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# The Effect of Maternal Work Conditions on Child Development<sup>1</sup>

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## **Abstract**

This study goes beyond the much-studied impact of mothers' labor force participation on children's development and investigates how mothers' working environment affects children's cognitive and non-cognitive performance. Using data from the Child Development Supplement of the Panel Study of Income Dynamics and the Occupational Information Network and applying a value added plus specification we find a negative impact of the hazards involved in mothers' jobs on their children's non-cognitive achievement, but not on their cognitive performance. Nevertheless, stratification according to mothers' verbal skills reveals that only the personality development of children of mothers with high verbal skills is affected. Upon further investigation, we find that a possible mechanism through which maternal work conditions affect child outcomes is through reduced mother-child interactions

## **Keywords**

Child Development, Maternal Labor Supply, Occupational Disamenities

## **JEL Classification**

J13; J22; J81

## 1. INTRODUCTION

How does maternal employment structure the day-to-day relations that mothers have with their children? Does the work environment mothers are exposed to affect their parenting behavior and hence affect children's development in ways that may influence later status attainment? These questions are particularly salient in light of fact that early maternal employment is commonplace in modern societies.

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 children's achievement. Studies have focused on understanding whether employment status (Desai et al., 1989; Baum, 2003; Ruhm, 2004, James-Burdumy, 2005), work hours (Berger, et. al., 2005), timing of maternal work (Brooks-Gunn et al., 2002), and nonstandard work hours (Han 2005) relate to child development. While some of these studies show that maternal employment may improve intellectual performance through increasing household incomes (Blau and Grossberg, 1992), others have also shown that it is associated with lower outcomes among children (Baum 2003, James-Burdumy, 2005). Still others suggest that the effects may depend on the characteristics of mothers and families (see Ruhm 2000 and Brooks-Gunn, et al., 2002 for full review of the literature).

The impact of maternal employment on child outcomes may also differ by the conditions of mothers' work environment.<sup>2</sup> Jobs vary quite dramatically in terms of the physical and mental toll they place on parents. As hazardous and stressful jobs have rapidly increased over the years (Kalleberg et al., 2000; Autor and Dorn, 2009),

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<sup>2</sup> Some descriptive studies have shown that parents who work in cognitively stimulating jobs are more likely to foster their children's development (Kohn and Schooler, 1982; Menaghan and Parcel, 1990 & 1991), while parents who experience stress at their workplaces provide their children with less attentive and responsive care (Repetti and Wood, 1997; Menaghan and Parcel, 1995).

important questions are raised regarding the consequence of work conditions for parenting behavior and child wellbeing.

The goal in this paper is to identify the impact of mothers' occupational conditions, such as work-related stress or hazards, on children's human capital and personality development. Moreover, we want to understand a possible mechanism through which these occupational traits exert its influence on children.

The 1997 and 2002 waves of the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS) are particularly suitable to address the outlined question as they provide comprehensive information on children's cognitive and non-cognitive performance, children's demographic and physical characteristics, children's time diaries and also children's family, school and regional environment. Additionally, linking the PSID-CDS via mothers' occupations, classified according to a 3-digit code, with the Occupational Information Network allows us to obtain detailed information on mothers' occupational conditions.

As mothers' occupational choice and parenting style might be correlated, the first step of our empirical analysis is to understand who are the mothers that work in hazardous and stressful jobs. We, therefore, examine this correlation by regressing mothers' work related stress and hazards on a comprehensive set of control variables.

Being aware of potentially confounding variables, we then address the main question of this study, namely the effect of mothers' working conditions on children's human capital and personality formation. For this purpose we employ a value-added plus specification (Todd and Wolpin, 2003 & 2007) which is based on a child development production function. In other words, we regress the different measures of children's cognitive and non-cognitive performance on an exhaustive set of current and lagged characteristics of children's family and social environment. Additionally,

we incorporate mothers' occupational conditions. To the extent that not only exposure to occupational disamenities, but also parenting style might vary with mothers' communication skills, we allow for a heterogeneous impact of mothers' work environment on children's development and stratify our analysis according to mothers' verbal skills. Finally, we shed some light on the underlying mechanism through which mothers' work characteristics might exert their influence on children, namely through parent-child dyadic relationships, as measured through time diary data.

The results of the analysis suggest that much of the negative association between exposure to hazards and stress and children's cognitive outcomes can be explained by differences in mothers' education and in particular mothers' communication skills. Nevertheless, for the group of children with verbally skilled mothers, the negative correlation between children's behavior and mothers' job related hazards remains even when controlling for the full set of current and lagged background characteristics. The underlying mechanism of this negative impact is, at least partially, a deduction in mothers' time devoted to their children.

The remainder of the paper is structured as follows. Section 2 describes briefly the underlying model of child development and Section 3 introduces the methodology used to identify the impact of maternal working conditions on children's development. Section 4 describes the datasets used for the analysis. The estimation results are presented in Section 5, while Section 6 finally concludes.

## **2. A MODEL OF CHILD DEVELOPMENT**

In this section we lay out the framework for modeling children's cognitive and non-cognitive development. It assumes that a child's human capital and personality

formation is a cumulative process by which current and past inputs are combined with a child's genetic endowment of mental capacity and personality:<sup>3</sup>

$$CP_{it} = CP(F_{it}; F_{it-1}; \dots; F_{i1}; S_{it}; S_{it-1}; \dots; S_{i1}; \mu_i; \varepsilon_{it}) \quad (1)$$

where  $CP_{it}$  is a child  $i$ 's performance in year  $t$ , which is determined by child  $i$ 's genetic endowment  $\mu_i$  and a variety of input factors. Commonly adopted input factors are related to the family as well as to the social environment. Hence,  $F$  refers to current ( $F_{it}$ ) and past ( $F_{it-1}, \dots, F_{i1}$ ) family related input factors and  $S$  to current ( $S_{it}$ ) and past ( $S_{it-1}, \dots, S_{i1}$ ) input factors related to the social environment. Last,  $\varepsilon_{it}$  represents a residual that includes any type of omitted inputs.

The social environment usually comprises features of the childcare facilities, the school as well as of the regional environment. With respect to the inputs related to the family, it is common to distinguish between investments in form of material goods as well as parental time devoted to the child. While the former one is assumed to be mainly determined by financial resources, such as parents' labor earnings, other assets and accumulated wealth, the latter one is usually assumed to be determined by parents' individual characteristics and their employment status. However, psychological studies have shown that the parenting behavior may as well be affected by parents' work environment (Kohn and Schooler, 1982; Menaghan and Parcel, 1990, 1991 and 1995, and Repetti and Wood, 1997). The rationale behind this is that the amount and the quality of parental time investment deteriorates because of the fatigue and the stress associated with parental employment, in particular with job-related hazards and stress. Thus, in our model we additionally allow parental time

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<sup>3</sup> The production function framework was first formally modeled by Ben Porath (1967) and has since served as the basis for much of the literature on skill acquisition in Economics. Leibowitz (1974) was the first to extend this framework to home investments in children.



