Work and Wage Dynamics around Childbirth*

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Abstract

This study investigates how the first childbirth affects the wage processes of women who are well-established in the labour market. We estimate a flexible fixed-effects wage regression model extended by post-childbirth fixed effects. We use register data on West Germany and exploit the expansionary family policy during the late 1980s and 1990s for identification. On their return to work after childbirth, mothers' wages drop by 3 to 5.7 per cent per year of leave. We find negative selection back to full-time work after childbirth. We discuss policy implications regarding statistical discrimination and results concerning the family gap.

JEL codes: C23, J24, J31

Key words: wages, parental leave, human capital, control function

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I Introduction

Integration and retention of women in the labour market are important issues in political and economic debate. One particularly important concern is the performance of women with children in the labour market, with an indicator of their relatively poor performance being the so-called "family gap", the lower hourly wages of women with children compared to those without.[1] To achieve a better family–work balance, parental leave policies have been widely employed. The main aspect of these schemes is the right to return to a previous position of employment within a certain period (job-protected maternity leave).

Work interruptions related to giving birth are expected to affect mothers' wages directly through changes in the formation of human capital. Identifying the causal effect is challenging, because women who return to work following childbirth may differ from those who do not. Therefore, comparing the wages of women before and after childbirth may yield biased estimates. International statistics show that the employment rates of women with young children are persistently lower than the overall rates of female employment.[2] Hence, the group that returns to work after giving birth is potentially a non-randomly selected group, and it is interesting to consider which women from the skill distribution return to work.

In this study, we investigate the effects of the first childbirth on the wage processes of women, focusing on the return to human capital before and after childbirth and the effects of the duration of parental leave. The novelty of our work is that the wage model explicitly accounts for the non-randomness of the return-to-work decision following childbirth. More

[1] For an overview of the literature on family gap, see Waldfogel (1998b).

[2] Employment rates for mothers with children younger than six years of age in 1999 were 61.5 % in the US, 55.8 % in the UK, 51.1 % in Germany and 56.2 % in France. They were higher in Scandinavian countries, but lower in Southern European countries. See OECD (2001).

particularly, the standard wage regression model with unobserved heterogeneity is extended to include post-childbirth fixed effects. This is meant to capture changes in motivation, energy and commitment in connection with childbirth. The post-childbirth effects in the wage regression are identified through a number of expansions of nationwide maternity leave durations over a relatively short period.

The empirical analysis is based on a large sample of women who are well-established in the labour market. Data are extracted from the Institute for Employment Research (IAB) employment register for West Germany covering the period 1975–2001. The sample is constructed such that the mothers' employment and wage histories are observed from the beginning of their working careers and include interruptions of work relating to first births (parental leave). The large sample of 30,000 women allows us to estimate the wage processes separately for education groups and women who become mothers at some point in our observation period (the mother sample) and women who remain childless (the non-mother sample). Hence, heterogeneity of behaviour among women across the education distribution can be investigated. An additional advantage of the data is that they cover an interesting period of family policy expansion in Germany. During a relatively short period of time, parental leave was expanded from six months in the period 1979 to 1986 to three years in 1992.[3] The large variation over time makes Germany's parental leave policy very suitable for our analysis.

While some studies have moved in the direction of controlling for complete work history and sequence of events (e.g. Datta Gupta and Smith 2002; Nielsen et al. 2004), and allowing for heterogeneity in the parameters across education groups (e.g. Anderson et al. 2002; Datta

[3] See Ondrich et al. (1996), Dustmann and Schönberg (2008) and Schönberg and Ludsteck (2007) for evidence of the effects of these reforms. However, none of these studies considers returning to work after childbirth and relative changes over time, or indirect effects on wage processes.

Gupta and Smith 2002), no study has explicitly modelled post-childbirth fixed effects. This study shows new evidence that mothers who return to full-time work are negatively selected, and this holds across all education groups. This implies that standard estimates comparing wages of women before childbirth with those they receive afterwards (first difference estimator) overstate the causal effect of interruption on a woman's wages. While there has been some evidence concerning return behaviour (e.g. Lalive and Zweimüller 2009; Burgess et al. 2008), little is known about the randomness of this decision.

Institutions regarding the length of parental leave and childcare coverage vary greatly across the OECD countries, and the effect of the extension of parental leave is likely to depend on the specific institutions.[4] Therefore, our results may be informative concerning behaviour around childbirth in countries with similar institutions such as the Netherlands, Spain and Portugal, which are all characterized by relatively long durations of job-protected parental leave and low provision of childcare for children aged 0 to 2 years. At the same time, Germany has one of the largest family gaps (Harkness and Waldfogel 2003; Davies and Pierre 2005), which raises questions about whether and how generous parental leave policies have affected the labour supply. In fact, previous evidence regarding full-time workers in West Germany suggests that an important source of the family gap is the large drop in wages of around 10–20 per cent per year on returning to work following childbirth (Kunze 2002; Ondrich et al. 2003; Ejrnæs and Kunze 2004; Schönberg and Ludsteck 2007; Beblo et al. 2009).

The main result in this study is that on return to full-time work after their first births, mothers' wages drop by 3 to 5.7 per cent per year of leave, and these estimates are smaller than those from first-difference estimation. When we estimate our model in first differences

[4]It may be expected that effects vary depending on whether leave periods are short or long (see Ruhm 1998) and childcare coverage is high or low.

using the control function approach, the estimates are lower because we find negative selection into the group returning to work after childbirth. This effect becomes empirically important because the return rate of mothers is only about 50 per cent. This means that those mothers who actually return are those who are exposed to the greatest loss. This is plausible if, for example, highly productive women also have highly productive partners, hence the marginal utility of income is lower. We also find that the return rates to full-time work decline across our observation period, and therefore the effect of negative selection, is aggravated over time. This finding indicates that mothers' position in the labour market has not improved. It is also noteworthy that our results relate to the effects throughout the total period of leave after the first birth, rather than the cost per child related to leave. Finally, a comparison of the predicted wage processes for mothers and women who remain childless shows sources of family gap around birth.

