage, reflecting women's productivity over the life course. Respondents in the SOEP reported the income from their primary job in the month preceding the interview, excluding any additional payments (i.e., vacation bonus or back pay), but taking into account earnings from overtime. We calculated hourly wages by dividing the gross monthly income by 4.35 times the reported weekly working hours at the primary job. If actual working hours were not available, we added up reported contractual working hours and overtime.

To estimate the effect of motherhood on wages, we used two different specifications. First, we constructed two dummy variables indicating whether, at the time of the interview, a woman had one child or two or more children. As an alternative measure, we introduced the number of children disaggregated into five age groups covering typical stages in the life of children. The first variable counted children younger than 3 years, whereas the next three variables included the number of children eligible for preschool (3–6 years), primary school (7–10 years), and secondary school (11–15 years), respectively. The last group consisted of children age 16 years and

older. By using the latter approach we attempted to capture a decreasing effect of children on wages following a decline in the demand of domestic labor as children grow older (Hill & Stafford, 1980; Kimmel & Connelly, 2007). Both specifications were created from monthly birth histories the female respondents completed during each interview. A drawback of using these birth histories was their omission of stepchildren and adopted children.

To assess the impact of family responsibilities on the wages of mothers, we introduced measures of former and current involvement in housework and child care. Former involvement was measured by the duration of employment breaks: years on maternity leave and years spent as a homemaker. These variables were constructed from monthly activity calendars collected in each survey wave. Respondents were asked to report on their employment and nonemployment activities during each month of the last calendar year. The categories were full-time and part-time employment, apprenticeship, further education, unemployment, retirement, maternity leave, school and university, community service and military service, and homemaker, as well as a residual category. In constructing the duration of employment breaks, periods for which respondents reported any other activity besides maternity leave and homemaking were not taken into account. Information on current involvement in family work was collected with the question "How many hours do you spend on the following activities on a typical weekday?" Among the activities presented to the respondents were housework (i.e., cooking, doing laundry, cleaning), errands (i.e., shopping, trips to government agencies, etc.), child care, and maintenance work (i.e., repairs in and around the house, gardening). Until 1990, housework and errands were combined into one category. Therefore, we summed up the time spent on these activities for the years after 1990 to derive a measure of routine housework. In the 1984 survey, housework and child care were subsumed under a single category, which was the reason why we excluded the first wave of the SOEP from the analysis. Further activities included in the questionnaire every year, which we did not use in the analysis, were education or further training; job, apprenticeship, or second job (including commuting); and hobbies. We also did not use the time spent on "care

of persons in need of care,” because the category was added only in 2001. In addition to the main effects of housework, child care, and maintenance work on wages, we modeled an interaction between the number of children and reported housework hours to capture differences concerning the intensity and time flexibility of routine housework for mothers and nonmothers.

Our control variables included reported age (linear and squared term) and marital status. Marital biographies were collected as monthly history data in the same way as the activity calendar. We distinguished among never-married singles; cohabiting women; married women; and women who were separated, divorced, or widowed. As measures of human capital we used years of education, full-time and part-time work experience, and tenure with the current employer. We relied on generated measures available in the SOEP that were based on self-reported educational degrees and the monthly activity data. For the experience and tenure measures we included an additional squared term. To control for the different job choices of mothers and nonmothers, we added measures of current working hours (<16, 16–35, >35 hours) that were constructed from the variables used to calculate the hourly wage. Furthermore, we included Treiman’s (1977) Standard International Occupational Prestige Score, as provided by the SOEP, which is generated from self-reports of respondents’ current industry and occupation. We created the cumulative number of changes of employer on the basis of yearly data on occupational changes between interviews. Finally, we included firm size ( $\leq 20$ , 21–200, 201–2,000, >2,000 employees) and dummy variables indicating whether the respondent had participated in vocational training, worked in the public sector, or was self-employed at the time of the interview. These variables were all derived from self-reported information. In each model, we also included 23 indicators of the survey year.