investments to depend on parents' work conditions. Given that mothers still remain the primary caregiver, at least in terms of the time investment, we consider mothers' time explicitly and hence analogue also their work conditions. Fathers' time investment, both the quantity and the quality, is only proxied by his education and his labor market engagement.<sup>4</sup> The inputs of the child development production function are thus defined as follows:

$$F_{ij} = F(G(MC_{ij}; PC_{ij}; HC_{ij}); T_M(MC_{ij}; WC_{ij}) * Q_M(MC_{ij}; WC_{ij})) \quad (2)$$

$$S_{ij} = F(CC_{ij}; SC_{ij}; RC_{ij}) \quad (3)$$

where  $S_{ij}$  refers to the social environment of child  $i$  at time  $j$ , which comprises features of the childcare facility ( $CC_{ij}$ ), in case the child is taken care of by somebody else than the mother, of the school ( $SC_{ij}$ ), in case the child is enrolled in school, and last of the regional environment ( $RC_{ij}$ ). The family inputs are both material investments  $G$  and time investments. Material investments are assumed to be determined by maternal characteristics ( $MC_{ij}$ , which refers to the mother of child  $i$  at time  $j$ ), paternal characteristics ( $PC_{ij}$ ) and features of the household ( $HC_{ij}$ ). With respect to mothers' time investment we consider both the amount of time  $T_M$  and the quality of the time  $Q_M$ . Both are assumed to be affected not only by mothers' individual characteristics ( $MC_{ij}$ ), but as well by her working conditions ( $WC_{ij}$ ).<sup>5</sup>

The particular working conditions, examined in this study, are wages, working hours, hazards and stress. Knowledge about both dimension of a job, monetary and non-monetary ones, is particularly important in light of the theory of compensating

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<sup>4</sup> This is not at last due to the fact that data on fathers' time is very incomplete and hence an empirical analysis would first have to deal with a selected sample and second with a much smaller sample.

<sup>5</sup> We are aware that mothers' time investments might furthermore be influenced by their environment, e.g. by the availability of formal or informal childcare. Nevertheless, allowing for dependence of mothers' time investment complicates the exposition of the model and does not matter for the results, given that the final estimation takes place in reduced form.

wage differentials (see Rosen, 1986 for a seminal paper on compensating wage differentials). According to this theory, a job is a bundle of wages and disamenities, and workers who are exposed to certain job-related disamenities should receive some financial compensation. Hence, in case income is beneficial for children's development, due to increased investment into material goods, potentially detrimental effects of job-related hazards or stress on mothers' parenting behavior and thus on children's development could be offset by increased wages. Hence, controlling for both dimensions of mothers' jobs, monetary and non-monetary ones, allows us not only to control for the potential counteracting effects but also to relate the magnitude of potential damages to the one of potential benefits.

The empirical analysis, described in the next section, estimates the outlined functions in reduced form. We first estimate the child development production function taking into account all commonly adopted input factors as well as the conditions of mothers' work environment. Second, we analyze the underlying channel and evaluate how mothers' work conditions influence their time investments, measured in hours per day, investigating both days during the week and on the weekend.

### **3. IDENTIFICATION STRATEGY**

There is a broad literature estimating the above outlined child development production function (equation 1), summarized critically by Todd and Wolpin (2003). In the following we describe its main challenges.

It is widespread among researchers analyzing children's development to estimate children's human capital and personality formation as a function of only contemporaneous inputs. Many input factors, however, may be chosen endogenously

with respect to children's outcomes. In order to address this issue of simultaneity, we consider the input factors observed closely but prior to the assessment of children's cognitive and non-cognitive performance.

Another strategy adopted in previous studies is to employ children's past performance in the respective cognitive or non-cognitive test as a proxy for missing information on past input factors as well as children's unobserved genetic endowment. This specification puts, however, strong assumptions on how the impact of the input factors evolves over time. In order to relax this assumption, Todd and Wolpin (2007) emphasize the importance of controlling for the whole history of the input factors, conditionally on them being available. This specification, combined with children's lagged performance, is called the valued added plus approach of children's development function.

In order to estimate this specification a rich dataset is required, in particular a dataset which provides information on past input factors as well as on children's cognitive and non-cognitive outcomes measured both from children's birth until their current age. The data used in this study is, to the best of our knowledge, the only longitudinal dataset that provides information on children's intellectual abilities and their behavior as well as on time diary data on the amount of time children spend with their mothers. However, it assesses children at only two points during childhood (in 1997 and 2002).<sup>6</sup> Thus, we model children's development as a function of an unusual amount of inputs factors measured at birth as well as at two further moments during childhood, in particular one year and five years prior to the assessment of children's cognitive and non-cognitive performance. The exact specification of children's development production function estimated here looks as follows:

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<sup>6</sup> More information on the dataset used in this study, namely the Child Development Supplement of the Panel Study of Income Dynamics (1997 and 2002) is provided in Section 4.

$$\begin{aligned}
CP_{it} = & WC_{it-1}\alpha_1 + WC_{it-5}\alpha_2 + MC_{it-1}\beta_1 + MC_{it-5}\beta_2 + PC_{it-1}\gamma_1 + PC_{it-5}\gamma_2 + \\
& + HC_{it-1}\delta_1 + HC_{it-5}\delta_2 + CC_{it-1}\zeta_1 + CC_{it-5}\zeta_2 + SC_{it-1}\eta_1 + SC_{it-5}\eta_2 + \\
& + RC_{it-1}\theta_1 + RC_{it-5}\theta_2 + C_i\kappa_{it} + CP_{it-5}\lambda + \varepsilon_{it}
\end{aligned} \tag{4}$$

where  $CP_{it}$  signifies child  $i$ 's cognitive and non-cognitive performance, proxied by several indices resulting from a variety of cognitive and behavioral tests carried out in period  $t$ .<sup>7</sup>  $WC$  denotes maternal working conditions, which comprise wages, working hours, hazards and stress and are measured in the year prior to the assessment of children's development as well as five years earlier. Further control variables are characteristics of the mother ( $MC$ ), the father ( $PC$ ), the household ( $HC$ ), the childcare facility ( $CC$ ), the school ( $SC$ ) as well as the regional environment ( $RC$ ), all measured one year ( $t-1$ ) as well as five years ( $t-5$ ) prior to the assessment of child  $i$ 's cognitive and non-cognitive capacities. Moreover, we consider child  $i$ 's characteristics at birth ( $C_i$ ) and her performance in the respective intellectual or behavioral test five years before the current attainment ( $CP_{it-5}$ ).

One challenge when identifying the impact of mothers' work conditions on children's development is possible self-selection of mothers into occupations which differ in their level of hazards and stress. For instance, if those mothers working in less hazardous and less stressful jobs, provide their children also with more intellectually stimulating or more affectionate childcare, then a comparison of the child outcomes of children whose mothers work in better and worse jobs, contains not only the effects of different work conditions, but may also reflect differences between the mothers with regard to other dimensions. For this reason, it is crucial to control in our analysis not only for all input factors shaping children's development, but in

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<sup>7</sup> The following section provides more details on the content and the construction of these indices.

particular for all those factors which are simultaneously determining mothers' occupational choice.

As a result, the first step in our analysis, even before estimating the above outlined child development function (4), is to identify the determinants of the type of jobs mothers' are working in. For this purpose, we regress the main dimensions of mothers' jobs considered in this study, namely hazards and stress, on an exhaustive set of background characteristics. In particular, these background characteristics are characteristics of the mother, her child, her partner, her family background as well as features of the childcare, the school facilities and the region the family lives in. In an attempt to account for unobservable features, such as attitudes or parenting styles, which might be transmitted across generations, we also control for several characteristics of the mothers' mother, in particular her education and her occupational characteristics.

Once we determine the variables that significantly determine mothers' occupational choice, we are confident to account for all critical factors that are necessary in order to obtain unbiased coefficients for the impact of mothers' occupational characteristics on children's development. Moreover, knowing the most striking determinants of mothers' occupational conditions, which are, as we will see in the course of this paper, mothers' verbal skills, we can stratify our analysis according to this dimension. Stratification along the lines of mothers' verbal skills might be reasonable for the following reasons. First, stratification allows for heterogeneity in the effect of mothers' job-related hazards and stress on children's cognitive and non-cognitive development. Second, stratification might also cope with the fact that occupations of less and more verbally skilled mothers are composed of slightly different types of hazards and stress. We discuss more about this issue in Section 5.