The remainder of the paper is organized as follows. Section II provides the institutional setting for Germany. Section III presents the econometric model. Section IV describes the data and summary statistics. Section V presents the results and discusses the policy implications. Section VI concludes.

II German parental leave legislation (1981 to 1996)

Women who gave birth between 1981 and the end of 1985 were eligible for six months of job-protected maternity leave in Germany. These maternity leave provisions were regulated in the maternity leave law (*Mutterschutzgesetz*) introduced in 1968. A main component of maternity leave is that it guarantees the right to return to the previous position with the same employer (job-protected maternity leave). The law gives working women the right to six weeks leave

before the expected date of childbirth and eight weeks thereafter; meaning that working during the eight weeks after giving birth is prohibited. The 14 weeks of leave are fully paid. Women obtain compensation for income loss equivalent to the average wage for the three months before the start of the protected leave period. Compensation is shared by health insurance, the federal government and the employer. Since 1979, women have had access to an additional four months of job-protected leave. However, this is unpaid in the sense that the only benefits are paid by the federal government and health insurance. From 1979 until 1985, benefit payments from the third month after giving birth were fixed at a nominal level of 750 German marks (about 383 Euros); that is, about 20 to 30 per cent of average entry wages as observed in the IABS. These have been subsequently reduced and eligibility rules have been introduced along with a number of other changes.

Since 1985, maternity leave has been reformed several times. The 1986 reform was a major change because it introduced longer parental leave but also extended rights to benefit payments to non-working mothers, and extended the right to parental leave to fathers.[5] The main benefit of the parental leave reforms that this study exploits is the sequential extension of the periods during which the right to return to the previous job (job-protected leave) can be used. By 1992, the job-protection period had been increased to three years after giving birth. For a full overview, see Table 1. In the following, we refer to the complete period of job-protected leave as (job-protected) parental leave.

[Table 1 about here]

[5] Mothers and fathers can now share parental leave from the third month after a child's birth. We do not include this change, because it is rare for fathers to take parental leave: less than three per cent of fathers in Germany in 1995 did so.

In West Germany, childcare has traditionally been organized by public providers, only part-time (that is 3–4 hours a day), and primarily for children aged 3–6 years, and this has not changed very much during our period of interest. In 2001, less than 10 per cent on average of all children aged 0–2 years were in childcare. In terms of length of parental leave and low childcare coverage, West Germany is most similar to countries such as the Netherlands, Spain and Portugal (OECD Employment Outlook, 2001).

It is an empirical question whether the extension of protected leave directly affects the decision to return to work after childbirth, and whether the effect is positive or negative. In an international study, Ruhm (1998) concluded that short leave durations have a positive impact on employment while longer periods of leave have a negative effect. Lalive and Zweimüller (2009) found a decline in return rates in Austria when paid parental leave was extended from one to two years. Other studies showed spikes around the time of expiry of paid and unpaid leave; see Burgess et al. (2008) using British data and Schönberg and Ludsteck (2007) using German data.

III The econometric framework

Our model to estimate wage processes around childbirth builds on a wage regression with unobserved heterogeneity, as is standard in the literature, and is extended with post-birth fixed effects. The standard part of the model includes a vector of observed human capital characteristics, X_{it}, the duration of leave related to first birth, m_{it}, an unobserved individual-specific component μ_i and a time- and individual-varying shock, ϵ_{it}. The individual-specific effect, μ_i, captures the general unobserved ability or preference for work. The model allows for

varying coefficients before and after childbirth. In levels, it is written as:[6]

$$\begin{aligned} \ln w_{it} &= 1(t < t_i^{birth}) X_{it}\beta^{before} \\ &+ 1(t \geq t_i^{birth}) X_{it}\beta^{after} + 1(t \geq t_i^{birth})\delta m_{it} + 1(t \geq t_i^{birth})\gamma_i \\ &+ \mu_i + \varepsilon_{it}, \end{aligned} \tag{1}$$

where $1(\cdot)$ is an indicator function equal to one if the expression in parentheses holds and zero otherwise. t^{birth} denotes the period in which the first birth occurs. As an illustration, the model is written here in terms of the key parameters, β (before and after first birth) and δ, the effect through leave related to childbirth. A well-known challenge in the estimation of this model is unobserved heterogeneity, μ_i, and its correlation with m_{it} (e.g. Waldfogel 1998a). This will be taken into account by estimating equation (1) in first differences.[7]

As an extension of the standard model, the unobserved individual effect can change after giving birth; this is modelled by the post-birth individual-specific effect γ_i.[8] This is intended to capture possible heterogeneity across mothers in changes in motivation, energy and commitment in connection with childbirth. Thus, the impact of childbirth on women's wage processes occurs through three channels: change in return to human capital ($\beta's$), the effect of duration

[6] In the estimation, we ensure that the wage process is a continuous function of accumulated experience.

[7] Note that the estimated specification also controls for mobility (plant, occupation and sector) and time effects. Another minor extension that we introduce is that wages can increase at a declining rate, even before childbirth. In a wage regression, conditional on being a mother, this can capture effects through the timing of birth. Hence, it may be that women with relatively slow career progression decide to have children.

[8] Note that μ captures unobserved heterogeneity across individuals before and after giving birth. Hence, γ is essentially zero or equal to a constant before birth. It is only after giving birth that γ becomes crucial. The standard assumptions regarding individual fixed effects still apply: both μ and γ may be correlated with X and m, and $E(\mu) = E(\gamma) = 0$. Empirical estimation shows that relaxing these assumptions leaves the results unchanged.

of parental leave (δ) that may capture depreciation of human capital and the change in the individual-specific effect related to childbirth (γ_i).

We highlight two potential problems in estimating equation (1) by explicitly modelling γ_i. First, estimation in first differences does not remove γ_i and a potential source of endogeneity remains.[9] Second, because not all women return to work after childbirth, we only observe wages after giving birth for a selected group (a non-random sample). The selection problem arises because $E(\gamma_i|s_i^t = 1) \neq 0$, where s_i^t is an indicator of whether the woman returns to work after childbirth and t indexes the period after giving birth when the woman returns. To deal with these problems, we estimate the wage model in equation (1) in first differences and replace γ_i with a control function.

