Economic Consequences of Motherhood –

The Role of Job Disamenities

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Dedicated to my family and friends,

especially dedicated to Novis,

Mama and Papa.

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Introduction

Work-family balance is a hot topic on the current political agenda of OECD countries. Policies aimed at reconciling family and work pursue the following targets: (1) to encourage mothers to participate in the labor force; (2) to provide mothers with equal opportunities on the labor market; and at the same time (3) to guarantee high-quality parenting. In spite of recent achievements in the work-family balance, mothers still encounter difficulties to participate in the labor market[2] and face persisting inequalities with respect to career opportunities and in particular wages.[3] There are furthermore rising concerns regarding whether maternal employment might harm children's social and intellectual development.[4]

The purpose of this dissertation is to evaluate how job disamenities – job characteristics which decrease workers' utility – might help to explain the failure in achieving the outlined targets of work-family balance. In particular, the following questions are raised. (1) Is the decrease in mothers' wages around first childbirth accompanied by a simultaneous reduction in job disamenities? (2) How much wage are mothers willing to sacrifice in order to reduce job disamenities? And, (3) do disamenities involved in mothers' occupations go on to affect parenting behaviour and as a result harm children's cognitive development?

This thesis is divided into three chapters addressing these questions. Chapter I describes changes in job features around first childbirth and aims to explain the child penalty as a compensating wage differential (CWD). Chapter II provides a measure for mothers' marginal willingness to pay (MWP) to avoid job disamenities. Finally,

[2] According to Eichhorst and Thode (2007) married women with at least one child younger than 5 years have, in comparison to men and childless women, the lowest labor force participation rates: Germany (44.3%), Italy (49.7%), Greece (51.3%), and Spain (53.5%).
[3] The wage gap between women with and without children is, for instance, 20% in the US (Waldfogel, 1997), 13% in the UK (Harkness and Waldfogel, 1999) and 20% in Germany (Kunze and Ejrnaes, 2004).
[4] Cawley and Liu (2007) and Brooks-Gunn et al. (2002a) show that maternal employment, in particular during early childhood, might reduce maternal childcare and as a result harm children's progress.

Chapter III assesses the impact of mothers' work conditions on children's cognitive development. The context of these three chapters is briefly outlined below.

In Chapter I, I provide empirical evidence for changes in maternal working conditions beyond the much-studied empirical fact that women, once they have children, tend to earn lower wages. Exploring whether there exist simultaneous changes in pecuniary and non-pecuniary job traits around first childbirth is a necessary step to set up the hypothesis that mothers substitute income by improved working conditions and as a result part of the child penalty might be a CWD. For this purpose, I use data from the German Socio-Economic Panel (GSOEP) and apply the following methodology. First, I use an event study, which analyzes changes in job characteristics around first-time motherhood. Second, I estimate a hedonic wage regression, which is a standard wage regression including job turnover and job disamenities in addition to usual control variables. The results suggest that certain disamenities are compensated by a significant wage increase (around 2.5 per cent for a hazardous job, 2.5 per cent for stress, and 1 per cent for per cent for 10 km additional commuting distance) and hence, a significant fraction (10 per cent) of the child penalty can be interpreted as a CWD.

As shown by Hwang et al. (1998), hedonic wage regressions provide only a lower bound of the monetary compensation for job disamenities. Hence, **Chapter II,** which constitutes the core of this dissertation, suggests a more structural approach to estimate mothers' MWP for amenities and replaces the static framework of the hedonic wage regression by a more dynamic one. The identification strategy relies on German maternal leave length data, since among OECD countries Germany entitles mothers with the most generous parental leave (36 months). The key aspect of the maternal leave framework is that mothers can decide whether and when to return to their guaranteed job. Thus, in contrast to previous studies that analyze the job search of employed workers, this framework allows us to observe all relevant alternatives a worker, in this

case the mother, faces on the labor market. The theoretical model of the leave length decision is derived from a random utility approach. Using data from the Qualification and Career Survey (QCS) in addition to the GSOEP, the model is estimated by a discrete duration method that assumes a logistic hazard function. The MWP to avoid disamenities can be inferred through the estimated elasticities of the leave length with respect to the disamenities and the wage. The results provide evidence that mothers are willing to sacrifice a significant fraction of their wage to reduce hazardous working conditions (24 per cent for a decrease of one standard deviation) and to enjoy a working schedule compatible with available daycare (45 per cent to work in the evening and 66 per cent to work in rotating shifts).

While Chapter I and II address mothers' participation and opportunities on the labor market, **Chapter III** (joint with Amy Hsin) investigates the relationship between maternal employment and children's cognitive development. The previous literature focuses on the effect of maternal employment, in particular working hours and on children's intellectual performance. We contribute to this literature by additionally investigating the impact of occupational disamenities and identifying a mechanism through which work conditions might affect child outcomes. Using the 1997 and 2002 waves of the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS) and the Occupational Information Network (O*Net), we estimate how mothers' occupational characteristics influence children's cognitive test scores and study if the impact changes with the quantity and type of activities mothers perform with their children. We correct for selection into employment using the method suggested by Heckman (1986) and stratify the sample furthermore according to three different age groups. The results of the analysis indicate that menial occupations are associated with lower verbal scores among children. More importantly, the results show that mothers' time with children is a mechanism through which occupations can influence child

development. *Bad* jobs exert negative effects because exposure to disamenities (1) decreases maternal time devoted to activities fostering directly intellectual development, and (2) alters the effect of maternal time on child outcomes. For mothers who are exposed to certain disamenities at work, time spent targeted at directly stimulating children's cognitive skills has a positive effect, whereas less targeted time has a negative effect.

Overall, the current dissertation contributes to the literature in several ways. To begin with, it is the first study assessing simultaneously a broad range of maternal working conditions and studying how these are altered when a woman has her first child. It suggests and tests the hypothesis that part of the child penalty might be explained by a CWD. Furthermore it provides a direct estimate of mothers' MWP to avoid job disamenities – a first for the literature. Arguably a major contribution is the fact that the suggested methodology – the special setting of maternal leave enables us to improve on the measurement of the MWP. Lastly, this thesis adds to the literature by investigating the impact of occupational disamenities on children's intellectual development additional to the one associated with wages and working hours, and by determining a mechanism through which work conditions affect child outcomes.

Identifying the disamenities which complicate the balance of career and family, understanding how much mothers dislike these disamenities and how much they affect child outcomes is essential for an effective family policy design aimed at increasing mothers' LFP while protecting and fostering children's cognitive development.

Chapter I

The Child Penalty - A Compensating Wage Differential?

I.1. Introduction

The stylized fact that working mothers tend to earn less than women without children seems to be a well established fact in the economic literature and is called the 'child penalty' or the 'family gap'. Several researchers have found raw wage gaps of almost 20 per cent in the United States, up to 20 per cent in Germany and 13 per cent in the United Kingdom (Harkness and Waldfogel, 1999; Kunze and Ejrnaes, 2004). The following hypotheses about its sources have been established and investigated: unobserved heterogeneity between mothers and childless women, employer discrimination, loss in human capital owing to maternity leave, differences in working schedules, choice of sector or job type, etc. Yet so far, the hypothesis that the jobs of women with and of those without children may differ with respect to certain non-pecuniary characteristics has not been fully explored:[5] Once having a child, women might change their criteria according to which they make their decision to participate in the labor market and their job choice. If a better-paid job does not offer family-friendly conditions, a mother may decide to stay out of the labor market or to work at a lower paid job with better features. In the latter case, a mother might sacrifice income to avoid inconvenient job traits, referred to as disamenities. The hypothesis to be tested is that, if the labor market rewards disamenities, part of the child penalty might be a compensating wage differential (CWD) for the disamenities avoided by mothers.

In order to investigate the impact of motherhood on the choice between pecuniary and non-pecuniary job characteristics in Germany, data from the German

[5] To my knowledge, there is not any study exploring a broad range of disamenities. Existing studies have either looked only at part-time jobs, the public sector or segregation into sectors (Waldfogel, 1997; Bratti, et al., 2004; Nielsen, et al., 2001; Beblo, et al., 2004).

Socio-Economic Panel (GSOEP, 1984-2005) is used. The dataset provides detailed information about personal attributes and job characteristics, with attention given to the pecuniary and particularly the non-pecuniary aspects of jobs. The longitudinal nature of the data allows the observation of women during their fertile ages (defined as age 16 to 46). As a result, not only can we compare the jobs of mothers and non-mothers, but also the jobs of mothers before and after they have had their first child. Thus, it is possible to estimate changes in mothers' job characteristics around the time of first childbirth and to test the hypothesis of the child penalty as a CWD using the two steps outlined below.

First of all I investigate changes in mothers' jobs around the birth of the first child not only with respect to financial aspects, as shown in previous studies, but also with respect to non-financial ones. The methodology used is an event-study analysis, which allows me to examine the effect of motherhood on wages, job turnover and a variety of non-pecuniary job features. A simultaneous change in pecuniary and non-pecuniary job traits at the time of first childbirth suggests that women adjust their job selection criteria to their family situation. In a second step I measure how much of their wage mothers have to give up in exchange for a reduction in disamenities. For this purpose, I estimate a hedonic wage regression, which is a standard wage regression including additionally to usual control variables non-pecuniary job traits. The results show that women who accept certain disamenities receive significantly higher wages. Accounting for disamenities decreases the estimates of the child penalty, which provides evidence that a significant fraction of the family gap can be explained by a substitution of income for family-friendly working conditions.

The contribution of this chapter is to investigate if mothers adjust their jobs to their family life and hence, sacrifice income to avoid disamenities. Thus, I test the hypothesis of the child penalty as a CWD. Identifying job features, which facilitate the

balance of career and family, and estimating their price on the labor market, may be useful for the design of policies aimed at the compatibility of work and family.

The structure of the remaining chapter is the following. Section I.2 reviews previous research on the child penalty and the theory of CWD. Section I.3 describes the data and the methodology used to test for CWD. Section I.4 reports the results and Section I.5 concludes.

I. 2. Background

I. 2.1. The Child Penalty

The negative impact of motherhood on individual wages has been well studied. The most common approach to analyzing the wage effect of having children has been to estimate the child penalty, i.e. to compare the wages of women before and after giving birth to their first child while controlling for observed characteristics. The family gap in the US, according to Waldfogel (1994), is large and persistent. Among young women, mothers' wages lag 20 percentage points behind those of comparable non-mothers. Harkness and Waldfogel (1999) find some evidence of the child penalty in several industrialized countries, such as Australia, Canada, Germany, Finland, Sweden, United Kingdom and United States. They find that different institutions in these countries lead to a wide variation in the magnitudes of the gap. On the one hand, a larger family gap is positively correlated with the gender gap, while on the other hand it is negatively correlated with women's labor force participation.

Several theoretical explanations for the child penalty are offered in the socio-economic literature. The first hypothesis is that women differ with respect to abilities and preferences. Both characteristics may be correlated with fertility and are usually unobserved. Previous studies deal with this issue of unobserved heterogeneity by applying a fixed effect methodology. Using this approach Waldfogel (1997) cannot

detect any unobserved pay-relevant differences between mothers and non-mothers in the US. Lundberg and Rose (2000), however, find a family gap of 9 per cent even before the first birth. Kunze and Ejrnaes (2004) confirm the drop in wages prior to first childbirth for Germany. This early dip in wages might indicate unobserved heterogeneity between mothers and non-mothers.

A second hypothesis claims that the presence of children might limit mothers' mobility and hence, might restrict mothers in their job choice. Owing to higher job search costs, mothers might maintain poor job matches; thus, the quality of their job match improves only slowly and lower earnings follow as a consequence. Conversely, Waldfogel (1998a) and Phipps, et al. (2001) find that maintaining the same job position after maternity leave decreases the child penalty. Returning to the same employer acts as an insurance against income loss.

Employers might as well assume differences in productivity and flexibility and thus discriminate against mothers. Becker (1985) has been the first in suggesting the hypothesis of discrimination. Discrimination means that given the same individual attributes, employers treat mothers and non-mothers differently for reasons not related to productivity. Employer prejudices could include the idea that mothers are less productive since they have less time and effort for their job. However, it is hard to prove discrimination. Phipps, et al. (2001) include the numbers of hours spent on unpaid work in their estimation. This approach to testing the discrimination theory reveals that the child penalty declines, but remains significant.

Further hypotheses rest upon differences in accumulated human capital. One prominent supposition is that maternity leave interrupts the labor market career and leads, like all kinds of career interruptions, to a loss in work experience and thus to a depreciation of human capital (Mincer and Polachek, 1974). For the US and the UK, Waldfogel (1998b) shows this decrease in wages due to maternity leave. This wage

reduction following career interruptions is confirmed for German men and women (Beblo and Wolf, 2002). Despite the generous German parental leave system, the depreciation of human capital as a result of maternity leave is even higher than of unemployment (Kunze, 2002).

Alongside career interruptions, also periods of part-time work cause depreciation in human capital. Mothers might be particularly likely to take advantage of part-time since it promotes the combination of work and family. Traditional wage estimations that do not control for part-time periods might underestimate the return to work experience. Recent studies substitute actual work experience by the effective one, taking into account the duration of non-employment and part-time spells. Periods of part-time work are relevant for explaining the child penalty in the US and the UK (Waldfogel, 1997; Joshi et al., 1999). Nevertheless, there is still evidence of the family gap for women employed full-time. Beblo and Wolf (2000) include in their estimations not only part-time periods of work but also the timing of career interruptions. Using German data, their estimation results suggest that deviations from full-time employment are penalized by significant wage cuts. Additionally, the wage rate falls even more if the period of career discontinuity is postponed.

Previous studies have related the family gap also to sectoral or occupational segregation. Sectors or types of jobs held primarily by mothers are, in general, lower paid. They might however compensate their workers for the loss in income by a more family-friendly working environment. This might explain the child penalty to some degree. Nielsen, et al. (2001) address this issue. Using a model where the choice between private and public sector is endogenous, they find only a small wage effect of career interruptions in the public sector and no effects in the private one. Beblo et al. (2004) estimate the differences among sectors by matching comparable mothers and

non-mothers who are working for the same firm. They confirm a significant child penalty even within firms.

The last two hypotheses, referring to part-time periods and sector segregation, address to some extent the hypothesis investigated in this chapter: once being a mother, women's preferences for wages and aversion against disamenities might change and thus, they might sacrifice income to avoid inconvenient job characteristics. While the first studies are only considering one aspect of the job, namely part-time, the second ones are suggesting the general idea that mothers sort into jobs offering a family friendly atmosphere.

This study adds to the literature by considering a broader range of job characteristics and by determining the ones, which seem to be avoided by mothers. Its goal is to test whether women adjust their wage-disamenities package once having had a child and thus, if the child penalty can be interpreted as a CWD. Using a longitudinal dataset (GSOEP), the prevalence of several non-pecuniary job characteristics following first childbirth can be revealed. Including these job features in the wage regression provides evidence that mothers trade pecuniary against non-pecuniary job traits. Hence, these results provide evidence for the child penalty being partly a CWD.

Next I review briefly the theory of CWD in order to make a plausible case as to why a mother may give up some of her income for a job involving fewer disamenities.

I.2.2. Compensating Wage Differentials

The idea of compensating disadvantages with advantages of a job was first suggested by Adam Smith in his seminal work *An inquiry into the Nature and Causes of the Wealth of Nations, Book I*. Rosen (1986) formalizes this idea and established the theory of CWD: jobs are bundles of wages and disamenities and the loss in one dimension has to be compensated by an improvement in the other. In the following I review briefly the theory of CWD.

The utility a worker derives from a particular job depends upon the wage she can receive on the job, the disamenities offered by the job and her individual characteristics. Her utility can be defined as following:

$$U_{ijt}(w_{ijt}, d_{jt}, a_{it}) = w_{ijt}(d_{jt}) - a_{it} * d_{jt}$$

where w_{ijt} = wage of individual i in job j at time t

d_{jt} = disamenities of job j at time t

a_{it} = aversion of individual i against disamenities at time t

$U_{ijt}'(w_{ijt}) > 0$; $U_{ijt}'(d_{jt}) < 0$; $w_{ijt}'(d_{jt}) > 0$ and $w_{ijt}''(d_{jt}) < 0$

Under complete information and perfect mobility, a worker is able to 'visit' different markets and choose the job that gives her the greatest satisfaction. In other words, the problem of each worker consists of selecting the best combination of pecuniary and non-pecuniary job characteristics in order to maximize her utility. Assuming that participating in the labor market has a higher utility than not participating, the maximization problem can be written as:

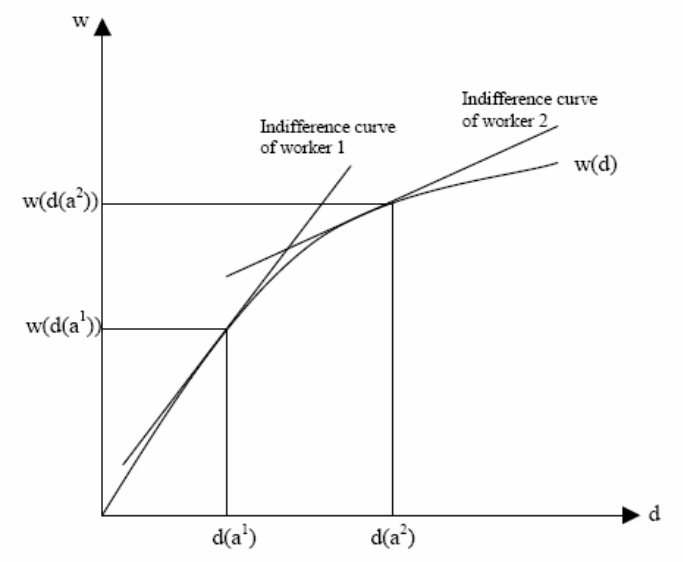
$$\max_{wijt,\, djt} \quad U_{ijt}(w_{ijt}, d_{jt}, a_{it}) = w_{ijt}(d_{jt}) - a_{it} * d_{jt}$$

$$\text{s.t. } U_{ijt}(w_{ijt}, d_{jt}, a_{it}) > U_{ijt}(0, 0, a_{it})$$

$$\text{FOC:} \quad \delta w_{ijt} / \delta d_{jt} = a_{it}$$

The solution to this problem indicates that workers choose the job in which the marginal return to disamenities $\delta w_{ijt}/\delta d_{jt}$ is equal to the aversion a_{it} it gives rise to. Since the marginal return to disamenities is decreasing with an increasing amount of disamenities, the amount of disamenities d_{jt} workers can stand diminishes with the aversion a_{it}.

Figure I.1: The theory of equalizing differences



Source: Rosen (1986)

Figure I.1 represents the choice of two workers differing in their aversion against disamenities. Worker 1, assumed to have a stronger dislike against disamenities (a^1), represents a woman once having a child. Worker 2, assumed to be less averse against disamenities (a^2), stands for a childless woman. The change from the intersection of the wage-disamenities offer curve w(d) with the indifference curve of worker 2 to the one with the indifference curve of worker 1 can be interpreted as the adjustment in the wage–disamenities package to a change in the family situation. Thus, in case women's preferences change around the time of first childbirth in a way that their aversion against disamenities increases, mothers have to sacrifice income in order to avoid certain disamenities.

The theory of CWD, however, applies only to job characteristics that are unequivocally desired or avoided, such as the risk of injuries, hazards, etc. Job features, which are unanimously seen as disamenities, are compensated by a wage increase. Job features, however, which are neither liked nor disliked by all workers, are not associated with an unambiguous wage change. Thus, in case there is no unanimous aversion

against a certain job feature, the fact alone that mothers might avoid it does not lead to a decrease in the wage.

The following section describes the data and explains the methodology used in order to estimate the changes in job characteristics around motherhood and to test whether the child penalty can be interpreted as a CWD.

I.3. Data and Methodology

The dataset used is the German Socio-Economic Panel (GSOEP), which is an annually repeated survey of Germans and foreigners in West and East Germany (1984-2005). Since 1984 the GSOEP has followed its members. In 2005 the GSOEP provided information about more than 12,000 households consisting of approximately 24,000 persons.

The longitudinal nature of the data allows us to observe mothers for the years around the birth of their first child. Thus, not only can we compare the jobs of mothers and non-mothers, but also the jobs of women before and after they become a mother. Another feature that makes the GSOEP especially suitable to a methodology for testing the hypothesis of the child penalty as a CWD is that it provides detailed annual information on pecuniary and non-pecuniary job characteristics. This information is necessary to set up a relationship between wages and disamenities.

The sample of interest includes all women in their fertile period, defined as age 16 to 46. It consists of 2,814 individuals, 1,989 of whom are mothers (defined as all women who have had a baby prior to 2005)[6] and 895 of whom are non-mothers as of

[6] An alternative dataset includes only the women who did get their first baby between 1985 and 2004. Taking into account as well attrition, this dataset guarantees that women are observed (at least one period) before and after the event of first birth. I decided to use the dataset including all women that got their first baby as of 2005 due to the following reasons: first, I cannot exclude the possibility that the timing of first birth might be endogenous and second, the larger sample size of the first dataset leads to more significant

2005. This definition, obviously, does not exclude the possibility that a woman, defined as a non-mother, might become a mother after 2005.

The interest lies in job characteristics and thus only working women are considered in the analysis. That being said, women are likely to drop out of the labor force when becoming a mother. This trend could lead to a sample selection bias, a problem addressed in Section I.3.1.2. Furthermore, missing observations for non-pecuniary job characteristics reduce the sample a great deal. Still, using information about job changes, some information can be reconstructed (see Section I.4.2.1).

In order to test the hypothesis of the child penalty as a CWD, I apply the following methodology, which is divided into two parts. A first step is to investigate whether motherhood really affects non-pecuniary job characteristics. In other words, we want to see if not only wages but also other job aspects change after motherhood and consequently the loss of wages may be compensated by a decrease in disamenities. In order to estimate changes in job features around and after motherhood, I use an event study analysis. It examines the effects of the first birth on wages, turnover and a variety of non-pecuniary job characteristics separately. This method is described in Section I.3.1. In a second step I measure the CWD, i.e. how much wage mothers have to give up for a reduction in job disamenities. Therefore, at this stage I perform a hedonic wage regression, which includes disamenities as further control variables additional to personal traits. In a last step, I include job turnover in the hedonic wage regression. This allows us to control for a loss in firm-specific human capital and further unreported changes in job characteristics due to a job change. Thus, we can disentangle the wage effect of particular disamenities from the one of a general job change. This hedonic regression is explained in detailed in Section I.3.2.

results. In any case the results using the dataset including mothers with first birth between 1985 and 2005 are available on request.

I.3.1. Empirical Test of Changes in Job Characteristics around First Birth

I.3.1.1. Event Study

As noted above, the first step involved in testing whether the child penalty can be interpreted as a CWD is to show that the jobs of women before and after first childbirth differ not only in wages but also in other non-wage aspects. This comparison is done in the form of an event study analysis; a method used to see if a particular event influences some outcome – here if motherhood affects women's job characteristics. The basic model is the following:

$$Y_{it} = \beta_1 * Pre1_{it} + \beta_2 * Birth1_{1it} + \beta_3 * Post1_{it} + \gamma * X_{it} + a_i + u_{it} \qquad (I.1)$$

where Y_{it} represents mother's i wage, job turnover and a variety of non-pecuniary job characteristics, described below. For the purpose of comparison of the periods before and after childbirth, the following three dummies have been introduced: $Birth1_{it}$ represents the year of birth of the first child, $Pre1_{it}$ all years prior, and $Post1_{it}$ all years afterwards.[7] An example might help to illustrate the definition of the three dummies as follows: if a mother gives birth to her first child in 1990, the year 1990 will be defined as the year of birth.[8] According to the definition given above, all years from 1984 to 1989 are summarized in the Pre1 dummy and all years from 1991 on are captured by the Post1 dummy. The Pre1 dummy is introduced in order to capture the heterogeneity between mothers and non-mothers that may already exist before the time of first childbirth. The child penalty can be measured as β_3-β_1, i.e. it compares how a woman's job changes after first childbirth in comparison to before.

[7] For a non-mother all three dummies (Birth1, Pre1 and Post1) take the value zero.
[8] In order to distinguish between births which are early and late in the year, I define year t as year of birth if the child is born before September of year t, and respectively year t+1 as the year of birth if the birth is between September and December of year t.

The event study documents changes in the job of mothers around the time of motherhood: first, changes in the wage which serves as a measure of the child penalty, second, the presence of job turnover and third, differences in several non-pecuniary job characteristics. An overview of all job features, their definition and construction can be found in Section Additional Tables and Figures[9], Table I.i.[10]

For the estimation of the wage gap the *logarithm of the gross wage rate* is calculated taking into account contracted working hours.[11] Job turnover is first considered in general and then on the one hand as a change of the employer and on the other hand as a change within the firm. The selection of the specific job disamenities, for which a mother may claim an increase in income, follows the literature on CWD, for example Rosen (1986), Usui (2003) and Villanueva (2007). They distinguish among different groups of disamenities such as the regulation of working hours and workload. Thus different aspects of the *working time* and the *workload* are investigated in this study. Furthermore I consider different *flexibility* measures, since this might be an important aspect for the combination of career and family

Time is a scarce resource for a mother since she has to allocate it to both job and family. Therefore it can be assumed that the marginal utility of time increases when a woman becomes a mother. This may lead to a reallocation of the hours spent on the job and on housework. Thus *weekly working hours* are considered, in fact the amount of hours a woman is actually working, i.e. the contracted working hours plus overtime. Furthermore, different aspects of the schedule are taken into consideration such as *work in the evening,* at *night* or in *rotating shifts*. I also investigate whether the job of a

[9] The tables numerated with Latin numbers can be found in the section Additional Tables and Figures, the ones numerated with Arabic numbers are included in the text.

[10] For simplicity reasons several variables have been made binary. For construction see Table I.i.(Additional Figures and Tables)

[11] Hourly wages are calculated by dividing the monthly salary by the contracted working hours per month. Since only weekly working hours are available, I adjust them to a monthly measure by multiplying them by 31/7 (days per month/ days per week). The advantage of taking contracted hours instead of actual working hours is that they are an objective measure and do not have many outliers

woman allows for a certain degree of *flexibility*. One aspect is a *flexible working schedule*, i.e. if a woman can set her working hours as she likes. Another feature determining the flexibility of a job is the possibility to *work from home*. Furthermore, the fixed costs of commuting play as well a role for the job decision; thus, the *distance to the workplace*, measured in kilometers, is evaluated. Jobs additionally differ in the level of *workload* measured by *stress*, *physical demand* and *working conditions* (such as extreme climate conditions, gases, etc.). Workload may be relevant for a mother since she has to face a double load of work on the job and at home. It is clear that these variables are highly subjective and may be evaluated differently by everyone – in particular by mothers and non-mothers.

Each of the above-described variables is regressed (separately) on the dummies Pre1, Birth1 and Post1 as well as on a set of control variables, such as marital status, age, age squared, education and geographic, represented by the variable X_{it}. Marital status is described by a dummy called 'partner', which is 1 for all women who are either married or who have a permanent partner; otherwise it is 0. Both age and age squared are included in order to capture positive, but decreasing marginal returns to experience. Education is measured in years. A woman may be West or East German, or a foreigner. Finally, I control for a set of dummies for the years from 1984 to 2005.

Taking the basic event-analysis model and the specification of variables described above allows us to measure the changes in certain job characteristics around the time of first childbirth. Linear fixed effect models are applied in order to account for unobserved heterogeneity, such as preferences for job characteristics and family life as well as the subjectivity in the evaluation of the different job characteristics.

It is important for this analysis to have in mind that women, especially mothers, often do not continuously participate in the labor market. In other words, women, particularly after motherhood, are likely to drop out of the sample. Thus, sample

selection bias might arise. Therefore a test of sample selection bias is applied, and where necessary the correction suggested by Wooldridge (1995). Both are explained in the next subsection.

I.3.1.2. Sample Selection and Labor Force Participation

As empirical evidence and past research confirm, there is still a strong negative impact of motherhood on labor force participation (LFP). We can observe this impact from looking at our sample, which includes all women aged between 16 and 46, who are observed to be employed at least at some point between 1984 and 2005 and who have either had a baby before 2005 or not had a baby as of 2005. An overview of LFP around the first birth can be found in Section Additional Tables and Figures, Table I.ii.