In a last step we pay attention to the underlying mechanism through which maternal work characteristics may influence children's development, in particular we investigate maternal time investment measured in hours per weekday and per weekend day. Hence, we examine the relation between mothers' work environment and the time mothers spend with their children. In order to overcome the problem that maternal time measured in hours is linearly correlated with mothers' working hours, we do not use maternal time in levels, but rather the fraction of the remaining time of a day after deducting work hours and hours of sleep, devoted to the child.<sup>8</sup> As before, we control for a rich set of background characteristics (similarly to the ones mentioned above) and include the lag of the respective mother-child interactions.

Taken together, the suggested identification strategy relies heavily on the assumption that the available information on background characteristics is sufficient to model all relevant determinants of both, mothers' occupational conditions and mothers' parenting style as well as children's human capital and personality formation. Nevertheless, given the exhaustive set of variables provided by the dataset used for this study namely the Child Development Supplement of the Panel Study of Income Dynamics described in full length in the next section, we are confident that we can capture confounding variables that might bias our results.

#### **4. THE DATA**

In this study we combine two different datasets: the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) and the

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<sup>8</sup> One alternative to circumvent this endogeneity problem is to perform the analysis only for a specific subsample, for instance, only for full-time workers. Under this solution we do not have to control for mothers' working hours, but get only the results for a specific subsample. Anyhow, the estimation results using this subsample barely alter and are available upon request.

Occupational Information Network (O\*NET).<sup>9</sup> The PSID is a longitudinal, nationally representative study of individuals and families in the United States. It contains comprehensive information on the individuals' personal and professional background. In 1997 and 2002, the PSID administered the CDS to include measures of cognitive and non-cognitive skills as well as time diaries of up to two children per parent(s) already included in the original PSID sample. The O\*Net, provides detailed information on key occupational attributes that are not provided by the PSID. Matching the two datasets via maternal occupation, which given the very detailed code (812 different occupations) should match mothers' individual situation pretty accurately,<sup>10</sup> enables us to create a new dataset disposing information on children's cognitive and non-cognitive skills, mothers' occupation-specific conditions, mothers' time spent with their children on different types of activities and a broad set of characteristics of the family and the social environment. The final sample contains 1349 children, who are between 0 and 12 years old when first interviewed and 5-17 years old when for the second time assessed.<sup>11</sup>

The following paragraphs introduce the main variables, such as the measures of children's cognitive and non-cognitive achievement, mothers' occupational conditions and mother-child interactions. For an overview of the descriptive statistics, please refer to Table 1.

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<sup>9</sup> The O\*NET is the online replacement of the Dictionary of Occupational Titles and is accessible through the O\*NET Online website <http://online.onetcenter.org/>.

<sup>10</sup> 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 only information on 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.

<sup>11</sup> From the initial sample of all children who were present in both waves of the PSID-CDS we drop those children for whom we do not possess every test score in 2002, whose mothers were not working in 2001 and whose mothers do not report any occupational code in 2001.

As mentioned above, the CDS provides detailed information on both children's cognitive and non-cognitive development. The cognitive performance is measured by the Woodcock Johnson Revised Test of Achievement (WJ-R). The WJ-R is a widely recognized measure of intellectual development, such as vocabulary, reading and mathematical competence and is composed of the following three subtests: applied problem solving, letter-word and passage comprehension. Notice, a higher score in any of the three tests means a better performance in the respective category. The non-cognitive component is evaluated by the Behavior Problem Index, which can be divided into two subscales: the Internal Behavior Problem Index, which contains characteristics such as children's feelings, self-perception, relation to other children and adults, etc. and the External Behavior Problem Index which includes characteristics such as sudden mood changes, anxiousness, meanness towards others, etc. In the case of the Behavior Problem Indices, a higher value signifies more behavioral problems. As dependent variables, we use the different scores evaluated in 2002 and standardize them to a 0 mean and a variance of 1. As explained in Section 2, we include the standardized (mean zero and variance one) lag of the respective test scores, which are available for 1997, as a control variable.<sup>12</sup>

Mothers' occupation-specific characteristics are taken from the O\*NET, which collects detailed information on 812 occupations. In this study we focus on a set of features describing the type and amount of hazards and stress involved in mothers' occupation, e.g. requirement of common or special safety equipment, exposure to contaminants, risk of diseases or infections, hazardous conditions or equipment,

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<sup>12</sup> Note, all tests were conducted for children age 3 and older, except the passage comprehension test which was done only by children age 6 and older. In other words, in 1997 we have missing observations for children age 2 and younger (respectively age 5 and younger for the passage comprehension score). In order to not unnecessarily restrict our sample, we set the lagged test score variable equal to 0 for those children for whom the test was not yet conducted, and control not only for the age of the children, but include additionally a dummy indicating missing test score values.



radiation, whole body vibration, minor burns or bits, very hot or cold temperatures, dangerous positions, frequency of conflict situations, contact to unpleasant and verbally or physically aggressive people, level of competition and time pressure. In order to summarize the numerous job features, we develop a factor-based scale. In other words, we estimate a maximum likelihood equation, which enables us to discover the latent structure of our set of variables. Applying varimax rotation to the factors from the first stage yields two indices comprising the various hazards on the one hand and stress factors on the other hand.<sup>13</sup> Both indices are standardized to a 0 mean and a variance of 1.

For illustrative reasons, let us describe the first and second moments of the two created indices, hazards and stress, using some common occupations (see Table 2). The average amount of hazards and stress involved in mothers' jobs corresponds, for instance, to the amount of hazards and stress involved in the occupation of a childcare worker. Occupations that expose mothers to at least one standard deviation more hazards are mainly held by mother with lower verbal skills. Examples include cleaners or assemblers. Additionally, hazardous occupations tend to require at least one standard deviation less stress. Women working as registered nurses or as social workers face at least one standard deviation more stress than the average. These types of occupation tend to be held by more verbally skilled mothers. Taken together, we can say that mothers with lower verbal skills tend to work in more hazardous jobs (0.2 versus -0.24 hazards), while mothers with higher verbal skills tend to face a higher stress level (mean of 0.08 versus -0.06 stress).

We include two further job-related aspects: the working hours, measured as hours per week, and the wage, included as the natural logarithm. As outlined in

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<sup>13</sup> We have tried alternative methods to reduce the broad range of occupational characteristics, such as unweighted averages, principal component analysis and unrotated maximum likelihood analysis. The results, however, do not differ significantly.

Section 2, we consider all job characteristics, wages, working hours, stress and hazards at two points in time, close to the evaluated assessment of children's development (measured in 2001) and five years earlier on (measured in 1997).<sup>14</sup>

A unique aspect of the PSID-CDS is the time use module, which provides detailed information on the time use of the children for a random day during a weekday and a random day during the weekend. To measure the quantity of time investments, we create a measure that indicates the fraction of the day that is not spent at work or sleeping that is spent with children. We create these measures separately for weekends and weekdays. In the empirical analysis we evaluate the impact of mothers work conditions measured one year prior to the assessment of time mothers spend with children (in other words, work conditions are measured in 2001 and time diaries in 2002).<sup>15</sup>

Additionally, we control for the standard set of child characteristics that is commonly examined in the child development literature, namely children's gender, age, race, as well as weight and health status at birth. With respect to mothers' characteristics, we consider mothers' education, mothers' verbal skills, as well as mothers' age at child birth. With respect to fathers' characteristics, we control for their presence, their age at childbirth, their education as a proxy for the amount and quality of the time they spent with his children, their' employment status, their working hours, and their labor earnings. Concerning the home environment, we include variables that measure the presence and age of siblings, the presence of grandparents at home, accumulated assets and savings as well as an index measuring the cognitive support a child experiences at home (such as the number of toys, books at home, frequency of

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<sup>14</sup> Notice, in 1997 not all mothers are necessarily working. Thus, we additionally include a dummy for mothers' employment status in 1997 and set the job conditions equal to zero in case she was not working.