The control function is based on the following selection equation describing the return to work after childbirth:

$$s_i^t = \mathbf{1}(Z_{i(t)}\rho + X_{i(t)}\tau + v_i > 0), \quad t = return \tag{2}$$

where $Z_{i(t)}$ is a set of variables and v_i is an error term assumed to be normally distributed. In the empirical analysis, we focus on the period before and after the first birth, and therefore only one return decision for each woman is observed and $X_{i(t)}$ and $Z_{i(t)}$ are measured before this birth. We cannot estimate γ_i, but only recover the covariance between γ_i and v_i. This is sufficient to estimate the key parameters consistently. The identifying assumption is that if we condition on v, then s and Z are exogenous to the wage process. Our approach is closely related to Heckman's sample selection model, because the inverse Mills ratio is used as the control function (see, for example, Blundell and Dias (2009)).

In this model, the endogeneity of the fertility decision is not considered explicitly. Note,

[9] In the first-difference model, γ_i will not be swept out in the first wage spell after childbirth.

however, that we estimate the wage processes conditional on individual work history and fixed effects. What we therefore assume is that the fertility decision conditioned on these characteristics is exogenous. We acknowledge that this approach does not completely remove the problem, yet it is very difficult to find valid instruments for fertility. To allow for more heterogeneity in the wage processes, we estimate the wage model separately for mothers and non-mothers and education groups.

To identify the post-childbirth parameters, we use changes in parental leave policy as a set of exclusion restrictions. Women who became mothers during the period 1981 to 1985 were eligible for 7.5 months of leave (the reference group). Women who gave birth after 1985 were subject to the extensions of parental leave, and this generates the variation used to estimate the effect of the policy changes (see Table 1) on the return to work after giving birth. We assume that the policies did not affect the wage process either directly, through the selection into motherhood, or through the timing of birth. The particular question for our application is whether the policy changes have induced changes in the timing of the first birth, because we are only interested in the effect through leave after the first birth. Lalive and Zweimüller (2009) have shown that the expansion of paid leave in Austria significantly increased the likelihood of second births. However, it is not obvious that this effect extends to the timing of first births in the German context of unpaid leave and extremely low fertility. A caveat of our data is that we do not observe the exact number of children and the birth of the second child. Therefore, we cannot estimate the cost per child through leave, and we focus on the total effect of leave related to the first birth.

IV Data

We extract our sample from the two per cent IAB employment sample (IABS)[10], which contains the population of workers in Germany with at least one period of employment covered by social security. This data source represents about 80 per cent of the total employment population in Germany.[11] These register data are of very high quality, because of the accuracy of data on both wages (which are based on taxable income) and employment history. We apply the usual adjustments to the data. For detailed descriptions of the data source, see Bender et al. (2000).

Data sample and variables

The sample contains cohorts of highly attached West German mothers who entered the labour market between 1975 and 1994 and whose post-school work history was observed from the start. The last period in which they can be observed is 2001. We define highly attached mothers as those who have never worked part-time before birth and who have worked for at least one year full-time until giving birth.[12] We keep women who were on job-protected leave during the period 1981–1995 but no later to ensure that we can follow them for a sufficiently long period after childbirth (five years). This also implies that everybody was eligible for at least 7.5 months of parental leave (including maternity leave of 14 weeks). Only for returners are wages used after childbirth. We focus on wage outcomes for those returning to full-time work within 3.5 years. We chose this duration as the cut-off point so as to have enough returners within

[10] IABS is an abbreviation for the **I**nstitut für **A**rbeitsmarkt und **B**erufsforschung **S**ample.

[11] Not included are civil servants, the self-employed, students, unpaid family workers and people who are not eligible for benefits from the social security system.

[12] By construction, we exclude from our sample those who did not start work in a job covered by the social security system after completing their education, and have never been in full-time work. Furthermore, we exclude those who began work after completing their education and dropped out to non-work or part-time work before having a child.

every year and education group.[13] Non-returners are those not remaining highly attached to the labour market and include those who switch to part-time work or drop out of work. We use only those periods until the second interruption reported in the data. This is to focus on the effects around first births through first parental leave.[14] For the counterfactual analysis, we retain in the sample women for whom no interruption is observed during their labour career and who are still childless by the age of 39 years (the non-mothers sample).[15] Finally, we distinguish between three education groups: low skilled (10 years of compulsory schooling and less than 1.5 years of vocational training or college), medium skilled (10 years of schooling and an apprenticeship) and high skilled (12 or 13 years of schooling with a 3–4-year technical college degree, or a 4–6-year university degree). To generate complete work histories from first entry into work, we require that the low- and medium-skilled women were no older than 16 years of age in 1975 and the high-skilled women were no older than 23 years of age in 1975.

In our analyses, the main variables are the log of real daily wages[16] for full-time work (more than 35 hours a week), work experience and the leave duration relating to the first childbirth. The duration of leave is defined as the sum of the total length of work interruption relating to the first birth (parental leave) and extended non-working periods immediately following. As we estimate the model in first differences, we use indicator variables for change of occupation

[13] Formally, we wish to use the longest period of protected leave throughout the observation window, which is 37.5 months. In our empirical implementation, we slightly extend this period to 42 months. Our definition of the cut-off point is important for the first stage of the estimator. In the second stage, the actual duration is used. We have modified the cut-off point to test robustness, and results were not affected.

[14] This is to ensure the best quality of the parental leave variable. See Schönberg (2009) for a discussion.

[15] We acknowledge that some of these women may have children later than 39, or had given birth before entry at a very young age.

[16] All wages are measured in Deutsche marks (DM). After 1998, Euros are converted into DM at the exchange rate of 1 Euro = 1.9553 DM. Wages are deflated by the Consumer Price Index, with 1995 as the base year.

based on three-digit occupation groups, change of sector based on 12 sector groups and changes of plant. Our instrumental variables for changes in parental leave duration are determined by the month and year of reforms.