A high percentage of women drop out of the labor force when having a child. Although before first childbirth participation in the labor market is continuously high (around 80 per cent), it falls dramatically in the year of first childbirth (34 per cent) and even more so the year after (25per cent). Some of the mothers decide to return to work, but this return is only observed gradually: 2 years after first childbirth maternal employment is 36 per cent; 3 years after it is higher than 40 per cent and 6 years after it rises to more than 50 per cent. Yet even if some mothers return to the labor market, others may never return after having children – even when the first child is an adult less than 65per cent work, while prior to the first child more than 80 per cent do.

As previously mentioned, the fact that women especially when becoming a mother drop out of the labor force constitutes a self-selection problem. It is well known that failure to account for sample selection can lead to inconsistent estimates. Linear panel data models, which take care of unobserved, individual permanent heterogeneity by adding a fixed effect, cannot eliminate the sample selection bias. This is because the sample selection effect is generally an unknown nonlinear function of both the observed time-varying regressors and the unobservable individual effects of the selection

equation, and is thus not constant over time. This problem of sample selection in panel data has been a topic of recent econometric investigation. One of the first approaches to assessing for sample selection was suggested by Wooldridge (1995). He proposed a test and correction procedure that allows for correlation between the unobserved effects of both the selection and primary equations. His model specifies a distributional assumption only for the error terms in the selection equation, but not for those in the primary equation. It furthermore allows the idiosyncratic errors to be serially correlated and heterogeneously distributed in both equations. [12]

As outlined above, the decision to stay out of the labor force might be correlated with motherhood, hence the test for endogeneity of self-selection by Wooldridge (1995) is carried out and if necessary, the correction method is applied as below.

1. First, the probability of participating in the labor force is estimated separately for each year, i.e. using a probit estimation for each year separately LFP is regressed on age, age squared, education and year dummies and, serving as exclusion restrictions, partner's income and mothers' satisfaction with the income and the household:[13]

$$P(Working_{it}=1) = \eta^* Z_{it} + v_{it} \qquad (I.2)$$

[12] Further estimators correcting for sample selection have been proposed by Ekaterina Kyriazidou (1997) and Maria Rochina-Barrachina (1999). Dustmann and Rochina-Barrachina (2000) reconsider and extend the above- mentioned estimators. They allow for additive individual specific effects in both the selection equation and the equation of interest, and, at the same time, for the equation of interest being defined for a non-random sub-population. Wooldridge and Semykina (2005) contribute further to the existing discussion of sample selection in panel data models taking into account the problem of endogeneity.

[13] I carry out regressions for two different specification of the reduced form: on the one hand I introduce as proposed by Wooldridge, the above-mentioned control variables for all years. This increases the explanative power of the probit regression but leads to a reduction of the sample since not for many individuals we have observations for all years. On the other hand I use control variables only for the same years, which has the opposite advantages. The results are similar, so for simplicity I present the results of the second specification. However the results of the first specification are available upon request.

Using the results of the probit estimation, the inverse mills ratio $\lambda(\eta*Z_{it})$ can be calculated for each individual in every year.

2. A fixed effect estimation is applied to equation (I.1) including as a further control the inverse mills ratio $\lambda(\eta*X_{it})$ and using only the sample of working women:

$$Y_{it} = \beta_1*Pre1_{it}+\beta_2*Birth1_{it}+\beta_3*Post1_{it} + \gamma *X_{it} + \rho* \lambda(\eta*Z_{it}) + a_i + u_{it} \qquad (I.3)$$

Using a t-statistic, a test can be run for the null hypothesis of no sample selection, i.e. if the coefficient of the inverse mills ratio is not significantly different from 0 (H_0: $\rho = 0$). In the case where the null hypothesis can be rejected, a correction procedure is used, which maintains the estimated inverse mills ratio in the regression equation (equation I.3).

I.3.2. Compensating Wage Differentials: Hedonic Wage Regressions

Once the job characteristics that are avoided by mothers are identified, the next step is to measure the CWD, i.e. how much income a mother must sacrifice to avoid unpleasant working conditions. The measurement of CWD has likewise been discussed in the economic literature and several methods for addressing different problems of the estimation have been suggested.

A substantial literature[14] has estimated hedonic wage regression models to infer whether or not labor markets place a premium on jobs that involve disamenities. A hedonic wage regression is a wage regression including disamenities as further control variables. The estimated coefficients of the disamenities are then commonly interpreted as the wage premium paid for these unpleasant job traits. One critique on this first

[14] See Lucas (1977) for an early application of hedonic wage regressions in the US. In Germany, Lorenz and Wagner (1989) find that job requirements and physical effort affect wages negatively, contrary to the predictions of the theory. For the French case, Daniel and Sofer (1998) find mixed evidence for CWD associated to environmental conditions on the job, like noise, physical effort, or exposure to vibration.

approach to estimate CWD has been its failure to control properly for workers' heterogeneity. Brown (1981) overcomes this criticism using panel data. Applying a first difference approach, he finds however no systematic effect of disamenities on wages in the US. Duncan and Holmlund (1983), using Swedish panel data and estimating a fixed effect model, find a significant effect only for stress and environmental conditions on wages.

A further problematic issue is the abstraction from job search and labor market imperfections. Hwang, et al. (1998) develop a model which accounts for job search and heterogeneity of firms with respect to their cost efficiency in reducing the amount of different disamenities. They show that standard hedonic wage regressions, which ignore the dynamic nature of the labor market, yield a premium for disamenities which might be underestimated or even wrongly signed.[15] For this reason, Villanueva (2007) suggests an estimation method taking only the sample of voluntary job leavers into account. Owing to the small sample used in this study, it is however not possible to estimate CWD after first childbirth using only the women who change their job voluntarily.

Here, I estimate a hedonic wage regression taking unobserved individual heterogeneity into consideration by applying fixed effects, but bearing in mind that the estimates might be underestimated. Thus, the estimated prices mothers have to pay in order to avoid certain disamenities provide only a lower bound and the reduction of the child penalty, due to CWD, might possibly even stronger. In Chapter II I suggest an alternative methodology, which takes into account the dynamic nature of the labor market and hence allows us to provide an accurate measure of how much wage mothers

[15] For a more detailed explanation of the approach by Hwang, et al. (1998), please refer to Section II.2.

are actually willing to sacrifice in order to avoid certain job disamenities. The function to be estimated in this chapter is as follows:[16]

$$Y_{it} = \beta_1 * Pre1_{it} + \beta_2 * Birth1_{1it} + \beta_3 * Post1_{it} + \gamma * X_{it} + \delta * Disamenities_{it} + a_i + u_{it} \quad (I.4)$$

The independent variable is the logarithm of the gross wage rate. As stated above, the hedonic wage regression is augmented by the disamenities, here the job characteristics that change around the first birth. I furthermore include dummies for the Pre1, Birth1 and Post1 periods and a set of controls X_{it}, which consists of marital status, years of education, age, age squared, region and a set of year dummies for 1985-2005.

In a last step I control additionally for turnover, on the one hand as a dummy representing a change in jobs and on the other hand a statistical interaction between job turnover and being a mother (represented by the dummy Post1). This allows us to control for a loss in firm-specific human capital and unreported changes in disamenities due to a job change Thus, it might help to disentangle the wage effect of the disamenities in particular from the one of a turnover in general.

The next section reports the description of the sample and the results of the two steps used for testing the hypothesis that the child penalty might be partly a CWD.

I.4. Results

I.4.1. Summary Statistics

The sample[17] consists of 2,814 women (12,640 observations) of which 1,989 are mothers. Table I.iii (see Additional Tables and Figures) gives an overview of the summary statistics of the sample.

[16] Sample selection bias, tested for by applying the test by Wooldridge (1995) explained in I.4.1.2, can be rejected.

The first major difference between mothers and non-mothers is the percentage of women who have a partner. While more than 80 per cent of the mothers have a partner, almost 50 per cent of the non-mothers are single. Non-mothers are younger than mothers (average age is 31 versus 35). This reflects to some extent the shortcoming of the sample that non-mothers could still choose to become mothers after 2005. The mean age given at first childbirth is 28 years, which is quite young compared with the current average in Germany (29.4 years for married and 27.7 years for unmarried women in 2004).[18] This can be explained by the fact that the mean age at first childbirth in our sample is an average over the last 20 years. Age at first childbirth, however, has risen substantially during the last decades. The sample also closely reflects the regional composition in Germany: around 65 per cent of the women are West German and around 22 per cent are East German. The rest are foreigners. On average women went to school for 11 years, which corresponds to an intermediate level that allows for vocational training and does not vary much between mothers and non-mothers.

I.4.2. Regression Results

I.4.2.1. Event Study

The first step to testing if mothers substitute income with job-related disamenities is to estimate whether not only wages but also further non-pecuniary job features change with motherhood. A summary of the statistics for all job characteristics can be found in Table I.iv (see Additional Figures and Tables).

The Child Penalty

Before looking at non-pecuniary job characteristics it is necessary to determine the child penalty for the sample of working women between ages 16 and 45. The child penalty, measuring the effect of motherhood on wages, is estimated applying fixed

[17] Since women who don't work drop out of the sample the descriptive statistics include only working women.
[18] All data for comparison purposes are taken from www.destatis.de

effects to equation (I.1), using as independent variable the logarithm of real gross wage rates. The real gross wage rates are calculated, taking into consideration contracted hours. Using contracted hours has the advantage of no extreme outliers,[19] but it may not reflect the true amount of hours worked. The logarithm of real gross wages for mothers is 2.35, while for non-mothers it is 2.38. As control variables age, age squared, marital status, education, region and a set of year dummies are included. The resulting effect (β_3-β_1) represents the child penalty. In addition, equation (I.3) is estimated including the inverse mills ratio,[20] which allows us to test for selection into employment. The results can be found in Table I.1. below, more detailed results are provided in Table I.v. (see Additional Figures and Tables).

Table I.1: Results of a fixed effect estimation for ln of real gross wage rates

	Ln real gross wage	**Ln real gross wage**
Pre1	0.006	0.006
	(0.29)	(0.29)
Post1	-0.188	-0.188
	(8.60)**	(8.60)**
Child Penalty	-0.194	-0.194
	(12.90)**	(12.90)**
Millsratio	-	-0.008
	-	(0.24)
Constant	-1.281	-1.268
	(16.79)**	(13.67)**
Observations	12460	12460
# of individuals	2814	2814
R-squared	0.37	0.37

T-statistics are reported in brackets below every coefficient, * indicates that the coefficient is significant at a 5per cent level and ** at a 1per cent level. The set of control variables included as well age, age squared, partner, years of education, origin and set of year dummies for 1985-2003

[19] However, I limit the observations of real wage rates to values above the 0.5th and below the 99.5th percentile.

[20] The inverse mills ratio is calculated using the selection equation (I.2). Results of the probit estimation of the selection equation (I.2) are available upon request.

As we can see in Table I.1, the empirical evidence of the child penalty is once again confirmed. After first childbirth, mothers face a loss in gross wage rates of almost 20 per cent with respect to their pre-birth wage rates (which corresponds to the difference between the coefficients of the Post1 and the Pre1 variable). The hypothesis of there being no sample selection cannot be rejected (the coefficient of the inverse mills ratio is not significant).

Recent findings by Kunze and Ejrnaes (2004) of a wage dip even before motherhood can be verified. In a regression where the years around first childbirth are split (from five years prior to first childbirth to six years afterwards, results see Table I.vi in Section Additional Tables and Figures) we can see that gross wages start to fall two years before first childbirth. A significant fall, however, is only detected starting from the forth year after childbirth. This might be explained by the fact that mothers have the right to take maternal leave, which allows mothers to come back to their guaranteed job during the first three years after giving birth. From year five on, the child penalty grows stronger over the years, while, as we have seen before, LFP rises over the years after childbirth. So it seems that only women for whom the opportunity costs of not working are high continue to work around the time of first childbirth. Women who return later are penalized even more because of the loss in human capital associated with longer career interruptions.

Job Turnover

Women might change job in case the current position does not allow for an easy combination of work and family. Looking at the average turnover in Table I.iv (Section Additional Figures and Tables) we can see that many job changes take place already before childbirth. This might indicate that women plan their career according to their fertility plans. Turnover in general, and then split into changes of the employer and or the position within firm, are regressed on the Pre1, Birth1 and Post1 dummy and the

same set of control variables as above. A sample selection test has been conducted, but the hypothesis of there being no sample selection cannot be rejected.[21] Results of a fixed effect estimation can be seen in Table I.2 below.[22]

Motherhood seems to have a significant impact on job turnover. Most of the changes are changes to a new employer, while no strongly significant movements happen within firms. Looking at the results of a regression where the years around childbirth are split, we can see that turnover is increasing over the years after giving birth.[23] This might indicate that, as children get older, women try to find work arrangements, which allow for a better combination of work and family.

Table I.2.: Results of a fixed effect estimation for job turnover

	Turnover	**New Employer**	**Within Firm**
Pre1	0.042	0.048	-0.006
	(2.19)*	(2.84)**	(0.56)
Post1	0.085	0.079	0.005
	(4.24)**	(4.52)**	(0.49)
Change	0.043	0.031	0.011
	(3.10)**	(2.60)**	(1.49)
Constant	0.88	0.687	0.192
	(12.67)**	(11.26)**	(5.06)**
Observations	12460	12460	12460
# of individuals	2814	2814	2814
R-squared	0.12	0.1	0.03

T-statistics are reported in brackets below every coefficient, * indicates that the coefficient is significant at a 5% level and ** at a 1% level. The set of control variables included as well age, age squared, partner, years of education, origin and set of year dummies for 1985-2005

Non-Pecuniary Job Characteristics

As previously mentioned three different categories of non-pecuniary job characteristics, suggested by the literature on CWD, might be of specific interest for the

[21] Results of the probit estimation of the selection equation (I.2) are available upon request.
[22] Detailed results, including the estimated coefficients of all control variables, are available upon request
[23] Regression results are available upon request.

combination of work and family: working schedule, workload and flexibility. Before going into the descriptive statistics of these different job features, it has to be noted that most of these job traits are only observed for a few years. Rotating shifts and the variables for workload (stress, physical demand and bad working conditions) are observed for the years 1985, 1987, 1989, 1995 and 2001; work in the evening and at night only for the years 1990, 1995 and 2000; and only in three years (1997, 1999 and 2002) women were asked if they work from home. In order to maximize the sample size, we impute these job characteristics applying the following technique.[24] A new variable, called job change, is created, which enables us to determine the years in which a woman holds the same job. Using this variable, the job characteristics reported for only certain years can be extended to all the years in which a woman retains the same job.

Let me now provide a short overview of the average characteristics of the jobs held by mothers and non-mothers.[25] In general, the contracts of non-mothers include more hours per week than that of mothers (37 hours vs. 31 hours). The actual working hours (agreed hours plus overtime) of non-mothers exceed those of mothers even more. The presence of children decreases also the probability to work during inconvenient hours such as in the evening (after 6 p.m.) or at night (10 p.m. to 6 a.m.). It increases, however, the engagement in rotating shifts, which might possibly allow for a better combination of career and family. Almost no women enjoy flexible working hours (not even 1 per cent). This reflects how regulated the German labor market is, or put more precisely, has been over the last 20 years. Nevertheless, more than 11 per cent of the mothers and almost 8 per cent of the non-mothers work from home. Mothers also live closer to their workplace (11km vs. 15km), which allows them to save on commuting time. This might be an important aspect, since time is a scarce resource for mothers.

[24] This technique is based on Villanueva (2007)
[25] Details can be found in Table I.iv in Section Additional Figures and Tables.

With respect to workload mothers report as well worse conditions than non-mothers: 55 per cent of non-mothers vs. 58 per cent of the mothers consider their work as stressful, while only 20 per cent of non-mothers vs. 28 per cent of mothers see it as physically strenuous. Mothers are also more likely to report bad working conditions (21 vs. 18 per cent). However, one has to bear in mind the subjective nature of these variables: Mothers may judge their work as more tiring owing to the double load of work and domestic activities.

In order to see how motherhood affects these job characteristics, a fixed effect method is applied to equation (I.1) regressing all non-pecuniary job features on the same set of control variables as before (dummies for the periods around childbirth, age, age squared, marital status, years of education, region and a set of year dummies). Furthermore, I estimate equation (I.3), which includes the inverse mills ratio derived from the results of a probit estimation of equation (I.2).[26] This allows us to test for sample selection bias and if necessary to correct for it. Results for the characteristics that significantly change around first childbirth are shown in Table I.3 below. The table presents the results with the inverse mills ratio included in case the null hypothesis of no sample selection can be rejected, otherwise without.[27,28]

The results of the event study show significant changes around first childbirth for all three categories. As already seen in the descriptive statistics, women tend to work less after having a child. We can observe a strong and significant decrease in working hours after motherhood. In addition, mothers seem to avoid a working schedule outside the usual working hours (8 a.m. to 6 p.m.). In other words, they work less during the evening and at night. A further indication for trying to decrease the time spent at work is the fact that the distance to the workplace decreases once a woman gives birth to her

[26] Results of the probit estimation of the selection equation (I.2) are available upon request.
[27] The standard error correction for the regression having been corrected for sample selection is pending.
[28] Detailed results are available upon request.

first child. Mothers also seem to dislike heavy workload. Once becoming a mother, their work tends to be significantly less stressful and offers better working conditions. The result for physical strains, however, indicates that mothers see their work as a greater burden than non-mothers. The double workload of job and domestic activities may explain this finding.

Table I.3: Results of a fixed effect estimation for non-pecuniary job traits[29]

	Working hours	Night work	Work evenings	Stressful job	Physical demand	Bad condition	Distance to job
Pre1	1.547	0.028	0.015	0.015	0.007	0.011	0.313
	(3.09)**	(2.37)*	(0.77)	(0.63)	(0.30)	(0.45)	(0.49)
Post1	-13.003	-0.028	-0.066	-0.088	0.044	-0.022	-0.957
	(24.93)**	(2.32)*	(3.31)**	(3.47)**	(1.72)	(0.89)	(1.44)
Change	-14.55	-0.056	-0.081	-0.103	0.037	-0.033	-1.27
	(47.56)**	(6.68)**	(5.88)**	(5.92)**	(2.08)**	(1.92)*	(2.78)**
Millsratio	-1.976	0.051	-0.011	-	-	-	-
	(2.54)*	(2.83)**	(0.37)	-	-	-	-
Constant	(6.68)	-0.162	-0.554	1.451	0.779	0.734	20.93
	(5.88)	(3.14)**	(6.58)**	(16.53)**	(8.76)**	(8.33)**	(9.07)**
Observations	12460	12460	12460	12460	12452	12460	12460
# individuals	2814	2814	2814	2814	2812	2814	2814
R-squared	0.19	0.06	0.15	0.58	0.23	0.16	0.03

T-statistics are reported in brackets below every coefficient, * indicates that the coefficient is significant at a 5% level and ** at a 1% level. The set of control variables included as well age, age squared, partner, years of education, origin and set of year dummies for 1985-2005

These results show that certain non-pecuniary job traits decrease around the first childbirth. This decrease indicates that these job features seem to be avoided by mothers. Given the significant changes not only in wages but also in non-pecuniary job features, it is reasonable to think that mothers sacrifice income to avoid certain

[29] This table only presents the results for variables that change significantly around first birth. I estimated as well the change around first childbirth for rotating shifts, work from home and flexible working schedules. The signs of the coefficients are as expected positive (but not significant), indicating that mothers prefer working arrangements involving certain flexibility. The results are available upon request.

disamenities. Furthermore, looking at regressions where the years around the time of first birth are further split (into five years before and six years after child-birth),[30] the change in mothers' job characteristics around the arrival of their first child seems strategic. Several non-wage job characteristics, such as stress and bad working conditions begin to improve already before first childbirth. This provides an intuitive contradiction against the possible endogeneity of fertility, i.e. against the concern that wage and career opportunities might determine the decision to have a baby. It seems that the decision to have children is rather planned than caused by a negative employment shock.

Having determined which job traits decrease around motherhood and thus can be referred to as disamenities (in the opinion of mothers), the next step is to estimate how much wage mothers have to sacrifice in order to diminish these undesired working conditions. Thus in the next section, I present the results of a hedonic wage regression.

I.4.2.2. Hedonic Wage Regression

After having determined the job features disliked by mothers, we can proceed estimating the price that mothers must pay to avoid these undesired characteristics. From there, we can derive the child penalty taking into account the premium mothers sacrifice.

For this purpose a hedonic wage regression, as represented in equation (I.4), is estimated. In other words, I re-estimate the event study using the logarithm of the real gross wage rate as dependent variable. As further control variables, I include all job characteristics that in Section I.4.2.1 have been shown to decrease significantly around first childbirth: actual working hours per week, night work, work in the evening, stress, physical demand, bad working conditions and lastly the distance to the workplace. Furthermore, I test for sample selection bias using the methodology described in Section

[30] Regression results available upon request.

I.3.1.2. Since the null hypothesis of no sample selection bias cannot be rejected, a correction is not necessary.

In a second step, I additionally include turnover (a dummy for job changes), in particular mothers' turnover (a statistical interaction between turnover and the dummy Post1). This allows us to control for the wage effect of unreported changes in working arrangements. Table I.4 below shows the results for the variables of most interest.[31]

In column 2 we can see that workers are remunerated for certain work conditions: they receive a significant wage increase of 2.5 per cent for heavy workloads, in particular for having a stressful job and bad working conditions and of 0.1 per cent for each kilometer more distance to work. A marginally significant premium is paid for one more working hour per week (0.1 per cent) and for working in the evenings (almost 2 per cent).

Given the results of the event study, a significant decrease in working hours, in evening shifts, stress, commuting time and hazardous working conditions, and of the hedonic wage regression, showing that these job traits are all compensated by a significant wage premium, one can guess that mothers might be willing to sacrifice wages to reduce job disamenities. Comparing the first and second columns reveals that including these job disamenities diminishes the child penalty by 8 per cent (from -0.194 per cent to -0.18 per cent). This may indicate that the child penalty can be (partly) explained by a CWD.

The results of the forth column show that in case a woman changes her workplace, she suffers generally a wage loss of 6 per cent, which increases to 8 per cent once being a mother. This suggests on the one hand that mothers might encounter more difficulties in finding a well-paid job, and thus point out some employer taste-based discrimination. On the other hand it reveals that new working arrangements might

[31] Detailed regression results, including the estimated coefficients of all control variables, are available upon request

involve fewer disamenities and thus a lower wage. Including additionally job turnover decreases the child penalty further to a 17.8 per cent.

Table I.4: Hedonic wage regression including disamenities

	Ln real gross wage	Ln real gross wage	Ln real gross wage	Ln real gross wage
Pre1	0.006	0.004	0.007	0.007
	(0.29)	(0.21)	(0.35)	(0.32)
Post1	-0.188	-0.176	-0.171	-0.171
	(8.60)**	(7.79)**	(7.59)**	(7.57)**
Child Penalty	-0.194	-0.18	-0.178	-0.178
	(12.9)**	(11.05)**	(10.95)**	(10.87)**
Working hours	-	0.001	0.001	0.001
	-	(1.42)	(1.24)	(1.24)
Night work	-	-0.018	-0.017	-0.017
	-	(0.90)	(0.86)	(0.87)
Work evenings	-	0.018	0.02	0.02
	-	(1.50)	(1.63)	(1.63)
Stress	-	0.024	0.024	0.024
	-	(2.71)**	(2.73)**	(2.74)**
Physical effort	-	0.002	0.002	0.002
	-	(0.20)	(0.19)	(0.19)
Bad conditions	-	0.026	0.025	0.025
	-	(2.78)**	(2.72)**	(2.72)**
Distance	-	0.001	0.001	0.001
	-	(3.15)**	(3.33)**	(3.34)**
Job turnover	-	-	-0.068	-0.06
	-	-	(6.06)**	(4.42)**
Turnover*post	-	-	-	-0.023
	-	-	-	(1.03)
Constant	-1.281	-1.375	-1.312	-1.307
	(16.79)**	(17.12)**	(16.23)**	(13.44)**
Observations	12460	12460	12460	12460
# of individuals	2814	2814	2814	2814
R-squared	0.37	0.37	0.37	0.37

I include as well age, age squared, marital status years of education, origin and a set of year dummies for 1985-2005.T-statistics are reported in brackets, * indicates that the coefficient is significant at a 5%level and ** at a 1% level

Looking at these results, we can see that taking into account job changes and several disamenities decreases the child penalty all together by 9 per cent. Hence, the results of the hedonic wage regression support the hypothesis of the child penalty as a CWD. Mothers might sacrifice some fraction of their income in order to avoid certain disamenities and thus the gap in wages due motherhood shrinks.

Yet, the difference between the estimated 'raw' child penalty and the one accounting for disamenities is not significant at a 90% confidence interval.[32] As mentioned in Section I.3.2, the results of hedonic wage regressions have to be interpreted carefully. Hwang, et al. (1998) pointed out that hedonic wage regressions might lead to downward biased coefficients. In other words, they provide only a lower bound for the prices mothers have to pay in order to diminish certain disamenities. The actual wage loss mothers are suffering when accepting a new work arrangement involving less disamenities, as well as the reduction in the child penalty, might be even higher than the one estimated. In Chapter II, I suggest a methodology addressing the problems of the hedonic wage regression and provide a more accurate measure of how much wage mothers are actually willing to sacrifice to reduce job disamenities.

Finally, it may be useful to know how much the hypothesis of the child penalty as a CWD contributes to explaining the remaining unexplained family gap after controlling for existing explanations. As previously noted, the following hypotheses have already been investigated: reduced work experience, less effort owing to the dual workload of job and home activities, sector segregation and the presence of further children in the household.[33] Even if taking into account other previously documented explanations, the contribution of the new hypothesis is notable. The existing

[32] The 90% confidence interval for specification (I.1) is [-0.165; -0.224], the one when including the amenities is [-0.147; -0.210], and when including the interaction between job change and post birth period [-0.147;-0.209].

[33] The results of the regressions including these alternative hypotheses in detail are not reported here since that is beyond the scope of this work. Detailed results including alternative hypotheses are available upon request.

hypotheses, especially the depreciation of human capital, decrease the child penalty by a 20 per cent. Controlling for the disamenities adds even more to the knowledge about the unexplained gap between mothers and non-mothers. The absence of disamenities in mothers' jobs reduces the child penalty further (by more than a 20 per cent) and the unexplained part of the loss in wages due to motherhood reduces to less than 7 per cent.

I.5. Conclusion

One indication that mothers still encounter barriers to success in the labor market is the child penalty – i.e. the fact that mothers earn lower wages than women without children. Even if several hypotheses about its sources have been explored, much of the gap remains unexplained. Recent studies have only partially exploited the hypothesis that women, once they get a baby, adjust their jobs in a way that they can combine work and family better, i.e. choose a more family oriented wage-disamenities package.

This chapter contributes to the literature by investigating changes in a broad range of non-pecuniary job features around the time of first childbirth. It furthermore estimates how much of their wage mothers have to sacrifice in order to avoid these job characteristics. The hypothesis tested is that if the labor market rewards disamenities, some fraction of the child penalty can be interpreted as a compensating wage differential (CWD).

In order to test this hypothesis, data from the German Socio-Economic Panel (GSOEP) has been used. The GSOEP provides detailed information on personal attributes and job characteristics, with attention given to the wage as well as non-wage features of jobs. Its longitudinal nature allows us to compare women before and after first childbirth, and thus to study changes in women's preferences around this time.

Using a sample of women aged 16 to 46, an event study has been undertaken to analyze changes in wages, job turnover and several non-wage job aspects around motherhood. The child penalty in this sample reaches almost 20 per cent when comparing the gross wage rates of women before and after first child-birth. Besides increased job turnover (by more than 4 per cent) several job characteristics change as well around this time. A sharp decline can be observed in working hours, which can be explained by reduced overtime and more part-time contracts. Mothers also work less at inconvenient working hours (i.e. in the evening or at night). Furthermore, when becoming a mother a woman is more likely to have a job that is close to her home. This enables her to save on commuting time. Finally, the results suggest that mothers tend to avoid heavy workload, such as a physically strain, stress and hazards.

The goal of this chapter is to estimate which fraction of the child penalty can be explained by the trade-off between wages and disamenities women are accepting once having a child. The results of a hedonic wage regression show that women have to sacrifice a significant fraction of their wages in order to reduce the amount of disamenities such as stress (2.5 per cent of their wage), bad working conditions (2.5 per cent) and commuting time (0.1 per cent). Job turnover is furthermore associated with a wage loss (8 per cent), which might point towards the fact that mothers change into working arrangements offering fewer disamenities and thus lower wages. Including certain disamenities and a dummy for job turnover in the wage regression decreases the estimates of the child penalty by almost 10 per cent. These results indicate that some part of the wage penalty may be a CWD for fewer disamenities in the jobs held by mothers.