<sup>15</sup> Note, in 2002 time diary information is only available for 1124 children. Hence, the analysis of the time use can only be done for a subset of the sample.

theater, museum visit, etc). As far as the social environment is concerned, we include measures such as the safety of the neighborhood, the size of the next bigger city and the degree of urbanicity. We furthermore control for the age when the child starts to attend extra-familial care, the different types of non-parental childcare arrangement used and different measures for school quality in case the child is enrolled in school, signifying the pupil-teacher ratio in 1997 and average teacher salary. Finally, as mentioned above, we also control for grandmothers' characteristics, such as their education and occupational hazards and stress during mothers' childhood in order to capture family-intern parenting styles or career ambitions.

Let me emphasize again, as long as the information is available, we include both current (2001) and past (1997) measures of all mentioned control variables. Moreover, all of the control variables, with the exception of variables describing the financial background, are included as dummy variables allowing for a nonlinear impact of the respective control variable.

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

## **5. RESULTS**

In line with the identification strategy, the presentation of the results is divided into three parts. First, we shed some light on the question who are the mothers that are working in hazardous and stressful jobs. Second, once we identify the main determinants of mothers' occupational choice, we move on to analyzing the effect of mothers' work environment on children's human capital and personality formation. Last, we investigate a potential underlying mechanism, namely maternal time investments.

### **5.1. Determinants of Occupational Conditions**

Selected results from our estimation of mothers' occupational sorting, where we regress mothers' hazards and stress separately on an exhaustive set of control variables, are shown in Table 3. Notice, for the analysis of mothers' occupational conditions we restrict the above mentioned sample to only one observation per mother. Given that there are 331 siblings observations in our sample, we restrict the sample to 1018 mothers.

To begin with, mothers' endowment at the beginning of their career, such as their verbal skills, education and initial working conditions seems to be among the most influential determinants of their later working conditions.

Mothers' verbal skills, for instance, have not only a highly significant impact on the amount of hazards involved in mothers' occupation, but also on the amount of stress. In particular, mothers with a higher verbal skill endowments (by one standard deviation) work in a more stressful (by 0.121 standard deviation), but in a less hazardous (by 0.119 standard deviation) job. Although only marginally significant, education seems to be another prerequisite for favorable working conditions: mothers who have dropped out of high-school are exposed to 0.274 standard deviation more hazards than the most educated mothers, and mothers with a high school degree still face 0.126 standard deviation more hazards.

Previously experienced work conditions are further strong predictors for mothers' work environment. Mothers who have already worked in the past (in 1997) under more hazards and more stress, are still facing worse conditions (in 2001): one standard deviation more hazards and stress in 1997 lead to an increase by 0.486 and 0.430 standard deviations respectively. Stress is furthermore highly positively correlated with previous wages (the coefficient has a magnitude of 0.173 and is

significant at a 5% significance level). Notice, however, we still have a lot of variation in mothers' occupational conditions over time. While 25.45% of mothers were not working at all in 1997, more than 60% of the mothers observed to be working in 1997 and 2001 report a different occupation in both years. Of course, part of these occupational changes could be due to misreporting of the occupational category. Nevertheless, given the increasing amount of job turnover, especially among young workers, this number seems to be reasonable. Notice, moreover, stratifying our sample according to mothers' verbal skills reveals that not only low verbally skilled mothers but also high verbally skilled mothers display a high tendency towards turnover (68.4 vs. 59.9%).

Besides skills, education and previous work environment, mothers' cultural background seems to be a decisive factor when determining mothers' work environment. Hispanic mothers work in less stressful (by 0.404 standard deviation), but more hazardous jobs (by 0.398 standard deviation). Intergenerational transmission, however, does not seem to be prevalent; neither grandmothers' education, nor her occupational conditions are significantly correlated with mothers' work characteristics.

As shown by previous studies (Parcel and Menaghan, 1990 & 1991; Baum, 2003), verbal skills are also significantly positively correlated with mothers' childrearing quality and hence, with their children's cognitive performance. In the following analysis of children's development, we therefore do not only control for, but also stratify according to mothers' verbal skills.<sup>16</sup> Stratification according to mothers' verbal skills is moreover useful for the following reasons. First, it allows the effect of mothers' job-related hazards and stress on children's cognitive and non-cognitive

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<sup>16</sup> We define high communication skills as a value of mothers' passage comprehension score above the mean value.

development to differ by mothers' verbal skills. Effects may vary by mothers' verbal proficiency because higher skilled mothers may better cope with strenuous work conditions relative to their lower skilled counterparts. Additionally, the composition of occupational hazards and stress that verbally skilled mothers hold may differ from the composition of occupational hazards and stress that less skilled mother hold. For instance, while mothers with lower verbal skills suffer from working in more hazardous work conditions, mothers with higher skills are more often exposed to radiation and face a higher risk of infection. Or yet another example, even if more skilled mothers bear on average a higher stress level, lower skilled mothers are exposed to more physically aggressive people at work. Stratification along the lines of verbal skills might cope with this differential composition of work conditions among mothers with differing levels of verbal skills.

## **5.2. Children's development**

In order to evaluate the impact of mothers' work conditions on children's development, we estimate the child development production function, represented in equation (4), using ordinary least squares and clustering standard errors on the family level. Selected results are shown in Table 4-8.<sup>17</sup>

Before analyzing the result, let us stress that our sample includes only children whose mothers are working. Hence, the goal of this study is not to compare the development of children whose mothers are working versus children whose mothers are staying at home, but to evaluate the impact of a marginal change in mothers'

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<sup>17</sup> Notice, we do not present the whole set of estimated coefficients, but the remaining estimated coefficients are in line with the findings of the literature (see for instance Baum, 2003) and are available upon request.

working environment, such as an increase in wages, a reduction in working hours or an improvement in non-monetary terms, conditional on the mothers being working.<sup>18</sup>

Raw correlations between maternal work conditions and the different measures for children's cognitive performance are mostly as expected. All three cognitive measures, the letter word score (Table 4, Column 1), the passage comprehension score (Table 5, Column 1) and the applied problem solving score (Table 6, Column 1) are significantly (at a 5% significance level) negatively correlated with mothers' working hours, significantly (at a 1% significance level) positively correlated with mothers' wages, significantly (at a 1% significance level) negatively correlated with mothers' work-related hazards, but do not seem to be related to mothers' work-related stress. Surprisingly, we do not observe any significant correlation between mothers' working environment and children's behavior (Column 1 of Table 7 and 8).

