



Maternal work conditions and child development

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ABSTRACT

How do maternal work conditions, such as psychological stress and physical hazards, affect children's development? Combining data from the Child Development Supplement of the Panel Study of Income Dynamics and the Occupational Information Network allows us to shed some light on this question. We employ various techniques including OLS with extensive controls, a value added approach and individual fixed effects in order to address potential endogeneity problems. Our results reveal that mothers' exposure to work-related hazards negatively affects children's cognitive development and to work-related stress negatively affects children's behavioral development. While maternal time investments play a small but significant role in mediating these negative associations, paternal time investments neither reinforce nor compensate these associations.

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1. Introduction

Numerous studies have sought to determine the effect of maternal employment on children's developmental outcomes (see Ruhm, 2004 for a full review of the literature). These studies offer mixed results with some studies suggesting that maternal employment may improve children's intellectual performance through increasing household incomes (Blau & Grossberg, 1992), others suggesting that there is no significant effect on children (Schildberg-Hoersch, 2011), and others showing a small, negative effect, particularly when employment occurs during the first years of children's lives (Baum, 2003; Bernal, 2008; Brooks-Gunn, Han, & Waldfogel, 2002; James-Burdumy, 2005).

Given that the vast majority of women with children in the U.S. nowadays work (71% of mothers with children under the age of 18 years and 64% of mothers with children under the age of 6 years worked in 2011, according to the 2012 Bureau of Labor Statistics) perhaps the more relevant question to answer for scholars concerned about the consequences of maternal employment for children is how maternal work conditions affect children's development. Some recent studies have sought to answer this question. These studies show that nonstandard work hours (Han, 2005), fluctuating work schedules (Johnson, Kalil, & Dunifon, 2012), lengthy commutes (Dunifon, Kalil, & Bajracharya, 2005), low prestige jobs (Raver, 2003) and job instability (Johnson et al., 2012) have negative effects on children's cognitive and socio-behavioral development, especially among children of less-skilled mothers.

This paper further contributes to this line of research. First, we consider how two important yet largely unexamined aspects of maternal work conditions – namely, psychological stress and physical hazards experienced at work – potentially influence children's cognitive and socio-behavioral development. Second, we explore

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a potential mechanism through which work conditions influence child outcomes, namely, via maternal time investments. Prior studies have shown that mothers who experience work-related stress and poor work conditions are more irritable, less attentive and more withdrawn (Parke et al., 2004; Raver, 2003; Repetti & Wood, 1997). We examine whether maternal time investments may be a similar mechanism through which work conditions affect children. Moreover, we make special effort to distinguish between the “quantity” and the “quality” of maternal time investments by disaggregating total time in order to differentiate between the different types of time investments. Namely, we distinguish between specific types of activities that may be the most productive in influencing children’s human capital development, such as shared time together engaged in *educational activities* (i.e. reading and doing homework), *structured play* (e.g. doing art and music, play sports, etc.) and *social time* (e.g. excursions to the park, museum, zoo), from activities that may be less directly productive, such as *unstructured play* activities (e.g. watching t.v., playing video games, etc.).

Third, we extend the literature by considering how maternal work conditions may influence children via its effect on the time children spend with their fathers. Poor maternal work conditions may influence fathers’ time in two opposing ways. On the one hand, prior studies have shown that fathers with working spouses increase their involvement with children relative to fathers of non-working spouses (Bianchi, 2000; Sayer, Bianchi, & Robinson, 2004). Therefore, fathers may compensate for the negative effects of maternal work conditions by increasing either the quantity of time devoted to children or the quality of time (e.g. increasing their time with children in educational or structured play). On the other hand, poor maternal work conditions may have negative “spillover” effects on fathers’ time with children. The strains of working under highly stressful conditions may negatively influence marital quality, which may in turn have a negative effect on fathers’ time allocation.

We use the 1997 and 2002 waves of the Panel Study of Income Dynamics–Child Development Supplement (PSID–CDS) to obtain comprehensive information on children’s cognitive and socio-behavioral development, time diary estimates of parental time investments in children, children’s demographic and physical characteristics as well as 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 (O*NET) allows us to obtain detailed, objective information on mothers’ occupational conditions.

We adopt a multi-step approach to understanding the associations between maternal work conditions – measured as psychological stress, physical hazards, work hours and wages – parental time and child outcomes. First, we look at the correlates of maternal work conditions in order to better describe the types of mothers who are the most likely to experience poor work conditions. Second, we establish the association between maternal work conditions and indicators of children’s cognitive and socio-behavioral development. Third, we determine whether parental time investments are a mediating pathway

linking work conditions and child outcomes. For this purpose, we estimate the association between maternal work conditions and mothers’ and fathers’ time investments as well as the association between parental time and child outcomes. Finally, we assess the relevance of parental time as a mediator in the association between maternal work conditions and child development. We estimate these associations using a variety of methods, including OLS with extensive controls, OLS augmented by the lagged dependent variable and individual fixed effect regressions.