As mentioned in Section I.3.2, the used estimation methodology, hedonic wage regressions, ignores the dynamic nature of the labor market and the estimated premium for disamenities and hence, the closure in the child penalty might be underestimated. In

Chapter II, I suggest a new methodology, which takes advantage of mothers' movements in and out of the labor market. Thus, it allows us to overcome certain limitations of the hedonic wage regression and to provide a more accurate measure of mothers' willingness to pay to avoid job disamenities.

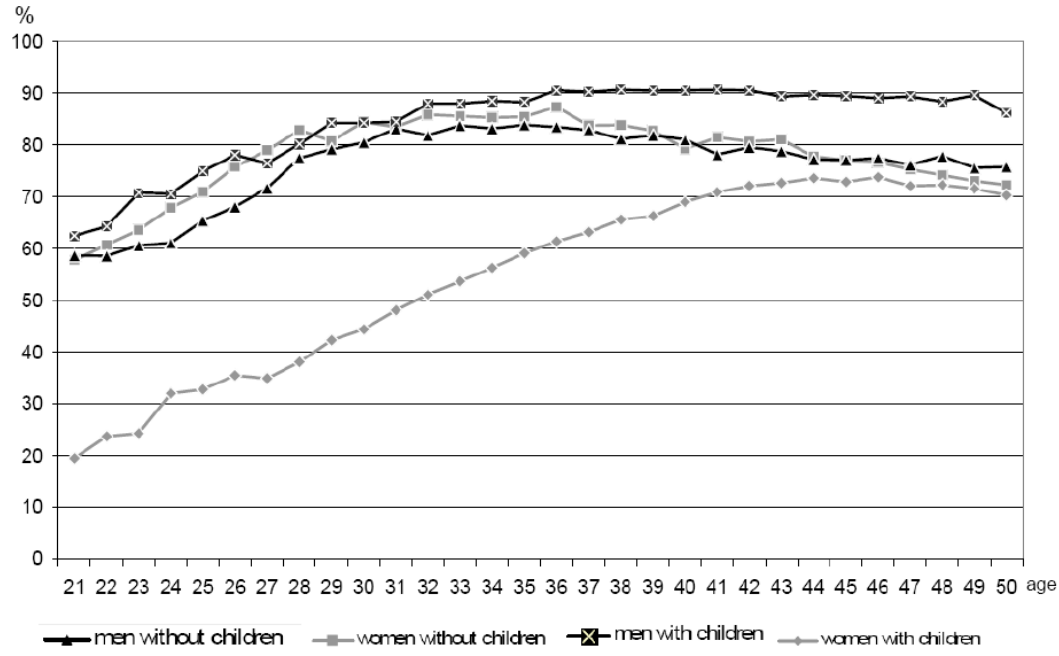
CHAPTER II

Returning to Work – Mothers' Willingness to Pay for Job Amenities

II.1. Introduction

In spite of recent achievements in the compatibility of family and work, mothers still encounter difficulties in some countries to participate in the labor market. Germany, along with Italy, Greece and Spain, has the lowest labor force participation rate (LFP) among mothers: 44.3% compared to more than 60% in other OECD countries such as Austria, Belgium, France, Portugal, the Netherlands, the UK and the US.[34] In Germany, this low share of working mothers contrasts with the high participation rate among childless women; a difference that is less pronounced only at higher ages (see Figure II.1).

Figure II.1: LFP of men and women with and without children in Germany (2004)



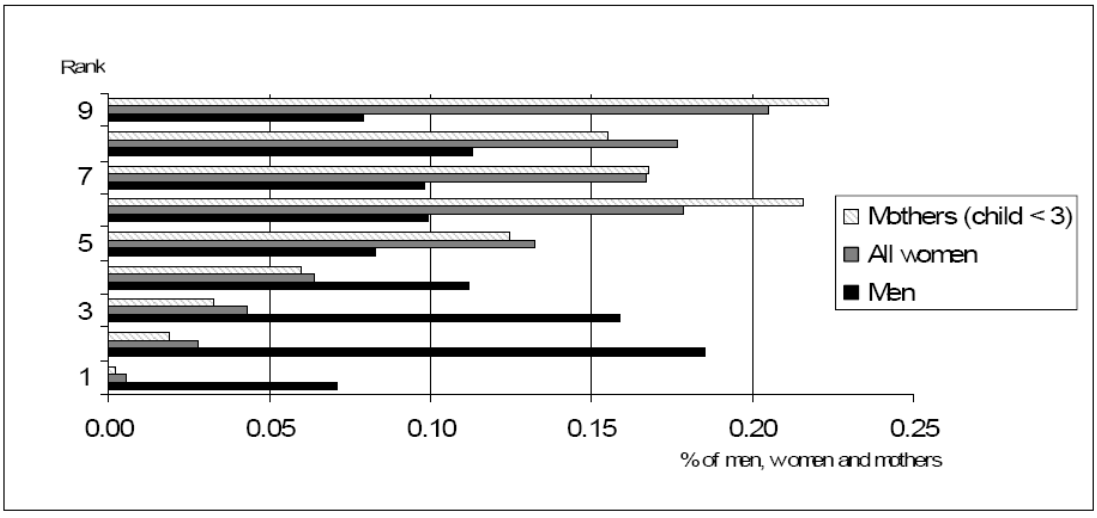
Source: Dressel, C, et al. (2005); Gender-Datenreport

[34] Numbers are taken from http://unstats.un.org/unsd/demographic/products/indwm

Career interruptions, as is generally known, lead to depreciation in human capital and hence, to a loss in long-term income and career opportunities. Therefore, an explicit goal of family policy, as set out by the European Council in 2000, is to increase women's, and in particular mothers' LFP. For this purpose, it is crucial to understand the disincentives that mothers face when deciding whether and when to return to work after childbirth. It is indispensable to know how much mothers are deterred by certain adverse job features, so-called disamenities, and which fraction of their wage they are willing to sacrifice to avoid them; in other words, this research seeks to estimate mothers' marginal willingness to pay (MWP) to reduce certain job-related disamenities.

Previous studies about the MWP to diminish disamenities focus mainly on young males. The distribution of men and women across occupations with respect to the level of disamenities shows, however, sharp differences. Ranking jobs according to the level of hazards, where the jobs with the highest level of hazards are ranked one and those with the lowest level on place ten, reveals that women are, relative to men, over-represented in jobs that expose them to fewer inconveniences and health risks (see Figure II.2 below).[35]

Figure II.2: Distribution of men, women and mothers over jobs varying in the disamenities level



Source: German Socio-Economic Panel and own calculation (2004)

[35] A similar distribution can be observed for the level of workload and inflexible working schedules.

As we can see in Figure II.2., at the moment of having a child, this crowding is even more pronounced. This empirical evidence suggests that mothers with young children differ from men and women without or with older children in their MWP to avoid disamenities. Thus, in order to design an efficient family policy aimed at increasing mothers' LFP, it is essential to investigate mothers' MWP to reduce disamenities.

There are only a few studies about the averseness of women, in particular mothers, towards disamenities. Some empirical evidence has shown that a low risk of injuries, job protection and employment stability are relevant job features for mothers, in particular when deciding whether and when to return to work after childbirth (Bratti, et al., 2004; De Leire and Levy, 2004). These studies, however, investigate only few job aspects and do not measure mothers' aversion towards disamenities. Chapter I of this thesis investigates a broader range of job features and shows how these job traits change around the time of motherhood. Nevertheless, it also fails to provide yet an accurate measure for mothers' MWP to avoid these job traits.

To my knowledge, this is the first study providing a direct estimate of mothers' MWP to reduce disamenities. The identification strategy relies on German maternal leave length data. Among OECD countries, Germany belongs to the ones offering the longest parental leave; since 1992 German working mothers are entitled to a leave of 36 months.[36] During this period mothers enjoy a job guarantee and hence, are free to decide whether and when to return to their jobs.[37] The remarkable length of this period enables us to observe sufficient variation in the chosen duration of maternal leave. Using the estimated elasticities of the leave length with respect to wages on the one

[36] Austria, Finland, France and Germany provide the most generous parental leave system in the OECD. The US, for instance, entitles recent mothers only to a leave of 12 weeks. For a comparison see: http://unstats.un.org/unsd/demographic/products/indwm/.

[37] A woman has to inform her employer six weeks in advance of when she wants to take maternal leave and how long she wants to go on leave (she has to declare her leave intention for the first 24 months at least).

hand and to disamenities on the other hand I can infer mothers' MWP to moderate disamenities.

The specific framework, maternity leave, allows me to overcome some methodological limitations of previous studies that estimated the MWP to avoid disamenities. Earlier research focused on the job search of employed workers.[38] One shortcoming of this approach is that one cannot observe potential job offers. In other words, the studies based on job search only estimate the impact of current job features on the job tenure, but fall short of separating these effects from those of wage and disamenities of latent job offers. The advantage of the maternal leave setting is that we can examine the features of all relevant options mothers face while on leave: staying at home or returning to their guaranteed job at any time during their legally granted leave period of 36 months. One may argue that mothers search for a new job while being on leave, and hence we may likewise fail to observe possible outside job offers. The data shows, however, that mothers rarely change jobs during maternal leave (only 2% do so). The job guarantee during the maternal leave period is thus the key element of our strategy to estimate the MWP.

A further reason for choosing Germany, besides its generous parental leave system, is the availability of two excellent datasets, the German Socio-Economic Panel (GSOEP, 1984-2005), already used in Chapter I, and the Qualification and Career Survey (QCS, 1998/99). The GSOEP is a panel dataset, providing besides yearly data on personal and occupational attributes, monthly data on activities such as working, being on leave, and so forth. Its longitudinal nature permits the construction of maternal leave spells and the determination of the detailed occupation previous to giving birth. The QCS contains a wide range of occupations and a great variety of disamenities, from which it is possible to create objective disamenities for the different occupations.

[38] See Gronberg and Reed (1984), which is explained in more detail in Section II.2.

Combining these two datasets via the occupation und using the years 1992-2005, I can estimate the impact of wages and disamenities on maternal leave length and hence, infer the parameter of interest. The results show that mothers are willing to accept significant wage losses to reduce hazardous working conditions and to enjoy a working schedule compatible with available childcare.

This chapter, thus, provides a first insight into mothers' MWP to reduce disamenities, whose understanding is essential for an effective family policy design aimed at increasing mothers' LFP. It furthermore contributes to improving the measurement of the MWP to diminish disamenities, using the special setting of maternal leave, in which all relevant alternatives available to mothers eligible for parental leave are observable.

The remaining chapter is structured in the following way. Section II.2 briefly reviews previous literature, while Section II.3 introduces the German leave legislation. The theoretical and empirical model is developed in Section II.4. Section II.5 describes the data and Section II.6 reports the detailed results of the basic and additional specifications. Section II.7 concludes, with suggestions for an efficient policy design targeted at a balance between work and family.

II.2. Previous Estimation Methodologies

The theory of compensation wage differentials (CWD), outlined in Chapter I (Section I.2.2.), postulates that jobs are packages of wages and disamenities and that a loss in one dimension has to be compensated by a gain in the other.

One of the first estimation approaches aiming at providing empirical support for the theory of CWD has been the so-called hedonic wage regression, introduced and applied in Chapter I (Section I.3.2.). Hedonic wage regressions, however, face certain criticism. The first shortcoming, the failure to control for workers' heterogeneity, has

been addressed in Chapter I by using panel data and applying a fixed effect method (following Brown, 1981; Duncan and Holmlund, 1983). The second criticism, inconsistent estimates which arise due to the fact that hedonic wage regressions ignore the dynamic and imperfect nature of the labor market, nevertheless, has been ignored so far.

Hwang, et al. (1998) provide the theoretical proof for this inconsistency. The standard hedonic wage regression is a static model which assumes that workers make a once and for all decision when accepting a job. In reality, though, the labor market is considerably dynamic; workers search for better jobs, and firms for more productive workers, such that there is a constant turnover. This might give an incentive for firms to create jobs offering attractive wage-disamenity bundles. Firms, on the one hand, may differ in their cost efficiency of avoiding disamenities. Thus, a more cost efficient firm might be able to offer jobs with both a higher salary and less disamenities. Workers, on the other hand, might not be perfectly aware or informed about the differences in the wage-disamenity bundles offered by different jobs. Hedonic wage regressions, conversely, neither take into account heterogeneity among firms nor labor market imperfections; thus, the estimated premium for disamenities may be underestimated or even wrongly signed.

A new generation of research on CWD has focused on incorporating job turnover and search behavior when studying the trade-off between wage and disamenities. One of the first studies of this generation is the one by Gronberg and Reed (1994) who do not estimate the premium paid on the labor market to compensate for disamenities, expressed by the CWD, but rather workers' MWP to avoid disamenities. They use data on job tenure and propose that tenure in jobs with higher wages or less disamenities is expected to be longer if quits are voluntary. Given this proposition they derive the MWP to reduce disamenities by simply taking the ratio of the elasticity of job

tenure with respect to a certain disamenity over the elasticity with respect to the wage. One limitation of their study, considered not negligible, is the failure to incorporate an explicit wage-disamenity offer process, which would permit them to isolate the effects of the current wage and disamenities from those of wage and disamenities of subsequent jobs.[39]

The present chapter suggests an alternative framework that enables us to overcome this limitation. The focus is on maternal leave and thus on the time mothers spend out of the labor force after childbirth. In Germany, working mothers are entitled to a leave of 36 months. During this period mothers can decide whether and when to return to their guaranteed job. Mothers view this job guarantee as insurance and hence rarely change job after maternal leave (only 2% do so). Thus, in contrast to the framework used by Gronberg and Reed, this setting allows us to examine the features of all relevant alternatives mothers face while on leave: staying at home or returning to their guaranteed job at any of the 36 months. The job guarantee during the maternal leave period is thus the key element to estimate the MWP more accurately.

In the following section, I provide an overview of the maternity leave legislation in Germany, which serves as a natural setting that allows for an accurate measurement of mothers' MWP to decrease certain disamenities.

II.3. Parental Leave Legislation

Germany is one of the OECD countries with the most generous parental leave system. It consists of three parts: maternity protection, protected parental leave and parental benefits.

[39] One recent study by Bonhomme and Jolivet (2005) explicitly models the wage-disamenity offer process. They show that despite weak CWD in cross-sectional data, there is a systematic and significant MWP for amenities such as the type of work or working conditions. A further approach to measure the CWD accurately has been suggested by Villanueva (2007); using only voluntary job changers, he derives bounds on the monetary returns to disamenities in the West German labor market.

The first, maternity protection, regulated by the maternity protection law (1979), refers to a period of 6 weeks before and 8 weeks after childbirth during which mothers must not work.[40] The second, protected parental leave, allows the mother to choose between staying on leave and returning to work during a certain period after giving birth.[41] Since the maternal leave is the true period during which a mother is free to decide about her participation in the labor market, the present study focuses on this period.

Table II.1: Reforms of the Federal Law of Parental Leave and Parental Benefit

Year	Parental Leave	Benefit
1986	10 months	10 months (300Euros)
1988	12 months	12 months (300Euros)
1989	15 months	15 months (300Euros)
1990	18 months	18 months (300Euros)
1992	36 months	24 months (300Euros)
2001	36 months	12months(450€)/24months (300€)

Source: Weber (2004) and Schönberg and Ludsteck (2006)

The Federal Law of Parental Leave and Parental Benefit was introduced in 1986. It allows a woman to take some extra months off beyond the maternity protection period,[42] while keeping the option to return to her former job. This means that the employer has to guarantee her a position comparable to her former one. A mother is eligible for parental leave if she has worked at least 6 months in the same job when

[40] During this period, the mother receives her net wage rate. The social security pays 13€ per day, while the employer has to cover the remaining amount.
[41] In theory both parents can qualify for parental leave. In practice however, not even 5% of the fathers currently take parental leave. Thus, I will use the terms parental and maternal leave synonymously.
[42] The time of the maternity protection is included in the maternal leave period, thus a women can legally be on leave up to the maximum time of the maternity leave period without losing the right to return to her job.

giving birth. As we can see in Table II.1, the parental leave has been subsequently extended from a length of 10 months at the time of its introduction in 1986 to a length of 36 months from 1992 onwards.

As the name of this law already indicates, it also regulates the parental benefits, the third pillar of the maternity leave legislation. The government pays the benefit conditional on the mother taking care of her child; in other words, it is paid as long as the mother remains on leave.[43] Until 1992 this benefit was provided for the whole leave period, but from then on only for at most 24 months of the total parental leave period. While before 1994 the parental benefit was independent from total household income, afterwards it became income dependent. There are two income thresholds, one affects the payment of the benefit in months 1-6 and the other applies to months 7-24.[44,45]An income higher than the respective threshold incurs a gradual reduction of the benefit after month six, but a complete loss during the first six months. Since 2001 a mother has the choice between two different benefit versions; either, as before, she receives a benefit of 300€ for 24 months or a higher benefit of 450€ for a shorter period of 12 months.

Previous studies have shown that the leave legislation, especially the total leave length, affects mothers' decisions of when to return to work.[46] Therefore, in the following analysis I consider only the years 1992 up to 2005, during which the parental leave of 36 months has gone unchanged.[47] The parental leave legislation during this period provides an appealing framework to estimate mothers' MWP to reduce disamenities; the job guarantee that allows a mother to freely decide whether and when

[43] A mother is allowed to work at most 19h/week (from 2001 on: 30h/week) to receive the benefit.
[44] The total income during the first six months after childbirth cannot be more than 51000€ for a two parent household and not more than 38000€ for a single parent household.
[45] The total income during the months 7-24 can not exceed an amount of 20500€ for a two parent household and not more than 16500 € for a single parent household.
[46] See Ondrich, J,.et al. (2003) and Schönberg and Ludsteck (2006).
[47] The total period, including all years during which mothers have the right to some leave (1986-2004) is considered in the robustness checks in section II.6.3.

to return to her job permits the observation of the relevant alternative possibilities a mother has while on leave.

The empirical analysis stems from an underlying random utility model, which sheds light on the relationship between the leave length and the wage on the one hand, and the disamenities on the other hand. The following section describes this model.

II. 4. A Model of Maternal Leave Length

II.4.1. The Basic Model[48]

The following model captures the relevant considerations of a mother when deciding about the maternal leave length. The objective is to reveal the impact of the characteristics of a woman's job, such as wage on the one hand and disamenities on the other hand, on the chosen duration of maternal leave. The decision about the length is implicitly assumed to be the result of rational decision-making, in the sense that choice is influenced by the expected costs and benefits of the alternatives available to the individual.

I assume that a woman derives utility from her own consumption, leisure time and the disamenities implied by her job. Leisure is assumed to be binary; in other words, the woman can only derive utility from leisure when being on leave.[49] In the same vain, she only suffers from the disamenities when being back to work. She faces a budget constraint that, besides other income sources such as her husband's income, capital income and so forth, is determined by her own wage and by the maternal benefit. Given her budget constraint, she chooses the leave length in order to maximize her total utility during the guaranteed leave period of 36 months. After month 36, the job guarantee no longer exists, so she would have to start searching for a new job if she

[48] The basic model leans on the approach suggested by Gronberg and Reed (1994). An alternative way of modeling mothers' decision about her labor supply is the model suggested by Browning, et al. (2006).
[49] In the following I use the terms leisure and leave synonymously.

would like to participate in the labor market again. Therefore the model considers only the 36 months of the total leave period during which a mother enjoys a job guarantee and thus, does not need to search for a job to re-join the labor market.

The utility function of a mother i for every single month t of the leave period, before making any assumptions about functional forms, can be expressed as follows:

$$U_{it} = U\,(C_{it};\, tL_{it};\, D_{io}(1- L_{it});\, X_i;\, \varepsilon_{Lit,it}) \qquad \text{(II.1)}$$

where C_{it} is the consumption level of woman i in month t and L_{it} stands for the binary variable leisure, which is 1 if mother i in month t is on leave and 0 if she is back to work. The interaction between the dummy leisure and the months the mother has been already on leave, indicated by the variable t, allows the utility of leisure to change over time. This accounts for the possibility that a mother's time spent at home might be worth less over time, e.g. due to home productivity decreasing with the age of the child (e.g. reduced need of breastfeeding). D_{i0} are the disamenities implied by the guaranteed job. The index 0 of the disamenities refers to the period previous to birth and indicates that the disamenities do not change during the leave period. This is due to the fact that a woman on maternal leave has the right to return to her previous job, where she will face the same disamenities as before leave was taken. The interaction of the disamenities with the leisure variable indicates that a mother can only experience disutility from disamenities while working. X_i contains both relevant personal and professional characteristics. Finally, $\varepsilon_{Lit,it}$ incorporates the heterogeneity between women, depending on their working status, with respect to the utility they derive from having a baby in the different months after giving birth.

A mother's consumption is determined by her wage if she is back to work, by the benefit if still on leave, and by other income sources. Her budget constraint is as follows:[50]

$$C_{it} = I_{i0} + W_{i0}(1 - L_{it}) + B(I_{io}; yr; t)\, L_{it} \qquad \text{(II.2)}$$

where I_{i0} stands for other income sources such as the husband's earnings, capital income etc.,[51] W_{i0} is the wage she receives when being back to her guaranteed job and $B(I_{i0};yr;t)$ represents the maternal benefit while being on leave. The benefit, as explained in Section II.3, is a function of other income sources I_{i0}, the year yr in which the baby is born, and t, the number of months woman i has been already on leave.

The above-stated problem describes a utility maximization problem: conditional on being eligible for maternal leave and given her budget constraint, a mother decides about the duration of her leave in order to maximize her utility over the 36 months period. If working, the utility is assumed to stay constant over the total leave period, since a mother has the right to return to her former job with the same wage and the same disamenities.[52] The utility gained by staying on leave, however, is dependent on time. On the one hand, this is due to the declining benefit, and on the other hand, due to the decreasing utility of staying at home over time. Thus, once the utility of being on leave is lower than that of working in a given month t, it remains below for the rest of the leave period. The decision of returning to work is thus a once and for all decision; i.e.,

[50] Note that I assume no savings.
[51] Other income sources are assumed to be constant over the whole leave period since, first, a mother has to decide about the length of her leave before actually taking it and, second, the benefit is calculated using the average income of the year previous to birth.
[52] The employer is obliged to guarantee the mother a comparable job. There is no wage guarantee. Note, however, that the majority of workers in Germany (ca. 75 %) are covered by collective bargaining agreements. Firms that recognize unions have to pay at least the union wage to its workers. This restricts firms by how much they can reduce wages of returning mothers. In section II.6.3, I discuss the assumption that the job features remain the same, present a comparison of pre- and post-leave job features and extend the model by incorporating the possibility of a wage decrease over the time of maternal leave.

as soon as the utility of working is greater than or equal to the utility of being on leave, a mother returns to work and stays "forever", i.e. until the end of the total leave period. The hazard rate λ ($work_{it}$), which is the probability that a mother i starts working in month t conditional on having been on leave until month t-1, is thus as follows:

$$\lambda (work_{it}) = \lambda (U_{workit} > U_{leaveit})$$
$$= \lambda (U(I_{i0} + W_{i0}; 0; D_{i0}; X_i; \varepsilon_{0it}) > U(I_{i0} + B(I_{i0}; yr; t); t; 0; X_i; \varepsilon_{1it}) \quad \text{(II.3)}$$

This expression allows some predictions regarding the effect of the variables of interest on mothers' decision to return to work. The first important determinant of the leave decision is the wage a mother is sacrificing while not working: the higher the wage, the higher the opportunity costs of being on maternal leave and thus the higher the probability of returning to work (i.e., the shorter the leave). Assuming that disamenities, the second group of variables of interest, enter negatively into the utility function, a mother is more likely to stay at home when she is exposed to disamenities.

Our final objective is to estimate mothers' MWP to avoid certain disamenities. Following the approach by Gronberg and Reed, we can use the elasticities of the hazard to return to work with respect to wage and to a certain disamenity to derive the MWP:

$$MWP = \frac{\partial W_{io}}{\partial D_{io}} = \frac{\dfrac{\partial \lambda(work_{it})}{\partial D_{io}}}{\dfrac{\partial \lambda(work_{it})}{\partial W_{io}}} \quad \text{(II.4)}$$

From here it is straightforward, using the derivatives of the hazard rate with respect to wage and disamenities, to calculate the MWP to reduce a certain disamenity:

$$MWP = \frac{U_D}{U_C} \tag{II.5}$$

We can see that the MWP is determined by the marginal utility of consumption U_C and the marginal utility of the disamenity U_D. The MWP is inversely related to the marginal utility of consumption; i.e., the higher the marginal increase in utility due to more consumption, the less wage a mother is willing to sacrifice to decrease the amount of a certain disamenity. The opposite is true for disamenities; i.e., the higher the marginal disutility of a disamenity the more wage a mother would give up in order not to suffer from this disamenity.

This model is of course simplistic and ignores the possibility that mothers might search for a new job while being on leave. However, as the data demonstrate, this assumption is far from being unrealistic; mothers see their job guarantee as a kind of insurance and thus rarely change jobs during maternal leave. [53] This assumption of no job searching is the key stone of the model; in contrast to the approach by Gronberg and Reed, the setting of maternal leave allows us to observe the features of all relevant alternatives mothers face when being on leave: staying at home or returning to their previous job, which offers the same wage and the same disamenities as before leave was taken. The model thus offers a framework that allows for an economic interpretation of the parameters, for a better understanding of the problems mothers face when deciding whether and when to return to work after childbirth, and for the derivation of mothers' MWP to diminish certain disamenities.

[53] In our dataset during the period of maternal leave only 2% of the women change their job when back to work.

II.4.2. Implementation

In order to estimate the model, we need to make some assumptions about the functional form of the utility and the distribution of the residuals. For simplicity, I assume a linear individual utility function, so that equation (II.1) becomes:

$$U_{it} = \beta C_{it} + \gamma_0(1 - \gamma_1 t)L_{it} + \delta D_{i0}(1 - L_{it}) + \eta_{Lit}X_i + \varepsilon_{Lit;it} \qquad \text{(II.6)}$$

where again C_{it} stands for consumption, L_{it} for the binary variable leisure, D_{i0} for the disamenities of the guaranteed job, and X_i for both personal and professional characteristics. Consumption, as given by equation (II.2), is determined by the total income of a household which consists of the mother's wage W_{i0}, if she is back to work, and of the maternal benefit $B(I_{i0};yr;t)$ otherwise, plus other income sources I_{i0}. As explained in Section II.3, the amount of the maternal benefit varies with the total available household income, the year the child is born and the length of maternal leave. Thus, in order to capture the determinants of the maternal benefit, I include additionally a set of year and month dummies. The coefficient β is expected to be positive since an increase in disposable income is assumed to lead to an increase in utility.

As already introduced in the main model, the effect of leisure on utility is assumed to be not only direct but also to change over time. This is captured by a decomposition of the leisure coefficient: one general coefficient, γ_0, and another one, γ_1, which interacts with the leave length t. In this way, I allow the marginal utility of leisure to decrease over time. This effect is controlled for by a set of month dummies.

The main interest lies in the impact of disamenities on utility. Thus, a great variety of disamenities D_{i0} is included in the regression. The available disamenities and the construction of the disamenity indices are described in detail in Section II.5.2. The

coefficient δ is expected to be negative, indicating a decreasing effect of the presence of a disamenity on utility.

Last, utility is assumed to vary with both personal characteristics, such as age, marital status, education, geographical region and the number of children, and with professional features, such as the sector in which the woman works, all captured by X_i. Including the sector shall account for several differences between sectors, especially differences in the rate of human capital depreciation. Allowing the coefficient η to depend on the working status of the mother reflects the possibility that professional and personal features might influence the utility differently, depending on if a mother is on leave or back to work.