The picture, however, changes as soon as we control for the comprehensive set of current and past background characteristics, described in detail in Section 4. Notice, in line with the findings of the occupational sorting analysis and findings of the psychological literature, the most severe loss in magnitude and in particular in significance is observed as soon as we control for mothers' verbal skills. When looking at children's abilities with respect to vocabulary (Table 4, Column 2), passage comprehension (Table 5, Column 2) and calculation skills (Table 6, Column 2), none of mothers' working conditions, neither the monetary nor the non-monetary ones, seem to have a noteworthy impact. The only exception is mothers' wages which have a significantly (at a 5% significance level) positive, but only negligible influence on

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<sup>18</sup> In a previous version of this paper we tested for potential bias due to selection in employment. Using a Heckman two step estimator, reveals that the coefficient of the inverse mills ratio is not significant. Nevertheless, be aware that the results of this study are only applicable to working mother and allow us to draw only conclusions about the effect of altering working conditions given that the mother is working.

children's vocabulary; a wage increase by one dollar per hour raises children's letter word score by 0.009 standard deviations.

Genetic endowment seems to play the most important role in determining children's cognitive abilities. Despite controlling for a rich set of past input factors, children's previous performance in the respective test has a highly significant (at a 1% significance level) positive impact on children's later achievement: the better previous performance (by one standard deviation), the higher the future scores; in the case of the passage comprehension test by 0.423 standard deviation, in the case of the letter word test by 0.446 standard deviation and in the case of the applied problem solving test by 0.581 standard deviation.

At first sight, the influence of mothers' working conditions on children's personality formation seems to be negligible. The regression results using the complete sample (Column 2 of Table 7 and 8) do not reveal any significant effect of mothers' working conditions on children's personality development. Again, previous diagnosis of behavioral problems is the most powerful predictor of children's later personality development: earlier prevalence of behavioral problems (by one standard deviation) predicts also more current behavioral problems, in both dimensions internal problems (0.34 standard deviation) and external problems (0.516 standard deviation).

Nevertheless, stratification of our analysis according to mothers' verbal skills brings forward very interesting findings with respect to the non-cognitive development of children raised by mothers with good communication skills. If mothers with high oral endowments are exposed to innocuous conditions at work, the personality development of their children - in fact both dimensions of their children's personality, internal and external behavior - is severely affected. As we can see in column 4 of Tables 7 and 8, an increase in mothers' occupational hazards by one



standard deviation raises children's external behavioral problem index by 0.101 standard deviation and the internal behavioral problem index even by 0.150 standard deviation. Both effects are highly significant (at a 1% significance level).

Decomposition of mothers' occupational conditions into the single hazardous conditions provides some further insights. Among the job-related hazards which harm children's personality the most are *contaminants and risks of diseases or infections*, both being conditions mostly faced by verbally skilled mothers.<sup>19</sup> Those disamenities are moreover, mostly involved in jobs of the health or the service sector.

Despite the rich set of control variables, one might doubt the causality of the negative effect of occupational hazards involved in the jobs of verbally skilled mothers on children's personality and wonder about the underlying mechanism. One possible explanation relates to occupational misplacement which proposes that the negative effects observed for verbally skilled women is driven by a select group of verbally skilled women who are misplaced into odd or rare types of hazardous occupations. Given that verbally skilled women tend to work in less hazardous occupations, one might argue that those that do work in hazardous occupations may be working in specialized occupations that place particular demands on mothers which may negatively affect their children's behavioral development. In other words, these women may be working in rare or odd types of jobs that are not representative of the typical types of hazardous occupations.

To address concerns raised by the occupational misplacement argument, we turn to descriptive results presented in Table 9. As we can see in Table 9, these are mainly occupations in the health and the service sector, such as nurses, dentists or scientist as well as cooks or cosmetologists. Those are neither particularly bizarre nor

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<sup>19</sup> The results of the regression including the disaggregated occupational conditions are available upon request.

rare occupations. Moreover, in line with the findings of the decomposition, those occupations expose their workers to contaminants or health risk, which have been shown to be the most harmful for children's development. Hence, we feel confident that our findings are not driven by a small sample of verbally skilled women who are misplaced into unrepresentative and rare occupations.<sup>20</sup>

Another concern that one might raise is that verbally skilled mothers who work in hazardous conditions are systematically different than less skilled mothers who work in hazardous conditions. In particular, they may differ in regards to their parenting behaviors which may in turn effect children's behavioral development. We address this concern by determining whether the underlying mechanism through which the occupational hazards associated with the occupations of high-skilled mothers go on to affect their children's behavior. The subsequent section investigates upon a possible channel, which has been already outlined in the model.

Before analyzing the underlying channel, we still want to assess the magnitude and hence the severity of mothers' occupational hazards on their children behavior. For this purpose, we first compare the hazard coefficient to the coefficient of children's lagged assessment of their respective behavioral problem. In case of children's external problems it amounts to almost 20% of the magnitude of the lagged performance coefficient, and in case of children's internal problems to more than a third (36%). In other words, mothers' work environment can contribute substantially to children's personality development over and beyond children's initial conditions.

However, as pointed out in Section 2, the theory of compensating wage differentials, predicts that mothers who are exposed to job-related hazards, should

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<sup>20</sup> Additionally, analyzing the turnover of high skilled mothers who work in the upper 25% most hazardous occupations, we cannot detect any anomaly with respect to job changes; among these women, there are still 45% who have changed their occupation over the last five years. Moreover, on average these job changes are related to an improvement in the working conditions, or put it differently to a decrease in hazards (by 0.11 standard deviation).

receive a financial compensation. Hence, if mothers who are exposed to hazards receive higher wages, the harmful effect of hazards on children's personality could be potentially offset through an investment into material goods that are beneficial for children's development. Nevertheless, comparing the estimated coefficients of mothers' wages and occupational hazards stresses once again the relevance of the non-monetary aspects of mothers' jobs. In particular, the results show that wages actually do not exhibit any significant impact on children's cognitive and non-cognitive development. Hence, even if the prediction of the theory of compensating wage differentials holds true, in other words even if mothers do receive a monetary compensation for exposure to hazards, it would not help offset the harm caused by mothers' innocuous working conditions.

Summarizing these findings, we can state that children's cognitive abilities are basically unaffected by mothers' work conditions. Occupational hazards, such as safety and health risks, have, however, a detrimental impact on children's personality development, but only in the case of children with verbally skilled mothers.

The next section presents the results of how maternal work conditions go on to affect children's maternal time devoted to their children.

### **5.3. Mother-child interactions**

As described in Section 3, mother-child dyadic relations, proxied by the total time mothers devote to their children, are modeled as a function of the same set of family and social inputs as in the analysis of children's development. Selected results of these estimations, all done using OLS and clustering standard errors on the family level, are shown in Table 10. In particular, Table 10 displays the results for the impact of mothers' job-related hazards on mothers' total time spent with their children, both on a day during the week and on a day during the weekend. Instead of considering

time measured in hours, we assess maternal time as the fraction of time in a day after deducting work hours and 8 hours of sleep.

Overall, we can see that parental time investments seem to be affected by the conditions mothers are exposed to at work: if mothers suffer from one standard deviation more hazards at work, they reduce the time devoted to their children on the weekend by 2.12% (significant at a 5% significance level). This is equally true for children of low-skilled mothers and children of high-skilled mothers.

The results seem to suggest that whereas working in hazardous occupations reduces the time both high skilled and low skilled mothers' spend with children, only reductions in time with higher skilled mothers translates into worse child outcomes. A reduction in the time spent with less skilled mothers, however, does not translate into greater behavioral problems among children.

Why might time be a mechanism through which work conditions effect child development among children of verbally skilled mothers but not among children of less verbally skilled mothers? One explanation is that the returns to spending time with more verbally skilled mothers is greater than the returns to spending time with their less skilled counterparts. Mothers who are more verbally proficiently may provide more cognitive stimulation and be more attentive and responsive to their children's needs. Therefore, the benefits to interacting with a verbally skilled mother - in terms of children's behavioral development - may be greater than the returns to interacting with a less skilled mother.