Descriptive statistics

The summary statistics of the mother and non-mother samples are presented in Table 2. We can see that age at first birth is 25 for low-skilled mothers and increases as education level increases. This corresponds to 5.6 years of work experience for the low-skilled mothers, and 4.8 years for high-skilled mothers at first birth. Entry wages differ considerably between the skill groups, showing the importance of entry conditions. Wage levels during their careers also increase with education and experience. In addition, 16–19 per cent per year of workers change plant, and around 10 per cent per year change occupation.

[Table 2 about here]

The descriptive statistics show two main findings. First, we find low return rates among mothers. On average, only 50 per cent of mothers return to full-time employment, even within 3.5 years after giving birth.[17] Second, the returning wage levels are some 5–10 per cent lower in real terms immediately after giving birth than in the last period before birth. Taken together, this raises the question of whether the wage drop is purely due to heterogeneity, or whether it is because the group of returning mothers is a selected group.

The data also reflect typical findings that returns to experience, or wage growth, are relatively large early in careers and declining thereafter, as is mobility. Comparing mothers and non-mothers shows that entry wages for mothers are significantly lower than for non-mothers,

[17] Approximately one-fourth of the mothers return to part-time work.

but the differences are not very substantial, being only 3–7 per cent lower.[18]

[Figure 1 about here]

Figure 1 depicts changes in the distribution of completed leave duration throughout the reforms. The figure reveals spikes around the time of expiry of protected parental leave. The proportion of women not returning to full-time employment increased from 32–37 per cent in 1981–85 to 50–56 per cent from 1992. These patterns hold across the three education groups. Hence, despite the reforms making return to employment more attractive because a similar position was guaranteed, the actual return-to-work rate has declined (at least within the 3.5 years we regard as the medium run).

In the econometric analysis, we take into account general trends in the pattern of return to work and use the within-year variation induced by the reforms for identification. The variation we exploit can be illustrated by the reforms in January 1986 and July 1989. The lower part of Table 3 reports that those women giving birth in the second half of 1989 (and commencing leave six weeks before the expected birth date) had a 2–6 percentage point lower probability of returning to work than those who gave birth in the first half of 1989. While the variation is smaller in the years when the reform occurred on 1 January, for example in 1986, we can still exploit this effect because the period of leave commenced before childbirth.

[Table 3 about here]

V Results

Estimation results

[18] In the US, Lundberg and Rose (2000) found a difference of 9 per cent on average across all education groups.

We estimate the model in equation (1) by first-difference estimation separately for the low-, medium- and high-skilled mothers and correct for the non-random decision to return to work after childbirth. In the first-stage probit regression in Table 4, in addition to the five dummy variables for the policy changes defined by month and year, we include exogenous variables from the wage equation in first differences; that is, changes in individual characteristics and the time dummies. All explanatory variables are measured in the last spell of employment before childbirth. Our estimation results show very clearly that conditional on the controls, the reforms decrease the probability of returning to full-time employment for all education groups. Tests for joint significance of all the dummy variables for policy changes show that they are highly significant for all three education groups. Based on the probit estimation, we generate the control function (the inverse Mills ratio) and add it to our main wage regressions in first differences.

[Table 4 and 5 about here]

The estimation results from the control function approach are reported in Table 5. The return to experience during early career and before birth is quite high. It is greatest for low-skilled mothers and lowest for high-skilled mothers, 8.9 per cent and 4.0 per cent, respectively, for an increase from 3 to 4 years of experience. An additional non-linear effect works through the time effects three years before birth that we allow for in the estimated wage model. This shows that even before childbirth, wage growth starts to decline, except for the high-skilled mothers. Across all education groups, returns to experience decrease substantially after giving birth to around 2.6 per cent (low-skilled mothers) and 2.1 per cent (high-skilled mothers) when experience increases from 3 to 4 years.

Extended parental leave in connection with childbirth leads to a significant wage decline

in all education groups. For the medium skilled, the fall is 5.8 per cent per year in real wages. It is somewhat lower for the high-skilled, only 4.4. per cent per year, but this is less precisely estimated. It is lowest for low-skilled mothers, at only 3.4 per cent per year. The differences are only statistically significant between low- and medium-skilled mothers. The test for homogeneity across education groups is, however, rejected (See Table 5). It is interesting to note that while these are not negligible values, the estimated falls in real wages are smaller than those from simple first-difference estimates; for the estimation results, see Table 6.[19] The fact that first-difference estimation yields smaller effects than previous studies may be because the effects are estimated separately by education group and account for more heterogeneity than in other studies. Interestingly, the estimated effects decrease further once we control for non-randomness in the return process. Hence, the estimated effect for first-difference estimation is a composite effect. Simple calculations show that selection accounts for 40 per cent of the first-difference estimate of the effect through leave duration for the low skilled. The corresponding figures are 60 per cent for the medium skilled and 53 per cent for the high skilled. We regard the remaining effect as human capital depreciation.[20]

While other controls for mobility have economically plausible signs, interpretation is complicated because mobility may still be endogenous. The average effect of mobility during the entire period of observation is positive, particularly for plant mobility. In connection with return to work after giving birth, we find negative effects. For the low-skilled mothers the estimate is -7.5 per cent $(= 5.3 - 12.8)$ and for medium-skilled mothers -2.2 per cent $(= 5.4 - 7.6)$. It is

[19] These estimates are also smaller than findings from previous studies. See Beblo et al. (2009) and Schönberg et al. (2007). Both studies focus on full-time working women.

[20] As shown in a previous study using GSOEP data, we cannot rule out the possibility that part of this gap is explained by the loss of bonus payments and other fringe benefits. See Ejrnæs and Kunze (2004, p. 43).

not significant for the high-skilled.

[Figure 2 here]

In Table 5 we can see that the estimated coefficient for the control function is highly significant and negative for all three education groups. This reflects negative selection back to full-time employment among mothers. To illustrate the operation of negative selection, in Figure 2 we depict the predicted wage profile for a medium-skilled woman giving birth in 1990 who actually returned to full-time employment after a year of leave. We find that this woman, compared with the "average"mother[21], experiences a much larger drop in wages around the first childbirth. This implies that ignoring the selection process back to full-time employment will lead to an overestimation of the mean drop in wages in connection with childbirth. A comparison between the education groups shows that negative selection is less pronounced for the low skilled and more pronounced for the medium and high skilled.[22]

In Figure 2, we compare the same woman's wages to the hypothetical wages that she would have experienced without giving birth; that is, if she were to postpone first childbirth to very late, here 1999.[23] Then, we see a gain from postponement, primarily because the returns are highest early in careers, and already begin to decrease before childbirth.