Under the additional assumption that (ε_{1it}-ε_{0it}) follows a logistic distribution, the probability of working in month t conditional on having been on leave in month t-1, equals:[54]

$$\lambda(work_{it}) = \frac{e^{\beta W_{i0} + \delta D_{i0} - \beta B(I_{i0}; yr; t) - \gamma_o(1-\gamma_i t) + \psi_t}}{1 + e^{\beta W_{i0} + \delta D_{i0} - \beta B(I_{i0}; yr; t) - \gamma_0(1-\gamma_1 t) + \psi_t}} \qquad \text{(II.7)}$$

where ψ_t represents the set of personal variables, sector and year dummies. I estimate this hazard rate λ ($work_{it}$) to return to work at a given month by a discrete logistic duration model; the likelihood function includes all months a mother stays on leave, modeled by (1-λ ($work_{it}$)) for month 1 until t-1, and the month t when she returns to work, expressed by the hazard rate λ ($work_{it}$). The estimation results are presented in Section II. 6. Using this functional form we can derive the MWP as follows:

[54] The results are robust assuming different distributions of the error. Results are available upon request.

$$MWP = \frac{\partial W_{io}}{\partial D_{io}} = \frac{\frac{\partial \lambda(work_{it})}{\partial D_{io}}}{\frac{\partial \lambda(work_{it})}{\partial W_{io}}} = \frac{\delta}{\beta} \tag{II.8}$$

Given the positive coefficient of the wage and the negative one of the disamenities, the MWP for a disamenity should be negative. Thus, the model predicts that a mother would have to receive money in order to be compensated for a disamenity; or, conversely, that a mother is willing to sacrifice part of her wage to avoid suffering from a disamenity. An example might illustrate this result: Let's assume a mother has a job that exposes her to hazards, such as a certain gas. A mother would give up part of her wage, namely the exact fraction (II.8) given above, to diminish the quantity of gas she is exposed to.

Below I describe in detail the datasets used, the variety of disamenities and the construction of the disamenity indices.

II.5. Data

II.5.1. German Socio-Economic Panel and Qualification and Career Survey

For the analysis of mothers' MWP to avoid disamenities, two datasets are used: as in Chapter I, the German Socio-Economic Panel (GSOEP) and additionally, the Qualification and Career Survey (QCS). In this chapter, I use only waves 1992-2005 of the GSOEP, since these waves correspond to the period during which the maternal leave period has remained unchanged. The QCS is a survey of employees carried out by the German Federal Institute for Vocational Training (Bundesinstitut für Berufsbildung) and the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung). There are four cross-sections launched in 1979, 1985/86, 1991/92,

and 1998/99, each covering about 30,000 individuals. For this study, the latest cross-section is used since it lies within the time at which the sample of mothers takes parental leave and is the only cross-section that includes a 4-digit occupational code for the current profession that allows a more accurate merging of the two datasets. [55]

The GSOEP and the QCS have several features that make them especially suitable for the proposed methodology to estimate mothers' MWP to reduce disamenities using the maternal leave decision. The GSOEP has detailed annual information on personal as well as on some professional characteristics such as the individual's occupation, the wage and the working schedule. Furthermore, it provides monthly information on fertility as well as professional activities, such as working, being on maternal leave, and so forth. This information allows us to construct maternal leave spells for each woman and to determine her occupation prior to childbirth. Besides occupation, the QCS contains a great variety of disamenities, which goes beyond the occupational information provided by the GSOEP. Details about the disamenities contained in the QCS are given in the next section.

The sample of interest includes all women who gave birth during 1992-2004 and are eligible for maternal leave. [56] As described in Section II.3, a woman is eligible for maternity leave conditional on having worked for at least 6 months in her job. According to the Federal Statistical Office, in 2003, 90 per cent of West German women qualified for maternal leave, while not even two thirds of the East German mothers did so. In spite of being less eligible for maternal leave, East German women more often exercise their right to maternal leave: more than 95 per cent of eligible women in East Germany take some leave, while in West Germany only slightly more than 80 per cent do so.

[55] In section II.6.3, the alternative using a 3-digit occupational code available for waves 1991/92 and 1998/99 is discussed and regression results using theses codes are shown.
[56] An important part of the information is reported retrospectively; thus, not all necessary information can be recovered for the last available wave 2005.

The data provided by the GSOEP suffer from two shortcomings: first, the monthly activity history is partly left censored, which complicates the exact derivation of mothers' eligibility for maternal leave. Relaxing the eligibility condition and treating every woman as eligible who is observed to have been in an employment contract for at least one month before giving birth, 85 per cent of West and 65 per cent of East German women in the sample qualified for maternal leave in 2003.

The second problem in the data is that activities are often simultaneously and sometimes incorrectly reported. If declaring several parallel activities I give preference to being on leave. [57] According to the maternity protection law, women are not allowed to work in the first 8 weeks after giving birth. However, more than 5 per cent of the women reported working during the maternity protection period. Since these spells are certainly miss-reported, I exclude all leave spells that are shorter than two months.

The final sample includes 1370 leave spells (26,559 individual-month observations). 623 women return to their job, out of which 37 continue working immediately after the maternity protection period. [58,59] 193 women are on leave for the whole parental leave period and do not exercise their right to return to work during the first three years after birth. The remaining 554 spells are right censored, thus we do not know whether and when they return to work. That said, we observe high panel attrition. In Section II.6.3, I propose a robustness check in order to handle this attrition problem.

[57] It might be the case that these women see themselves as working since during the maternity protection period their employment continues and even their full net wage is paid.

[58] This number might be too small since I excluded the women who reported working in month 0 or 1 after giving birth. As a robustness check, I treated these women as having returned to work after the maternity leave period; in this case 8.5 per cent came back to work after two months. The estimation results using this extended sample are not significantly different and are available upon request.

[59] These spells include leave spells following the first until the fifth birth (56.5 per cent are birth of the first child, 34.5 per cent of the second, 7 per cent of the third, 1.5 per cent of the fourth and 0.5 per cent of the fifth child). In cases where a woman reported being on leave several times, I treat these spells as separate spells, while controlling for the order of birth. In Section II.6.3., I estimate additionally a competing risk model of only first birth leave spells and mothers choosing between returning to work, staying on leave or having a second child

II.5.2. Disamenities

As mentioned above, the GSOEP contains information on individual wages and personal working schedules, in particular contracted working hours per week, actual working hours (including overtime), frequency of working in the evening (6-9pm), during the night (9pm-6am) and in rotating shifts.

The QCS provides information on additional, more specific job features that are not provided by the GSOEP:[60] physical demand of the job, lifting heavy weights (more than 20 kg), lying down or kneeling, standing during most of the shift, if the job is tiring for the eyes, if the job exposes the worker to dust or smoke, to a dirty working environment, to extreme temperatures or weather conditions, to noise, and to risks of injury or death. These disamenities can be matched with our sample of women on maternal leave via the 4-digit occupational code of the Federal Statistical Institute, which is contained in both datasets.[61]

In other words, the final sample contains information about the occupation in which a woman worked prior to giving birth, the individual wage, the personal working schedule, and the average occupational aspects of workload and environmental hazards.

In order to create representative average occupational characteristics, I restrict the 1998/99 wave of the QCS to women in their child-bearing ages (16-46 years), like the ones in the sample of interest. These women are engaged in 772 different occupations. For each occupation I calculate the mean of every disamenity. On the one hand, due to the average of 15 women per occupation, these calculated disamenities can be regarded as being "objective".[62] On the other hand, due to the fine distinction

[60] The GSOEP contains some information about disamenities. However, these disamenities are very general (such as being exposed to bad working conditions, having a physically demanding job, etc.) and highly subjective.
[61] The 4-digit occupational code is a classification that includes about 1400 different occupations.
[62] I previously estimated the model using the available subjective disamenities in the GSOEP. However, the results display only low significance levels.

between occupations, the average characteristics should match the job traits of every single woman in the GSOEP very well.[63]

In the original QCS questionnaire, the women are asked if they are never, rarely, sometimes, often or always exposed to the respective disamenity, which is coded into discrete values of 0 to 4.[64] However, averaging these discrete values for all occupations produces values that are close to being continuous on a scale from 0 to 4, where higher values indicate suffering more from a certain disamenity. In order to make the comparison and the interpretation more comprehensible I rescale the average occupational disamenities from 0 to 100: the occupation with the highest level of a certain disamenity takes the value 100 and the lowest level takes 0.[65] An example might illustrate this ranking: workers in the plastic industry are the ones most exposed to risks of injury and death (they all report the value 4); while secretaries are least threatened by these dangers (all secretaries report the value 0). Thus, the plastic industry gets the average value of 100 for risks of injury, while secretaries get 0. All other occupations are ranked in between; painters, for example, have a value of 50, which means they are only exposed to half the risks workers in the plastic industry face.

The above-described disamenities are very detailed and specific. For the purpose of significance and plausible interpretation, I create two indices (unweighted averages),[66] summarized as "workload" and "environmental hazards", according to the distinction made in the literature on CWD.[67] The following disamenities are included in each of the two indices: "workload" contains having a physically demanding job, lifting

[63] An alternative is to use a 3-digit occupational classification, where 289 different occupations are observed and on average 37 women are working in each occupation. The estimation results barely alter and are shown in Section II.6.3.
[64] In the original specification, the lowest value stands for always being exposed to a certain disamenity and the highest value for never. I reverse this order for interpretational convenience.
[65] For every disamenity we observe both the highest (100) and the lowest (0) value in at least one occupation.
[66] Additionally I estimate weighted averages using factor analysis. The results are described in Section II.6.3.
[67] See Rosen (1986) or Villanueva (2007).

heavy weights, lying down or kneeling, standing all the time and having a job that is tiring for the eyes; while "environmental hazards" incorporate being exposed to dust or smoke, dirt or oil, extreme temperatures or bad weather conditions, noise and risks of injury. The respective disamenities within the two groups are sufficiently correlated among each other and hence represent reliable measures for the aspects of workload and working environment.[68]

To summarize, the sample used for estimation contains women eligible for maternal leave, their individual wages, their personal working schedule (working hours per week, working in the evening, at night and in rotating shifts) and indices for average occupational workload and environmental hazards. In the subsequent section, I present the descriptive sample statistics, the estimation results and several robustness checks.

II.6. Estimation Results

II.6.1. Variables and Summary Statistics

As introduced in Section II.4, I estimate the model of mothers' decision about maternal leave length. A mother decides to return to work as soon as the utility of working is higher than that of staying on leave. Under the assumptions discussed in Section II.4, I estimate the leave decision, described by equation (II.7), using a discrete logistic duration model.

The determinants of interest are on the one hand the wage W_{i0} and on the other hand the disamenities D_{i0}. These job characteristics belong to the job a mother holds before going on maternal leave and to which she can return given the job guarantee during the whole leave period. An overview of the wage and the non-pecuniary job features in the sample can be found in Table II.2.

[68] The Cronbach's alpha is 0.75 for both workload and environmental conditions.

Table II.2: Summary statistics of occupational characteristics

	Obs	*Mean*	*Std. Dev.*	*Min*	Max
Ln real gross wage	1370	2.3062	0.4897	0.0182	3.6162
Working hours (contract)	1370	33.1223	9.6325	4	48
Working hours + overtime	1367	35.2145	11.0773	4	70
Work in the evening	1370	0.2044	0.4034	0	1
Night work	1370	0.0891	0.2849	0	1
Shift work	1370	0.1124	0.3160	0	1
Environmental hazards	1370	10.4739	10.9298	0	100
Workload	1370	39.9248	14.2291	0	95

Note: The sample consists of women who are eligible for maternal leave. It consists of 26,559 observations for 1370 women.

The pecuniary aspect of the job is included in the estimation as the natural logarithm of the real gross wage rate. The average monthly gross income is 1600€ (the ln of real gross wage is 2.3). The non-pecuniary characteristics are grouped into the following three aspects: the working schedule, workload and environmental working hazards. With respect to the working schedule, reported on the individual level, we observe the following: The contracts schedule on average a 33 hour-week, while the women report to be working on average around 2 hours more per week. Since workers are likely to over-report their hours worked, I use contracted working hours. Quite a few mothers work according to an unusual schedule: 20 per cent work in the evening, 9 per cent during the night and 11 per cent in rotating shifts.

For illustrative purposes, I establish a ranking of the jobs, ranked in a descending order according to their level of disamenities. With respect to average occupational workload and environmental hazards the ranking tells us the following: The industry that demands the highest workload is the plastic industry, followed by the glass production and the agricultural sector. However, recent mothers work in occupations that require on average only 40 per cent of the physical effort required in the plastic industry (which corresponds to the physical effort of a tailor or a high school teacher).

The environmental hazards such as dust, dirt, noise, health risks and so forth are also highest in the plastic industry, followed by the agricultural and chemical sector. But again, most occupations of recent mothers involve only a small share of the bad working conditions of the plastic industry (on average 10 per cent, which corresponds to the occupation of an elementary school teacher or a nurse).

Besides the conditions of the previous job, also institutions, such as the maternal benefit or the childcare facilities, influence the maternal leave decision. The benefit is proxied by its determinants: the total household income I_{i0} and a set of year (1992-2004) and month dummies (36). The month dummies account furthermore for the fact that the utility of being on leave may decline with the age of the child. With the exception of East Germany (where we observe coverage of 35 per cent), publicly available childcare for children under the age of three is very precarious in Germany; only 3 out of 100 children can actually be taken care of in formal childcare. I control for this difference due to the region where the mother lives by including a dummy for East and West Germany. In Section II.6.3, I present more detailed results focusing on these regional differences show whether these differences go on to affect the MWP to reduce disamenities.

As explained in Section II.4, individual characteristics may play an important role for the leave decision. Hence, Table II.i (see Additional Tables and Figures) gives an overview of the personal and household characteristics of the women in the sample. I control for age, marital status (a dummy for having a partner), education (measured in years), income (dummies for income groups according to the thresholds for the parental benefit described in Section II.3), and the number of previous children. I also include the sector in which the woman has been working (dummies for the technological, agricultural, industrial, manufacturing and public sector). This might be important due to the varying depreciation rate of human capital among different sectors; i.e., a woman

working in a technology oriented occupation might find it more difficult to return to work after a prolonged absence than one working in agricultural or manufacturing occupations, where changes due to technological advances are less frequent.

Before describing the regression results, let's have a brief look at the length of maternity leave and its relation with each disamenity. Table II.3 below shows the duration of the maternal leave and the Kaplan-Meier Survival estimates.

Table II.3: Duration of the maternal leave – Kaplan-Meier Survival Estimates

Time	Total	Fail	Lost	Function	Error	[95% Conf. Int.]	
2	1370	37	14	0.973	0.0044	0.9629	0.9804
3	1319	34	22	0.9479	0.006	0.9347	0.9585
4	1263	24	18	0.9299	0.0069	0.9150	0.9423
5	1221	19	26	0.9154	0.0076	0.8993	0.9291
6	1176	19	18	0.9006	0.0082	0.8833	0.9155
7	1139	26	23	0.8801	0.0089	0.8613	0.8964
8	1090	25	21	0.8599	0.0096	0.8399	0.8776
9	1044	19	15	0.8442	0.0101	0.8233	0.8629
10	1010	26	14	0.8225	0.0107	0.8005	0.8424
11	970	19	9	0.8064	0.0111	0.7836	0.8271
12	942	41	14	0.7713	0.0119	0.7470	0.7936
13	887	25	11	0.7496	0.0123	0.7244	0.7728
14	851	23	23	0.7293	0.0127	0.7035	0.7533
15	805	24	9	0.7076	0.0131	0.6811	0.7323
16	772	25	17	0.6846	0.0134	0.6575	0.7101
17	730	22	23	0.664	0.0137	0.6363	0.6901
18	685	23	24	0.6417	0.014	0.6135	0.6685
19	638	20	14	0.6216	0.0143	0.5929	0.6489
20	604	16	10	0.6051	0.0145	0.5761	0.6329
21	578	15	15	0.5894	0.0147	0.5601	0.6175
22	548	13	25	0.5755	0.0148	0.5458	0.6039
23	510	10	13	0.5642	0.015	0.5343	0.5929
24	487	16	22	0.5456	0.0152	0.5154	0.5748
25	449	15	22	0.5274	0.0154	0.4968	0.5570
26	412	13	15	0.5108	0.0156	0.4798	0.5408
27	384	12	8	0.4948	0.0157	0.4636	0.5252
28	364	7	8	0.4853	0.0158	0.4539	0.5159
29	349	7	10	0.4756	0.016	0.4440	0.5064
30	332	14	10	0.4555	0.0162	0.4236	0.4868
31	308	6	11	0.4466	0.0162	0.4146	0.4782
32	291	8	8	0.4343	0.0164	0.4021	0.4662
33	275	10	13	0.4186	0.0165	0.3860	0.4507
34	252	7	7	0.4069	0.0166	0.3742	0.4393
35	238	3	16	0.4018	0.0167	0.3690	0.4343
36	219	0	26	0.4018	0.0167	0.3690	0.4343
37	193	0	193	0.4018	0.0167	0.3690	0.4343

We can see that out of the 1370 women, 1319 women go on leave for at least one more month, in addition to the compulsory maternity protection period of two months. After month 2 for example, 37 women went back to their job, thus the probability that a woman stays on leave for more than 2 month is 97 per cent.[69] 193 women do not go back to their guaranteed job after the maximum possible leave period. On average 3 per cent drop out of the sample in every period, for instance after the maternity protection period (2 months of leave) 14 women are lost. For these women we are lacking any information on whether and when they return to work. This relatively high attrition might be a matter of concern. In Section II.6.3 I check the robustness of the estimation results assuming different scenarios for the women dropping out of the dataset.

A first look at the relation between leave length and wage on the one hand and disamenities on the other hand, without controlling for any other variables (see Table II.4 below), gives already some useful insights before looking at the multivariate regression results.

As expected, a higher wage is associated with a shorter leave length. A strong positive correlation can be observed between the maternal leave length and the environmental hazards and workload: the worse the hazards or the workload, the longer the maternal leave. Perhaps surprisingly, night work is negatively correlated with the leave length: the more a woman works at night the earlier she returns to work. A lack of childcare facilities and inflexible working schedules might explain this phenomenon. This is, however, only a first impression gained from the raw data. In the next section I present the results of the multivariate regression analysis which allow for more interpretation.

[69] As discussed earlier, this percentage of mothers returning to work after the maternity protection period might be quite low. Reasons for this low number are that I exclude mothers underreporting their true duration of maternal leave.

Table II.4: Binary relation between the disamenities and the total leave length

Leave in months	**<6**	**7-12**	**13-24**	**25-36**
Spells	231	252	438	449
Frequency in %	0.1686	0.1839	0.3197	0.3277
Ln real gross wage	2.3863	2.3850	2.2799	2.2464
Working hours	33.2277	31.9587	33.0491	33.7924
Working hours(+overtime)	35.9104	34.4960	35.1631	35.3111
Work in the evening	0.2338	0.2579	0.2534	0.1114
Night work	0.1126	0.1032	0.1096	0.0490
Shift work	0.0519	0.1548	0.1370	0.0958
Environm. conditions	9.1145	9.2694	11.1478	11.1917
Physical demand	38.0960	39.4969	41.0187	40.0387

Note: The table above shows raw data: for four different leave lengths windows (0-6 months; 7-12 months, 13-24 months and 25-36 months) the means of job characteristics of the guaranteed job are displayed.

II. 6.2. Results

Table II.5 shows the results of estimating equation (II.7), modeling mothers' decision whether and when to return to work after childbirth.

Table II.5 displays the coefficients of the individual wage, the different aspects of the personal working schedule and the two average occupational disamenity indices "workload" and "environmental hazards" estimated by a discrete duration model assuming a logistic hazard function. The observations are clustered on the individual level, which shall account for serial correlation between the monthly observations for one spell. Since individual heterogeneity might be still a matter of concern, this issue is discussed in Section II.6.3. The table shows furthermore the z-statistic (in parenthesis) and the marginal effects (in brackets).

Table II.5: Results for the coefficients of the job characteristics

	Working[1]	**Working[2]**	**Working[3]**	**Working[4]**	**Working[5]**
Ln real gross wage	**0.421**	**0.472**	**0.568**	**0.586**	**0.566**
	(4.28)**	(3.76)**	(4.14)**	(4.23)**	(4.13)**
	[0.0100]	[0.0108]	[0.0117]	[0.0125]	[0.0121]
Hazards	**-0.015**	**-0.013**	**-0.014**	**-0.013**	**-0.014**
	(3.00)**	(2.53)*	(2.30)*	(2.26)*	(2.29)*
	[-0.0004]	[-0.0003]	[-0.0003]	[-0.0003]	[-0.0003]
Workload	**0.004**	**0.005**	**0.005**	**0.005**	**0.005**
	(1.08)	(1.21)	(1.13)	(1.10)	(1.13)
	[0.0001]	[0.0001]	[0.0001]	[0.0001]	[0.0001]
Working hours	**-0.003**	**-0.008**	**-0.006**	**-0.006**	**-0.006**
	(0.89)	(1.87)	(1.38)	(1.42)	(1.35)
	[-0.0001]	[-0.0002]	[-0.0001]	[-0.0001]	[-0.0001]
Work evenings	**0.298**	**0.284**	**0.254**	**0.265**	**0.253**
	(2.62)**	(2.47)*	(2.05)*	(2.12)*	(2.05)*
	[0.0078]	[0.0071]	[0.0057]	[0.0062]	[0.0059]
Night work	**-0.051**	**-0.166**	**-0.193**	**-0.194**	**-0.195**
	(0.31)	(1.00)	(1.11)	(1.10)	(1.12)
	[-0.0012]	[-0.0035]	[-0.0037]	[-0.0039]	[-0.0038]
Shift work	**0.343**	**0.357**	**0.373**	**0.38**	**0.369**
	(2.80)**	(2.89)**	(2.73)**	(2.75)**	(2.69)**
	[0.0093]	[0.0093]	[0.0089]	[0.0094]	[0.0091]
Constant	**-4.619**	**-5.262**	**-5.356**	**-5.06**	**-5.218**
	(13.86)**	(3.33)**	(2.67)**	(2.70)**	(2.78)**
Observations	26559	26559	26559	26559	26559

Note:
The coefficients are from a discrete logistic duration estimation.
Robust z statistics in parentheses: * significant at 5%; ** significant at 1%
Marginal effects are displayed in brackets
[1] Model 1: no further controls are included
[2] Model 2: Controls are partner, age, age squared, education, further births, region and income
[3] Model 3: Additional controls, besides the one in model 2 are sector, month and year dummies
[4] Model 4: I use log(t) for the baseline hazard and include the same set of controls as in model 3
[5] Model 5: I include t, t squared and t cubic for the baseline hazard ande same controls as in model 3

Model 1 to 3 compare the results of estimating equation (II.7), including first no other control variable, then personal characteristics (age, education, partner, region, total household income and birth order), and last sector, month and year dummies. I also estimate equation (II.7) under different assumptions for the functional form of the baseline hazard: including, instead of month dummies, either the logarithm or a polynomial of the time being on leave (Model 4 and 5 respectively). The results barely change with the different specifications. Hence, the following discussion focuses on the specification assumed in Model 3, including all control variables and using a non-parametric baseline hazard (month dummies).

The theory predicts that the higher the wage, and consequently the higher the opportunity costs of not working, the more likely a mother is to return to her job. The estimated coefficient of the ln real gross wage confirms the predicted impact of the wage on mothers' decision about leave length: women who have a job that pays 10 per cent more wage per hour are 0.1 per cent more likely to return to work in a given month (at the 1% significance level).

The model, as introduced in Section II.4, suggests a negative effect of disamenities on the decision to return to work. A significant impact, however, can only be found for environmental hazards: women who have been working under bad working conditions, such as dust, dirt, extreme temperatures, noise or certain health risks tend to stay significantly (at the 5% significance level) longer on maternal leave: women who work in a job that exposes them to one standard deviation more of environmental hazards (which corresponds, for example, to the difference in environmental conditions between the occupation of a secretary to the one of a nurse, or between an economist and an electrician), are 0.3 per cent less likely to work in a given month. Estimating equation (II.7) using as controls each of the different aspects included in the index "environmental hazards" separately shows that the deterring effect stems mainly from

jobs exposing the women to dust, smoke and extreme weather conditions, such as working in a hot or cold environment or even outside.[70]

The actual effect of workload is opposed to the effect predicted by the model: an increase in workload by one standard deviation, which corresponds to the difference in physical strains between a banker and an electrician or between an economist and a stewardess, leads to a 0.1 per cent more likely return. This coefficient is, however, not significant. If we look at the separate effects of the different aspects of workload, we can observe that working in an uncomfortable position such as lying down, kneeling, etc., has a significantly negative effect on the probability of returning to work. [70]

The working schedule influences the decision of leave length as follows: on the one hand, mothers in jobs entailing on average ten hours more per week, are 0.1 per cent less likely to work in a given month. Jobs requiring night work are also less attractive to mothers after childbirth: mothers in jobs that demand night work are 0.4 per cent less likely to work in a given month. Both effects, however, are only marginally significant. On the other hand, women who have jobs that involve working in the evening or in rotating shifts are significantly (at the 5% level) more likely to work in a given month: if working in the evening, women are 0.6 per cent more likely to work in a given month, and if in rotating shifts, 0.9 per cent. This result may perhaps be surprising. The precarious offer of childcare facilities, particularly in West Germany, may explain these results. While, in general, working outside the usual shopping hours are seen as inconvenient since one could spend this time with family or friends, mothers may not perceive an unorthodox working schedule as a disamenity in the traditional sense. It actually allows recent mothers to combine work and family since during these hours childcare can be arranged informally with partners, relatives or friends. An event-study analysis, estimating if having a child changes also fathers' working schedule,

[70] The results for the estimation including all disamenities separately are available upon request.

supports this explanation.[71] On becoming a father, men work less in the evening and more in rotating shifts. This indicates that both parents coordinate childcare among themselves. In Section II.6.3 I discuss the aspect of childcare, proxied by differences in daycare facilities between East and West Germany, in more detail.

The effect of personal characteristics on the leave length decision is shown in Table II.ii. (see Additional Figures and Tables). As reported in previous studies, women who have a partner, several children and more financial resources are less likely to work soon after childbirth. Women who live in East Germany, are older and highly educated tend to return to work earlier.

Given the elasticities of the hazard rate to work with respect to wage and the selection of disamenities, it is straightforward to derive how much mothers are willing to pay to reduce these disamenities. As derived in Section II.4, I calculate the MWP as follows:

$$MWP = \frac{\partial W_{io}}{\partial D_{io}} = \frac{\frac{\partial \lambda(work_{it})}{\partial D_{io}}}{\frac{\partial \lambda(work_{it})}{\partial W_{io}}} = \frac{\delta}{\beta} \qquad \text{(II.8)}$$

Since the wage variable is measured in logarithms, the MWP calculated according to equation (II.8) indicates the percentage change in the wage a mother would be willing to pay to suffer from one unit less of a disamenity. Table II.6 shows the results for the MWP in percentage.

[71] Regression results of the event-study are available upon request.

Table II.6: MWP for certain disamenities derived from the main specification

	MWP	Std. Err.	Z	P>z	[95% Conf. Interv.]
Hazards	-0.0239	0.0122	-1.96	0.05	-0.0478 -.0000
Workload	0.0090	0.0082	1.1	0.272	-0.0071 .0250
Working hours	-0.0103	0.0079	-1.31	0.189	-0.0258 .0005
Work evenings	0.4471	0.2502	1.79	0.074	-0.0433 .9374
Night work	-0.3397	0.3142	-1.08	0.28	-0.9554 .2761
Shift work	0.6564	0.2864	2.29	0.022	0.0950 1.2178

Note: The coefficients for the MWP to avoid disamenities are derived using equation (II.8).

In line with the coefficients of the estimation results above, mothers are only willing to sacrifice a significant percentage of their wage to reduce environmental hazards and to overcome a working schedule incompatible with given daycare facilities.

For a less hazardous work, mothers are willing to give up a significant (at the 5% level) amount: in order to suffer one standard deviation less dust, dirt, noise, extreme temperature or health risks, recent mothers are willing to sacrifice almost 25 per cent of their wage. This means that on average, a mother would pay 2.80€ per hour in order to decrease unpleasant and hazardous working conditions by one standard deviation. An example might help to illustrate this result: a difference in environmental conditions of one standard deviation corresponds to the change in hazards from the occupation of a secretary and to the one of a general nurse, or from an economist and to an electrician.

Due to the poor availability of childcare facilities, especially in West Germany, it might be convenient for mothers to work outside the usual working hours, such as in the evening or in rotating shifts. As mentioned above, the results of an event-study analysis, which shows changes in fathers' working schedule when having a baby (towards less work in the evening), support this idea: mothers prefer a working schedule that might allow them to coordinate childcare with their partner. Consequently, we can

see that recent mothers are willing to sacrifice 45 per cent of their wage to work in the evening and 66 per cent for rotating shifts.