Our results show that poor work conditions are overall negatively associated with children’s cognitive and socio-behavioral outcomes. Specifically, increased physical hazards experienced at work relate negatively to children’s cognitive outcomes and increased psychological stress experienced at work relates negatively to children’s behavior. Yet, while our results demonstrate that maternal time investments, particularly the time mothers spend with children engaged in educational and social activities, mediate the effect of poor maternal work conditions, we also show that the mediating effect is small; maternal time investments mediate less than 2% of the effect of physical hazards on children’s cognitive development and less than 6% of the effect of psychological stress on children’s behavior. Moreover, our analysis of fathers shows that maternal stress at work reduces both the amount of time fathers spend with children in educational activities and structured play. But the time children spend with fathers on these types of activities are not significantly associated with child outcomes. Therefore, while mothers’ time investments play a small but significant role in mediating the effect of poor work conditions, fathers’ time does not.

The remainder of the paper is structured as follows. Section 2 describes briefly the underlying rationale why maternal work conditions may relate to children’s development. Section 3 introduces the methodology used to identify the association between maternal working conditions and 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

2.1. Maternal work conditions and child development

The main interest of this study lies in establishing and understanding the link between maternal work conditions and children’s development, represented by the following reduced form equation of children’s human capital production function²:

$$CD_{it} = CD(WC_{it}; MC_{it}; PC_{it}; HC_{it}; SC_{it}; CD_{it-1}; \mu_i) \quad (1)$$

² 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. The approach outlined in this section draws upon Todd and Wolpin (2003) and Cunha et al. (2006). Notice, however, that we do not intend to model the determinants of all inputs into the production function, but only to provide the reader with a clear understanding of how mothers’ work characteristics may influence their children’s development.

where CD_{it} stands for child i 's development in year t , in terms of cognitive skills and socio-behavioral outcomes. WC_{it} represents the work conditions of the mother of child i in year t . Further control variables are features of child i 's mother (MC_{it}), father (PC_{it}), household (HC_{it}), and social environment (SC_{it}) in year t . These variables are meant to proxy important input factors, such as parental care, material inputs and inputs of the school or the peer group. Child i 's genetic endowment μ_i as well as her accumulated human capital CD_{it-1} also play a role in determining her current developmental status.

When modeling mothers' work conditions, we consider both monetary and non-monetary features. The underlying reason for doing so is based on the theory of compensating wage differentials: a job is a bundle of wages and disamenities, and workers who are exposed to certain disamenities receive some financial compensation (Rosen, 1986; Smith, 1776). To the extent that greater income can increase material inputs that influence child development, any detrimental effects of deleterious work conditions may be offset by higher wages. Hence, it is important to control for both aspects of jobs, monetary and non-monetary factors.

We expect the included non-monetary work conditions, such as work hours, physical hazards and psychological stress to have a detrimental effect on children's development. Exposure to such deleterious work conditions might negatively affect parental care, in terms of time, warmth and responsiveness, which in turn may harm children's development. In the following two subsections we discuss the role of one of these channels, namely parental time, in mediating the link between maternal work conditions and children's development.³

2.2. Work conditions and parental time

Existing empirical studies show that parents' capacity to provide responsive and attentive care for their children is associated with their work environment (Menaghan & Parcel, 1995; Wilson, Ellwood, & Brooks-Gunn, 1995). Working in menial or low prestige occupations correlates with parents being less attentive, responsive and stimulating with respect to their children (Menaghan, 1983; Raver, 2003; Repetti & Wood, 1997). On the contrary, parents and children may benefit from working in a psychologically rewarding job. For example, Aber, Brooks-Gunn, and Maynard (1995) find that mothers who participated in self-sufficiency programs such as work, education, or training are more emotionally positive and less controlling than mothers who do not participate in such programs.

³ The association between maternal time investments and child outcomes as well as the association between maternal work conditions and maternal time may vary by child's age. Child care demands are the most intensive when children are young. Therefore, one might expect to see that the associations between work conditions, parental time and child outcomes vary by children's age. To address these concerns, we additionally conduct all analyses with samples that are stratified by children's age. We also conduct sensitivity analyses by excluding the youngest children from our sample (i.e. those younger than 6 years old). Our findings do not systematically differ from the results presented in the paper and thus the age-stratified results are not included, but are available upon request.

For similar reasons, poor work conditions may exert a negative effect on the amount of parental time devoted to their children. Mothers who work long hours under stressful and hazardous work conditions may spend less time with their children in order to have more time to "relax" and "decompress". Moreover, psychologically tired and stressed mothers may also re-allocate their child care time away from the most productive activities, such as reading and doing homework, to activities that require less mental and emotional energy, such as watching t.v.

Besides affecting maternal time, poor maternal work conditions may also effect children's time with fathers. On the one hand, fathers may try to compensate for the negative effects of maternal work conditions by spending more time with children and/or spending more time on activities that may be more enriching, such as educational or social activities. On the other hand, if poor maternal work conditions reduce marital quality, the negative effect of such work conditions may be exacerbated if fathers also respond by being more withdrawn and reducing their child care time.

In our study, we seek to examine the above-suggested associations between maternal work conditions and the amount and the content of parental time investments empirically by estimating the following equation:

$$T_{it} = T(WC_{it}; MC_{it}; PC_{it}; HC_{it}; SC_{it}; T_{it-1}; \eta_i) \quad (2)$$

where T_{it} stands for both, total amount of parental time (examining maternal and paternal time, separately) and different types of parental time investments. T_{it-1} represents past time inputs and is meant to proxy past parental behavior, while η_i incorporates parents' and children's unobservable time constant characteristics, such as personality or genetic features. All further control variables are already explained above following Eq. (1).