### Analytic Strategy

For our multivariate analysis, we estimated linear FE panel regression models (e.g., Wooldridge, 2010). In our baseline model, we regressed (log) hourly wages onto dummy variables for one child and for two or more children, age and age squared, and indicators of the survey year. FE models use multiple observations per

person to decompose the error term of a linear regression model into a time-constant error term,  $v_i$ , and an error term,  $\varepsilon_{it}$ , that varies over time. The model is given by the following equation:

$$\begin{aligned} \log(\text{wage}_{it}) = & \alpha + \beta_1 \text{child1}_{it} + \beta_2 \text{child2}_{it} \\ & + \gamma_1 \text{age}_{it} + \gamma_2 \text{age}_{it}^2 + \mathbf{wave}_{jit} \delta_j \\ & + v_i + \varepsilon_{it}, \end{aligned}$$

where  $\beta_1$  and  $\beta_2$  denote the motherhood penalty for one child, respectively, for two or more children. Applying the FE within-subject transformation—that is, subtracting the individual-specific mean of each variable from its actual value in each time period—eliminates the time-constant error component  $v_i$  from the equation. Hence, we estimated the following equation:

$$\begin{aligned} \Delta \log(\text{wage}_{it}) = & \beta_1 \Delta \text{child1}_{it} + \beta_2 \Delta \text{child2}_{it} \\ & + \gamma_1 \Delta \text{age}_{it} + \gamma_2 \Delta \text{age}_{it}^2 \\ & + \Delta \mathbf{wave}_{jit} \delta_j + \varepsilon_{it}, \end{aligned}$$

where  $\Delta(\cdot)$  denotes deviations from the individual-specific mean. Including indicators of the survey wave in the regression model also controls for changes in the wage structure over (calendar) time, affecting both mothers and nonmothers (i.e., period effects). This allowed us to assess the impact of motherhood against a common wage trend. Similarly, age effects gave a baseline wage profile against which the motherhood penalty could be singled out. We interacted age and its square with indicators of the birth cohort (1960–1964, 1965–1969, and 1970–1974) to account for the trend toward steeper wage trajectories for women over time.

Because the FE estimator builds solely on intraindividual change (i.e., within-subject variation), it rules out any bias due to time-constant unobservables. Estimates of the motherhood penalty thus are not biased by any individual factors affecting fertility decisions, time allocation, and market wages constantly over the life course. Although coefficients are also not affected by sample selectivity that is caused by individually stable factors, sample selection that evolves over time may bias the results. For example, low-wage women might opt out of the labor force after childbirth, thus biasing the effect of motherhood toward zero.

We corrected our models for dynamic sample selection, as proposed by Wooldridge (1995) and implemented by Gangl and Ziefle (2009), but the selection correction did not affect the main conclusions of the analysis. Therefore, we decided to report conventional FE estimates. The consistency of our models still rests on the assumption that the impact of unobservables, such as career orientation, does not change over time.

## RESULTS

### *Number of Children and Women's Wages*

The data in Table 2 show the effect that the number of children had on wages that was obtained from FE regressions after successively adding different explanatory variables. In the table we also report the coefficients for family-related employment breaks and current involvement in domestic work. Model 1 took into account age and period effects only. Using this specification, we obtained a large penalty of about 16% ( $= [e^{-.178} - 1] \times 100$ ) for one child and of 29% for two or more children. Already from this first model it seems clear that unobserved stable differences in career orientation between mothers and childless women do not explain the lower wages of mothers.

Model 2 included the variables capturing differential investment in market-specific human capital as well as indicators for current marital status. These factors accounted for another portion of the wage loss associated with motherhood, reducing the wage penalty slightly, to 14% and 24%, respectively. A test of the hypothesis that mothers earn less because they sort themselves into mother-friendly jobs with low pay was provided by Model 3. Including the job-related variables (cf. Table 1) hardly reduced the effect of having one child. The effect of having two or more children, on the other hand, further declined to 17%. Mothers' job choices seemed to be significantly affected only by higher parity (i.e., affected only by higher order births). Although the included job characteristics were important predictors of women's wages, as shown by the large increase in explained variance, they did little to account for mothers' wage disadvantages. Thus, the residual effect of having children was still strong and significant.

In the next step, we included measures of former family-related employment breaks. In

Model 4, years on maternity leave and years as a homemaker, without formal employment, had a strong impact on wages. Hence, the time in women's lives devoted mainly to raising children and doing housework decreased their future earning potential. In part, this explains why mothers earn less than nonmothers. This refinement of the model reduced the wage penalty for having one child to 8% and to 9% for having two or more children. In this model, the penalty did not increase substantially after the birth of a second child, pointing to a remaining effect of the motherhood status rather than of the number of children.