To illustrate the differences between wage processes for mothers and non-mothers, we also plot the predicted wage processes for a medium-skilled non-mother in Figure 2.[24] As shown, non-mothers have a slightly higher entry wage but a lower return to experience in the beginning

[21] The "average" mother is defined as a woman who has γ_i equal to 0, whereas the mother that returns has γ_i equal to $E(\gamma_i|s_i^t = 1)$.

[22] The figures for the low- and high-skilled mothers are available from the authors upon request.

[23] We chose as an example the postponement of first childbirth to 1999 because from then until 1995 the profile is purely based on the estimated return to experience before childbirth.

[24] The complete results for the non-mother samples are available on request.

of their labour market career. However, the average return to experience after giving birth (for those women having children) is much lower than before birth, and is also low when compared to non-mothers. The comparison reveals four sources of family gap for those who have children: the wage level of mothers is comparably low at first entry (see Table 2); wage growth rates decrease immediately before birth; mothers fall behind because of a wage decline on return after leave; and their return to experience is relatively low after giving birth.

Discussion

The result that those who return to work are negatively selected may be surprising. This result holds within each education group. It is consistent with a number of economic explanations. Our data, however, are too limited to pinpoint which of these best fits the data. Negative selection can, for example, arise because of assortative matching. If highly productive women are married to highly productive men with high earnings, these women can work less and therefore the negative selection is driven by an income effect. The negative selection could also be generated by specialization in work after giving birth and by purchasing childcare. This outcome can be derived in a model extending Becker 's (1985) one-period model to a two-period one (before and after first childbirth) where the effort intensity of household production increases after giving birth. In this case, wages will decline after giving birth because more effort is devoted to housework. The finding may also capture that highly productive women choose to space their births closer and therefore do not return to work within 3.5 years.[25] Other explanations could follow from a backward-bending labour supply curve.

Negative selection is also interesting from a policy perspective. As we have seen, negative selection implies a tendency to overestimate the mean loss from childbirth if this aspect is

[25] Kreyenfeld (2002) showed for West Germany that approximately 50 per cent of all mothers born between 1961 and 1963 had a second birth within 3.5 years.

ignored. This is important if employers form their expectations about the productivity losses of mothers on the basis of their observations (which means the performance of women who actually returned). Employers then overestimate the losses, and this means that if an "average mother" decides to return, she would actually be paid too low a wage because of statistical discrimination.

[Figure 3 here]

To illustrate this aspect, we compare the impact of the reforms during the late 1980s. In Figure 3, we plot the predicted wage paths for a medium-skilled woman giving birth in 1981 and the same hypothetical woman giving birth in 1990. The wage profile of the "average mother" is not affected by the reforms, but if we only look at those who actually return, the drop in wages becomes much larger for the woman giving birth in 1990 compared to the same woman giving birth in 1981. The expansion of parental leave has the effect that the proportion of mothers returning to full-time employment declines, and this leads to an indirect effect on those mothers who do return because they are more exposed to statistical discrimination. These indirect effects of parental leave schemes on labour supply are important for the design of parental leave schemes, because this mechanism induces less productive mothers to return.

Our results focus on the wage processes of women who remain highly attached to the labour market; that is, those who return to a full-time career after birth, which amounts to an important and large group of women. A concern in generalizing results is that the definition of highly attached may be restrictive, primarily because it does not include those who temporarily switch to part-time work and then return to full-time work. While the IABS data are too limited to make wages from full-time work and part-time work comparable, we argue that inclusion of wages from part-time work would not change our main results on negative selection. It may

be that the most productive women temporarily transit into part-time work. However, even if this were the case our results will still show that there exists a potential to increase the labour force by adding women who are on average more productive. In this case this may be done by encouraging mothers in part-time work to return to full-time employment. The size of the potential increase in the labour force will of course depend on how many of and how fast these women in part-time work return to full-time work.

VI Concluding remarks

In this study, we analysed women's wage processes for Germany with a particular focus on the period around first childbirth. We found that the selection process of return to work and the wage process around childbirth are strongly related. The results also indicate negative selection; i.e., mothers who suffer relatively large wage losses in connection with childbirth are more likely to return to full-time employment after giving birth. Women's wages are negatively affected by the duration of leave relating to childbirth. Furthermore, the return to experience is lower after childbirth than before, and lower for mothers than for non-mothers. Comparisons across education groups reveal considerable heterogeneity. Finally, we document that the wage processes of women who become mothers and those who remain childless develop very differently, despite small differences at labour market entry.

Our results contrast with previous findings for Germany that have shown large declines by international standards in wages after giving birth for women in full-time work (Schönberg et al. 2007; Beblo et al. 2008). Our findings suggest that estimates conditional on returning to work underestimate the average productivity of women with young children. Furthermore, our results demonstrate that the expansionary parental leave policy did not create incentives

for highly productive mothers to return to work. These findings have important implications. First, expansionary reforms between 1985 and 1995 have prevented the improvement of mothers' positions in the labour market. Two indicators of this are the decline in the rate of return to full-time work across this period and the increase in the average duration of leave. Second, given that mothers who return to work relatively shortly after childbirth are a negatively selected group, firms may have excessively low expectations about the mean productivity of all mothers.

A question following from our analysis is whether non-random selection back to work is generally of importance for studies of the wage changes of women around childbirth and the family gap. One argument supporting the view that this is potentially a more general issue is that the employment rates of women with young children are lower than for women overall in many countries. The result of negative selection may arguably be important for countries with parental leave and childcare institutions similar to those in Germany. In addition, the career changes of women after giving birth are widely observed, and a question is what proportion of women return to their pre-birth (highly attached) profile. Only detailed analyses of large longitudinal micro data can reveal such compositional changes. We consider these questions of broad interest for future research.