2.3. Parental time investments and child development

Along with financial and material investments, the time parents spend with children are theorized to be inputs into the production of human capital. Social capital theories speculate that mother-child interactions create the necessary social interactions that facilitate the intergenerational transmission of knowledge and skills (Coleman, 1988). Developmental psychologists argue that maternal employment is detrimental for children primarily because it deprives children of the type of mother-child interactions that are essential for children's sense of security and attachment (Belsky, 2001; Brazelton, 1986).

Whereas maternal time investments feature prominently in child development and human capital theories, fewer studies have empirically examined the relationship between direct measures of maternal time investments and child outcomes. Investigating the effect of maternal time, measured directly from time diaries, on early indicators of child development (e.g. attachment security measured as early as 7–37 months) existing studies generally find no significant effects (Booth, Clarke-Stewart, Vandell, McCartney, & Owen, 2002; Cox, Owen, Henderson, & Margand, 1992; Huston & Aronson, 2005).

The content of parent–child interactions that occur and the type of activities that are performed during the time parents spend with children may be as important as the total time spent together. For example, studies show that better-educated women are more verbally engaged with their children (Hart & Risley, 1995), provide more cognitive stimulation at home (Brooks-Gunn & Duncan, 1997; Menaghan & Parcel, 1991) and that these differences in parent–child interactions partially account for socio-economic disparities in children’s cognitive outcomes. Yet, the few studies that have examined how different types of activities performed together influence children’s development suggest that like total time, the types of activities performed together, might not matter at least with regard to developmental outcomes during early childhood (Huston & Aronson, 2005; Cox et al., 1992).

The time fathers spend with children is speculated to exert the same direct effect on children as mothers’ time in that time together is necessary for children to gain opportunities for enriching and cognitively stimulating interactions with their primary care providers and to develop a sense of attachment and security (Pleck, 2010). Studies generally show that aspects of paternal involvement – such as paternal accessibility, emotional investment, and responsibility – are positively associated which children’s outcomes (Amato & Rejac, 1994; Amato & Rivera, 1999; McLanahan & Sandefur, 1994). Yet, research examining the effect of paternal time investments per se, is surprisingly scarce. Since fathers are increasingly more involved in the daily care of children, above and beyond their traditional roles as the family bread-winners (Sandberg & Hoeffler, 2001; Sayer et al., 2004), we should, however, expect to see that fathers’ time is as salient in children’s lives as mothers’ time is widely speculated to be.

In our study, we aim to provide empirical evidence for the association between parental time and children’s development using the following equation:

$$CD_{it} = CD(T_{it}; MC_{it}; PC_{it}; HC_{it}; SC_{it}; CD_{it-1}; \mu_i) \quad (3)$$

where CD_{it} corresponds to a child i ’s development in year t , and T_{it} represents the main variable of interest, parental time investments. All other control variables are the same as explained above following Eq. (1) and are meant to proxy commonly adopted input factors, such as material investments or the social environment.

3. Estimation

The empirical analysis is divided into two parts. First, we establish whether there is an association between maternal work conditions and child development. Second, we investigate the role of parental time investment as a potential pathway through which maternal work conditions may exert their effect on children’s development. For this purpose, we estimate the association between maternal work conditions and parental time, separately for mothers’ and fathers’ time, as well as the association between time investments and child development.

In identifying the association between maternal work conditions and child development, we potentially face a selection problem. For instance, the association between

work conditions and child outcomes might be biased due to mothers adjusting their jobs according to their children’s development. In an effort to tackle these issues, we use different estimation strategies.

One way of addressing occupational selection is to use an unusually rich data set and to control for observable characteristics that might determine child development and occupational choice. This strategy is called “selection-on-observables”. To employ this strategy, we use data from a large and nationally representative sample of children and families (for more details please refer to Section 4). But because conditioning on observables cannot account for biases due to unobservable heterogeneity, this strategy is limited.

An alternative strategy, otherwise referred to as the “value added” approach, is to control for the lagged dependent variable. Children’s past performance in cognitive or behavioral tests is likely to be a strong determinant of children’s current performance in the respective test. Additionally, mothers might adjust their work environment according to their children’s past development. As a consequence, we control not only for an exhaustive set of background characteristics, but also for the lagged measure of children’s performance in the respective test.

While controlling for the respective lagged dependent variable brings us one step further, confounding variables may remain that biases our estimates. Fixed effect methods allow us to eliminate any bias due to time-invariant unobservable features, such as the personality of the mother or the innate ability of the child. To estimate our model within a fixed effect framework, we use data from two time periods and estimate our model using variables measured as differences between these two periods. Thus, we identify the association between maternal work conditions and child outcomes using changes over time.

In the second part of the analysis, we assess the role of parental time as a mediator for the observed association between maternal work conditions and child outcomes. We take two approaches. We begin by estimating the associations between work conditions and parental time as well as the association between parental time and child outcomes, separately. This approach allows us to understand whether parental time may act as a mediator between maternal work conditions and child outcomes, but does not allow us to assess the extent to which it may mediate this association. We therefore choose a second approach, and re-estimate the association between maternal work conditions and child outcomes, but include parental time as an additional control. Yet, doing so may lead to biased estimates. As demonstrated in the previous section, parental time investments are endogenous to maternal work conditions and thus they constitute so called “bad controls” in the regression of child development on maternal work conditions (Angrist & Pischke, 2009). Nevertheless, we take this additional estimation approach as it helps us gain some intuition about the role of parental time in mediating the association between maternal work conditions and child outcomes. Yet, we recognize that doing so is not without its problems.