With Model 5, we went beyond the existing literature by introducing detailed measures of women's current engagement in family work, to further decompose the residual wage penalty for motherhood. We estimated the motherhood penalty net of reported time devoted to daily domestic work. The results suggested that a woman's wage decreases by 1% for each hour spent on routine housework during the working day. In addition, each hour devoted to child care was associated with 0.3% lower wages. Like in previous research in the United States (Noonan, 2001), time spent on maintenance work had no significant wage effects. Most important, these factors further reduced the residual motherhood wage penalty. The effects of having one child and those of having two or more children both decreased to -6%. Interestingly, and as one would expect, the effect of years on maternity leave became smaller when we used this specification. In Germany, for most of the period 1985 to 2007, maternity leave was granted from 2 months before childbirth to 3 years after childbirth. Because this is the time when child care is most intensive, part of the effect of maternity leave was explained by time devoted to these daily routine tasks. According to our estimates, the first year of maternity leave decreased the woman's wage by 4%, the second year decreased it by 8%, and the third year decreased it by 12%. These figures are similar to those reported earlier for Germany (Ziefle, 2004). For 1, 2, and 3 years of homemaking, Model 5 predicted that wages are lowered by 4%, 8%, and 11%, respectively.

In sum, employment breaks and current family work explained more than half of the wage penalty for motherhood remaining after controlling for human capital and job characteristics. Including the three measures of

Table 2. Summary of Fixed-Effects Regression Analyses Predicting Women’s Log Real Hourly Wage from Number of Children and Covariates (N = 13,843 Individual-Years From 1,810 Women)

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	SE								
One child	-.178**	.019	-.148**	.021	-.127**	.021	-.083**	.030	-.059*	.030
Two and more children	-.339**	.029	-.268**	.034	-.184**	.032	-.090†	.048	-.063	.047
Daily child care (hours)									-.003*	.001
Daily housework (hours)									-.011**	.003
Daily maintenance (hours)									-.002	.005
Maternity leave (years)							-.049*	.023	-.047*	.023
Maternity leave squared							.002	.003	.002	.003
Homemaker (years)							-.045**	.016	-.043**	.016
Homemaker squared							.001	.001	.001	.001
Other explanatory variables										
Job-related variables	No		No		Yes		Yes		Yes	
Human capital	No		Yes		Yes		Yes		Yes	
Marital status	No		Yes		Yes		Yes		Yes	
Age and survey year	Yes									
R <sup>2</sup> (within subject)	.394		.421		.578		.580		.581	

Note: All models include age, age squared, and 23 indicator variables for the survey year. Marital status includes the categories never-married single; cohabiting; married; and separated, divorced, or widowed. Human capital is measured by years of education, full-time and part-time work experience, and job tenure. Job-related variables are number of changes of employer; working hours; occupational prestige (Treiman’s [1977] Standard International Occupational Prestige Score); firm size; and indicator variables for self-employment, employment in the public sector, and participation in vocational training.

†  $p < .1$ . \*  $p < .05$ . \*\*  $p < .01$ .

domestic work in the analysis further reduced the effect of having one child by one fourth and the effect of having two and more children by one third. Because women who did not have children themselves reported very little time spent on child care, the measure was, to some degree, collinear with the number of children. As a sensitivity test, we reestimated Model 5, including only person-years of mothers after the first birth. The coefficients for all types of domestic work remained virtually unchanged in this model. Each hour of housework reduced the wage by 1% ( $p = .02$ ). The effect of child care remained at -3% ( $p = .05$ ), whereas the effect of maintenance work was still not significant ( $p = .78$ ). Therefore, we are confident that time spent on housework and child care indeed lowers mothers’ wages and thus helps explain the wage gap between them and nonmothers.

#### Children’s Age and Women’s Wages

In the next step of the analysis, we looked at the variation of the motherhood penalty as the children grow older and investigated whether

time dedicated to housework and child care accounted for the time path of the penalty. In Table 3 we show the results of regression analyses in which we substituted the dummy variables for having one and for having two or more children from the models in Table 2 by disaggregated linear measures of the number of children belonging to five age groups; otherwise, the model specifications were the same as those in Table 2. These results revealed the time path of the wage penalty for motherhood. Model 6 showed clearly that the motherhood penalty increased as the children grew older, reflecting the cumulative negative effects of all mechanisms, including employment breaks and job changes. For children younger than age 3, we found a wage penalty of 13.2%. In the oldest age group (16 years and older), each child lowered wages by 18.2%. The penalties for children 3- through 15-years-old ranged in between. Holding constant the differences in education, work experience, and job characteristics in Model 7 and Model 8 mainly reduced the effects of children at age 3 and older. In Model 8, the wage penalty became strongest for children