As proven theoretically by Hwang et al. (1998) and explained in Section II.2, hedonic wage regressions might lead to biased results. The proposed method is one way to master the failure of the hedonic wage regression to account for labor market dynamics and frictions. Looking at the results of a cross-sectional hedonic wage regression (see Table II.7), using the same sample (reduced to one cross-section) and variables as in the main specification, this weakness becomes clear.

Table II.7: Prices for certain disamenities derived from a hedonic wage regression

	Coeff.	Std. Err.	Z	P>z	[95% Conf. Interv.]	
Hazards	-0.0024	0.0012	-1.93	0.054	-0.0049	.0000
Workload	0.0007	0.0010	0.69	0.491	-0.0013	.0026
Working hours	0.0005	0.0010	0.47	0.635	-0.0015	.0024
Work evenings	0.0675	0.0310	2.18	0.029	0.0067	.1282
Night work	-0.0023	0.0432	-0.05	0.958	-0.0870	.0824
Shift work	0.0322	0.0351	0.92	0.359	-0.0366	.1010

Note: The results displayed in this table stem from a hedonic wage regression using only a cross-section of the women eligible for maternal leave. Beside the characteristics of the previous job, I control additionally for partner, age, age squared, education, further births, region, income, sector and year dummies.

The hedonic prices, as predicted by Hwang et al., are mostly insignificant, biased towards zero or even wrongly signed. For example, the coefficient of the environmental hazards, interpreted as the premium by which a worker is compensated if exposed to hazards, predicts a penalty. The compensation paid for an extra hour of work estimated by a hedonic wage regression is biased towards zero and insignificant; it only reaches 5 per cent of the wage increase that mothers charge on average to return to work after childbirth. According to the results of a hedonic wage regression, work in the evening and in rotating shifts are accompanied by a wage increase (by 7 per cent and 3

per cent, respectively); women after childbirth, on the contrary, seem to appreciate these types of working schedule. However, one has to admit that mothers, relative to men and childless women, might dispose of a high MWP to work during evening hours or in rotating shifts, which contrasts the conventional premium paid on these working schedules. The comparison of the results shown in Tables II.6 and II.7 provides once more evidence of the striking differences between the hedonic prices and the MWP to avoid disamenities.

With knowledge of the basic results, it is now interesting to investigate individual or institutional characteristics that possibly trigger mothers' high MWP for certain working conditions. Thus, in the next subsection, I study the MWP of different subgroups of the population and provide additionally a variety of robustness checks for the results presented above.

II.6.3. Additional Specifications and Robustness Checks

Besides the basic specification, I perform the analysis considering different subgroups and carry out a series of robustness checks. Detailed results of all additional specifications in this section are presented in the Section Additional Tables and Figures.

Subgroups: The main specification used in this paper stems from a simplified model assuming a linear utility function. The estimated measures of mothers' MWP to reduce a selected variety of disamenities represent only average values. In order to allow for more heterogeneity, I analyze the impact of wages and disamenities on the chosen leave duration, distinguishing between mothers that differ in their regional, financial and educational background. This enables us to shed some light on the sources of the MWP. For this purpose, I re-estimate equation (II.7) including interaction terms between variables representing each of the mentioned backgrounds (West and East Germany, three income groups and three educational levels), and the wage on the one hand and the disamenities on the other hand. Tables II.iii.a to c provide an overview of

the estimated MWP derived from a discrete logistic duration model taking into account each of the different subgroups separately. [72]

The results from regressions that control for interactions between the variety of job features and a dummy for East Germany highlight once again the differences between West and East Germany. As can be clearly seen in Table II.iii.a, only West German women have the disposition to sacrifice significant (at the 5% level) amounts of their wage in order to adjust the working schedule to their family life; they are willing to accept a wage reduction of 2 per cent to work one hour less, 69 per cent to have a working schedule in the evenings and 72 per cent to enjoy rotating shifts. East German women, on the contrary, do not reveal any significant willingness to trade wage for an unconventional working schedules; their MWP to work in rotating shifts does not even reach half of the one of West German women; in order to work in the evenings they would have to receive a premium (43 per cent of their hourly wage). These sharp differences between East and West Germany can be traced back to institutional arrangements. As mentioned above, the coverage of childcare facilities for children under the age of three is very poor in West Germany, as only 3 per cent of the children can be accommodated in formal daycare. In East Germany, on the contrary, public childcare is available for every third child. Thus, I interpret the positive MWP for a schedule in the evening and in rotating shift as an informal solution of a lack in childcare facilities. An event-study analysis, shown above, indicates that different types of working schedules help parents to coordinate the childcare among each other; during the day the mother might take care of the child, while during the evening the husband does so. Rotating shifts may furthermore allow for some flexibility to arrange childcare, since it is possible to exchange them among employees.

[72] Results for the coefficients estimated using a discrete logistic duration model are available upon request.

The basic regression results reveal that women after childbirth are disposed to pay significant amounts to avoid environmental hazards at the workplace. Distinguishing between women with different financial and educational background, however, shows that not all women are willing or able to sacrifice significant parts of their wage to reduce unpleasant or unhealthy conditions. Tables II.iii.b and II.iii.c provide the MWP for selected job characteristics derived from estimating equation (II.7) including interactions between the wage and disamenities on the one hand and different income groups and educational levels on the other hand.[73] The estimated MWP to reduce environmental hazards show a clear pattern: the more financial resources, the more wage a mother is willing to give up to diminish these hazards (the MWP increases from an insignificant 1 per cent, to a significant (at the 10% level) 5 per cent); likewise the higher educated a woman, the bigger the accepted trade-off between wage and hazardous conditions (the MWP rises from 3 per cent to 7 per cent, significant at the 15% level).

Contrary to the estimated MWP to avoid hazards, only lower educated women charge a significant amount if their work requires certain physical effort. As we can see in Table II.iii.c, only less educated women show a negative MWP not to bear physical strain (at the 5% significance level). One reason for this result might be the type of occupation in which lower and higher educated women are working: less educated women work, for example, as a cleaning lady or in a warehouse, jobs that demand a different amount of workload than jobs of higher educated women, who work, for instance, as a nurse, or a teacher.

Summarizing the results for different backgrounds of recent mothers, we can conclude that the MWP to avoid environmental hazards comes mainly from high-

[73] The income groups are created according to the income thresholds of the maternal benefit payment described in Section II.3. The educational levels correspond to the three school tracks offer in Germany; a lower one leading to a vocational training, an intermediate one, and a higher one allowing for university access.

income and in particular high-educated women, in other words, women who can either afford to pay for better conditions or who are aware of the consequences. The disposition to work during non-standard working hours is only observed in West Germany and hence can be mainly attributed to a lack of publicly available childcare.

Fertility decisions: It is reasonable to think that the features of women's guaranteed jobs influence not only their decision to return to work, but also the one to have another child. The main sample includes, however, all leave spells, following first, second and further births. In case the birth of a further baby lies within the maternal leave period following the birth of a previous baby, this spell is treated as a censored spell. In order to take into consideration the possibility that women's fertility decision are influenced by their job situation, I use a sample including only spells after first birth and examine how these mothers behave within the 36 months of leave period. In particular I analyze their decision between staying on leave, returning to work or having another baby. For this purpose, I estimate a competing risk model that represents the choice of mothers between these three alternatives during the 36 months after the first childbirth. I can derive their MWP for certain job features through the elasticities of the decision to return to work with respect to the wage and the disamenities of their guaranteed job. As we can see in Table II.iv, the MWP estimated using the sample of only leave spells following first childbirth barely differs from the MWP of all mothers. First-time mothers demonstrate a comparable willingness to accept significant wage cuts in order to reduce environmental hazards (35 per cent for a decrease of one standard deviation), and to be able to work during the evening (62 per cent) and according to rotating shifts (55 per cent).[74]

One might further argue that the job situation has already an impact on the decision to have a first baby. Women might change their family plans due to an

[74] Results of the estimated coefficient using a competing risk model are available upon request.

unsatisfying job situation; women who are exposed to unpleasant working conditions might, for instance, want to take a break from work and anticipate their family plans. In this case our sample would over-represent women in worse job conditions who stay longer on leave. Consequently, the estimated disamenities coefficients would be downward biased. However, as shown in Chapter I (Section I.4.2.1.), Lauer and Weber (2003) and Bratti et al. (2004), empirical evidence favors the idea that fertility is planned strategically rather than determined by the employment situation.

Furthermore, we can test for selection bias by applying a two-step testing procedure suggested by Wooldridge (1998). This procedure implies as a first step the estimation of a selection equation: using a probit model separately for every single year and as exclusion restriction the number of a mother's siblings, I estimate the probability of having a baby. As a second step, I re-estimate the probability of returning to work (equation II.7) including besides the previous control variables the inverse mills ratio (calculated using the results of the first stage estimation). The results, provided in Table II.v., confirm the hypothesis derived from the empirical evidence: the results are not affected by a selection bias due to endogeneity of fertility with respect to disamenities, i.e. the level of disamenities and wage does not seem to influence the fertility decision.

Ability and Preferences: Besides the observable characteristics controlled for in the main specification, women may be heterogeneous in other not (directly) observable aspects. In the economic literature, well-known sources of unobservable heterogeneity are ability and preferences. Omitting both characteristics may bias the results. In the following I review critically a standard method how to handle unobserved heterogeneity, discuss the bias that may arise if not controlling for ability or preferences and suggest several specifications which can help to reveal the existence and direction of a possible bias.

One methodology correcting a bias due to unobserved heterogeneity in a discrete duration model has been suggested by Heckman and Singer (1984). They approach the problem by fitting an arbitrary distribution of the heterogeneity using a set of parameters that comprises a set of mass points and the probabilities of a person being located at each mass point. Using the method suggested by Heckman and Singer barely alters the estimated impact of wages and disamenities on the leave decision (see Table II.vi.a) and the derived MWP (see Table II.vi.b). The key assumption, however, is no correlation between the unobserved characteristics, such as ability and taste, and the control variables, here wage and disamenities. Once we suspect that the key assumption of exogenous control variables is violated, the suggested correction method is not successful in yielding unbiased estimators. Let me therefore discuss in more detail the bias that might arise due to unobserved heterogeneity.

To begin with, I explore the implications of individual ability. One may think that on the one hand employers are willing to offer more productive women both a higher wage and fewer disamenities. On the other hand, one might assume that more capable women are also more likely to return to work early. If ability is correlated with both better working conditions and a tendency to work, the coefficients estimated in the main specification may be overestimated; i.e., the wage coefficient might be too positive, while the hazard coefficient too negative. Firstly, we are considering average occupational characteristics, which should not be correlated with individual ability. Considering the nature of disamenities, such as dust, dirt, extreme temperatures, noise and certain health risks, it is furthermore difficult for an employer to discriminate differently productive women with respect to the level of these disamenities. Secondly, the wage, measured on the individual level, should be a function of education,

experience, ability, and so forth, and thus should incorporate individual ability; i.e., the potential problem of endogeneity should be ruled out.[75]

The direction of the bias that may arise due to omitting preferences for work and career is less obvious. On the one hand, one could argue that women who are career oriented return earlier to work, have a high preference for wage but not a strong aversion against disamenities. In this case, our estimated disamenities coefficients would be biased towards zero and the estimated wage coefficient would be upward biased. The derived MWP for disamenities would consequently provide a lower bound of the price mothers are willing to pay to avoid certain hazards.

On the other hand, women who aim to combine career and family, i.e., want to have a child but also intend to work as soon as possible, may change into a job that offers them a low level of disamenities and thus allows for the compatibility of work and family. In this case of presorting, the disamenity coefficients and the MWP would be overestimated.[76]

One exercise to investigate if presorting may bias the coefficients is to re-estimate the model using a subsample of women who actually cannot choose their job according to their personal preferences. In the former German Democratic Republic, people could not freely choose their job, but were assigned an occupation after finishing their education (in a so-called "interview about the personal appropriateness"). Consequently, East German women who had a baby shortly after the reunification had the same right to maternity leave as West German women, but did not have the chance to sort into a job according to their family plans. Thus, restricting the sample to the first

[75] Instead of the individual wages, one might use average occupational wages which are less likely to be correlated with ability. The results barely alter, which indicates that the estimated coefficients might not suffer from a bias due to unobserved ability.

[76] Mothers are observed to change jobs in the years before giving birth; 11 per cent of all mothers eligible for maternal leave, start to work in their guaranteed job only one year, 8 per cent two years and 5 per cent three years before childbirth Changes in the job characteristics are available upon request.

three years after reunification, 1992-94,[77] and estimating equation (II.7) including interaction terms for the wage and disamenities on the one hand and a dummy for East German women on the other hand should help us to investigate a bias that might arise due to presorting. The results of a discrete logistic duration model do not reveal any significant differences between the MWP for disamenities of East German women soon after the German reunification (1992-94) and all women who have a baby between 1992 and 2004. Hence, these results give rise to think that presorting into family friendly jobs might not seem to affect mothers' MWP for disamenities. However, the sample size might not be sufficiently big to conclude statistically significant results.

Job and Wage guarantee: One can furthermore question the assumption of our basic model that women go back to exactly the same job after giving birth. It may be the case that women, despite the job guarantee, change their job if they find a better offer. In our data we observe only a low turnover during the first 36 months after childbirth (2%). Besides changing jobs, though, women may face different conditions when returning to work.[78]

Comparing the disamenities before and after maternal leave, see Table II.8 below, we can observe a slight decrease in wages. This reflects the fact, as already mentioned above, that the job guarantee does not imply a wage guarantee. A mother might be aware of the possible wage depreciation and integrate the wage discount into her decision about the leave length. Thus, the impact of the wage on the maternal leave decision might vary over time and is not, as previously assumed, stable over the whole leave period. For this purpose, I re-estimate the leave decision, including interaction terms between the wage and dummies for all three years of the leave period. As we can

[77] A further reduction of the sample is not possible due to a small sample size. Due to high unemployment in the East German states, East German women, however, did not frequently change their job in the years 1992-1994. The results of the estimation on equation (7) including interaction terms between wage and disamenities and dummies for the East German women who gave birth in the early years after re-unification are available upon request.

[78] See Ondrich, et al. (2003)

see in Table II.vii., the MWP to diminish environmental hazards increases slightly, but not significantly over the years.[79] This increase can be attributed to the expected depreciation of the wage over time.

Table II.8: Comparison of job traits previous and posterior to maternal leave

	Job characteristics previous to leave	Job characteristics posterior to leave
Ln real gross wage	2.3062	2.271
Working hours	33.1223	24.1039
Actual working hours	35.2145	22.9607
Work in the evening	0.2044	0.2044
Night work	0.0891	0.0755
Shift work	0.1124	0.1237
Hazards	10.4739	10.9962
Workload	39.9248	41.0542

Note: Column 1 shows the characteristics reported by a woman before going on leave and column 2 the ones reported by a mother conditional on having come back to work. Thus the sample sizes differ, column two excludes all censored spells

Substantial differences in the previous and posterior job characteristics are also visible for working hours. The drop in working hours per week can be explained by the high fraction of mothers coming back to a part-time job. Since 2001, one has the right to reduce working hours when the company has more than 15 employees. Table II.VIII shows the results of estimating equation (II.7) by a discrete logistic duration model that contains a dummy for the reform in 2001 and if a woman has worked part-time before going on leave. The results reveal that part-time work seems to be attractive to mothers and that the 2001 reform had a positive, but not significant impact on the leave length

[79] The results for the estimated coefficients from the discrete logit duration model are available upon request.

decision. Once more it can be shown that the working schedule, in particular its compatibility with the family life, is a crucial aspect in a mother's LFP decision.

Attrition: One further concern, as discussed in Section II.5.1 and visible in Table II.3 (fourth column "lost"), is the substantial fraction of women who drop out of the sample (on average 3 per cent every month). In the main specification, I implicitly assume that "missing" women behave as the women continuously observed in the dataset. This is a strong assumption, since we cannot be sure that attrition is a random event. One way to check the robustness of the basic model is to re-estimate the model under two extreme assumptions: on the one hand the "missing" women might start working as soon as they drop out of the sample, on the other hand they might never return to their job during the maternal leave period of 36 months. Extending the sample according to the two assumptions, I re-estimate the discrete logistic duration model specified in equation (II.7). Under both extreme assumptions the estimation results are robust with respect to size and significance (see Table II.ix). As a result, treating attrition as random and including the censored spells in the sample does not significantly influence our estimated coefficients and the derived MWP to avoid disamenities.

Occupational classification and index construction: As described in Section II.5.2, in order to construct objective disamenities, I create average characteristics for each occupation using a 4-digit classification. For this categorization, we observe 772 occupations and on average 15 women per occupation. While matching well the occupational conditions of every woman included in the sample, the choice of this occupational code has two shortcomings: first, the average of 15 women per occupation may not guarantee the objectivity of the working conditions for every occupation. Second, the 4-digit classification, as mentioned in Section II.5.1, is only available for

the 1998/99 wave. Thus, possible changes in the occupations with respect to the working conditions are not captured by the 4-digit occupational code.

In order to test the main specification with respect to the possible shortcomings of the 4-digit occupational code, i.e., objectivity and time changes, I re-estimate equation (II.7) using the average disamenities constructed for each occupation contained in the 3-digit classification of the waves 1991/92 and 1998/99. The 3-digit categorization contains 289 different occupations in which on average 37 women are working. The estimation results and the calculated MWP are shown in Tables II.x.a and II.x.b respectively.

The results for the coefficients of workload and environmental hazards estimated using the average disamenities of the 3-digit occupations gain in absolute size and significance. In contrast, the coefficient of the wage becomes slightly smaller. These results imply a stronger and more significant MWP for a good working environment (4 per cent instead of 2.4 per cent), but conversely to the prediction of the theory as well a more positive significant MWP for the workload (2 per cent instead of 1 per cent).

Besides the occupational code used to construct the average occupational disamenities, the method applied to derive the two disamenity indices might also be subject to criticism. In the main specification, I group the disamenities according to the distinction usually made in the literature of CWD and create unweighted averages. In order to test if this construction is not subject to any arbitrariness of the author, alternative indices are constructed via a factor analysis (using maximum likelihood and varimax rotation). Similar to the indices of the main specification, the disamenities get reduced to two factors that can be interpreted as "workload" and "environmental hazards". The estimation results of a discrete logistic duration model using the indices created by a factor analysis and the derived MWP, shown in Tables II.xi.a and II.xi.b, do not significantly differ from the ones using unweighted averages. We can conclude

that neither the occupational classification nor the method used to construct the indices biases our estimates for the MWP to avoid disamenities.

Sample Period: In order to assure that the restriction of the sample to the years 1992-2004 is random and does not influence the decision about the maternal leave length, I re-estimate equation (II.7) using the sample extended to all years for which mothers are entitled to some, even if shorter, optional parental leave (1986-2004; see Section II.3). The results using this longer sample are shown in Table II.xii.a and II.xii.b.

While the coefficients for wage and disamenities loose some size and significance, the impact of certain aspects of the working schedule gets stronger in absolute magnitude and precision. As a consequence, the MWP to reduce environmental hazards decreases, but the one to enjoy a working schedule allowing to arrange childcare, such as work in the evening or in rotating shifts, increases: taking into consideration all years from 1984 to 2004, the estimation results are telling that women are on average willing to sacrifice more than 60 per cent of their wage if working in the evening, and more than 70 per cent if according to a rotating schedule. Since working arrangements were even less flexible during earlier years, this indicates once more that recent mothers try to overcome inflexible working arrangements by following an unorthodox schedule.

Finally, I control for further aspects of the job (distance to the workplace, stress, pressure or challenges of the job and repetitive tasks).[80] In all cases the estimation results are consistent with those of the main specification.

Additional specifications and robustness checks confirm that the less hazardous the guaranteed job and the more flexible the working schedule, the shorter the maternal leave length.

[80] The results including further controls for the type of job are available upon request.

The following section concludes and provides recommendations for a policy designed to increase mothers' LFP.

II.7. Conclusion

This study is, to my knowledge, the first to directly estimate mothers' MWP to avoid job-related disamenities. The suggested framework contributes to the existing methodologies to measure the MWP to reduce disamenities.

In the line of Gronberg and Reed (1994), the MWP is estimated by taking advantage of movements in or out of existing employment. In contrast to Gronberg and Reed, who look at job tenure in the U.S., this study focuses on maternal leave length in Germany. There, maternity leave legislation gives a woman the right to return to her former job during the first 36 months after having given birth. This job guarantee is the key to estimating the MWP more accurately than in the previous study since it allows us to overcome the failure to observe the different alternatives available to a worker: in the case of Gronberg and Reed, all potential job offers, and in our case, the alternatives of staying on leave or returning to the guaranteed job at some point during the 36 months period. Consequently, the proposed framework enables me to improve on the existing methodologies to estimate the MWP precisely.

Using data from the German Socio-Economic Panel (1992-2005) and the Qualification and Career Survey (1998/99) I estimate the effect of wage and disamenities on the chosen leave duration. The MWP to avoid a certain disamenity can be inferred through the estimated elasticities of the hazard rate with respect to this disamenity and to the wage.

As predicted by the theory, the wage significantly determines mothers' leave decision. The higher the wage and hence, the higher the opportunity cost of staying at home, the shorter the leave. Besides the pecuniary, also some non-pecuniary job

features, such as the hazards and the working schedule have a non-negligible impact on mothers' LFP choice; while a menial working environment deters mothers from an early return to work, a working schedule allowing them to arrange for childcare encourages them to do so.

The results of this study reveal that mothers' have a significant aversion towards environmental hazards, such as dust, dirt, extreme temperatures, noise and health risks. Mothers are willing to sacrifice 25 per cent of their wage to improve these environmental conditions by one standard deviation. This difference corresponds to the level of hazards implied in the occupation of a nurse and a secretary, or an electrician and an economist. The analysis of mothers differing in the financial and educational background sheds further light on the high MWP to reduce hazards at the workplace; mainly high-income and high-educated women are willing to cut wages in favor of better working conditions; i.e., women who can either afford to pay for better conditions or who are aware of their consequences. Educational advertising about risks or dangers involved in occupations that imply a huge amount of disamenities, might therefore correct mothers' assessment of the consequences of certain hazards and thus help to protect the health and the life of mother and child.

The working schedule is pivotal for mothers when deciding how long to stay at home after childbirth. An unorthodox schedule seems to be attractive for recent mothers; they are willing to accept severe wage cuts (more than 50 per cent) to be able to work during the evening or in rotating shifts. However, examining differences between East and West Germany demonstrates that only West German mothers exchange wage for this type of working schedule. This result suggests that the source of the high MWP for a working schedule beyond the usual hours are institutional differences: the lack of child care facilities in West Germany (only 3 per cent of children under the age of three are covered by daycare arrangements), might trigger the

high MWP to work according to this unusual schedule. Mothers can only return to work if they either have enough income to pay for formal childcare or if they can coordinate childcare informally with their husband, relatives or friends; i.e. they work when somebody else can take care of the child. Thus, as becomes clear from these results, an increase in the coverage of public childcare is crucial for a policy targeted at an increase in maternal LFP.

The insights gained by this study are of relevance for an efficient design of family policies. In order to achieve a higher LFP among mothers, it is important to know and to improve the conditions, which facilitate mothers' return to work. It is, however, not straightforward to pursue adjustments in all dimension shown to be appreciated by mothers. While it is feasible to establish a working schedule compatible with available daycare or provide childcare on a public or company basis, it might not be obvious how to reduce the amount of environmental hazards within a given occupation: e.g. nurses are always exposed to certain health risks, bakers to heat, cleaning ladies to dust and dirt, etc.. Nevertheless, recent reforms, such as the *Law of Safety at Work* (1996) or *the Law of Part-time* (2001), have shown that establishing general norms and providing guidelines for employers can help to achieve some improvements.

Besides the methodological contribution and the relevance for policy design, I view these results as an encouraging step towards understanding the remaining unexplained part of the wage gap between women with and without children, the so-called child penalty. In Chapter I, I put forward the hypothesis that if labor markets reward disamenities, part of the child penalty might be a CWD. By means of a hedonic wage regression, I estimate the price that mothers pay in order to avoid bad working conditions. The estimated child penalty (20 per cent) can actually be reduced only by a small and insignificant amount. As shown by Hwang et al. (1998) the estimated

coefficients of a hedonic wage regression, however, may be downward biased so that, the estimated hedonic prices may only provide a lower bound of the price mothers pay in order to avoid exposure to certain disamenities.

The results of this study reveal that mothers care about disamenities when deciding about the return to work after parental leave. Their MWP to reduce certain disamenities is significantly higher than the prices estimated by the hedonic wage regression; 25 per cent of their wage for a decrease in hazards of one standard deviation and even more (around 50 per cent) for a working schedule compatible with available daycare. Thus, mothers might trade income for working conditions allowing for a better combination of family and work, a fact that possibly explains a non-negligible part of the child penalty.

Chapter III

The Impact of Mothers' Job Disamenities on Children's Cognitive Development

(joint with Hsin, Amy)

III.1. Introduction

The intergenerational transmission of occupational status has been the dominant means through which social scientists have measured the degree of social fluidity. We know that an individual's occupational prospect is dependent on parents' occupational status and that this process is, in part, achieved through the transmission of educational achievement (Featherman and Hauser, 1978; Hout 1988) and also through the transmission of values and personality traits (Kohn et al., 1982). Less is known about how occupational characteristics structure the day-to-day relations that parents have with their children? Do these differences go on to affect children's achievement and personality development in ways that may influence later status attainment?

These questions are particularly salient in light of the fact that early maternal employment is now commonplace in industrialized countries. Since mothers still remain children's primary caregivers, much attention has been paid to understanding the consequences of maternal employment, especially employment during children's preschool years, on child development. Studies have focused on understanding whether employment status (Harvey 1999; Desai et al., 1989; Brooks-Gunn et al., 2002a), work hours (Berger, et. al., 2005), timing of maternal work (Brooks-Gunn et al., 2002b) and nonstandard work hours (Han, 2005) relate to child development. The results of these studies show that the effects are heterogeneous. While most suggest that employment during children's first year is related to lower cognitive outcomes among children,

studies also suggest that the effects may depend on the characteristics of mothers and families.

The effect of maternal employment on child outcomes may also differ by the conditions of mothers' work environment. Jobs vary quite dramatically in terms of the physical and mental toll they place on parents. Jobs that expose caregivers to physically hazardous conditions or that are emotionally demanding may be particularly stressful for parents which may, in turn, reduce their capacity to provide responsive and consistent childcare. As these types of *bad* jobs—those offering low pay and disamenities—have rapidly increased over the years (Kalleberg, et al. 2000), important questions are raised regarding the consequence of work conditions for child wellbeing.

The goal in this chapter is to examine how disamenities involved in mothers' occupations relate to children's cognitive development. We want to understand possible mechanisms through which occupational traits exert its influence on child development. In this line, we assess whether the observed relationship between work conditions and child outcomes is due to the deleterious effects *bad* jobs have on childrearing behaviors and consider how the quantity and type of mother-child interactions may alter the effect of *bad* jobs on child development.

Using the 1997 and 2002 waves of the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS)[81] we obtain information on child outcomes, parenting behavior (e.g. quantity and type of maternal time with children) and mothers' occupation. We link mothers' occupations, classified according to a 3-digit code, with the Occupational Information Network (O*NET) to obtain detailed information on

[81] One might wonder why the analysis of this chapter, analog to Chapter I and II, is not applied to Germany. Besides information on mothers' working behavior, the German Socio-Economic Panel provides data on children, in particular on cognitive child outcomes. However, it does not contain detailed time use data and thus would not allow us to identify a possible mechanism through which mothers' work conditions go on to affect child development. Furthermore the sample size of the German data is quite small and due to a lower labor force participation of German mothers (see table I.ii) decreases even more once we restrict the sample to only working mothers.

maternal occupations. Factor analysis on 57 different occupational characteristics identifies 4 important work dimensions (hazards, physical requirements, stressful contacts and degree of repetitive tasks). In order to address the questions outlined above - what is the effect of occupational disamenities on child outcomes and what is the transmitting mechanism - we apply OLS regressions clustered at the family level and corrected for selection into employment (using Heckman, 1976). We regress child cognitive test scores on occupational traits, mother-child interactions and furthermore on an exhaustive set of background characteristics, including features of the child, the mother and the household. Last we stratify our sample by age and perform the analysis separately for three different age groups: infants (age 0-2), pre-school children (age 3-5) and school children (age 6-12 years).