## **6. DISCUSSION AND CONCLUSION**

Does mothers' exposure to hazardous and stressful working conditions affect their children's human capital and personality formation? The current study addresses

this question by shedding some light on the relation between maternal working conditions and child outcomes as well as on a possible transmitting mechanism, namely mothers' time investment in their children.

Using the 1997 and 2002 waves of the Child Development Supplement of the Panel Study of Income Dynamics we first identify the determinants of the degree exposure to hazardous and stressful work environments. Once, we have defined the potential confounding characteristics between mothers' work environment and their time investments, we go on to investigate if mothers' occupational hazards and stress harm children's cognitive and non-cognitive characteristics. Finally, we explore the possibility that exposure to unfavorable work environments may have a negative effect on mother-child interactions, and hence maternal time might be the underlying mechanism through which maternal work conditions affect children's development.

The results show that all of the negative association between occupational conditions and children's cognitive performance can be explained by differences in mothers' education and in particular mothers' verbal skills. Nevertheless, stratification with respect to mothers' verbal skills reveals that in the case of children with verbally skilled mothers, children's behavior is negatively affected by mothers' hazardous working conditions. In particular, deterioration in mothers' work-related safety and health risks increase children's behavioral problems, both internalizing and externalizing behavioral problems, by 0.150 and 0.101 standard deviation respectively. These effects are non-negligible, in particular in light of the fact that income does not seem to compensate for these effects.

When examining the relationship between occupational hazards and stress, on one hand, and maternal time investments in children, on the other, it becomes clear that mothers who work under innocuous conditions spend less time with their

children, particularly on the weekends. Hence, one underlying mechanism through which mothers' work environment might affect children's behavior might be through maternal time. Unlike low-skilled mothers, high-skilled mothers might spend their time in a way that stimulates their children's development, and hence, a loss in their time devoted to their children, might have a relatively stronger detrimental effect on their children, than a reduction in the time low-skilled mothers devote to their children.

In line with a growing body of literature, one policy recommendation of this study is that high quality center-based care may play a positive role in promoting children's development. In the particular case of children raised by verbally skilled mothers, exposure to a well-trained and verbally engaged care provider may offset some of the negative effects associated with having a mother who works in a hazardous environment.

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## FIGURES AND TABLES

Table 1: Descriptive Statistics

	Mean	Std. Dev.	Min	Max
<b>Children's assessment</b>				
Std. Letter word score 2002	0.0000	1.0000	-4.1556	4.2094
Std. Passage comprehension score 2002	0.0000	1.0000	-6.1793	4.9557
Std. Applied problem solving score 2002	0.0000	1.0000	-3.7107	3.9907
Std. Behavioral Problems Internal 2002	0.0000	1.0000	-0.9865	3.5766
Std. Behavioral Problems External 2002	0.0000	1.0000	-1.3800	2.7902
Letter word score 1997	0.0000	1.0000	-3.5647	5.3550
Passage comprehension score 1997	0.0000	1.0000	-3.6801	2.9628
Applied problem solvings core 1997	0.0000	1.0000	-4.3441	2.9688
Behavioral Problems Internal 1997	0.0000	1.0000	-0.9699	4.1888
Behavioral Problems External 1997	0.0000	1.0000	-1.5059	2.5171
<b>Mothers' work conditions</b>				
Std. Hazard 2001	0.0000	1.0000	-1.2738	3.3815
Std. Stress 2001	0.0000	1.0000	-2.3145	2.1753
Mom's wage 2001	37.7654	10.5345	10	100
Mom's work hours/week 2001	13.5873	7.7739	0.3	49.48
Mom's working status 1997	0.7465	0.4352	0.0000	1.0000
Hazard 1997	-0.0143	0.9904	-1.3062	3.4363
Stress 1997	0.0286	0.9983	-2.4428	2.1403
Mom's work hours/week 1997	36.0721	10.7028	1	75
Mom's wage 1997	9.3120	4.3681	0.01	25
<b>Mother-child relation</b>				
Hours spent with child on weekday 2002	4.1059	2.4681	0.0833	19.5833
Hours spent with child on weekend day 2002	7.3286	3.7834	0.0333	19.7000
Hours spent with child on weekday 1997	5.3563	3.0031	0.0833	16.8333
Hours spent with child on weekend day 1997	8.6221	3.4856	0.1667	16.3333
<b>Mom's characteristics</b>				
Mom's age at chidbirth	27.8888	6.0865	15	63
Single mom (=1 if yes) 2001	0.3195	0.4665	0	1
Mom education (in years) 2001	13.3125	2.1477	3	17
Single mom (=1 if yes) 1997	0.2639	0.4409	0	1
Mom education (in years) 1997	13.2607	2.1526	2	17
Stand. Mom's Verbal Skills 1997	0.0000	1.0000	-5.1484	2.2423
<b>Father's characteristics</b>				
Dad's age at birth	30.7598	6.0623	12	59
Dad's education (in years) 2001	13.5403	2.3158	3	17
Dad's employment status (=1 if working) 2001	0.8606	0.3466	0	1
Dad's work hours/week 2001	45.5063	10.7460	0	91
Dad's wage 2001	21.8020	17.6557	0	161.41
Dad's education (in years) 1997	13.4323	2.3190	3	17
Dad's employment status 1997	0.8902	0.3128	0	1
Dad's work hours 1997	45.3824	9.7010	0	96
Dad's wage 1997	16.9327	14.1226	0	144.3



**Home characteristics**

# of siblings 2002	1.3766	1.2707	0	9
Grandparents present 2002	0.0252	0.1568	0	1
Amount Savings 2002	1399	4547	0	50000
Stock amount 2002	1611	9210	0	200000
Home Scale 2002	19.3715	3.6846	8	27
# of siblings 1997	1.2261	1.0414	0	9
Grandparents present 1997	0.0482	0.2142	0	1

**Childcare**

No extrafamilial care (=1 if yes) 1997	0.7242	0.4471	0	1
Cared by relatives < 13 years old (=1 if yes) 1997	0.0215	0.1453	0	1
Cared by relatives > 13 years old (=1 if yes) 1997	0.2339	0.4239	0	1
Cared by nonrelatives (=1 if yes) 1997	0.0484	0.2149	0	1
Cared in relatives home (=1 if yes) 1997	0.1694	0.3756	0	1
Cared in daycare (=1 if yes) 1997	0.1317	0.3386	0	1
Care in prekindergarten (=1 if yes) 1997	0.0403	0.1970	0	1
Cared before and after school (=1 if yes) 1997	0.1962	0.3977	0	1
Cared by child herself (=1 if yes) 1997	0.1398	0.3472	0	1
Age of first care	0.6353	1.2412	0	8
Student Teacher Ratio	20.4283	5.2547	.2	35
Average teacher salary	24009.54	4063.046	7800	35000

**Regional Characteristics**

Neighborhood rating 2002	2.1675	1.0442	1	5
> 0.5 mio. people 2001	0.1794	0.3838	0	1
100k-499k people 2001	0.2691	0.4437	0	1
50k-99k people 2001	0.1231	0.3286	0	1
25-49k people 2001	0.1067	0.3089	0	1
10k-24k people 2001	0.1594	0.3662	0	1
< 10k people 2001	0.1623	0.3689	0	1
Rural urban code (1= urban, 10 rural) 2001	3.2520	2.3604	1	10
Neighborhood rating 1997	2.3107	1.0819	1	5
Ever moved for children	0.5441	0.4982	0	1