Table 3. Summary of Fixed-Effects Regression Analyses Predicting Women's Log Real Hourly Wage from Number of Children in Different Age Groups and Covariates (N = 13,843 Individual-Years From 1,810 Women)

Variable	Model 6		Model 7		Model 8		Model 9		Model 10	
	B	SE	B	SE	B	SE	B	SE	B	SE
No. children aged 0–2	-.142**	.019	-.133**	.019	-.117**	.019	-.071**	.024	-.054*	.024
No. children aged 3–6	-.151**	.015	-.120**	.018	-.071**	.016	-.007	.023	.001	.023
No. children aged 7–10	-.174**	.019	-.134**	.023	-.065**	.019	.000	.024	.005	.024
No. children aged 11–15	-.162**	.024	-.120**	.029	-.043†	.024	.021	.026	.020	.027
No. children aged ≥16	-.201**	.032	-.173**	.040	-.064†	.033	-.001	.035	-.004	.035
Daily child care (hours)									-.003*	.001
Daily housework (hours)									-.010**	.003
Daily maintenance (hours)									-.002	.005
Other explanatory variables										
Employment breaks	No		No		No		Yes		Yes	
Job-related variables	No		No		Yes		Yes		Yes	
Human capital	No		Yes		Yes		Yes		Yes	
Marital status	No		Yes		Yes		Yes		Yes	
Age and survey year	Yes		Yes		Yes		Yes		Yes	
R <sup>2</sup> (within subject)	.394		.421		.578		.581		.582	

Note. All models include age, age squared, and 23 indicator variables for the survey year. Marital status includes the categories never-married single; cohabiting; married; and separated, divorced, or widowed. Human capital is measured by years of education, full-time and part-time work experience, and job tenure. Job-related variables are number of changes of employer; working hours; occupational prestige (Treiman's [1977] Standard International Occupational Prestige Score); firm size; and indicator variables for self-employment, employment in the public sector, and participation in vocational training. Employment breaks are measured by years on maternity leave and years as a homemaker.

†  $p < .14$ . \*  $p < .05$ . \*\*  $p < .01$ .

under age 3 at 11%. Each child 3- through 6-years-old reduced wages by 6.9%. The wage penalties for children in the three subsequent age groups were 6.3%, 4.2%, and 6.4%, respectively. The change in the wage penalties for younger and older children between Model 6 and Model 8 resemble the conflicting results for the effect of children's age on wages in the United States. Controlling for education, work experience, and other factors similar to those in Model 7, Budig and Hodges (2010) found that the wage penalty increased with children's age. Also holding constant the job characteristics as in Model 8, Anderson et al. (2003) found that the largest penalties were associated with having very young children.

How did this picture change after we controlled for the time mothers invested in child-rearing? The coefficients of Model 9 show that controlling for family-related employment breaks reduced the wage penalty for children of all ages, but changes compared with those in Model 8 were strongest for the four oldest age groups. This finding further highlights the fact

that family investment accumulates as children grow up, causing the negative effects on the career to accumulate. Also, note that only the wage effect of toddlers remained significant in this model, suggesting that domestic work may affect wages primarily when children are very young.

In Model 10, we added measures for current time spent on domestic work. Consistent with the hypothesis that young children demand the most household labor, controlling for time devoted to housework, child care, and maintenance work reduced the penalty for toddlers. Nonetheless, the penalty remained at -5.3%. Therefore, we do not claim that our measures of family work accounted for the entire time path of the motherhood penalty.

#### Interaction Between Number of Children and Routine Housework

In the final analysis, we returned to Model 5 and allowed for an interaction between the number of children and reported housework hours to

test whether the time spent on domestic tasks affected the wages of mothers and nonmothers in different ways. We found that housework had a detrimental effect on wages only for mothers. For nonmothers, the effect of reported daily housework, at  $-0.4\%$  per hour, was nonsignificant ( $p = .21$ ), whereas the same effect was  $-1.5\%$  ( $p = .03$ ) for mothers with one child and  $-2.7\%$  ( $p = .00$ ) for mothers with two or more children. This finding is consistent with the notion that the negative productivity effect of the time devoted to domestic work is caused by the inflexibility of tasks associated with the care of children (e.g., preparing their meals, doing their laundry, or cleaning up after them). Previously, this argument has been used to explain the smaller wage effects of male-type housework (i.e., maintenance work) compared with female-type housework in general (cf. Noonan, 2001). Our results suggest that housework typically done by women can, in the absence of children, also be shifted to the evening or to weekends so it does not interfere with one's employment schedule.