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Table 1: **Parental leave durations between 1979 and 2001**

		Job-protected leave		
Children born between..	Maternity leave[a] paid	Parental leave [benefit eligibility] , month 3 plus after birth	Total protected leave before and after birth	Hours of part-time per week[b]
1.7.1979-31.12.1985	1.5+2 months	4 months [4 months]	7.5 months	
1.1.1986-31.12.1987	1.5+2 months	8 months [8 months]	11.5 months	15
1.1.1988-30.6.1989	1.5+2 months	10 months [10 months]	13.5 months	15
1.7.1989-30.6.1990	1.5+2 months	13 months [13 months]	16.5 months	19
1.7.1990-31.12.1991	1.5+2 months	16 months [16 months]	19.5 months	19
1.1.1992-31.12.1992	1.5+2 months	34 months [16 months]	37.5 months	19
1.1.1993-30.12.2000	1.5+2 months	34 months [22 months]	37.5 months	19

Notes: [a]Maternity leave is fully paid based on average wage during the three months before birth.
[b] These are the number of hours one is allowed to work while on leave.
Sources: Mutterschutzgesetz 25.06.1979,
Bundeserziehungsgeldgesetz 6.12.1986 and newer versions. Zmarzlik, et al. (1999).

Table 2: **Summary statistics**

		Mothers						Non-mothers					
		Low skilled		Medium skilled		High skilled		Low skilled[c]		Medium skilled[d]		High skilled[e]	
Phase	Variables	mean	(sd)	mean	(sd)	mean	(sd)	mean	(sd)	mean	(sd)	mean	(sd)
Entry[a]	log real wage	4.13	(.39)	4.26	(.39)	4.77	(.43)	4.16	(.47)	4.33	(.41)	4.84	(.42)
Before birth	No. spells	54,334		100,826		5,970		20,196		21,566		4,444	
	log real wage	4.52	(0.33)	4.57	(0.33)	5.02	(0.38)	4.75	(.15)	4.82	(.35)	5.2	(.35)
	Experience (yrs)	4.03	(2.93)	3.61	(2.69)	3.10	(2.48)	8.63	(4.77)	8.4	(4.5)	6.99	(4.16)
	Δ log real wage	0.069	(0.17)	0.069	(0.16)	0.074	(0.20)	.0332	(.15)	.033	(.14)	.029	(.18)
	Plant change	0.16	(0.37)	0.19	(0.39)	0.18	(0.38)	.1384	(.35)	.1334	(.13)	.148	(.36)
	Occupation changes	0.11	(0.31)	0.10	(0.30)	0.11	(0.30)	.0922	(.29)	.073	(.07)	.085	(.28)
At birth	Age	25.0	(3.41)	25.7	(3.08)	30.1	(3.26)						
First empl	No. spells/No. women	4,872		7,779		578							
spell after	Returning to emp (%)	55		48		52							
birth	log real wage	4.50	(0.41)	4.55	(0.44)	5.05	(0.48)						
	Experience (yrs)	5.68	(3.14)	5.46	(2.88)	4.79	(2.52)						
	Δ log real wage[b]	-0.051	(0.33)	-0.10	(0.36)	-0.059	(0.39)						
	Duration of leave (yrs)	0.86	(0.76)	0.90	(0.81)	0.77	(0.73)						
	Plant changes	0.13	(0.34)	0.16	(0.37)	0.14	(0.35)						
	Occupation changes	0.10	(0.30)	0.10	(0.29)	0.08	(0.26)						
After birth	No. spells	16,776		24,268		1926							
(excl. first	log real wage	4.62	(0.40)	4.66	(0.42)	5.11	(0.43)						
spell after	Experience (yrs)	9.38	(4.61)	8.87	(4.27)	8.57	(4.06)						
birth)	Δ log real wage	0.009	(0.18)	0.009	(0.17)	0.005	(0.19)						
	Plant change	0.14	(0.34)	0.14	(0.35)	0.12	(0.32)						
	Occupation change	0.09	(0.29)	0.08	(0.26)	0.06	(0.22)						
All	No. spells	75,982		132,873		8,474		20,196		21,566		4,444	
	No. women	8,969		16,342		1,113		1,671		1,787		480	

Notes: IABS 1975–2001, sample of highly attached women.

[a] The average of the log wages for the first two years in the labour market is reported.

[b] Δ log real wage= $log(wage_{return}) - log(wage_{birth})$. [c]: average age is 29.9, [d]: average age is 30.1, [e]: average age is 34.8.

Table 3: **The return rate of mothers going on parental leave in 1985 and 1989**

Leave starts	Appr. date of first birth	Max. leave (months)	Low skilled		Medium skilled		High skilled	
			no obs	pct	no obs	pct	no obs	pct
1.1-31.10.1985	1.3-31.12 1985	7.5	564	64.18	920	64.35	53	67.92
1.11–31.12.1985	1.1-28.2 1986	11.5	39	58.97	53	49.06	3	66.67
Test for no difference $\chi^2_{(1)}$ $(p-value)$			0.42 $(p=0.51)$		5.05 $(p=0.03)$		0.01 $(p=0.96)$	
1.1-30.4.1989	1.1 -30.6 1989	13.5	283	49.47	538	48.33	39	56.41
1.5-31.12.1989	1.7-31.12 1989	16.5	419	47.73	732	43.31	38	50.00
Test for no difference $\chi^2_{(1)}$ $(p-value)$			0.20 $(p=0.65)$		3.15 $(p=0.08)$		0.31 $(p=0.58)$	

Notes: IABS 1975–2001, sample of highly attached mothers.