The results of the analysis suggest that disamenities involved in mothers' occupations are associated with lower verbal scores among children. Controlling for maternal characteristics, in particular education and verbal skills, reveals that much of these correlations is due to negative selection into menial occupations. However, a reduced, but significant impact of occupational traits, in particular of hazards, on child outcomes remains and grows even stronger the older the child gets. More importantly, the results show that maternal time with children is one mechanism through which occupations influence child outcomes. *Bad* jobs exert negative effects because exposure to disamenities 1) changes the distribution of maternal time across developmentally oriented and less targeted activities (i.e. mothers working in hazardous and menial jobs spend relatively less time in structured activities, such as reading, performing housework together, etc.), and 2) alters the effect of maternal time on child outcomes (for mothers who are exposed to certain disamenities at work, time spent with children performing structured activities has a positive effect whereas less structured time, such as feeding, washing, running errands, etc., has a negative effect). Therefore *bad* work

conditions are detrimental of child development because they reduce children's exposure to the most productive types of maternal time and increase the unfavorable impact of activities that are less conducive to fostering intellectual development.

Our study contributes to the literature the following way. First, we focus on a broad range of occupational characteristics by considering several dimensions of the work environment (disamenities, wage and working hours), rather than focusing on any singular job trait as previous literature did. Second, we identify a mechanism through which work conditions affect child outcomes (i.e. parenting behavior). And last, we control for selection into employment applying the estimation method suggested by Heckman (1976).

This chapter is structured in the following way. In Section III.2, previous literature on the relationship between work conditions and parenting behavior on the one hand, and child outcomes on the other hand, is briefly reviewed and the contribution and hypotheses of our study are introduced. The data is described in Section III.3 and the results of the regression analysis, stratified by ages, are presented in Section III.4. Section III.5 concludes, with suggested avenues for further research.

III.2. Background

III.2.1. Work Conditions and Parenting behavior

Developmental theories suggest that economic hardship lowers an individual's capacity to provide consistent and responsive care. For example, fathers who experienced heavy economic loss during the Great Depression were more irritable and explosive, and were more likely to use violent and arbitrary punishment towards children (Elder, et al., 1985; Elder, 1999). Likewise, studies using a nationally representative sample of children and families from the National Longitudinal Survey of Youth (NLSY) show that poor mothers are less affectionate and use more physical

discipline than non-poor mothers (Bradley et al., 2001). In the same vain, poor work conditions may exert a physical and mental toll on parents. Several studies show that certain work conditions – highly repetitive, low autonomy, and little demand for substantively complex work – lead to worse psychological functioning (Kohn and Schooler, 1982; Gecas, 1989; Menaghan and Parcel, 1991; Raver 2003). Analyzing a sample of 1,403 mothers with children aged 3 to 6 from the NSLY, Menaghan and Parcel show that entry into menial jobs is associated with larger drops in quality of home environment than entry into more substantively complex jobs.

III.2.2. Work Conditions and Child Outcomes

To our knowledge, there is only one study (Parcel and Menaghan, 1990) that examines the influence of maternal work conditions on child outcomes, in spite of the large body of evidence that suggests that work conditions affect parenting behavior. This study analyzes a sample of 697 employed mothers with 3 to 6 year old children from the NLSY. Using the 1980 Census occupation codes and the Dictionary of Occupational Titles (DOT), they choose to exclusively consider one dimension of job content - substantive complexity of occupations - even though factor analysis performed on the 42 job traits obtained from the DOT identified 5 dimensions that capture variation in job characteristics. Using a factor-based scale of occupational complexity, they examine associations between occupational complexity, as well as hourly pay and work hours, and children's verbal scores measured by the Peabody Picture Vocabulary Test-Revised (PPVT-R), using ordinary least square estimations.[82] The results show that both pay and occupational complexity is positively correlated with children's verbal facility and that full-time work is more negatively correlated with verbal achievement than part-time work. But once mother's education, verbal skills and other background characteristics are included in the regression, the estimate of occupational complexity

[82] Verbal tests and work conditions were measured contemporaneously. Contemporaneous measures, however, may lead to biased results since the causality between the two aspects is not a priori clear.

falls to zero and becomes statistically insignificant. Estimates of hourly pay and work hours, on the contrary, reduce in magnitude but remain statistically significant.

III.2.3. Contribution and Hypotheses

This chapter seeks to extend the existing literature in several ways and to test the following hypotheses. First, occupational complexity may not be the best or the most important non-pecuniary dimension of jobs to consider. It is not clear why only this occupational feature was included in the analysis and not also the other 4 factors. Additionally, occupational complexity may not be capturing a distinct dimension of work conditions apart from mother's own verbal skills and education. Of the 19 items that were used to construct the factor-based scale of occupational complexity many are simply proxies for mother's education and skill, such as measures of the verbal, numerical aptitude and educational level required of jobs. This may explain why the effect of occupational complexity is entirely explained by the inclusion of maternal characteristics such as mothers' schooling and AFQT scores. In our paper, we include all dimensions of mothers' work environment identified as being significant by factor analysis. By considering these characteristics, we can test if disamenities involved in mothers' occupations might have an effect on the cognitive development of children beyond the impact of mothers' education and skills.

Second, we attempt to identify whether the effect of maternal work conditions works through the productivity of mothers' time spent with children. We suggest and assess the following hypothesis: Maternal time spent with children may represent the mechanism through which occupational traits exert its influence on child outcomes and different types of mother-child time may moderate or aggravate this impact. We use a unique feature of the PSID-CDS, time diary information on the quantity and type of time mothers spend with children, to answer this question. Previous studies have shown that the distribution of maternal time performing more or less developmentally oriented

activities varies by occupational class (Lareau, 2002) and that, in addition to total time, the amount of time devoted to activities fostering cognitive skills is positively associated with improvements in children's language development (Hsin, 2007). Following these studies, we distinguish between shared time performing activities that directly foster human capital development (e.g. reading, doing homework together, playing, etc., referred to in the subsequent text as *structured time*) versus less targeted activities that are only indirectly related to human capital development (e.g. watching television, running errands, etc., referred to as *unstructured time*). We look in particular at statistical interactions between occupational characteristics and the different types of maternal time in order to investigate if the effect of *bad* jobs on child development may alter with the quantity and type of maternal time.

Third, previous studies do not correct for selection bias due to differential selection into employment status and types of occupation. In the first case, the following bias might arise. On the one hand, if better skilled mothers are both more likely to work and also more productive caregivers then the sample of working women is positively selected and the estimated effect of parenting behavior possibly downward biased. On the other hand, as shown in Chapter II, mothers are reluctant to work in case the job exposes them to disamenities; hence, the negative impact of bad jobs on child outcomes is possibly underestimated. We attempt to correct for this type of bias by implementing a Heckman selection correction (1976). In the second case, women, in addition to differential sorting into employment status, may also be differentially sorted into types of occupations. The direction of a potential bias arising due to this type of selection, however, is not a priori clear. Assuming a mother chooses a job, which involves fewer disamenities in order to take better care of her child, our estimates for the impact of disamenities on the child development might be overestimated. However, as shown in Chapter II, women who work in occupations which involve a high amount of

disamenities are more likely to stay longer at home after childbirth; hence, the estimated negative impact of *bad* working conditions on the child development might be offset by the increase in maternal child care. In Section III.6 we suggest possible extensions of this approach that can explicitly account for differential selection into occupation types.

One further important issue, not always considered by the literature on the impact of maternal employment on children's cognitive development, is the assessment date of child outcomes. Using contemporaneous measures of maternal working conditions and children's test scores, between which the causality is not a priori clear, might lead to biased estimates. Hence, in the current study we take advantage of the two available waves of the PSID-CDS and evaluate the impact of maternal occupational traits reported in the first wave (1997) on child outcomes reported 5 years later in the second wave (2002).

The next section describes our estimation strategy, first, the test score equations used to identify the impact of mothers work conditions on child outcomes and second, the selection equation necessary to correct for mothers sorting into employment.

III.3. Estimation Strategy

As mentioned above, we address the following questions: first, how do mothers' occupational traits relate to children's cognitive skills and second, through which mechanisms might they exert their influence? In the next paragraphs we provide an outline of the estimation strategy used to address these questions and suggest a method that allows us to correct for the fact that our sample includes only working mothers.

III.3.1. Job Disamenities and Children's Cognitive Test scores

The relationship between the conditions of mother's occupational environment and child outcomes is studied within a multivariate framework. Hence, we examine this

relationship by successively including controls for child, mother and family characteristics that may be both correlated with child outcomes and work features.

First, we examine the impact between children's cognitive test scores and the 4 occupational dimensions resulting from the factor analysis without including any further control variables. Second, we introduce maternal characteristics in additions to child, household and childcare information. This allows us to investigate if the negative impact of occupational disamenities might work through negative selection into menial occupations, i.e. if a certain type of mother works in hazardous job and hence the impact of disamenities on child outcomes might be entirely explained by mothers' personal features. Third, we explore the following pathway through which job characteristics may be translated into child outcomes: maternal time, differentiating between time devoted to structured activities fostering directly children's intellectual development and time spent at other unstructured activities. In a last step, we also control for statistical interactions between occupational characteristics and the two types of maternal time, in order to investigate if the effect of *bad* jobs may alter with both the quantity and the type of time mothers spend with their children. The final specification looks the following:

$$CO_{it+1} = \beta_1 * WC_{it} + \beta_2 * MC_{it} + \beta_3 * CC_{iBirth} + \beta_4 * HC_{it} + \beta_5 * PB_{it} + \beta_6 * PB_{it} * WC_{it} + v_i \quad \text{(III.1)}$$

where CO_{it+1} are different measures of cognitive outcomes for child i in year t+1,[83] WC_{it} contains the different dimensions of mother's occupation in year t, MC_{it} represents a variety of maternal characteristics, CC_{iBirth} includes child i's characteristics at birth, HC_{it} stands for other household characteristics (including school quality), PB_{it}

[83] We estimate the "long-run" (5 year) effect of maternal work conditions on cognitive child outcomes. We use information on mothers' work environment, parenting behavior and other controls from the first PSID-CDS wave (1997) and the cognitive test scores provided in the second wave (2002).

represents the different aspects of parenting behavior (maternal time spent with children, differentiating between time spent on structured and unstructured activities), and last $PB_{it}*WC_{it}$ represents the interaction term between a mother's parenting behavior and her work characteristics.

Numerous studies in the child developmental literature (Brooks-Gunn et al. 2002a and b) emphasize the fact that children's cognitive development occurs through key developmental stages. Following these studies, we stratify our sample by children's age in 1997 and perform our analysis separately for the following age groups: 0-2 (infants), 3-5 (pre-school) and 6-12 (school) years old. Using the different sub-samples, we apply ordinary least squares to estimate equation (III.1) and cluster the standard errors at the family level.

III.3.2. Selection Issues

As empirical evidence and past research confirm, there is still a strong negative impact of motherhood on women's labor force participation (Table I.ii; Ruhm, 2004)). Hence, the fact that our sample contains only working mothers might lead to biased results. If better skilled mothers are both more likely to work and also to be more productive caregivers, then the sample of working women is positively selected and the estimated effect of parenting behavior possibly downward biased. Additionally, if mothers are reluctant to work in case the job exposes them to a high amount of disamenities as shown in Chapter II, the negative impact of bad jobs on child outcomes is possibly underestimated. We attempt to correct for this type of bias by implementing the selection correction procedure suggested by Heckman (1976).

In a first step, the selection equation, we estimate the probability of a mother being working in year t. Hence, we run the following equation:

$$\text{Prob}\,(Work_{it}=1) = \gamma_1 * MC_{it} + \gamma_2 * HC_{it} + \gamma_2 * CC_{iBirth} + \gamma_3 * ER_{it} + w_i \qquad \text{(III.2)}$$

where $Work_{it}$ is a binary variable, equal to 1 if the mother of child i is working in year t, MC_{it} again represents maternal characteristics, HC_{it} household characteristics, CC_{iBirth} child i's conditions at birth and ER_{it} exclusion restrictions, such as county unemployment rates and mothers' attitude towards daycare.[84] Using the predicted values from this estimation we calculate the inverse mill's ratio λ_i. In order to test and if necessary to correct equation (III.1) from a selection bias, we include the inverse mill's ratio and estimate the following equation:

$$CO_{it+1}=\beta_1*WC_{it}+\beta_2*MC_{it}+\beta_3*CC_{iBirth}+\beta_4*HC_{it}+\beta_5*PB_{it}+\beta_6*PB_{it}*WC_{it}+\beta_7\lambda_i+v_i \quad \text{(III.3)}$$

Besides selection into employment status, also sorting into occupations, differing in their work conditions is a matter of concern. On the one hand, in case a mother chooses a job, which involves fewer disamenities in order to take better care of her child, our estimates for the impact of disamenities on the child development might be overestimated. On the other hand, as women who work in occupations which involve a high amount of disamenities are more likely to stay longer at home after child birth (see Chapter II), the estimated negative impact of *bad* working conditions on the child development might be offset by the increase in maternal child care. In Section III.6. we suggest possible extensions of this paper that can explicitly account for differential selection into occupation.

In the following section we describe the data and explain how we construct the occupational characteristics and match them to the sample of working mothers.

[84] The exact wording of the question in the PSID is: "Do you think that preschool children suffer from having a working mother" The answer categories are: =1 strongly disagree; =2 disagree; =3 agree; =4 strongly agree.

III.4. Data

In this chapter, we combine individual and family level data from the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS) with detailed occupational data from the Occupational Information Network (O*NET).[85] The Panel Study of Income Dynamics (PSID) is a longitudinal, nationally representative study of individuals and families in the United States. Starting in 1997, the PSID administered the PSID-CDS to include assessments of the children of parents included in the original PSID sample. This sample includes approximately 3,600 children between the ages of 0 to 12. In 2002, the PSID-CDS re-contacted 2,907 children for a follow-up survey. The PSID-CDS obtained assessments of children's cognitive and behavioral development, children's time use, and parenting behavior. While the PSID-CDS provides information on maternal occupations, it does not provide detailed information on work conditions. As a result, we use the 3-digit occupational codes provided in the PSID-CDS to link occupations to occupational characteristics in the O*NET, which contains comprehensive information on key attributes of 812 occupations.

Matching the two datasets via maternal occupation,[86] we create a new dataset disposing information on 1) occupation-specific conditions, 2) children's cognitive outcomes, 3) children's characteristics at birth, 4) maternal time spent with their children performing different types of activities and 4) mothers' personal and further household characteristics.

[85] The O*NET is the online replacement of the Dictionary of Occupational Titles (last edition was published in 1991) and is accessible through the O*NET Online website http://online.onetcenter.org/. In order to cope with changes of the occupational landscape it has been last time revised in 2006.

[86] The two datasets are matched via the occupational code. While the O*Net is based on the 2000 Standard Occupational Classification (SOC) system, which consists on a 6-digit level classification, the PSID provides occupations only for the 3-digit level occupation code from 1970 Census of Population. Nevertheless, the majority of the occupations contained in the PSID have an exact counterpart among the occupations in the SOC. For the remaining more general occupations contained in the PSID, we use the average of the corresponding more detailed occupations contained in the O*NET. A list containing the exact matches between the two classifications is available upon request.

Our final sample contains 1624 children, who belong to 1239 mothers and are between 0 and 12 years old in 1997. Of the 2,414 children who were present in both waves of the PSID-CDS (1997 and 2002) and of whom we possess complete time diary information, 582 children were dropped because their mothers were not working in 1997 and some further 73 because their mother's occupation was not reported. Of the 1759 remaining children we loose 135 due to missing test scores in 2002.

In the next paragraphs, the main variables and the different categories of control variables are discussed. For an overview of the descriptive statistics of all dependent and control variables, please refer to Table III.i.(see Additional Figures and Tables).

Occupation-Specific Conditions: Occupation-specific characteristics are taken from the O*NET, which collects detailed information on 812 occupations. In this study we focus on 57 features describing the work context, e.g. physical requirements and hazards exposure.

In order to summarize the numerous job features, we develop factor-based scales. At the first stage, we estimate a maximum likelihood equation which enables us to discover the latent structure of our set of variables. At the second stage, we apply varimax rotations to the factors from the first stage. [87] This process allows us to reduce the 57 job features to the following 4 key occupational dimensions: physical demand, aggravating social contacts, exposure to hazardous working conditions and the degree of repetitive tasks. [88] Table III.ii (see Additional Figures and Tables) presents the most

[87] We have tried alternative methods to reduce the broad range of occupational characteristics, such as using the most general characteristics, unweighted averages, principal component analysis, unrotated maximum likelihood analysis and last different types of factor analysis selecting a priori the working conditions which are clearly disamenities or amenities. The results, however, do not differ significantly. Hence, we decided to not impose any restriction on the range of job features and apply maximum likelihood with a subsequent varimax rotation.

[88] Exposure to the outdoor environment was identified as a dimension of work conditions, independent of physical demand. A priori, we have no theories regarding why maternal exposure to the outdoors should influence child outcomes, net of the physical demands of her job. Preliminary regressions also show that it is not significantly correlated to child outcomes. We, therefore, omit it from our analysis.

important occupational characteristics contained in every factor and their respective factor loadings.

For illustrative reasons, let us briefly review the occupations which expose their workers to the most quantity in each of the 4 occupational dimensions: the service sector requires the highest physical effort (e.g. maids or waitresses) and the greatest amount of stressful social contacts (e.g. flight attendants, bus drivers); the health sector exposes workers to most hazardous conditions (e.g. nurses or laboratory technicians); finally, occupations like telephone operators or bus drivers require the most repetitive activities.

With respect to the occupations involving average occupational characteristics, we observe the following: first, teachers or dental assistants have to bear the average amount of physical effort, while secretaries have to fulfill one standard deviation (0.998 units) less; second, secretaries are exposed to the average amount of stressful social contacts, while safety guards have to deal with one standard deviation (0.975) more aggressive people; third, maids and housekeepers are exposed to the average amount of hazards, while jobs in educational administration involve one standard deviation less hazards; and last, the average repetitive job is the one of receptionists, while the job of family practitioners or pre-school teachers is one standard deviation more complex.

Aside from these 4 occupational dimensions, we include two other maternal work conditions that may also matter. First, we include mothers' wage, measured in dollars per month and included as its natural logarithm. This allows us to relate the impact of the non-monetary work characteristics to monetary ones. Second, we control for the number of working hours per week.[89] This is meant to account for the simultaneous impact of maternal employment on both the quantity and content of

[89] Opposite as one may expect, maternal work hours are only weakly correlated with the amount of maternal childcare: the correlation of maternal working hours with structured time is -0.26 (at a 1% significance level) and with unstructured time -0.09 (at a 1% significance level). Hence, we can exclude strong multicollinearity.

mother-child time (Bianchi 2000; Booth et al., 2002; Huston and Aronson, 2005) and child cognitive outcomes (Desai, et al., 1989; Waldfogel, et al., 2002; Ruhm, 2004; James-Burdumy, 2005). [90] In this sample mothers earn, on average, $9.22 per hour and work 26.76 hours per week.

Child Outcomes: The PSID-CDS provides detailed information on cognitive performance of children. Cognitive outcomes are measured by the Woodcock Johnson Revised Test of Achievement (WJ-R). The WJ-R is a widely recognized measure of intellectual development, reading and mathematical competence. Cognitive assessment is composed of three subtests: applied problem solving, letter-word and passage comprehension. All assessments of child performance are taken from the 2002 PSID-CDS, when children are between the ages of 5 and 17 years old. Children in this sample score on average 104.2 points (standard deviation of 18.8) in the letter-word, 104.1 points (15.4) in the passage comprehension and 102.6 points (16.5) in the applied problem solving test.

Child Characteristics: In order to control for innate conditions, that might affect later cognitive and behavioral development, we include furthermore children's weight and any health, cognitive and physical problems at birth. At the time of birth children in our sample weight 117.8 ounces, 8.6 per cent suffer from a poor health, 4.6 per cent from cognitive problems and 29.6 per cent from physical problems. In addition, we control for the standard set of variables that are examined in the child development literature. These variables include child's gender (50.7 per cent are male), race (40.2 per cent are Black and 1.8 per cent Hispanic) and age at time diary and the cognitive test assessment (6.08 years in 1997).

[90] Both, the wage and the working hours, are taken from the 1996 wave of the PSID

Maternal Time: [91] The children's time use module, a unique aspect of the PSID-CDS, provides information on the time use of up to two children per family for a random weekday and weekend. It contains details on the duration and type of activity performed by the mother together with her child.

Based on the un-aggregated time diary module of the 1997 PSID-CDS and following Bianchi et al. (2006) and Stafford and Yeung (2005), we create the following measures of mother child interactions: shared time engaged in developmentally oriented activities that may more directly foster child development, referred to as *structured time*, and shared time spent in less targeted activities that are less conducive to promoting intellectual and behavioral development, referred to as *unstructured time*. Developmentally oriented activities include activities such as play and companionship, achievement-related activities, and participation in social/religious events. Activities that can be classified as less explicitly developmental in nature include the time children spent as the passive recipient of routine care (e.g. being fed and groomed), traveling and shopping with mothers, and watching television/listening to music with mothers. On average mothers spend approximately 42.7 hours per week with their children of which 51.9 per cent is devoted to structured activities.

Mothers' Characteristics: Mothers' education and cognitive aptitude may simultaneously determine child cognitive development and occupational choice. Better-educated mothers may engage in types of interactions that make them more effective at translating their time with children into positive cognitive outcomes. Additionally, better-educated mothers may have better employment options and be less likely to be employed in less desirable jobs (e.g. physically demanding, low paying jobs). Mother's education is measured as a continuous variable signifying the total years of completed schooling (average years of schooling are 12.3). Net of education, studies find that more

[91] For more details on the construction of maternal time variables, please refer to Hsin, 2007.

verbally able mothers provide children greater exposure to the cognitive stimulation necessary for child development (Hsin 2007). At the same time, mothers' verbal ability may also be predictive of her employment status and employment characteristics. As a result, we control for mother's verbal skills using her passage comprehension score. Maternal verbal aptitude is treated as a continuous variable (average score are 31.4).

Other maternal and household characteristics include mothers' age in 1997 (33.6 years old), marital status at child's birth (25.6 per cent are single moms), mother's health, treated as a binary variable being equal to one when being in a rather fair or poor health status (10.8 per cent report not being well),[92] other household income sources except maternal labor income in 1997 (measured in logs: average log income is 9.3) and number of siblings (on average 2.2). We furthermore include a measure for school quality, signifying the pupil-teacher ratio in 1997 (17.1 pupils per teacher).

The next section presents the results for all different steps of the analysis.

III.5. Results

III.5.1. Descriptive Results

Table III.1 presents the raw correlations between conditions of maternal occupations, on the one hand, and maternal traits and parenting behavior, on the other hand. First, between occupational and maternal features we can detect the following correlations: Physical demand and repetitive tasks are both (at a 1% significance level) negatively correlated with maternal education, verbal aptitude and log wages, suggesting that women are negatively selected into these types of jobs. Stressful social contacts, on the contrary, are significantly positively related to maternal verbal aptitude and log wages. Occupational hazards are only significantly correlated to log wages, suggesting that there might be no selection happening with respect to hazards.

[92] Individuals were asked to assess their health as being poor, fair, good, very good and excellent.

Table III.1: Raw correlations between mothers' working conditions, personal characteristics and parenting behavior

	Mother's education	**Mother's pc score**	**Mother's log wage**	**Total maternal time**	**Time in structured activities**	**Time in unstructured activities**	**% time in structured activities**	**% time in unstructured activities**
Physical demand	-0.1867	-0.2265	-0.246	0.0422	0.0167	0.0482	-0.0511	0.0511
	0.0000	0.0000	0.0000	0.0771	0.4830	0.0433	0.0324	0.0324
Stressful contacts	0.0221	0.1314	0.0915	-0.0589	-0.064	-0.0205	-0.0304	0.0304
	0.3554	0.0000	0.0001	0.0134	0.0072	0.3913	0.2039	0.2039
Hazards	0.016	-0.0194	0.1496	-0.0927	-0.1023	-0.0304	-0.0689	0.0689
	0.5038	0.4173	0.0000	0.0001	0.0000	0.2029	0.0039	0.0039
Repetitive tasks	-0.1335	-0.1521	-0.1054	-0.1981	-0.187	-0.0979	-0.062	0.062
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0024	0.0024
Log wage	0.1933	0.147	1.0000	-0.1981	-0.187	-0.0979	-0.062	0.062
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0024	0.0024

* p-values are shown in the lower rows.

Second, we observe the following correlations between work conditions and aspects of parenting behavior, such as mother-child time. All four work conditions are significantly correlated with the total weekly hours mothers spend with their children. Working in jobs with stressful social contacts, hazardous conditions, and repetitive tasks is associated with reductions in total maternal time. Only physical demanding is positively related. When we look at the relationship with the distribution of maternal time across structured and unstructured activities, we see that the positive relationship between physical demand and total maternal time is largely due to increases in time which does not foster directly intellectual development. Stressful contacts, hazards and repetitive tasks are associated with less time spent on structured activities. In terms of the percentage of time in structured activities, all 4 work conditions are associated with spending a lower percentage of time in the types of activities that can more directly promote children's cognitive skills.

III.5.2. Regression Results[93]

Table III.2 summarizes the results of ordinary least square regressions of maternal work conditions on child cognitive outcomes clustering on the family level and using the full sample of children, age 0 to 12. In the next set of regressions, we stratify the estimation according to children's age in 1997: Table III.3 separately examines children age 0 to 2, Table III.4 examines children age 3 to 5, and Table III.5 examines children age 6 to 12.

To investigate the relationship between mothers' work conditions and child test scores, we successively add in covariates. Additional regressors are detailed at the bottom of the tables: B refers to the vectors of basic characteristics previously described (see Additional Figures and Tables, Table III.i). To identify a possible mechanism

[93] Given that the PSID over-samples low-income and immigrant families, groups of the population which might differ in their working and child-rearing habits, we have repeated the whole analysis using child-specific probability weights to adjust for over-sampling and attrition between waves. The results, however, barely alter and are available upon request.

through which work conditions affect child outcomes, we include furthermore parenting behavior and its statistical interactions with occupational traits.

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Columns 1, 4 and 7 in Table III.2 show that work conditions are significantly correlated with all 3 dimensions of children's cognitive achievement. In particular, physical demand and repetitive tasks are both significantly negatively correlated with all 3 test scores. Once characteristics of children and families are subsequently controlled for (inclusion of the basic set of covariates, B, see columns 2, 5 and 8), the estimates for physical demand significantly reduce in magnitude by close to three quarters, the ones for repetitive tasks decrease even more and all become statistically insignificant.

Key characteristics causing this loss of magnitude and significance are maternal education and verbal skills. As expected, the estimated coefficients of these two maternal features show up significantly across all specifications. Furthermore, as discussed already before (see Table III.1), both of these maternal characteristics are significantly and strongly negatively correlated with certain dimensions of mothers' occupations, such as physical demand and degree of repetitive tasks. Thus, like occupational complexity (used in the study by Parcel and Menaghan, 1991), these occupational characteristics may not be capturing any distinct dimension of work conditions apart from mother's own verbal skills and education. Hence, one might infer that the estimated impact of physical effort and repetitive tasks is mostly due to a negative selection into menial occupations.

The only occupational dimension remaining marginally significant in regressions with child letter-word scores after family and child characteristics are introduced is hazards. This finding is consistent with the descriptive results that show that occupational hazards are the least correlated with maternal attributes, in particular with maternal education and verbal aptitude.