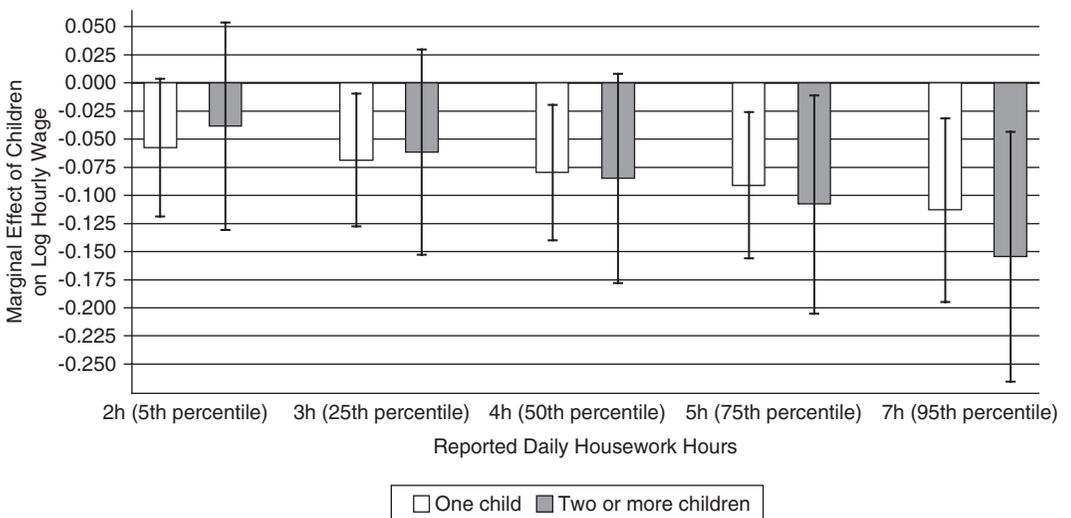
The interaction between motherhood and housework in determining a woman's wage is illustrated in Figure 1, which shows the marginal effect of the number of children at specific percentiles of the distribution of reported daily housework hours. We observed that the effect of the number of children became larger

the more time a woman spent on housework during a typical weekday. At 2 hours of routine housework, the effects of one child and two or more children were not statistically significant. The effects turned significantly negative only at 3 hours and 5 hours of daily housework, respectively. Again, these results showed that if mothers perform only a moderate amount of domestic work, their wages are not significantly different from those of nonmothers. Taken together, these analyses support the hypothesis that differences in the amount and intensity of daily domestic tasks, along with prolonged family-related work interruptions, are crucial in explaining the heterogeneous wage profiles of mothers and nonmothers.

### DISCUSSION

In this study we tested the hypothesis that an increased domestic workload contributes to mothers' wage loss on childbirth. Using panel data on West German women from 1985 to 2007, we first replicated the core finding in the literature of a strong residual motherhood penalty, that is, an effect of having children on women's hourly wages net of differences in unobserved career orientation, acquisition of human capital, and job characteristics between mothers and nonmothers. Thereafter, we went beyond existing research and accounted for

FIGURE 1. MARGINAL EFFECT OF HAVING CHILDREN ON WOMEN'S LOG HOURLY WAGES BY REPORTED DAILY HOUSEWORK HOURS (H).



women's self-reported time spent on housework and child care during a typical weekday. As a consequence, the residual penalties of 8% for the first child and 9% for subsequent children were reduced considerably (by nearly one third); moreover, the pattern of the time path of the penalty changed when we included measures of involvement in family responsibilities. Whereas overall wage disadvantages were most pronounced for mothers with older children, mothers with toddlers incurred the largest wage penalty, once differences in human capital and job characteristics were held constant. Although the effect of children younger than age 3 was not completely explained by the measures we used, the presumed mechanism received considerable support. Previous family-related employment breaks reduced mainly the effect of older children, whereas current involvement in domestic tasks reduced the effect of young children. Finally, we showed that reported housework hours significantly diminished hourly wages only for mothers. This result is consistent with the argument that household tasks associated with raising children are particularly strenuous and time inflexible and thus lead to conflicting obligations in the home and the labor market (Greenhaus & Beutell, 1985).