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Table 4: **Selection equation: return or not return to full-time work after birth decision estimated by a probit model**

	Low skilled		Medium skilled		High skilled	
	coef.	s.e.	coef.	s.e.	coef.	s.e.
ΔExperience (yrs)	.074	(.072)	-.057	(.052)	-.133	(.214)
ΔExperience (yrs)^2	-.013***	(.002)	-.006***	(.002)	-0.009	(.008)
Plant change	.041	(.068)	.107**	(.046)	.643***	(.200)
Occupation change	.036	(.073)	.156***	(.056)	.190	(.248)
Protected leave in months (period)						
Leave=10 (1/1986-12/1987)	-.125	(.121)	-.135	(.090)	-.809*	(.437)
Leave=12 (1/1988-6/1989)	-.220*	(.123)	-.329***	(.090)	-.867**	(.417)
Leave=15 (7/1989–6/1990)	-.420***	(.128)	-.607***	(.092)	-.995**	(.418)
Leave=18 (7/1990–12/1991)	-.523***	(.128)	-.705***	(.091)	-1.284***	(.394)
Leave=36 (1/1992-12/1995)	-.759***	(.138)	-.654***	(.091)	-1.034***	(.367)
Number of observations	8,969		16,342		1,113	
Pseudo R-squared	0.028		0.022		0.044	
	Test for joint significance of the leave duration variables					
Test statistic $\chi^2_{(5)}$	36.95	(p=0.00)	92.49	(p=0.00)	11.74	(p=0.04)

Notes: IABS 1975–2001, sample of highly attached mothers.

Other controls are included for year and industry.

***,**,* indicate significance at the 1%, 5%, 10% level, respectively

Table 5: **Estimation results of the wage regression in first differences (control function approach) for the mothers sample**

	Low skilled		Medium skilled		High skilled	
	coef.	(s.e.)	coef.	(s.e.)	coef.	(s.e.)
	Variables before first birth					
ΔExperience (yrs)	.138***	(.003)	.109***	(.002)	.065***	(.008)
ΔExperience (yrs)^2	-.007***	(.001)	-.006***	(.000)	-.004***	(.001)
Dummy for 3 years before	-.013***	(.001)	-.010***	(.001)	.007	(.005)
	Variables in connection with first birth					
Duration of leave (yrs)	–.034***	(.007)	-.058***	(.006)	-.044*	(.023)
Plant change×(mat. leave)	-.128***	(.018)	-.076***	(.012)	.049	(.051)
Occupation change×(mat.leave)	.021	(.030)	-.005	(.016)	-0.08	(.069)
	Variables after first birth					
ΔExperience (yrs)	.024***	(.003)	.026***	(.004)	.026**	(.025)
ΔExperience (yrs)^2	.0004**	(.0001)	-.000	(.0002)	-.001	(.001)
	Other controls					
Plant change	.053***	(.003)	.054***	(.001)	.031***	(.001)
Occupation change	.008**	(.004)	.012***	(.002)	.040***	(.012)
Inverse Mills ratio	-.046***	(.010)	-.082***	(.008)	-.084**	(.034)
Number of observations	75,982		132,873		8,474	
Number of individuals	8,969		16,342		1,113	
R-squared	0.154		0.166		0.110	
	Test for educational homogeneity					
Test statistic $\chi^2(92)$	343.66		p-value	0.00		

Notes: IABS 1975–2001, sample of highly attached mothers.

Other controls are included for year and industry.

***,**,* indicate significance at the 1%, 5%, 10% level, respectively

Table 6: **Estimation results of the wage regression in first differences for the mothers sample**

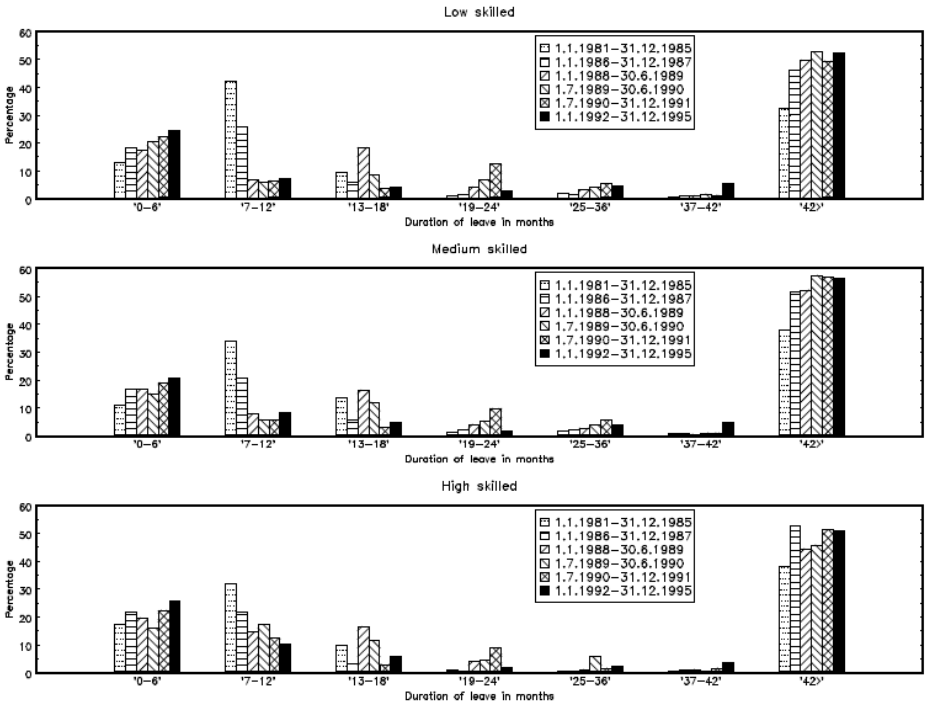
	Low skilled		Medium skilled		High skilled	
	coef.	(s.e.)	coef.	(s.e.)	coef.	(s.e.)
	Variables before first birth					
ΔExperience (yrs)	.137***	(.003)	.108***	(.002)	.064***	(.008)
ΔExperience (yrs)^2	-.007***	(.001)	-.006***	(.000)	-.004***	(.001)
Dummy for 3 years before	-.013***	(.001)	-.010***	(.001)	.007	(.005)
	Variables in connection with first birth					
Duration of leave (yrs)	–.055***	(.005)	-.096***	(.004)	-.083***	(.018)
Plant change×(mat. leave)	-.130***	(.019)	-.086***	(.012)	.040	(.051)
Occ. change×(mat.leave)	.021	(.020)	-.005	(.016)	-.096	(.068)
	Variables after first birth					
ΔExperience (yrs)	.019***	(.003)	.014***	(.004)	.022	(.025)
ΔExperience (yrs)^2	.0004**	(.0001)	-.000	(.000)	-.001	(.001)
	Other controls					
Plant change	.053***	(.003)	.054***	(.002)	.032***	(.010)
Occupation change	.008**	(.004)	.012***	(.002)	.039***	(.012)
Number of observations	75,982		132,873		8,474	
Number of individuals	8,969		16,342		1,113	
R-squared	0.153		0.164		0.108	
	Test for educational homogeneity					
Test statistic $\chi^2(90)$	336.50		p-value	0.00		

Notes: IABS 1975–2001, sample of highly attached mothers.