When assessing the role of parental time, we again face issues of selection. For example, more concerned mothers

may select into particular occupations. Analogously those mothers might also provide their children with better care. In a similar vein, more engaged fathers may compensate for any negative effects work conditions may have on their wives by spending more time with their children. In order to address these problems, we pursue the same strategies outlined above: (1) selection on observables, (2) value added approach and (3) fixed effects.

While addressing any endogeneity due to time constant determinants of occupational choice, parenting styles or child development, our proposed strategies do not tackle any bias due to time-varying unobservable determinants. For example, we cannot address bias due to unobserved shocks that may cause mothers' to switch jobs or adjust their child care, such as unexpected changes in children's development.

4. The data

4.1. *The datasets and the sample*

Our identification strategy requires a longitudinal dataset that provides information on children's development, parental time, maternal work conditions and further background information. The data used in this study – the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) – is, to the best of our knowledge, the only longitudinal dataset that provides information on basically all required dimensions. The PSID is a longitudinal, nationally representative study of individuals and families in the United States. It contains comprehensive information on individuals' personal and professional background. In 1997 and 2002, the PSID administered the CDS to include child development measures as well as time diaries of up to two children per parent(s) already included in the original PSID sample.⁴

Despite providing detailed information on parents' professional backgrounds, such as employment status, occupation, wages or work hours, the PSID lacks any information on work-related stressors. For this purpose, we consult the Occupational Information Network (O*NET),⁵ which is a comprehensive database of worker attributes and job characteristics. The information contained in the O*Net draws upon the ratings of occupational analysts as well as surveys from a broad range of workers employed in the respective occupation. Overall, it provides us with detailed information on average characteristics of the workers and the jobs belonging to 965 occupations which correspond to the 3-digit rating of the Standard Occupational Classification. The average occupational features, which are of interest for our study – in particular

characteristics which describe the amount of hazards and stress – can be matched to the sample of mothers in the CDS/PSID via the 3 digit-occupational code.⁶

Our main analysis is based on the second wave of the PSID-CDS (2002), when children are age 5–17. From the initial sample, we drop children for whom we do not possess complete information on test scores. Additionally, we restrict our main sample to children whose mothers are working and report their occupational code. As a result, the main sample, which is used for establishing the association between maternal work conditions and child development, contains 1630 children. We only draw upon the first wave (1997) when employing the value added approach and the fixed effect approach. In order to not unnecessarily restrict the sample further, we impute missing values for children's test scores in 1997.⁷ Notice, however, that parental time investments are not available for all children: we possess information on maternal time investments for 1039 children and on paternal time investments for 734 children. As a consequence, the second part of the analysis is based on these smaller samples.

We would like to emphasize that the final sample consists only of children whose mothers are employed at the time of the survey. Notice that this sample is appropriate for the specific goal of this study: we are not interested in comparing children whose mothers are working versus children whose mothers are staying at home, but we want to evaluate the impact of a marginal change in mothers' 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 employed. To the extent that working mothers differ from non-working mothers, our results may, however, not be generalizable to children of non-working mothers.

4.2. *Variables of interest and descriptive statistics*

In turn, we introduce the main variables, such as the measures of children's cognitive and behavioral development, mothers' work conditions as well as parent-child interactions. [Table 1a](#) presents the descriptive statistics of the variables measured in 2002, the main year of interest, [Table 1b](#) presents all variables available in 1997.

⁶ Using information on occupational characteristics has the advantage of providing rather objective information on the individual work situation. In other words, the description of work conditions on the occupational level does not reflect any individual perception of the work environment. Yet, the disadvantage of using average occupational features is that such measures might only imperfectly describe the individual work environment. Given the absence of any information about work-related stressors in the PSID, we need to rely on average occupational characteristics only and cannot compare alternative measures.

⁷ Notice that children only participate in cognitive and behavioral tests from age 3 onwards (in the case of the passage comprehension score even from age 5 onwards). Thus, in the value added approach and the fixed effect methods, we impute test scores for all children younger than age 3(5) in 1997 by including an informative missing dummy and setting the test score equal to the sample mean. Thus, when using the value added or the fixed effect approach, our analysis only draws on additional information from children born in 1994 or earlier. As a robustness check, we exclude all children born later than 1994. Results barely change and are available upon request.

⁴ The PSID is a longitudinal survey of a representative sample of US individuals and families, which has been ongoing since 1968. Unfortunately from 1997 onwards, the PSID is operated only every second year. As a consequence, all variables which are taken from the PSID – in other words, maternal work conditions as well as any information about the family background – are taken from the surveys in 1997 and 2001.

⁵ 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/>.

Table 1a
Descriptive statistics (variables from year 2002/2001).