Table III.2: Results of a clustered OLS regression using pooled sample

	Letter-word Score			PassageComprehension Score			Applied Problem Solving Score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Physical demand	-2.199	-0.499	-0.514	-1.866	-0.467	-0.474	-2.069	-0.295	-0.303
	(3.9)**	(0.94)	(0.97)	(3.8)**	(1.08)	(1.10)	(4.1)**	(0.64)	(0.66)
Stressful contacts	0.56	-0.531	-0.433	0.864	-0.033	0.095	0.626	-0.367	-0.263
	(1.02)	(1.08)	(0.87)	(1.89)	(0.09)	(0.25)	(1.28)	(0.86)	(0.60)
Hazards	-1.252	-0.753	-1.567	-0.789	-0.249	-1.364	0.153	0.439	-0.206
	(2.2)*	(1.57)	(1.50)	(1.64)	(0.69)	(1.69)	(0.29)	(1.03)	(0.23)
Repetitive tasks	-2.079	-0.268	-0.288	-1.306	0.083	0.062	-1.596	0.25	0.348
	(3.3)**	(0.45)	(0.49)	(2.7)**	(0.20)	(0.15)	(3.0)**	(0.54)	(0.76)
Log wage	1.909	-0.246	-0.075	1.006	-0.506	-0.451	1.185	-0.52	-0.557
	(2.3)*	(0.33)	(0.10)	(1.41)	(0.85)	(0.75)	(1.47)	(0.76)	(0.82)
Mom's ed (yrs)	-	1.03	1.075	-	0.531	0.551	-	1.199	1.149
	-	(3.8)**	(3.8)**	-	(2.9)**	(3.1)**	-	(4.7)**	(4.5)**
Mom's verbal skills	-	0.767	0.73	-	0.587	0.565	-	0.422	0.389
	-	(5.8)**	(5.4)**	-	(6.1)**	(5.8)**	-	(3.8)**	(3.5)**
Unstruct. Activities	-	-	0.013	-	-	0.018	-	-	0.013
	-	-	(0.31)	-	-	(0.53)	-	-	(0.34)
Structured Activity	-	-	0.039	-	-	0.021	-	-	0.034
	-	-	(1.01)	-	-	(0.66)	-	-	(1.01)
Hazards*unstruct.	-	-	-0.058	-	-	-0.063	-	-	0.033
	-	-	(1.06)	-	-	(1.29)	-	-	(0.63)
Hazards*struct.	-	-	0.048	-	-	0.058	-	-	0.001
	-	-	(1.34)	-	-	(2.05)*	-	-	(0.02)
Inverse Mills	-	-	7.738	-	-	5.211	-	-	0.398
	-	-	(1.33)	-	-	(1.59)	-	-	(0.07)
Other regressors	-	B	B	-	B	B	-	B	B
Constant	103.22	64.785	62.729	105.2	86.251	85.116	103.34	60.498	60.465
	(40)**	(9.6)**	(7.9)**	(49)**	(16)**	(14)**	(40)**	(10)**	(8.7)**
Observations	1624	1624	1624	1564	1564	1564	1620	1620	1620
R-squared	0.04	0.2	0.21	0.04	0.27	0.27	0.04	0.23	0.24

Robust t statistics in parentheses: * significant at 5%; ** significant at 1%
In column 3:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1, 1006)=2.40 → Prob > F= 0.1219
Test: β(hazards)+β(hazards*structured time)= 0 → F(1, 1006)=2.21 → Prob > F= 0.1374
In column 6:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1, 982)= 3.35→ Prob > F= 0.0674
Test: β(hazards)+β(hazards*structured time)= 0 → F(1, 982)= 2.93 → Prob > F= 0.0875
In column 9:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1,1005)=0.04 → Prob > F= 0.8342
Test: β(hazards)+β(hazards*structured time)= 0 → F(1,)= 0.06 → Prob > F= 0.8016

In order to shed some light on a possible mechanism through which occupational traits at mothers' workplace might be transmitted to child outcomes, we include interactions between the occupational dimensions, on the one hand, and mother-child time spent in structured and unstructured activities, on the other hand.[94] However, significant findings are only observed for the interaction terms between hazards and maternal time.[95] Columns 3, 6 and 9 show that the effect of work hazards on children's verbal development may depend on the types of activities mothers perform with their children. Column 6, for example, shows that child passage comprehension scores are positively associated with structured maternal time even when mothers are working in hazardous jobs. In contrast, unstructured time is associated with lower passage comprehension scores among children when mothers are exposed to work hazards. Similar patterns can be found with respect to children's letter-word scores, although those estimates are only marginally significant.[96] In summary, the negative impact of work hazards on child outcomes can be compensated by devoting time on activities fostering children's intellectual development, but aggravates when not doing so. The coefficient on the Mills ratio is only marginally significant with respect to children's passage comprehension scores, i.e. correcting for selection barely alters the results.

Children Age 0-2

Table III.3 shows that maternal work conditions, when children are between the ages of 0 to 2, are not significantly correlated with children's tests scores five years later. Likewise the impact of mothers' wages does not show up significantly in the regression results. Only mothers' verbal skills are positively and significantly correlated with children's cognitive test scores. The coefficients for maternal education and

[94] Maternal time itself, without controlling for statistical interactions with occupational traits does not seem to have a significant impact on child outcomes. More detailed results are available upon request.
[95] Results including interactions terms with the other occupational traits are available upon request.
[96] F-tests for the added effects of hazards and the statistical interactions are marginally significant for letter-word and passage comprehension scores.

structured time are positive but only marginally significant. As before the estimate of the inverse mill's ratio is not significant and hence, selection correction is not necessary.

Table III.3: Results of a clustered OLS regression using only infants

	Letter-Word Score			Passage Comprehension Score			Applied Problem Solving Score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Physical demand	-1.805	-0.076	-0.539	-0.619	0.673	0.673	-1.684	-0.076	-0.085
	(1.63)	(0.08)	(0.57)	(0.60)	(0.71)	(0.71)	(1.54)	(0.07)	(0.08)
Stressful contacts	1.578	0.185	0.371	0.476	-0.629	-0.597	0.505	-0.818	-0.793
	(1.14)	(0.17)	(0.33)	(0.43)	(0.69)	(0.64)	(0.39)	(0.71)	(0.67)
Hazards	-0.354	-0.149	-0.169	-1.104	-0.304	-0.319	0.505	0.989	1.075
	(0.34)	(0.14)	(0.15)	(1.10)	(0.32)	(0.34)	(0.44)	(0.90)	(1.00)
Repetitive tasks	-1.307	0.774	0.757	-0.105	1.024	1.001	-1.282	0.931	1.186
	(1.11)	(0.67)	(0.68)	(0.10)	(1.04)	(1.01)	(1.11)	(0.82)	(1.05)
Log wage	1.438	-0.512	-0.141	2.578	0.662	1.117	2.637	-0.018	-0.054
	(1.06)	(0.34)	(0.09)	(1.94)	(0.45)	(0.73)	(1.84)	(0.01)	(0.04)
Mom's ed (yrs)	-	0.661	0.708	-	0.479	0.498	-	0.814	0.839
	-	(1.49)	(1.49)	-	(1.43)	(1.51)	-	(1.78)	(1.68)
Mom'sverbal skill	-	0.735	0.694	-	0.513	0.52	-	0.663	0.661
	-	(2.8)**	(2.7)**	-	(2.10)*	(2.18)*	-	(2.8)**	(2.7)**
Unstruct. Activ.	-	-	-0.024	-	-	0.089	-	-	0.038
	-	-	(0.31)	-	-	(1.06)	-	-	(0.40)
Structured Activ.	-	-	0.09	-	-	0.024	-	-	0.119
	-	-	(1.25)	-	-	(0.35)	-	-	(1.73)
Inverse Mills	-	-	-5.96	-	-	2.557	-	-	-0.639
	-	-	(0.69)	-	-	(0.36)	-	-	(0.07)
Other regressors	-	B	B	-	B	B	-	B	B
Constant	107.302	72.671	76.287	105.84	76.587	70.342	96.073	39.191	32.833
	(27)**	(5.2)**	(4.8)**	(29)**	(5.2)**	(4.6)**	(24)**	(2.6)**	(1.88)
Observations	385	385	385	331	331	331	386	386	386
R-squared	0.03	0.19	0.21	0.03	0.18	0.19	0.03	0.21	0.22

Robust t statistics in parentheses: * significant at 5%; ** significant at 1%

As shown in previous studies (Brooks et al., 2002a and b), maternal employment, and in other words maternal absence, has the strongest effect during early childhood. Hence, one possible interpretation of these findings, which are subject to our own interpretation, might be the following: During infancy it is mostly the availability

of the mother, i.e. her physical presence, but not the type of activity or quality of the time spent with children that matters.

Children Age 3-5

Table III.4: Results of a clustered OLS regression using pre-school children

	Letter-word Score			Passage Comprehension Score			Applied Problem Solving Score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Physical demand	-2.758	-1.158	-1.157	-1.797	-0.549	-0.307	-3.141	-1.474	-1.267
	(2.96)**	(1.41)	(1.43)	(2.17)*	(0.84)	(0.47)	(3.06)**	(1.81)	(1.55)
Stressful contacts	-0.345	-1.51	-2.307	0.313	-0.499	2.004	-0.21	-1.323	-0.012
	(0.44)	(1.97)*	(1.20)	(0.46)	(0.78)	(1.39)	(0.25)	(1.70)	(0.01)
Hazards	-0.679	-0.888	-0.921	0.553	0.232	0.1	0.656	-0.116	-0.265
	(0.89)	(1.22)	(1.23)	(0.75)	(0.40)	(0.18)	(0.62)	(0.13)	(0.29)
Repetitive tasks	-2.572	-0.789	-0.858	-1.949	-0.47	-0.465	-1.924	-0.095	-0.135
	(2.86)**	(0.90)	(0.99)	(2.36)*	(0.71)	(0.71)	(1.96)	(0.11)	(0.15)
Log wage	0.604	-0.338	-0.207	-0.342	-0.857	0.071	-0.232	-0.416	0.608
	(0.56)	(0.36)	(0.21)	(0.33)	(1.14)	(0.09)	(0.16)	(0.45)	(0.60)
Mom's ed (yrs)	-	0.738	0.014	-	0.039	0.122	-	-0.179	-0.061
	-	(1.53)	(0.20)	-	(0.10)	(0.32)	-	(0.33)	(0.12)
Mom's verb.skills	-	0.513	-0.025	-	0.505	0.427	-	0.393	0.337
	-	(2.58)*	(0.37)	-	(3.13)**	(2.76)**	-	(1.87)	(1.60)
Unstruct. Time	-	0.017	-1.157		-0.058	-0.121	-	-0.126	-0.202
	-	(0.25)	(1.43)		(0.82)	(1.72)	-	(1.35)	(1.87)
Structured Time	-	0.025	0.047	-	0.032	0.055	-	0.087	0.121
	-	(0.44)	(0.81)	-	(0.67)	(1.13)	-	(1.39)	(1.85)
Contacts*unstruct.	-	-	-0.237	-	-	-0.272	-	-	-0.362
	-	-	(2.20)*	-	-	(3.01)**	-	-	(2.81)**
Contacts*struct.	-	-	0.126	-	-	0.071	-	-	0.138
	-	-	(2.01)*	-	-	(1.67)	-	-	(2.82)**
Millsratio	-	-	7.546	-	-	7.225	-	-	9.468
	-	-	(1.31)	-	-	(1.82)	-	-	(1.13)
Other regressors	-	B	B	-	B	B	-	B	B
Constant	103.58	72.59	71.66	108.21	109.23	109.43	109.79	98.66	97.29
	(26.5)**	(6.1)**	(5.8)**	(28.7)**	(10.8)**	(10.7)**	(20.2)**	(8.8)**	(8.4)**
Observations	352	352	352	351	351	351	350	350	350
R-squared	0.06	0.31	0.34	0.04	0.36	0.40	0.06	0.32	0.37

Robust t statistics in parentheses: * significant at 5%; ** significant at 1%
In column 3:
Test: β(contacts)+β(contacts *unstructured time)= 0 → F(1,298)=1.4 → Prob > F= 0.2371
Test: β(contacts)+β(contacts *structured time)= 0 → F(1, 298)=1.83 → Prob > F= 0.1773
In column 6:
Test: β(contacts)+β(contacts *unstructured time)= 0 → F(1, 296)=1.27 → Prob > F= 0. 2613
Test: β(contacts)+β(contacts *structured time)= 0 → F(1, 296)= 1.88→ Prob > F= 0.1712
In column 9:
Test: β(contacts)+β(contacts *unstructured time)= 0 → F(1, 297)= 1.94 → Prob > F= 0.1648
Test: β(contacts)+β(contacts *structured time)= 0 → F(1, 297)= 2.16 → Prob > F= 0.1430

Baseline regressions in Column 1, 4 and 7 in Table III.4 show that physical demand and repetitive tasks are negatively correlated with all three test scores. Once the

basic set of covariates is introduced (Columns 2, 5 and 8), the estimates for repetitive tasks reduce in magnitude and become statistically insignificant across all test scores. Estimates for physical demand also reduce in magnitude, but remain marginally significant with respect to letter-word and applied problem solving score. In contrast, additional covariates increase the size and significance of the estimated relationship between social contacts and all test scores.

To further investigate the relationship between work conditions and child outcomes, we include types of maternal time shared with children and statistical interactions between work conditions and mother-child time. Columns 3, 6 and 9 represent the results, including the interactions terms with unpleasant social contacts.[97] For children in pre-school age, maternal time if not spent performing structured activities has a marginally significant negative effect on child outcomes. Once the mother suffers from stressful contacts at work this effect increases in magnitude and significance, i.e. time centered on activities that do not directly foster intellectual development aggravates the negative effect of occupational stress. Spending time on structured activities can compensate this effect.[98] Overall, the magnitudes of these estimates are not trivial. Assuming that mothers are spending the average amount of time with children (i.e. 23 hrs/wk in structured time and 20 hrs/wk in unstructured time), a standard deviation increase in stressful social contacts is associated with a 0.22 standard deviation reduction in children's letter-word scores, a 0.12 standard deviation reduction in passage comprehension scores and a 0.25 standard deviation reduction in applied problem solving scores. One hour more spent on structured activities compensates this negative effect by a 0.002 standard deviation increase in letter-word

[97] Results including interactions with the remaining work dimensions do not show up significantly, but are available upon request.

[98] The F-test for the sum of the estimates for social contacts and statistical interaction terms with the respective type of maternal time show that the total effect of stressful contacts, on the one hand varying with structured and on the other with unstructured activities, is marginally significant.

scores, a 0.003 increase in passage comprehension scores and a 0.007 increase in applied problem solving scores. One hour more doing unstructured activities, however, aggravates this effect by a decrease of 0.013 standard deviations in letter-word scores, a decrease of 0.017 in passage comprehension scores and a decrease of 0.022 in applied problem solving scores.

Log wage is not significantly correlated with any of the 3 scores across all specifications. Neither is mothers' education. Alternatively, mothers' passage comprehension scores are positively correlated with both indicators of children's verbal achievement. In contrast to what we have seen in regressions for children age 0 to 2, mothers' verbal aptitude is only marginally significantly related to children's math reasoning once we control for parenting behavior.

Children Age 6-12

Table III.5 presents the results for children at school ages (6-12 years old) in 1997. Again the results show that when family background characteristics are not accounted for, physical demand and repetitive tasks are both negatively correlated to all 3 measures of children's cognitive outcomes.

Once background characteristics are included, however, these estimates reduce in magnitude and become statistically insignificant. Hazards are marginally significant in the regression of letter-word score independently of background traits.

Table III.5: Results of a clustered OLS regression using school children

	Letter-word scores			Passage Comprehension Score			Applied Problem Solving Scores		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Physical demand	-2.018	0.01	-0.012	-2.542	-0.859	-0.875	-1.915	0.312	0.315
	(2.28)*	(0.01)	(0.02)	(3.7)**	(1.39)	(1.42)	(2.7)**	(0.52)	(0.53)
Stressful contacts	0.659	-0.443	-0.369	0.962	0.277	0.316	1.071	-0.008	0.015
	(0.74)	(0.55)	(0.46)	(1.56)	(0.48)	(0.55)	(1.63)	(0.01)	(0.02)
Hazards	-1.535	-0.816	-2.828	-0.509	-0.119	-0.946	-0.245	0.277	0.192
	(1.69)	(1.08)	(2.3)*	(0.77)	(0.25)	(0.98)	(0.35)	(0.53)	(0.15)
Repetitive tasks	-2.557	-0.626	-0.68	-1.5	-0.058	-0.106	-1.587	0.293	0.32
	(2.6)**	(0.68)	(0.73)	(2.22)*	(0.10)	(0.18)	(2.01)*	(0.44)	(0.47)
Log wage	2.154	-0.247	-0.324	0.072	-1.475	-1.405	0.923	-0.616	-0.636
	(1.30)	(0.17)	(0.23)	(0.05)	(1.17)	(1.12)	(0.63)	(0.50)	(0.52)
Mom's ed (yrs)	-	1.491	1.51	-	0.782	0.789	-	1.64	1.628
	-	(3.4)*	(3.5)*	-	(2.6)*	(2.6)*	-	(4.8)**	(4.8)**
Mom's verb.skills	-	0.859	0.84	-	0.539	0.52	-	0.26	0.262
	-	(4.0)**	(4.0)**	-	(4.0)**	(3.8)**	-	(1.81)	(1.84)
Unstruct. Activity	-	-0.02	-0.017	-	-0.015	-0.017	-	-0.023	-0.02
	-	(0.32)	(0.28)	-	(0.32)	(0.37)	-	(0.48)	(0.40)
Struct. Activity	-	0.032	0.021	-	-0.02	-0.029	-	0.002	0.002
	-	(0.44)	(0.28)	-	(0.36)	(0.52)	-	(0.04)	(0.04)
Hazards*unstruct.	-	-	-0.092	-	-	-0.099	-	-	0.033
	-	-	(1.09)	-	-	(1.71)	-	-	(0.49)
Hazards*struct.	-	-	0.106	-	-	0.076	-	-	-0.014
	-	-	(1.79)	-	-	(2.1)*	-	-	(0.31)
Inverse Mills	-	12.79	13.05	-	6.756	6.606	-	-1.255	-1.886
	-	(1.57)	(1.61)	-	(1.18)	(1.14)	-	(0.23)	(0.35)
Other regressors	-	B	B	-	B	B	-	B	B
Constant	101.48	38.43	39.13	102.35	78.15	79.16	101.01	61.33	61.34
	(21.1)**	(3.1)**	(3.1)**	(29.3)**	(8.6)**	(8.7)**	(26.8)**	(6.2)**	(6.1)**
Observations	750	750	750	747	747	747	747	747	747
R-squared	0.04	0.24	0.26	0.05	0.24	0.26	0.04	0.32	0.35

Robust t statistics in parentheses: * significant at 5%; ** significant at 1%
In column 3:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1, 550)=5.42 → Prob > F= 0.0203
Test: β(hazards)+β(hazards*structured time)= 0 → F(1, 550)=5.09 → Prob > F= 0.0244
In column 6:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1, 547)= 1.17 → Prob > F= 0.2799
Test: β(hazards)+β(hazards*structured time)= 0 → F(1, 547)= 0.84 → Prob > F= 0.3588
In column 9:
Test: β(hazards)+β(hazards*unstructured time)= 0 → F(1, 5)=0.3 → Prob > F= 0. 0.8593
Test: β(hazards)+β(hazards*structured time)= 0 → F(1, 5)= 0.2 → Prob > F= 0.8863

In columns 3, 6 and 9, we include interactions between hazards and maternal time with children.[99] The results show that the effect of work hazards on children's language development significantly depends on the type of activities that are performed together[100]. For both letter-word and passage comprehension scores, women, who are exposed to work hazards, can compensate the negative average effect by spending time in developmentally oriented activities. In contrast, the negative effect aggravates the more time is spent on unstructured oriented activities.

Findings in columns 3 and 6 suggest that a standard deviation increase in maternal work hazards in 1997 is associated with a 0.14 standard deviation decrease in children's letter-word scores and a 0.11 standard deviation decrease in children's passage comprehension scores in 2002, among mother who spend the average amount of time with their children. One hour more devoted to performing structured activities compensates this negative effect by a 0.006 and 0.004 standard deviation increases in the two respective verbal tests, while one more hours spent doing unstructured activities aggravates this effect by 0.005 and 0.006 standard deviations respectively.

The findings in Table III.5 suggest that maternal education plays a more prominent role in predicting children's cognitive achievement among children six years old and above. Mothers' years of schooling are positively and significantly associated with all 3 test scores. Mothers' verbal aptitude is also positively correlated with child development but the size of these estimates is at least half the size of the effect of years of schooling. At older ages, maternal education seems to trump mothers' verbal aptitude in determining child outcomes. Furthermore all occupational features, except hazards,

[99] Once more we try all statistical interaction terms between other dimension of mothers' work environment, such as social contacts and physical demand, and maternal time. These, however, do not seem to alter the impact of these work conditions significantly.

[100] Moreover, F-tests show that the coefficients on work hazards and the interactive terms are statistically significant for letter-word test score tests score and marginally for the passage comprehension score.

seem not to have any other distinctive effect on child outcomes than the one already captured by maternal education.

III.6. Discussion and Conclusion

The current chapter seeks to extend the existing literature on the impact of maternal employment on children's intellectual development by addressing the following key questions: How do the characteristics of mothers' occupation relate to children's cognitive development? What is a possible mechanism through which these occupational characteristics may exert its influence on child development?

Using the Panel Study of Income Dynamics-Child Development Supplement and the Occupational Information Network, we investigate the relationship between child outcomes and a comprehensive set of mothers' occupational characteristics controlling for child and family characteristics. In contrast to previous studies, which investigate only separate aspects of maternal employment, this study goes one step further and focuses on a broad range of occupational characteristics, such as disamenities, wages and working hours. Including statistical interactions between occupational features and parenting behavior allows us furthermore to study how the effect of maternal work conditions alters with the amount and type of activities mothers share with their children. In line with previous studies (Brooks-Gunn et. al, 2002a), we stratify our sample by three different age groups (0-2, 3-5 and 6-12 years old).

The results of the analysis suggest that disamenities involved in mothers' occupations are associated with lower verbal scores among children. However, controlling for an exhaustive set of control variables, in particular mothers' education and verbal skills, reveals that only certain work conditions, in particular hazards, matter net of maternal characteristics. Other occupational features, such as the degree of repetitive tasks, physical effort and wages, do not go on to affect children's cognitive

outcomes once including maternal features. These occupational traits most likely do not capture any other distinct dimension than mothers' education and verbal skills, and the correlation between these characteristics and child outcomes can mostly be explained by a negative selection into menial occupations.

Stratification of our analysis by age group reveals the developmental nature of these effects: while work conditions seem not to matter during early childhood (0-2 years old), the strongest impact is observed during preschool age (3-5 years old). Once attending school (6-12 years old), these effects weaken, but are still persistent. Possible reasons for these findings, which are subject to our own interpretation, might be the following: During infancy it is mostly the availability of the mother, i.e. her physical presence, but not the type of activity or quality of the time spent with children that matters. Age 3-5 is a critical age, which corresponds to the few years before schooling takes over. During this period children's verbal skills start taking off and so the learning environment at home may make a bigger difference. As a consequence, how a mother behaves at home and how she interacts with her child, both likely to be affected by her work environment (she might get home tired, frustrated or grumpy), may influence children during pre-school years stronger than during other years of childhood. At school ages, however, not what a mother does at home, but her education plays an important role. Due to a high correlation with mothers' occupational conditions, such as wage, complexity, physical demand and stressful social contacts, maternal education trumps the impact of these work dimensions on child outcomes. Work hazards, however, which are equally performed by low and highly educated women, go on to affect child development even at older ages.

Besides extending the range of occupational aspects, which might influence child development, one major contribution of this study is the identification of a mechanism through which occupations influence child outcomes. *Bad* jobs exert

negative effects because they lead 1) to a decrease in the relative amount of developmentally-oriented time a mother spends with her child, i.e. a mother who is exposed to stressful or hazardous jobs devotes less time performing activities that foster directly children's intellectual development, and 2) to a change in the effect of maternal time on child outcomes, i.e. while for mothers who are working in a pleasant job unstructured time has a positive or at least neutral effect, for mothers who are exposed to certain disamenities at work, this type of activity harms children's cognitive development. Only by performing activities that promote directly children's intellectual skills, mothers can compensate for the negative impact *bad* jobs have on child development.

One last concern, that has not been yet addressed in past research, is the bias that might arise due self-selection into employment status. In order to solve this issue we apply the correction procedure suggested by Heckman (1976), which, however, reveals to alter the results only marginally. One remaining caveat is still the selection into types of occupation. In case selection into jobs differing in their work environment is non-random, our estimates for the impact of maternal work conditions might be biased. The direction of this bias, however, is not a priori clear: if the selection occurs according to precautious motives against occupational disamenities which might affect parenting quality and hence child outcomes, our estimates might be overestimated; however, if women in *bad* jobs are more prone to stay longer out of the labor force (see Chapter II), our estimates might actually be conservative. Hence, one future necessary extension of this study is to explicitly account for differential selection into occupation types. Mothers' work history, especially job turnover and related changes in the work environment prior to childbirth and during early childhood, might help us to tackle this issue.