Other controls are included for year and industry.

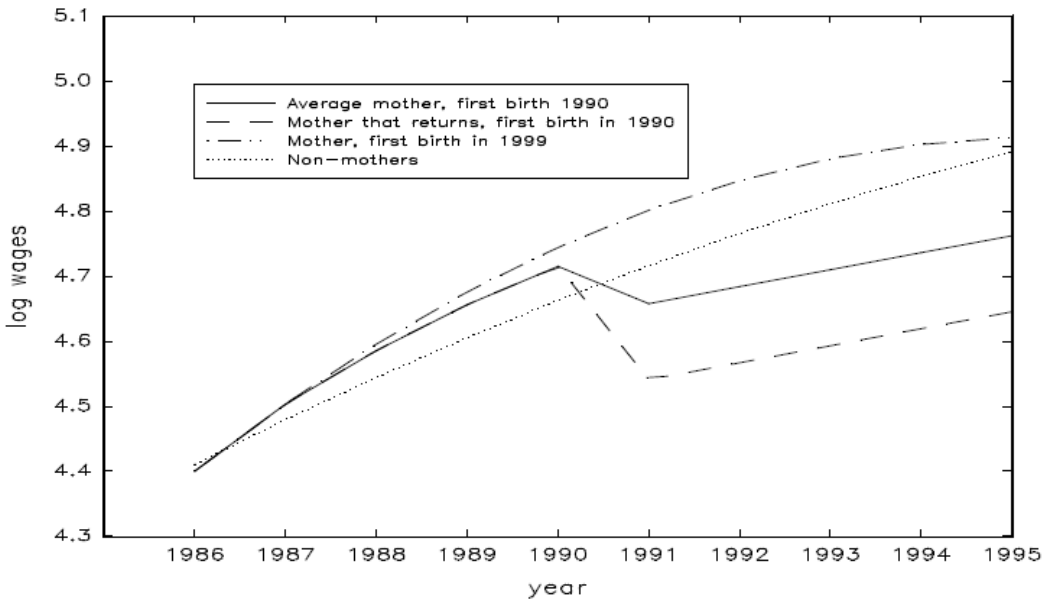
***,**,* indicate significance at the 1%, 5%, 10% level, respectively

Figure 1: The distribution of actual leave, by education groups



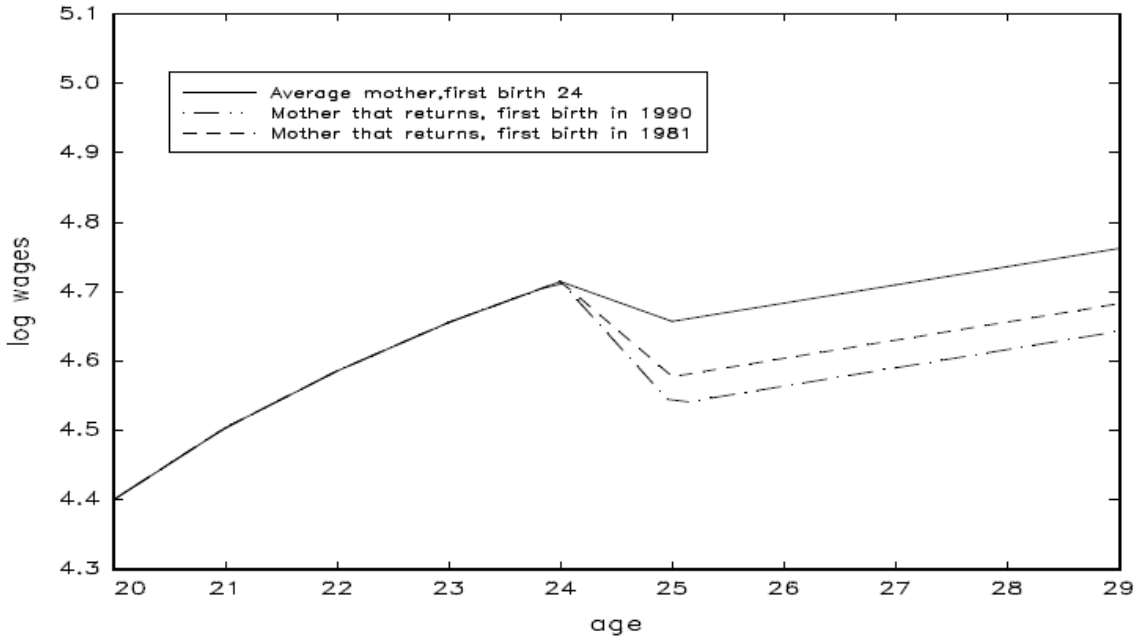
Notes: IABS 1975-2001, sample of highly attached mothers.

Figure 2: The predicted wage profiles for medium-skilled women



Notes: The predicted wage profiles assume entry into first job in 1986 and that non-mothers work throughout the entire period. Women in the mother group experience first birth, depicted in 1990, followed by one year of parental leave. It is assumed that all stay in the same occupation and plant since entry. Effects from calendar years are neglected. Calculations are based on our estimates.

Figure 3: The predicted wage profiles for medium-skilled mothers giving birth in 1981 and 1990



Notes: The predicted wage profiles assume entry into first job at age 20, birth at age 24 and return to full-time employment after one year of leave from work. It is assumed that all stay in the same occupation and plant since entry. Effects from calendar years are neglected. Calculations are based on our estimates.