	Observations	Mean	Std. dev.
Children's assessment			
Std. letter word score 2002	1630	0.00	1.00
Std. passage comprehension score 2002	1630	0.00	1.00
Std. applied problem solving score 2002	1630	0.00	1.00
Std. behavior problems internal 2002	1630	0.00	1.00
Std. behavior problems external 2002	1630	0.00	1.00
Mothers' work conditions			
Log of wage/hour in US\$ 2001	1630	2.40	0.64
Work hours/week 2001	1630	36.01	12.97
Std. hazards 2001	1630	0.00	1.00
Std. Stress 2001	1630	0.00	1.00
Mother-child relation			
Total time/week (in hours) 2002	1039	35.19	15.17
Structured time/week (in hours) 2002	1039	1.26	2.85
Unstructured time/week (in hours) 2002	1039	14.97	10.81
Educational time/week (in hours) 2002	1039	4.26	5.17
Social time/week (in hours) 2002	1039	3.11	5.57
Fathers' work conditions			
Log wage/hour in US\$ 2001	1054	2.68	0.97
Work hours/week 2001	1054	42.25	15.27
Father-child relation			
Total time/week (in hours) 2002	734	22.58	18.46
Structured time/week (in hours) 2002	734	1.08	2.92
Unstructured time/week (in hours) 2002	734	9.93	10.74
Educational time/week (in hours) 2002	734	2.64	4.95
Social time/week (in hours) 2002	734	2.24	4.85
Child's characteristics			
Male (=1 if yes)	1630	0.50	0.50
White (=1 if yes)	1630	0.48	0.50
Hispanic (=1 if yes)	1630	0.06	0.23
Black (=1 if yes)	1630	0.41	0.49
Age in 2002	1630	11.14	3.53
In school (=1 if yes)	1630	0.87	0.33
Bad health at birth (=1 if yes)	1630	0.09	0.29
Low birth weight (=1 if yes)	1615	0.04	0.21
Mother's characteristics			
Age at childbirth <20 years old	1630	0.08	0.28
Age at childbirth 20–24 years old	1630	0.22	0.42
Age at childbirth 25–29 years old	1630	0.31	0.46
Age at childbirth 30–34 years old	1630	0.26	0.44
Age at childbirth 35–39 years old	1630	0.10	0.48
Age at childbirth >40 years old	1630	0.03	0.17
High school dropout	1513	0.09	0.29
High school education	1513	0.38	0.49
Some college education	1513	0.31	0.46
Single parent (=1 if yes) 2001	1630	0.32	0.47
Low verbal skills 1997	1630	0.50	0.49
Father's characteristics			
Age at childbirth <20 years old	1054	0.01	0.11
Age at childbirth 20–24 years old	1054	0.15	0.36

Table 1a (Continued)

	Observations	Mean	Std. dev.
Age at childbirth 25–29 years old	1054	0.28	0.45
Age at childbirth 30–34 years old	1054	0.32	0.47
Age at childbirth 35–39 years old	1054	0.14	0.50
Age at childbirth >40 years old	1054	0.07	0.26
High school dropout	1054	0.10	0.30
High school education	1054	0.37	0.48
Some college education	1054	0.25	0.43
Working (=1 if yes)	1054	0.92	0.27
Family background			
Number of siblings 2001	1630	1.38	1.30
Grandparents present in 2001	1630	0.05	0.21
Log of family income in US\$ 2002	1630	10.42	1.11
Savings (=1 if yes) 2002	1630	0.45	0.50
Log of savings amount 2002	1630	2.72	3.52
Stocks (=1 if yes) 2002	1630	0.17	0.38
Log of stocks amount 2002	1630	1.08	2.84
Other assets (=1 if yes) 2002	1630	0.26	0.44
Social environment			
Length of residence <1 year 2002	1630	0.13	0.33
Length of residence 1–3 years 2002	1630	0.15	0.36
Length of residence 3–5 years 2002	1630	0.14	0.34
Length of residence >5 years 2002	1630	0.58	0.49
Neighborhood quite safe (=1 if yes)	1630	0.34	0.47
Neighborhood ok (=1 if yes)	1630	0.22	0.41
Neighborhood more/less safe (=1 if yes)	1630	0.31	0.42
Neighborhood not so safe (=1 if yes)	1630	0.10	0.30
Neighborhood unsafe (=1 if yes)	1630	0.03	0.16
City size: >0.5 mio. people 2001	1630	0.19	0.39
City size: 100k–499k people 2001	1630	0.27	0.44
City size: 50k–99k people 2001	1630	0.11	0.32
City size: 25k–49k people 2001	1630	0.11	0.31
City size: 10k–24k people 2001	1630	0.16	0.36
City size: <10k people 2001	1630	0.16	0.37
By relatives (=1 if yes)	1630	0.18	0.39
By non-relatives (=1 if yes)	1630	0.05	0.21
In formal care (=1 if yes)	1630	0.12	0.32

The CDS provides detailed information on both children's cognitive and behavioral development. The Woodcock Johnson Revised Test of Achievement (WJ-R) measures the cognitive performance and is administered for children age 3 and older. The WJ-R is a widely recognized measure of cognitive ability. Verbal ability is measured using two subtests: vocabulary and reading comprehension. Analytical ability is measured using tests of applied problem solving skills. Two behavioral problem indices, developed by Peterson and Zill (1986), serve as indicators for children's socio-behavioral development. The Internal Behavior Problem Index captures negative feelings children may have towards themselves, adults and other children. The External Behavior Problem Index measures characteristics such as sudden mood changes, anxiousness, and meanness towards others. In the case of

Table 1b
Descriptive statistics lagged variables (variables from year 1997/1996).