Additional Tables and Figures

Table I.i: Definition and construction of dependent variables

Name of variable	Definition & Construction
Pecuniary Aspect	
Ln of real gross wage rate	Ln of ((monthly gross income/ weekly contracted working hours)*7/31)
Non Pecuniary Aspects	
1.Time	
Actual hours worked	Weekly working hours including overtime, but excluding days missing due to illness and holidays
Work in the evening	Binary variable indicating if mother works between 6pm – 10pm; Variable has been made binary, before there where 3 categories (never, occasionally, frequently)
Night work	Binary variable indicating if mother works after 10pm; Variable has been made binary, before there where 3 categories (never, occasionally, frequently)
Shift work	Binary variable indicating if mother works in rotating shifts, Variable has been made binary, before there where 3 categories (never, occasionally and frequently)
2.Workload	
Stress at work	Binary variable indicating if mother works in a stressful job; Variable has been made binary, before there where 3 categories (not at all, partly, fully.
Physical demand of job	Binary variable indicating if mother works in a physically demanding job; Variable has been made binary, before there where 3 categories (not at all, partly, fully)
Bad working conditions	Binary variable indicating if mother is exposed to bad working conditions such as hazards, heat, gases, etc. Variable has been made binary, before there where 3 categories (not at all, partly, fully)
3. Flexibility	
Flexible working hours	Binary variable indicating if schedule can be set freely or if hours are set
Work from home	Binary variable indicating if mother can work from home; Variable has been made binary, before there where 3 categories (not possible, occasionally, frequently)
Distance to work place	Distance to work place in kilometers

Table I.ii: Labor Force Participation around first childbirth

	Mean Labor Force Participation
5 years pre birth	79.58%
4 years pre birth	81.34%
3 years pre birth	82.96%
2 years pre birth	82.13%
1 year pre birth	80.51%
Birth1	34.45%
1 year post birth	24.64%
2 years post birth	35.61%
3 years post birth	40.28%
4 years post birth	45.20%
5 years post birth	48.02%
6 years post birth	52.60%
18 years post birth	63.56%

Table I.iii: Summary statistic of the sample

Variable	Mean	Std. Dev.	Min	Max
Age	34.2511	7.4317	17	46
Partner	0.7387	0.4394	0	1
Years of education	11.2665	3.7516	0	18
West	0.6543	0.4756	0	1
East	0.2206	0.4147	0	1
Foreigner	0.1251	0.3309	0	1
Pre	0.1283	0.3345	0	1
Birth	0.0142	0.1183	0	1
Post	0.5425	0.4982	0	1

	Non-mother	Mothers	Pre1	Birth1	Post1
Observations	3925	8535	1599	177	6759
# of individuals	825	1989	487	177	1666
Age	31.25	35.63	25.40	28.24	38.24
Partner	0.53	0.84	0.69	0.86	0.87
Years of education	11.28	11.26	10.72	11.12	11.39
West	0.75	0.61	0.74	0.74	0.58
East	0.12	0.27	0.14	0.16	0.30
Foreigner	0.13	0.12	0.12	0.10	0.12

Table I.iv: Descriptive statistics of the dependent variables

	Mean	Std. Dev.	Min	Max
Ln of real gross wage rate	2.3612	0.4568	-0.0440	3.7980
Actual working hours/week	35.4273	10.1228	3	70
Agreed working hours/week	33.2246	8.9375	4	48
Overtime	1.5092	2.6124	0	28
Shift work	0.2690	0.4435	0	1
Night work	0.1103	0.3132	0	1
Work in the evening	0.1334	0.3400	0	1
Stressful job	0.5676	0.4954	0	1
Physically demanding job	0.2571	0.4371	0	1
Bad working conditions	0.2030	0.4022	0	1
Flexible hours	0.0046	0.0675	0	1
Work from home	0.0975	0.2967	0	1
Distance to workplace	12.4070	13.4749	0	120
Job Change	0.0517	0.2214	0	1
New Employer	0.0388	0.1932	0	1
Within firm change	0.0128	0.1126	0	1

	Non-mother	Mothers	Pre1	Birth1	Post1
Ln of real gross wage rate	2.38	2.35	2.16	2.35	2.40
Actual hours/week	39.74	33.45	39.84	37.88	31.82
Agreed hours/week	37.07	31.46	37.97	35.98	29.79
Overtime	1.82	1.36	1.45	0.92	1.36
Shift work	0.30	0.26	0.18	0.24	0.27
Night work	0.12	0.11	0.08	0.12	0.11
Work in the evening	0.11	0.14	0.15	0.19	0.14
Stressful job	0.55	0.58	0.76	0.66	0.53
Physically demanding	0.20	0.28	0.34	0.28	0.27
Bad working conditions	0.18	0.21	0.30	0.21	0.19
Flexible hours	0.01	0.00	0.01	0.01	0.00
Work from home	0.07	0.11	0.12	0.12	0.11
Distance to workplace	14.68	11.36	13.57	14.45	10.76
Job Change	0.06	0.05	0.12	0.02	0.03
New Employer	0.05	0.04	0.09	0.01	0.03
Within firm change	0.02	0.01	0.03	0.01	0.01

Table I.v: Child penalty – Results of a fixed effect estimation

	ln real gross wage rate	ln real gross wage rate
Pre1	0.006	0.006
	(0.29)	(0.29)
Post1	-0.188	-0.188
	(8.60)**	(8.60)**
Child Penalty	-0.194	-0.194
	(12.90)**	(12.90)**
Mills ratio	-	-0.008
	-	(0.24)
Partner	0.019	0.019
	(1.90)	-1.92
Years of education	0.009	0.008
	(2.94)**	(2.81)**
Age	0.18	0.18
	(42.91)**	(40.89)**
Age squared	-0.002	-0.002
	(34.19)**	(33.58)**
Yr85	-0.001	-0.002
	(0.06)	-0.08
Yr86	0.017	0.016
	(0.83)	-0.8
Yr87	0.049	0.049
	(2.50)*	(2.46)*
Yr88	0.045	0.044
	(2.21)*	(2.16)*
Yr89	0.071	0.071
	(3.72)**	(3.64)**
Yr90	0.07	0.069
	(4.13)**	(3.99)**
Yr91	0.089	0.088
	(5.10)**	(4.97)**
Yr92	0.118	0.118
	(6.75)**	(6.64)**
Yr95	0.034	0.033
	(2.82)**	(2.75)**
Yr96	0.039	0.039
	(3.27)**	(3.21)**
Yr97	0.029	0.028
	(2.07)*	(2.03)*
Yr98	0.033	0.033
	(2.87)**	(2.81)**
Yr99	0.000	0.000
	(0.00)	(0.00)
Yr00	-0.01	-0.01
	(0.74)	(0.76)
Yr01	-0.011	-0.011
	(1.04)	(1.06)
Yr02	0.01	0.01
	(1.03)	(1.00)
Yr03	0.018	0.018
	(1.879	(1.85)
Yr04	0.015	0.015
	(1.50)	(1.49)
Yr05	0.00	0.00
	(0.00)	(0.00)
Constant	-1.281	-1.268
	(16.79)**	(13.67)**
Observations	12460	12460
Number Fixed ID	2814	2814
R-squared	0.37	0.37

T-statistics are reported in brackets below every coefficient. Set of control variables included as well age, age squared, years of education, origin and set of year dummies for 1985-2005

Table I.vi: Child penalty over the years – Results of a fixed effect estimation

	ln of real gross wage rate
Yr5prebirth	0.042
	(1.70)
Yr4prebirth	0.078
	(3.23)**
Yr3prebirth	0.089
	(3.70)**
Yr2prebirth	0.081
	(3.24)**
Yr1prebirth	0.079
	(3.07)**
Birth1	0.069
	(2.31)*
Yr1postbirth	0.017
	(0.47)
Yr2postbirth	-0.037
	(1.07)
Yr3postbirth	-0.022
	(0.63)
Yr4postbirth	-0.086
	(2.45)*
Yr5postbirth	-0.113
	(3.11)**
Yr6postbirth	-0.131
	(3.59)**
Post6	-0.211
	(5.72)**
Constant	-0.84
	(6.14)**
Observations	8535
Number of Fixed ID	1989
R-squared	0.32

T-statistics are reported in brackets below every coefficient
Set of control variables included as well age, age squared, years of education, origin and set of year dummies for 1985-2005

Table II.i: Descriptive statistics of personal and occupational characteristics

Variable	Mean	Std. Dev.	Min	Max
Age	30.7175	4.5191	18	46
Partner (in %)	0.9299	0.2554	0	1
Education (in years)	11.9551	3.1582	1	18
West (in %)	0.8149	0.3885	0	1
East (in %)	0.1851	0.3885	0	1
Other income sources	32321	17123	0	219523
Low income	0.260	0.4387	0	1
Intermediate income	0.385	0.4870	0	1
High income	0.355	0.4779	0	1
Technology (in %)	0.0518	0.2218	0	1
Service (in %)	0.6212	0.4853	0	1
Manufacturing (in %)	0.1533	0.3604	0	1
Agriculture (in %)	0.0080	0.0893	0	1
Public admin. (in %)	0.0774	0.2673	0	1
Educational sector (%)	0.0723	0.2590	0	1

Table II.ii: Results for the coefficients of personal variables

	Working[2]	Working[3]	Working[4]	Working[5]
Partner	-0.149 (0.90)	-0.182 (1.05)	-0.188 (1.09)	-0.195 (1.13)
Age	0.13 (1.37)	0.061 (0.59)	0.061 (0.58)	0.063 (0.61)
Age squared	-0.002 (1.47)	-0.001 (0.86)	-0.001 (0.88)	-0.001 (0.88)
Education	0.056 (3.27)**	0.061 (3.27)**	0.061 (3.27)**	0.06 (3.24)**
West	-0.723 (1.34)	-1.054 (1.90)	-1.047 (1.87)	-1.055 (1.87)
East	-0.406 (0.73)	-0.79 (1.39)	-0.761 (1.33)	-0.79 (1.37)
Second Birth	-0.578 (4.07)**	-0.288 (1.97)*	-0.319 (2.19)*	-0.278 (1.89)
Inter. income	-0.971 (1.78)	-1.993 (1.93)	-1.961 (1.91)	-1.958 (1.89)
High income	-1.026 (1.87)	-2.103 (2.02)*	-2.076 (2.01)*	-2.07 (1.99)*
Month dum.	no	yes	No	no
Log(t)	-	-	0.312 (5.83)**	-
T	-	-	-	0.144 (3.61)**
t squared	-	-	-	-0.006 (2.17)*
Year dum.	no	yes	Yes	yes
Sector dum.	no	yes	Yes	yes
Constant	-5.262 (3.33)**	-5.356 (2.67)**	-5.06 (2.70)**	-5.218 (2.78)**
Observations	26559	26559	26559	26559

Note: The results stem from a discrete logistic duration estimation
[2, 3, 4, 5]These specifications refer to the same as in table 6a.The coefficients are from a discrete logistic duration estimation including furthermore wage, working hours, work evenings, night, in shifts, workload and environmental conditions. Robust z statistics in parentheses: * significant at 5%; ** significant at 1%

Table II.iii.a: MWP derived from a logistic model including interactions between job features and region

	MWP	Std. Err.	z	P>|z|	[95%Conf.	Interval]
Hazards (west)	-0.0238	0.0125	-1.900	0.057	-0.0484	0.0007
Hazards (east)	-0.0393	0.0258	-1.520	0.128	-0.0898	0.0113
Working hours (west)	-0.0162	0.0079	-2.050	0.040	-0.0317	-0.0007
Working hours (east)	0.0221	0.0178	1.240	0.214	-0.0127	0.0568
Work evenings (west)	0.6855	0.2898	2.370	0.018	0.1176	1.2535
Work evenings (east)	-0.4310	0.3894	-1.110	0.268	-1.1943	0.3323
Shift work (west)	0.7221	0.3190	2.260	0.024	0.0968	1.3474
Shift work (east)	0.3398	0.4450	0.760	0.445	-0.5324	1.2121

Note: Using the results of a discrete duration estimation of equation (II.7) including interaction terms for the region, I can calculate the displayed MWP to avoid certain disamenities according to equation (II.8).

Table II.iii.b: MWP derived from a logistic model including interactions between job features and income

	MWP	Std. Err.	z	P>z	[95%Conf.	Interval]
Hazards (low income)	-0.0144	0.0190	-0.760	0.448	-0.052	0.023
Hazards (intermed. income)	-0.0332	0.0299	-1.110	0.266	-0.092	0.025
Hazards (high income)	-0.0460	0.0261	-1.760	0.078	-0.097	0.005
Working hours (low income)	-0.0139	0.0106	-1.300	0.192	-0.035	0.007
Working hours (intermed. income)	-0.0086	0.0152	-0.570	0.572	-0.038	0.021
Working hours (high income)	-0.0044	0.0151	-0.290	0.773	-0.034	0.025
Work evenings (low income)	-0.1940	0.4393	-0.440	0.659	-1.055	0.667
Work evenings (intermed. income)	0.8288	0.6487	1.280	0.201	-0.443	2.100
Work evenings (high income)	0.9094	0.5226	1.740	0.082	-0.115	1.934
Shift work (low income)	0.4620	0.3926	1.180	0.239	-0.307	1.231
Shift work (intermed. income)	2.0841	1.0767	1.940	0.053	-0.026	4.194
Shift work (high income)	0.2290	0.4938	0.460	0.643	-0.739	1.197

Note: Using the results of a discrete duration estimation of equation (II.7) including interaction terms for the income, I can calculate the displayed MWP to avoid certain disamenities according to equation (II.8).

Table II.iii.c: MWP derived from a logistic model including interactions between job traits and education

	MWP	Std. Err.	z	P>z	[95%Conf.	Interval]
Hazards (low education)	0.0257	0.0180	1.4300	0.153	-0.010	0.061
Hazards (intermed. education)	-0.0415	0.0225	-1.8400	0.065	-0.086	0.003
Hazards (high education)	-0.0676	0.0481	-1.4000	0.160	-0.162	0.027
Working hours (low education)	-0.0038	0.0108	-0.3500	0.728	-0.025	0.017
Working hours (intermed. education)	-0.0122	0.0125	-0.9700	0.330	-0.037	0.012
Working hours (high education)	-0.0099	0.0173	-0.5700	0.565	-0.044	0.024
Work evenings (low education)	0.5888	0.4441	1.3300	0.185	-0.282	1.459
Work evenings (intermed. education)	0.3687	0.3949	0.9300	0.350	-0.405	1.143
Work evenings (high education)	0.9725	0.6983	1.3900	0.164	-0.396	2.341
Shift work (low education)	0.0232	0.4160	0.0600	0.956	-0.792	0.839
Shift work (intermed. education)	0.9819	0.5122	1.9200	0.055	-0.022	1.986
Shift work (high education)	0.8002	0.5997	1.3300	0.182	-0.375	1.976
Workload (low education)	-0.0288	0.0118	-2.4400	0.015	-0.052	-0.006
Workload (intermed. education)	0.0192	0.0147	1.3000	0.193	-0.010	0.048
Workload (high education)	0.0245	0.0226	1.0800	0.278	-0.020	0.069

Note: Using the results of a discrete duration estimation of equation (II.7) including interaction terms for the education, I can calculate the displayed MWP to avoid certain disamenities according to equation (II.8).

Table II.iv: MWP derived from a competing risk model of mothers after first birth

	MWP	Std. Err.	Z	P>z	[95% Conf.	Interval]
Hazards (first birth)	-0.0344	0.0175	-1.97	0.049	-0.0688	-0.0001
Hazards (all births)	-0.0239	0.0122	-1.96	0.05	-0.0478	-.00000
Workload (first birth)	0.0091	0.0100	0.92	0.359	-0.0104	0.0287
Workload (all births)	0.0090	0.0082	1.1	0.272	-0.0071	0.0250
Work evening (first birth)	0.6170	0.3362	1.84	0.067	-0.0420	1.2759
Work evening (all births)	0.4471	0.2502	1.79	0.074	-0.0433	0.9374
Shift work (first birth)	0.5464	0.3288	1.66	0.097	-0.0981	1.1908
Shift work (all births)	0.6564	0.2864	2.29	0.022	0.0950	1.2178

Note: Using the sample of only mother giving birth for the first time, I calculate a competing risk model for the options of a mothers to stay at home, return to work or have another child. I can calculate the displayed MWP to avoid certain disamenities according to equation (8).

Table II.v: Results using the method by Wooldridge (1995)

	Working	**Working**
Ln real gross wage	0.551	0.551
	(4.33)**	(4.33)**
Hazards	-0.014	-0.014
	(2.29)*	(2.29)*
Workload	0.005	0.005
	(1.20)	(1.21)
Working hours	-0.006	-0.006
	(1.43)	(1.43)
Work in the evening	0.259	0.259
	(2.09)*	(2.09)*
Night work	-0.189	-0.189
	(1.08)	(1.08)
Shift work	0.37	0.37
	(2.71)**	(2.70)**
Mills ratio	-	0.037
	-	(0.58)
Constant	-6.983	-7.071
	(3.73)**	(3.75)**
Observations	26560	26560

Note: The estimation is a two step estimation correcting for possible sample selection (Wooldridge (1995). At the first stage I estimate the probability to have a baby at every year between 1992 and 2005, given the characteristics of the job a mother is working in and control additionally for the siblings of the mothers (exclusion restriction). Calculating the inverse mills ratio and including it in equation (II.7) I can estimate the discrete duration model as before, but now accounting for possible sample selection. Further controls are partner, age, age squared, education, further births, region, income, sector, month, year and reform dummies.

Table II.vi.a: Results using the method by Heckman and Singer(1984)

	Logistic hazard	**Complementary log log**	**Heckman and Singer**
	Working	**Working**	**Working**
Ln real gross wage	**0.551**	**0.564**	**0.620**
	(4.33)**	(4.55)**	(4.53)**
Hazards	**-0.014**	**-0.013**	**-0.013**
	(2.29)*	(2.45)*	(2.26)*
Workload	**0.005**	**0.005**	**0.004**
	(1.20)	(1.22)	(1.01)
Working hours	**-0.006**	**-0.005**	**-0.004**
	(1.43)	(1.43)	(0.88)
Work evenings	**0.259**	**0.255**	**0.268**
	(2.09)*	(2.2)*	(2.12)*
Night work	**-0.189**	**-0.186**	**-0.181**
	(1.08)	(1.13)	(1.02)
Shift work	**0.37**	**0.365**	**0.389**
	(2.71)**	(2.91)**	(2.86)**
Constant	**-6.289**	**-5.294**	**-5.348**
	(3.51)**	(2.64)	(2.50)
Observations	26559	26559	26559

Note: The coefficients are from discrete duration models assuming different hazard functions.
Robust z statistics in parentheses: * significant at 5%; ** significant at 1%
Further controls are partner, age, age squared, education, further births, region, income, sector, month, year and reform dummies.

Table II.vi.b MWP derived from estimation results using Heckman and Singer

	MWP	Std. Err.	z	P>z	[95%Conf.	Interval]
Hazards (logistic)	-0.0245	0.0124	-1.97	0.05	-0.0489	-0.0002
Hazards (hshaz)	-0.0217	0.0109	-1.99	0.05	-0.0430	-0.0004
Work evenings (logistic)	0.4708	0.2572	1.83	0.07	-0.0333	0.9748
Work evenings (hshaz)	0.4317	0.2321	1.86	0.06	-0.0231	0.8866
Shift work (logistic)	0.6719	0.2920	2.30	0.02	0.0996	1.2441
Shift work (hshaz)	0.6274	0.2610	2.40	0.02	0.1158	1.1389

Note: The displayed MWP are calculated using the results of the Heckman and singer (1984) estimation method and applying equation (II.8).

Table II.vii: MWP in the different years of maternity leave

	MWP	Std.Err.	z	P>z	[95%Conf	Interval]
Hazards (year 1)	-0.0219	0.0139	-1.57	0.115	-0.049	0.005
Hazards (year 2)	-0.0273	0.0184	-1.48	0.138	-0.063	0.009
Hazards (year 3)	-0.0259	0.0255	-1.01	0.311	-0.076	0.024
Work evenings (year 1)	0.4192	0.2785	1.51	0.132	-0.127	0.965
Work evenings (year 2)	0.5229	0.3659	1.43	0.153	-0.194	1.240
Work evenings (year 3)	0.4953	0.5053	0.98	0.327	-0.495	1.486
Shift work (year 1)	0.5979	0.3410	1.75	0.080	-0.070	1.266
Shift work (year 2)	0.7458	0.4659	1.60	0.109	-0.167	1.659
Shift work (year 3)	0.7064	0.6816	1.04	0.300	-0.629	2.042

Note: The table above is based on the results of a discrete duration estimation of equation (II.7) including interaction terms of the wage with dummies for each of the three years of maternal leave. Using equation (II.8) I can calculate the MWP for each disamenity but depending on the year after giving birth.

Table II.viii: Results of a discrete logistic model accounting for part-time

	Working	Working	Working	Working
Ln real gross wage	**0.568**	**0.534**	**0.573**	**0.553**
	(4.14)**	(4.22)**	(4.46)**	(4.33)**
Hazards	**-0.014**	**-0.013**	**-0.012**	**-0.012**
	(2.30)*	(2.20)*	(2.12)*	(2.03)*
Workload	**0.005**	**0.005**	**0.004**	**0.003**
	(1.13)	(1.08)	(0.91)	(0.78)
Working hours	**-0.006**	**0.004**	**-0.007**	**0.004**
	(1.38)	(0.67)	(1.65)	(0.60)
Work evenings	**0.254**	**0.243**	**0.332**	**0.315**
	(2.05)*	(1.95)	(2.70)**	(2.57)*
Night work	**-0.193**	**-0.176**	**-0.177**	**-0.164**
	(1.11)	(1.01)	(1.01)	(0.94)
Shift work	**0.373**	**0.378**	**0.385**	**0.393**
	(2.73)**	(2.76)**	(2.94)**	(3.02)**
Part-time	**-**	**0.316**	**-**	**0.328**
	-	(2.28)*	-	(2.38)*
Reform 01	**-**	**-**	**0.053**	**0.069**
	-	-	(0.36)	(0.47)
Constant	**-5.356**	**-6.595**	**-5.836**	**-7.041**
	(2.67)**	(3.68)**	(3.44)**	(3.97)**
Observations	26559	26559	26559	26559

Note:
Robust z statistics in parentheses: * significant at 5%; ** at 1%
Furthermore I include the following controls: age, age squared, partner, domicile, number of kids, education, sector, year, months and reform dummies.

Table II.ix: Robustness check for panel attrition

		Never[1]	Ever[2]
	Working	**Working**	**Working**
Ln real gross wage	**0.568**	**0.547**	**0.551**
	(4.14)**	(4.30)**	(4.33)**
Hazards	**-0.014**	**-0.015**	**-0.014**
	(2.30)*	(2.39)*	(2.31)*
Workload	**0.005**	**0.007**	**0.006**
	(1.13)	(1.40)	(1.23)
Working hours	**-0.006**	**-0.007**	**-0.006**
	(1.38)	(1.59)	(1.46)
Evening work	**0.254**	**0.233**	**0.257**
	(2.05)*	(1.81)	(2.08)*
Night work	**-0.193**	**-0.186**	**-0.19**
	(1.11)	(1.02)	(1.09)
Shift work	**0.373**	**0.405**	**0.372**
	(2.73)**	(2.87)**	(2.72)**
Constant	**-5.356**	**-7.294**	**-8.623**
	(2.67)**	(4.17)**	(4.84)**
Observations	26599	37511	27359

Note:
Robust z statistics in parentheses: * significant at 5%; ** significant at 1%
The above-shown coefficients result from a discrete logistic duration model. I furthermore include the following control variables: age, age squared, partner, number of kids, years of education, domicile, sector, year, months and reform dummies.
[1] Never: Assumption that women who are dropped from the dataset never come back to work
[2] Ever: Assumption that women come directly back to work once they are dropped from the dataset

Table II.x.a Results of a discrete logistic model using 3-digit occupations

	4-digit occupational code Working	**3-digit occupational code Working**
ln real gross wage	**0.568**	**0.549**
	(4.14)**	(4.27)**
Hazards	**-0.014**	**-0.022**
	(2.30)*	(2.93)**
Workload	**0.005**	**0.011**
	(1.13)	(2.23)*
Working hours	**-0.006**	**-0.007**
	(1.38)	(1.72)
Work evenings	**0.254**	**0.257**
	(2.05)*	(2.06)*
Night work	**-0.193**	**-0.198**
	(1.11)	(1.11)
Shift work	**0.373**	**0.342**
	(2.73)**	(2.48)*
Constant	**-5.356**	**-8.172**
	(2.67)**	(4.54)**
Observations	26599	26218

Note: Robust z statistics in parentheses: * significant at 5%; ** at 1%
Furthermore I include the following controls: age, age squared, partner, domicile, number of kids, education, sector, year, months and reform dummies.

Table II.x.b: Comparison of the MWP yielded from regressions using 3- and 4-digit occupational codes respectively

	MWP	Std. Err.	z	P>z	[95%Conf.	Interval]
Hazards (4-digit)	-0.0239	0.0122	-1.96	0.05	-0.0478	-0.0239
Hazards (3-digit)	-0.0403	0.0174	-2.31	0.02	-0.0744	-0.0061
Workload (4-digit)	0.0098	0.0084	1.17	0.24	-0.0066	0.0262
Workload (3-digit)	0.0195	0.0098	1.99	0.05	0.0003	0.0387
Workload (4-digit)	0.0098	0.0084	1.17	0.24	-0.0066	0.0262
Workload (3-digit)	0.0195	0.0098	1.99	0.05	0.0003	0.0387

Note: The MWP are calculated according to equation (8) using the coefficients estimated on the one hand using the 3digit and on the other hand the 4-digit occupational code to construct the average occupational disamenities

Table II.xi.a: Results of a discrete logistic duration model using factors derived from a factor analysis

	Working	**Working**
Ln real gross wage	0.551	0.55
	(4.33)**	(4.32)**
Hazards	-0.014	-
	(2.29)*	-
Workload	0.005	-
	(1.20)	-
Factor hazards	-	-0.089
	-	(2.72)**
Factor workload	-	0.057
	-	(1.96)
Working hours	-0.006	-0.006
	(1.43)	(1.30)
Work in the evening	0.259	0.257
	(2.09)*	(2.07)*
Night work	-0.189	-0.176
	(1.08)	(1.02)
Shift work	0.37	0.359
	(2.71)**	(2.61)**
Constant	-6.289	-6.246
	(3.51)**	(3.54)**
Observations	26559	26559

Note:
Robust z statistics in parentheses: * significant at 5%; ** at 1%
Furthermore I include the following controls: age, age squared, partner, domicile, number of kids, education, sector, year, months and reform dummies.

Table II.xi.b: MWP yielded from a discrete logistic duration model with factors

	MWP	Std. Err.	z	P>z	[95%Conf.	Interval]
Hazards	-0.0245	0.0124	-1.97	0.05	-0.0489	-0.0002
Hazards (factor)	-0.1618	0.0714	-2.27	0.02	-0.3017	-0.0220
Workload	0.0098	0.0084	1.17	0.24	-0.0066	0.0262
Workload (factor)	0.1038	0.0574	1.81	0.07	-0.0088	0.2164

Note: The MWP are calculated according to equation (II.8) using the coefficients estimated by a discrete duration estimation of equation (II.7) that includes as controls disamenities measures constructed on the one hand as an unweighted averages and on the other hand by a factor analysis.

Table II.xii.a: Results of a discrete logistic duration estimation using all years

	1992-2004 Working	**1986-2004 Working**
Ln real gross wage	**0.568**	**0.444**
	(4.14)**	(4.03)**
Hazards	**-0.014**	**-0.008**
	(2.30)*	(1.63)
Workload	**0.005**	**0.003**
	(1.13)	(0.71)
Working hours	**-0.006**	**-0.006**
	(1.38)	(1.59)
Work evenings	**0.254**	**0.28**
	(2.05)*	(2.24)*
Night work	**-0.193**	**-0.133**
	(1.11)	(0.78)
Shift work	**0.373**	**0.323**
	(2.73)**	(2.80)**
Constant	**-5.356**	**-4.212**
	(2.67)**	(2.97)**
Observations	26599	31637

Note:
Robust z statistics in parentheses: * significant at 5%; ** at 1%
Furthermore I include the following controls: age, age squared, partner, domicile, number of kids, education, sector, year, months and reform dummies.

Table II.xii.b: Comparison of the MWP using years 1992-2004 and 1986-2004

	MWP	Std. Err.	z	P>z	[95% Conf	Interval]
Hazards (92-04)	-0.0239	0.0122	-1.96	0.05	-0.0478	-0.0239
Hazards (84-04)	-0.0180	0.0122	-1.48	0.14	-0.0418	0.0059
Work evenings(92-04)	0.4471	0.2502	1.79	0.074	-0.0433	0.4471
Work evenings(84-04)	0.6310	0.3313	1.90	0.06	-0.0183	1.2803
Shift work (92-04)	0.6564	0.2864	2.29	0.022	0.0950	0.6564
Shift work (84-04)	0.7283	0.3162	2.30	0.02	0.1086	1.3480

Note: The MWP are calculated according to equation (II.8) using the coefficients estimated by a discrete duration estimation of equation (II.7) that uses on the one hand a sample including all year 1984-2004 and then only the years during which the maternal leave has remained unchanged 36 months long.

Table III.i: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Child outcomes				
Letter-word score in 2002	104.2087	18.8202	35	183
Passage comprehension score 2002	104.0607	15.3959	30	187
Applied problem solving 2002	102.6216	16.4999	19	168
Mother's work characteristics				
Working hours per week	34.12993	12.4972	0	112
Log of hourly wage	2.036916	0.9853	-2.9957	6.5919
Physical effort	0.001803	0.9966	-1.7587	1.7389
Contacts at work	-0.0062943	0.9909	-2.5147	1.8102
Hazards at work	0.001376	0.9726	-1.2338	4.5420
Repetitive work	0.006352	0.9741	-2.0817	2.0798
Mother-child Time				
- unstructured activities in hrs/week	20.02365	11.8366	0	126.0667
- structured activities in hrs/week	22.72521	13.6920	0	85.6667
- structured care in %	51.93888	19.2247	0	100
Mother's characteristics				
Fair, Poor Health (=1 if poor)	0.1083744	0.3109	0	1
Single mom (=1 if single)	0.2647783	0.4414	0	1
Age in years in 1997	33.60653	6.9606	17	56
Education in years in 1997	12.32574	4.0350	0	17
Passage comprehension score 1997	31.36515	4.9401	8	43
Better if parents take care (0-4, from strongly disagree -strongly agree)	2.025862	0.7654	0	4
Household characteristics				
Total household income in log 1997	9.318844	2.7228	0	13.1558
Number of siblings in 1997	2.15702	0.9151	1	7
Pupil teacher ratio per classroom	17.13496	4.8758	8	70.6
Child characteristics				
Birth weight in ounces	117.8146	21.8407	24	203
Age in 1997	6.0844	3.6335	1	12
Child poor health at birth	0.0862	0.2808	0	1
Cognitive problems at birth	0.0462	0.2099	0	1
Physical problems at birth	0.2962	0.4567	0	1
Black	0.4021	0.4905	0	1
Latino	0.0185	0.1347	0	1
Gender (=1 if male, =0 otherwise)	0.5074	0.5001	0	1

Table III.ii: Factors resulting from a factor analysis

Factor 1	**Factor Loading**	**Factor 2**	**Factor Loading**	**Factor 3**	**Factor Loading**	**Factor 4**	**Factor Loading**
Standing	0.970	Deal With Unpleasant People	0.863	Specialized Safety Equip.	0.820	Bending/Twisting Body	0.354
Walking and Running	0.843	Contact With Others	0.802	Exposed to Radiation	0.733	Repetitive Motions	0.290
Bending/Twisting Body	0.792	Deal With Customers	0.763	Common Safety Equip.	0.664	Using Hands to Handle,	0.171
Keeping Balance	0.785	Impact of Decisions on others	0.656	Exposed to Disease,	0.639	Repeating Same Tasks	0.142
Exposed to Burns,	0.705	Frequency of Conflicts	0.595	Awkward Positions	0.615	Sitting	0.123
= Physical Occupations with highest amount of physical effort: Maid, Housekeeper, Waitress		**= Stressful Social Contacts** Occupations with most stressful social contacts: Flight Attendant, Bus driver, Nurse		**= Hazards** Occupations with highest amount of hazards: Nurse, Technician		**= Repetitive** Occupations with most repetitive context: Phone Operator, Bus driver	

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