**Grandmothers' characteristics**

Grandmother's education in years	11.4561	2.3192	2	17
Grandmother' job-related hazards	0.0000	1.0000	-1.4714	2.4447
Grandmother' job-related stress	0.0000	1.0000	-2.3090	2.4023

**Child characteristics**

Age child at first interview (1997)	6.1253	3.5067	1	13
Child is Male	0.4989	0.5002	0	1
Child is White	0.4885	0.5001	0	1
Child is Black	0.4181	0.4934	0	1
Child is Hispanic	0.0467	0.2111	0	1
Child's Birthweight (in pounds)	6.8577	1.4282	1	13
Child in bad health conditions at birth (=1 if yes)	0.0993	0.2992	0	1

Table 2: Most Frequent Occupations of Mothers

Rank	All		Low Skilled Occupation			High skilled occupations			
	Occupation	Hazards	Stress	Occupation	Hazards	Stress	Occupation	Hazards	Stress
1	Manager	-0.65	0.67	Nursing aides	0.38	0.47	Managers/administrator	-0.65	0.67
2	Elementary teacher	-0.76	-0.08	Cleaner	1.02	-1.66	Elementary school teacher	-0.76	-0.08
3	Nursing aides	0.38	0.47	Child care workers	-0.19	0.09	Registered Nurse	1.01	1.46
4	Clerical Worker	-1.01	0.04	Cashier	-0.31	0.8	General Secretary	-0.5	-0.18
5	Secretary (n.e.c.)	-0.5	-0.18	Clerical Worker	-1.01	0.04	Bookkeeper	-0.95	-0.46
6	Registered Nurse	1.01	1.46	Estimator/Investigator	-0.93	2.2	Clerical Worker	-1.01	0.04
7	Bookkeeper	-0.95	-0.46	Managers/administrator	-0.65	0.67	(Pre-)kindergarten teachers	-0.45	-0.55
8	Child Care Worker	-0.19	0.09	General Secretary	-0.5	-0.18	Sales clerk	-0.4	0.44
9	Assembler	1.54	-1.35	Assembler	1.54	-1.35	Social Worker	-0.72	1.51
10	Cashier	-0.31	0.8	Machine Operatives	2.79	-0.84	Child care workers	-0.19	0.09
<b>Mean</b>	<b>All</b>	<b>0</b>	<b>0</b>	<b>Low skilled occupations</b>	<b>0.2</b>	<b>-0.06</b>	<b>High skilled occupations</b>	<b>-0.24</b>	<b>0.08</b>

Table 3: Sorting into occupations exposing their workers to different disamenities

	Hazards	Stress
<b>Std. verbal skills (mom)</b>	-0.119** (0.0354)	0.121** (0.0374)
<b>High school dropout (mom)</b>	0.274 (0.144)	-0.0625 (0.142)
<b>High school graduate (mom)</b>	0.126 (0.0736)	0.0524 (0.0747)
<b>Lagged log of wages (mom)</b>	-0.0899 (0.1260)	0.1727* (0.0842)
<b>Lagged work hours (mom)</b>	-0.00280 (0.00270)	0.00237 (0.00274)
<b>Lagged hazards (mom)</b>	0.486** (0.0408)	-0.00184 (0.0401)
<b>Lagged stress (mom)</b>	-0.00783 (0.0327)	0.430** (0.0420)
<b>Black</b>	0.0521 (0.0774)	0.0593 (0.0873)
<b>Hispanic</b>	0.398* (0.158)	-0.404** (0.154)
<b>High school dropout (grandma)</b>	-0.0493 (0.136)	0.0649 (0.176)
<b>High school graduate (grandma)</b>	0.0425 (0.0914)	0.0806 (0.139)
<b>Hazards (grandma)</b>	0.0516 (0.0633)	-0.0289 (0.0757)
<b>Stress (grandma)</b>	0.0735 (0.0549)	-0.00955 (0.0658)
<b>Observations</b>	1018	1018
<b>R-squared</b>	0.331	0.228

Note: We also control for a set of dummies comprising mothers' age, marital status, number and age of children, dad's education, dad's employment status, home environment, neighborhood rating, the size of the next larger city and degree of urbanicity. Additionally we include dad's working hours and labor income, as well as savings and accumulated assets.

Robust standard errors are reported in parentheses, where \*\*  $p < 0.01$ , \*  $p < 0.05$ .

Table 4: Child production function - Letter Word Test Score

	No controls	All controls	Low skilled	High skilled
<b>Mom's work hours</b>	-0.0058* (0.0026)	-0.0024 (0.0023)	-0.0062 (0.0037)	-0.0006 (0.0032)
<b>Mom's wage</b>	0.0291** (0.0035)	0.0086* (0.0038)	0.00533 (0.0066)	0.0079 (0.0049)
<b>Hazard</b>	-0.1090** (0.0276)	-0.0116 (0.0270)	-0.0143 (0.0373)	-0.0368 (0.0446)
<b>Stress</b>	-0.0082 (0.0269)	0.0221 (0.0245)	-0.0081 (0.0367)	0.0414 (0.0360)
<b>Lagged Score</b>	- -	0.5810** (0.0275)	0.6170** (0.04)	0.5210** (0.0408)
<b>Background var.</b>	No	Yes	Yes	Yes
<b>Observations</b>	1349	1349	657	692
<b>R-Squared</b>	0.073	0.442	0.486	0.388

Note: In column 2 and 4 we additionally control for a set of current and lagged child (age, race, gender, birthweight, health at birth), mother (age, marital status, education, verbal skills), father (age, education, labor force status, wage and working hours), household (siblings, presence of grandparents, indicator of cognitive stimulation at home, savings and assets), and regional characteristics (neighborhood rating, size of the next larger city and urbanicity). Furthermore we control for grandmothers' education and job-related hazards, type of childcare (by whom and for how long during early childhood and current care) and school characteristics (pupil teacher ratio and average teacher salary).

Robust standard errors are reported in parentheses, where \*\*  $p < 0.01$ , \*  $p < 0.05$ .

Table 5: Child production function - Passage Comprehension Test Score

	No controls	All controls	Low skilled	High skilled
<b>Mom's work hours</b>	-0.00792** (0.0026)	-0.00507 (0.00264)	-0.00528 (0.00406)	-0.00579 (0.00376)
<b>Mom's wage</b>	0.0195** (0.0036)	0.00117 (0.00428)	0.00768 (0.00716)	-0.00339 (0.00575)
<b>Hazard</b>	-0.0985** (0.0283)	-0.00221 (0.0306)	0.00458 (0.0408)	-0.00704 (0.0519)
<b>Stress</b>	0.0234 (0.0275)	0.0383 (0.0278)	0.028 (0.0404)	0.059 (0.0421)
<b>Lagged Score</b>	- -	0.423** (0.0359)	0.464** (0.0529)	0.381** (0.0543)
<b>Background var.</b>	No	Yes	Yes	Yes
<b>Observations</b>	1349	1349	657	692
<b>R-Squared</b>	0.046	0.293	0.344	0.266

Note: In column 2 and 4 we additionally control for a set of current and lagged child (age, race, gender, birthweight, health at birth), mother (age, marital status, education, verbal skills), father (age, education, labor force status, wage and working hours), household (siblings, presence of grandparents, indicator of cognitive stimulation at home, savings and assets), and regional characteristics (neighborhood rating, size of the next larger city and urbanicity). Furthermore we control for grandmothers' education and job-related hazards, type of childcare (by whom and for how long during early childhood and current care) and school characteristics (pupil teacher ratio and average teacher salary).