	Observations	Mean	Std. dev.
Children's assessment			
Std. letter word score 1997	1043	0.00	1.01
Std. passage comprehension score 1997	741	0.00	1.00
Std. applied problem solving score 1997	1043	0.00	1.00
Std. behavior problems internal 1997	1043	0.00	1.00
Std. behavior problems external 1997	1043	0.00	1.00
Mothers' work conditions			
Log wage/hour in US\$ 1996	1630	2.11	0.49
Work hours/week 1996	1630	34.48	10.93
Std. hazards 1996	1630	0.00	1.00
Std. stress 1996	1630	0.00	1.00
Mother-child relation			
Total time/week (in hours) 1997	1039	44.93	17.93
Structured time/week (in hours) 1997	1039	1.22	2.57
Unstructured time/week (in hours) 1997	1039	21.55	12.76
Educational time/week (in hours) 1997	1039	3.36	4.87
Social time/week (in hours) 1997	1039	3.07	5.51
Fathers' work conditions			
Log wage/hour in US\$ 1996	876	2.67	0.63
Work hours/week 1996	876	45.60	9.64
Father-child relation			
Total time/week (in hours) 1997	734	26.76	17.77
Structured time/week (in hours) 1997	734	1.77	3.58
Unstructured time/week (in hours) 1997	734	12.91	10.81
Educational time/week (in hours) 1997	734	1.67	3.57
Social time/week (in hours) 1997	734	2.09	4.46
Child's characteristics			
Age in 1997	1630	6.14	3.53
Background characteristics			
Mother: high school dropout 1997	1630	0.10	0.30
Mother: high school education 1997	1630	0.36	0.48
Mother: some college education 1997	1630	0.29	0.45
Single parent (=1 if yes) 1997	1630	0.27	0.44
Number of siblings 2001	1630	1.22	1.03
Grandparents present in 2001	1630	0.05	0.21
Length of residence <1 year 2002	1024	0.15	0.35
Length of residence 1–3 years 2002	1024	0.24	0.43
Length of residence 3–5 years 2002	1024	0.18	0.38
Length of residence >5 years 2002	1024	0.43	0.50
Neighborhood quite safe (=1 if yes)	1024	0.28	0.45
Neighborhood more/less safe (=1 if yes)	1024	0.33	0.47
Neighborhood not so safe (=1 if yes)	1024	0.24	0.43
Neighborhood unsafe (=1 if yes)	1024	0.12	0.33

the WJ-R test a higher value signifies a better performance; in the case of the Behavior Problem Indices a higher value signifies more problems. All child development indices are standardized to have a mean of 0 and a variance of 1.

Mothers' work conditions are taken from the CDS/PSID and the O*Net. The CDS/PSID provides information on work hours, measured as hours per week, wages, and the occupational code, while the O*Net contains occupational features related to hazards and stress. As mentioned above, the O*Net provides detailed information on a set of features describing the type and amount of hazards and stress involved in mothers' occupation: the requirement of common or special safety equipment, exposure to contaminants, risk of diseases or infections, hazardous conditions or equipment, 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. Each of these features is measured on a scale from 0 to 100 where 0 indicates no exposure to the respective condition at all and 100 indicate full exposure to the respective condition. For the purpose of significance and plausible interpretation, we develop a factor-based scale, constructed employing factor analysis.⁸ The two resulting indices, summarized as "workload" and "hazards", are standardized to a zero mean and a variance of one.

For illustrative purposes, Table 2 presents the average scores of the hazard and stress indices for the most common occupations in our sample. Child care workers are exposed to the most typical levels of hazards (−0.19 s.d.) and stress (0.09 s.d.). Accountants experience the least amount of hazards (−1.23 s.d.) and the least amount of stress (−1.86 s.d.), while assemblers experience the most amount of hazards (1.54 s.d.) and investigators the most amount of stress (2.21 s.d.). Nurses and restaurant managers experience both above average stress and hazards levels (1.02 s.d. and 0.78 s.d. hazards and 1.46 s.d. and 1.62 s.d. stress, respectively).

A unique aspect of the PSID-CDS is the time use module. Up to two children in each family were asked to complete a random weekend and a random weekday time diary.⁹ Time diaries collected information on the type of activities that were performed and the duration of time spent on each activity. In addition, it also collected information on who was present with the child for each activity. Based on this information and previous literature on parental time (Hart & Risley, 1995; Lareau, 2002; Yeung, Linver, & Brooks-Gunn, 2002), we construct the following measures of time spent with the mother as well as the father, separately¹⁰:

⁸ In particular, 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.

⁹ Depending on the age children completed time diaries along with their mothers.

¹⁰ Total time can be divided into six mutually exclusive and exhaustive categories – the four activities specified in the text (i.e. education, structured, unstructured and social time) as well as personal care and housework. Personal care includes care the child received from parents

Table 2
Work conditions in women's most frequent occupations.