The main conclusion from our findings is that the domestic workload is an important contributing factor for mothers' wage disadvantages, as compared with nonmothers. The mothers in our sample did not earn less than equally skilled nonmothers if both held the same jobs and performed only a moderate amount of household tasks (as measured in our study). This finding is in line with previous research for the United States (Coverman, 1983; Noonan, 2001; Shirley & Wallace, 2004) and Scandinavia (Albrecht et al., 1999; Datta Gupta & Smith, 2002) that has reported no significant effect of children on earnings, once family-related work interruptions and the domestic workload were included in the respective models. Thus, we are confident that our findings bear some significance beyond Germany.

Like all studies investigating the wage penalty for motherhood, our analyses cannot rule out endogeneity bias. For example, as a result of curbing their work orientation or in response to their lowered earning potential, mothers might increase their time doing unpaid work. For our data, however, such an interpretation would imply that only mothers increase their

involvement in domestic work when their market wages decline, because the correlation between housework and wages was not significant for nonmothers. We provided a more plausible explanation for this outcome, namely, that housework has no effect on wages if it does not have to be scheduled to accommodate the needs of children.

This is not to deny that more research on the interrelationship among work orientation, family transitions, and career trajectories is needed. In this study, we assumed women's preferences for employment and domestic work to be constant during their childbearing years. It would be important to assess whether this assumption can be maintained, or whether work orientation changes endogenously after childbirth, operating as another mechanism by which childbirth affects wages.

Another possible caveat to our analysis is that the measurement of domestic work hours might affect the results. Time use data obtained by means of stylized questions, such as those of the SOEP, are prone to greater error than is information gathered with time diaries (e.g., Kan & Pudney, 2008). Kan and Pudney distinguished between *random* and *systematic* measurement error and studied implications of using stylized measures of housework hours as an explanatory variable in regression models. Their results showed that respondents systematically overstated the time spent on household chores. Nonetheless, in an analysis of the effect of housework hours on satisfaction with housework, the attenuation bias due to random measurement error clearly dominated the results, thus yielding conservative estimates. Applying this approach to the effect of domestic work on wages would increase confidence in our results. Certainly, future research would benefit a great deal from time diary data collected at different points in individuals' life courses.

Although our results clearly provide no direct evidence of discrimination toward mothers in the labor market, they do have some implications for further research in this regard. For instance, they challenge discrimination theory to explain why employers would discriminate, in particular, against mothers who spend the most time on domestic work. This would imply that employers have knowledge not only about average differences in household labor between mothers and nonmothers but also about individual differences among mothers.

Finally, our findings have several practical implications. On the basis of our results, we would expect a positive impact on women's careers, and thus on gender equality in the labor market, from policies that encourage men to take over a greater share of parental leave. An increase in the provision of public day care would further lighten women's workload and enable them to pursue rewarding careers, beyond a mere increase in their labor force participation. In fact, the German government has recently started to enact a number of policies in this regard (Henninger et al., 2008). In 2007, the means-tested maternity leave benefit that had been granted for up to 2 years was replaced by an income-related benefit that is granted for only 1 year. As an incentive to increase men's participation in child care, the duration of payment can be extended to 14 months if each parent goes on leave for at least 2 months. Although the federal government has also decided to extend coverage of nursery schools to provide public child care for every third child under the age of 3, implementation is still underway.

How these policies will be developed further, and the extent to which young families will make use of new opportunities, remains to be seen. Although there is evidence from cross-national research that family-friendly policies such as those outlined above are associated with greater gender equality in housework, changing the gender balance between domestic and paid work is a rather slow, incremental process (Hook, 2006, 2010). One may doubt that fathers will be willing to take on more responsibility in the home in the short run if they face costs regarding their career similar to those of mothers. Parents may also be concerned about negative side effects of public child care with respect to children's well-being. In addition, gendered norms shaping work-family preferences of fathers and mothers may act as a barrier to greater equality. Finally, specific subgroups of parents, such as single parents or lesbian and gay parents, may react in different ways to family policies. In the end, the effectiveness of parental leave and child care policies hinges on a better understanding of parents' decisionmaking and preferences.

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