Robust standard errors are reported in parentheses, where \*\*  $p < 0.01$ , \*  $p < 0.05$ .

Table 6: Child production function - Applied Problem Solving Test Score

	No controls	All controls	Low skilled	High skilled
<b>Mom's work hours</b>	-0.00721** (0.0025)	-0.00277 (0.0024)	0.00201 (0.0036)	-0.00825* (0.0034)
<b>Mom's wage</b>	0.0284** (0.0034)	0.00257 (0.0038)	0.00981 (0.0063)	-0.00299 (0.0053)
<b>Hazard</b>	-0.113** (0.0270)	-0.00622 (0.0273)	0.012 (0.0359)	-0.0354 (0.0475)
<b>Stress</b>	-0.0411 (0.0263)	-0.0166 (0.0249)	-0.00671 (0.0355)	-0.00644 (0.0383)
<b>Lagged Score</b>	- -	0.446** (0.0283)	0.448** (0.039)	0.437** (0.0445)
<b>Background var.</b>	No	Yes	Yes	Yes
<b>Observations</b>	1349	1349	657	692
<b>R-Squared</b>	0.08	0.407	0.431	0.358

Note: In column 2 and 4 we additionally control for a set of current and lagged child (age, race, gender, birthweight, helath at birth), mother (age, marital status, education, verbal skills), father (age, education, labor force status, wage and working hours), household (siblings, presence of grandparents, indicator of cognitive stimulation at home, savings and assets), and regional characteristics (neighborhood rating, size of the next larger city and urbanicity). Furthermore we control for grandmothers' education and job-related hazards, type of childcare (by whom and for how long during early childhood and current care) and school characteristics (pupil teacher ratio and average teacher salary).

Robust standard errors are reported in parentheses, where \*\*  $p < 0.01$ , \*  $p < 0.05$ .

Table 7: Child production function - Internal Behavioral Problem Index

	No controls	All controls	Low skilled	High skilled
<b>Mom's work hours</b>	0.0015 (0.0027)	-0.000323 (0.0029)	0.00914 (0.0047)	-0.00641 (0.0037)
<b>Mom's wage</b>	-0.00466 (0.0037)	0.000285 (0.0046)	0.00478 (0.0083)	-0.000586 (0.0056)
<b>Hazard</b>	0.0435 (0.0292)	0.0427 (0.0328)	-0.0664 (0.0474)	0.150** (0.0505)
<b>Stress</b>	-0.0436 (0.0284)	-0.0385 (0.0298)	-0.0634 (0.0469)	-0.0157 (0.0407)
<b>Lagged Score</b>	- -	0.394** (0.0306)	0.370** (0.0444)	0.416** (0.0430)
<b>Background var.</b>	No	Yes	Yes	Yes
<b>Observations</b>	1349	1349	657	692
<b>R-Squared</b>	0.009	0.21	0.267	0.297

Note: In column 2 and 4 we additionally control for a set of current and lagged child (age, race, gender, birthweight, health at birth), mother (age, marital status, education, verbal skills), father (age, education, labor force status, wage and working hours), household (siblings, presence of grandparents, indicator of cognitive stimulation at home, savings and assets), and regional characteristics (neighborhood rating, size of the next larger city and urbanicity). Furthermore we control for grandmothers' education and job-related hazards, type of childcare (by whom and for how long during early childhood and current care) and school characteristics (pupil teacher ratio and average teacher salary).

Robust standard errors are reported in parentheses, where \*\*  $p < 0.01$ , \*  $p < 0.05$ .

Table 8: Child production function - External Behavioral Problem Index

	No controls	All controls	Low skilled	High skilled
<b>Mom's work hours</b>	0.00192 (0.0027)	0.0000 (0.0026)	-0.00181 (0.0046)	0.000205 (0.0033)
<b>Mom's wage</b>	-0.0117 (0.0004)	-0.00245 (0.00426)	-0.000956 (0.00803)	-0.00304 (0.00503)
<b>Hazard</b>	0.0159 (0.0287)	0.00944 (0.0305)	-0.0812 (0.0657)	0.101** (0.0454)
<b>Stress</b>	0.00519 (0.0279)	0.00159 (0.0277)	-0.0333 (0.0450)	0.0262 (0.0367)
<b>Lagged Score</b>	- -	0.516*** (0.0287)	0.511*** (0.0441)	0.522*** (0.0392)
<b>Background var.</b>	No	Yes	Yes	Yes
<b>Observations</b>	1349	1349	657	692
<b>R-Squared</b>	0.01	0.294	0.336	0.373

Note: In column 2 and 4 we additionally control for a set of current and lagged child (age, race, gender, birthweight, helath at birth), mother (age, marital status, education, verbal skills), father (age, education, labor force status, wage and working hours), household (siblings, presence of grandparents, indicator of cognitive stimulation at home, savings and assets), and regional characteristics (neighborhood rating, size of the next larger city and urbanicity). Furthermore we control for grandmothers' education and job-related hazards, type of childcare (by whom and for how long during early childhood and current care) and school characteristics (pupil teacher ratio and average teacher salary).

Robust standard errors are reported in parentheses, where \*\* p<0.01, \* p<0.05.



Table 9: Top and Bottom 5% of mothers' occupations in terms of involved hazards

	Low Hazards		High Hazards	
	Occupational code	Hazards	Occupational code	Hazards
Low Skills	Newsboy	-1.209	Textile Oper. (carding, combing )	2.068
	Typist	-1.201	Filer, Polisher	1.740
	Statistical Clerk	-1.194	Machine operative/Machinist	1.717
	File clerks	-1.177	Key punch operator	1.472
	Medical Secretaries	-1.162	Dental laboratory technicians	1.428
	Office manager, not specified	-1.084	Construction laborer	1.278
	Miscellaneous clerical worker	-1.084	Vehicle equipment cleaner	1.154
	Telephone operator	-1.079	Health technologist	1.130
	Computer system analysts	-1.064	Freight and material handler	1.104
	Bookkeeper	-1.042	Miscellaneous laborers	1.104
High Skills	Legal Secretaries	-1.284	Machine operatives (misc.)	1.717
	Bank officer, Financial manager	-1.252	Operative (misc.)	1.512
	Economist	-1.250	Carpenter	1.415
	Accountants	-1.248	Health technologist	1.130
	Operations and system workers	-1.208	Registered Nurses	1.014
	Typist	-1.201	Biological scientist	0.971
	Stock and Bond Salesman	-1.199	Chemist	0.971
	Statistical Clerks	-1.194	Dentists	0.878
	File clerks	-1.177	Cooks	0.783
	Medical Secretaries	-1.162	Hair dresser, cosmetologist	0.744

Table 10: The effect of hazards on maternal time spent with children - Aggregate Time

	All	Low Skilled	High Skilled
<b>% time during weekday</b>	0.00284 (0.0168)	0.00619 (0.0301)	-0.0117 (0.0215)
<b>% time during weekend</b>	-0.0212* (0.00880)	-0.0198 (0.0139)	-0.0203 (0.0131)

Note: Each coefficient is taken from a separate regression where we run the different types of maternal time on maternal wages and workrelated stress, and additionally on set of current and lagged child (age, race, gender), mother (age, education, verbal skills, marital status), father (age, education, wage and working hours), household (siblings, presence of grandparents, total income, savings and wealth) and regional characteristics (neighborhood rating, safety of the neighborhood, amount of friends and family in the neighborhood, distance to next larger city, urbanicity). Robust standard errors are reported in parentheses, where \*\* p<0.01, \* p<0.05.