	Occupation	%	Cumul. %	Hazards	Stress
1	Elementary school teacher	5	5	−0.757	−0.080
2	Managers and administrator	5	9	−0.652	0.673
3	Bookkeeper	4	13	−0.952	−0.462
4	Secretary	4	17	−0.505	−0.175
5	Nursing aide	3	20	0.381	0.469
6	Child care worker	3	23	−0.187	0.087
7	Registered nurse	3	26	1.015	1.463
8	Clerical worker	3	28	−1.009	0.043
9	(Pre-)kindergarten teacher	2	31	−0.453	−0.547
10	Investigator	2	33	−0.925	2.205
11	Assembler	2	35	1.536	−1.346
12	Cleaner	2	37	1.017	−1.662
13	Accountant	2	39	−1.230	−1.861
14	Office manager	2	41	−1.009	0.043
15	Sales woman	2	43	−0.404	0.436
16	Cashier	2	45	−0.314	0.799
17	Social worker	1	46	−0.722	1.513
18	Restaurant manager	1	47	0.776	1.617
19	Cook	1	49	1.526	0.195
20	Clerical supervisor	1	50	−0.652	0.673

Note: The averages displayed above are based on the sample used in this study.

1. Total time, which is measured as total hours per week children spend with the parent.
2. Education-oriented activities, which include time spent studying, doing homework, reading and being read to as well as time spent in educational lessons.
3. Structured activities, which include classes for leisure (e.g. music, art and dance lessons), organized sports or leisure activities (e.g. sports, photography, crafts, music and theater).
4. Unstructured activities, which include playing, watching t.v., listening to music, and all unspecified leisure activities (e.g. activities reported as “doing nothing” or “wasted time”).
5. Social activities, which include visiting others, attending events (e.g. sports, museums, zoo, religious or other social events such as youth and volunteer organizations).

Finally, 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' marital status, education, verbal skills, as well as age at child birth. With respect to fathers' characteristics, we control for their age at childbirth, their education and

such as bathing, changing and grooming, as well as eating meals together. Household activities include housework, shopping and caring of siblings. These categories were not included in the main analysis for several reasons. First, they are reflected in total time. Second, in analysis not shown here but available upon request, our findings show that these activities are not significantly correlated to maternal work conditions nor are they significantly related to children's outcomes.

their employment status. Considered family background features are the household structure (presence of further siblings and grand-parents) and financial means (household income, stocks, savings and other assets). We also control for a set of dummies describing the type of care children receive when not being in school (e.g. relatives, non-relatives or formal care arrangements). Finally, we include some measures describing the social environment such as the safety of the neighborhood, the size of the next bigger city and the length of residence in the neighborhood.

Notice that all 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. In order to preserve our sample size, we impute missing values on all covariates by setting them to the sample mean and including indicators if values were missing. Moreover, in the fixed effect analysis we can only include variables which are available for both periods.

5. Results

5.1. Selection into specific work conditions

In a first step we want to shed some light on mothers' occupational selection. Doing so helps us to gain some intuition about which mothers are exposed to work-related stressors.

Table 3 displays correlations between mothers' background characteristics and the level of hazards and stress mothers are exposed to at work. Additionally, it displays correlations between adjustments over time (between the two consecutive waves of the PSID-CDS) regarding both work conditions as well as background features. Thus, the first set of correlations helps us to understand which are potentially confounding variables in the OLS regressions, while the second set helps us to get some idea about remaining confounders in the fixed effect regressions.

To begin with, mothers' endowment at the beginning of their career, such as their education and verbal skills, seems to be among the most influential determinants of their working conditions. Education appears to be the most important prerequisite for favorable working conditions: mothers who have dropped out of high school are significantly more likely to be exposed to hazards than their more educated counterparts. Mothers with a high school degree have still a higher propensity to be exposed to work-related hazards, while mothers' with a college degree are less likely to work under hazardous conditions. The amount of hazards mothers are exposed to at work correlates also strongly with mothers' verbal skills. In particular, mothers with a relatively low verbal skill endowment (below the median) work in more hazardous job. Interestingly, the correlations regarding the level of stress stand in stark contrast to the correlations regarding the level of hazards: less educated and less verbally skilled women are exposed to a lower level of stress than higher educated and higher verbally skilled women.

A similar picture arises with respect to women's socioeconomic background. Women from more advantaged families – with higher family income, savings, stocks,

Table 3
Precipitants of the level and changes of work-related hazards and stress.

	Level		Change	
	Hazards	Stress	Hazards	Stress
Mother's work conditions				
Std. stress	−0.219*** (0.024)	–	−0.210*** (0.0271)	–
Std. hazards	–	−0.219*** (0.024)	–	−0.169*** (0.022)
Work hours/week	0.130 (0.321)	1.174*** (0.320)	2.010*** (0.477)	0.248 (0.431)
Log wage/hour	−0.095*** (0.016)	0.086*** (0.016)	0.154*** (0.033)	−0.004 (0.030)
Mother's characteristics				
Age at childbirth	−0.015*** (0.004)	0.005 (0.004)	–	–
Single (=1 if yes)	0.057*** (0.012)	0.006 (0.012)	0.03*** (0.010)	−0.007 (0.009)
School dropout	0.764*** (0.086)	−0.427*** (0.088)	−0.000 (0.004)	−0.007** (0.003)
High school graduate	0.048*** (0.012)	−0.014 (0.012)	0.002 (0.005)	−0.008 (0.005)
College graduate	−0.049*** (0.011)	0.031*** (0.011)	−0.002 (0.006)	0.008 (0.005)
Low verbal skills	0.081*** (0.012)	−0.028** (0.012)	–	–
Father's characteristics				
Age at birth	−0.011*** (0.002)	0.001 (0.002)	–	–
School dropout	0.271*** (0.10)	−0.271** (0.100)	−0.002 (0.003)	0.003 (0.003)
High school graduate	0.005 (0.011)	−0.000 (0.011)	0.001 (0.005)	−0.009** (0.004)
College graduate	−0.036*** (0.009)	0.015* (0.009)	−0.011*** (0.004)	0.0023 (0.0038)
Employment	−0.302*** (0.051)	0.021 (0.052)	−0.089** (0.038)	0.078 (0.087)
Child's characteristics				
Age in 1997	0.015* (0.008)	0.002 (0.007)	–	–
Male	−0.010 (0.012)	0.004 (0.012)	–	–
White	−0.095*** (0.012)	0.007 (0.012)	–	–
Black	0.235*** (0.050)	0.121** (0.050)	–	–
Hispanic	0.037*** (0.006)	−0.033*** (0.006)	–	–
Low birth weight (=1 if yes)	0.015 (0.017)	−0.008 (0.005)	–	–
Bad health at birth (=1 if yes)	0.014 (0.015)	0.003 (0.007)	–	–
Family characteristics				
Number of siblings	0.023 (0.032)	0.054* (0.032)	−0.067** (0.028)	0.066*** (0.025)
Grandparents present (=1 if yes)	0.310* (0.158)	0.141 (0.158)	0.001 (0.005)	−0.003 (0.005)
Log family income	−0.198*** (0.027)	0.057** (0.028)	–	–
Savings (=1 if yes)	−0.070*** (0.012)	0.008 (0.012)	–	–
Log savings	−0.441*** (0.087)	−0.010 (0.087)	–	–
Stocks (=1 if yes)	−0.038*** (0.009)	0.000 (0.009)	–	–
Log stocks	−0.315*** (0.070)	−0.038 (0.070)	–	–
Other assets	−0.002 (0.011)	0.015 (0.011)	–	–
Neighborhood characteristics				
Residence (1 = <1 year, 4 = >5 years)	−0.032 (0.022)	−0.004 (0.022)	0.069 (0.049)	0.081* (0.044)

Table 3 (Continued)

	Level		Change	
	Hazards	Stress	Hazards	Stress
Neighborhood (1 = safe, 5 = unsafe)	0.090*** (0.023)	−0.011 (0.023)	−0.007 (0.041)	0.082** (0.037)
Child care				
Alone (=1 if yes)	0.025 (0.120)	0.016 (0.012)	−	−
Relatives (=1 if yes)	0.009 (0.010)	0.017 [†] (0.010)	−	−
Non-relatives (=1 if yes)	−0.010 (0.005)	0.010 [†] (0.005)	−	−
Formal care (=1 if yes)	−0.019** (0.008)	−0.004 (0.008)	−	−

Note: The displayed correlations are based on the sample under study (1630 observations).

[†] 10% significance level.

** 5% significance level.

*** 1% significance level.

Table 4

Maternal work conditions and children's cognitive development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Letter word score				
Log wage	0.239*** (0.049)	0.089** (0.044)	0.056 (0.041)	0.005 (0.035)
Hours worked	−0.006*** (0.002)	−0.005** (0.002)	−0.003 (0.002)	−0.005*** (0.001)
Hazards	−0.107*** (0.029)	−0.064** (0.029)	−0.049 [†] (0.026)	−0.055** (0.024)
Stress	−0.004 (0.027)	0.004 (0.027)	−0.002 (0.024)	0.012 (0.022)
Panel B: Passage comprehension score				
Log wage	0.135*** (0.0433)	0.004 (0.039)	−0.002 (0.036)	−0.016 (0.038)
Hours worked	−0.005** (0.002)	−0.004 [†] (0.002)	−0.003 (0.002)	−0.004*** (0.001)
Hazards	−0.100*** (0.030)	−0.064** (0.029)	−0.053 [†] (0.028)	−0.049 [†] (0.026)
Stress	0.023 (0.026)	0.025 (0.025)	0.021 (0.023)	0.004 (0.024)
Panel C: Applied problem solving score				
Log wage	0.208*** (0.058)	0.036 (0.054)	0.004 (0.051)	−0.051 (0.036)
Hours worked	−0.007*** (0.002)	−0.005** (0.002)	−0.003 (0.002)	−0.005*** (0.001)
Hazards	−0.111*** (0.030)	−0.062** (0.028)	−0.049 [†] (0.026)	−0.048 (0.025)
Stress	−0.037 (0.028)	−0.025 (0.025)	−0.031 (0.023)	−0.028 (0.023)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1630	1630	1630	3260
# of individuals	1630	1630	1630	1630

Note: The displayed coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996.

Further control variables are child characteristics (gender, age, race, health status at birth and birth weight), mothers' characteristics (age at child birth, education, single mother and verbal skills), fathers' characteristics (age at child birth, education and labor force status), household characteristics (number of siblings, presence of grandparents, logarithm of family income, savings, stock holdings and assets), neighborhood characteristics (length of residence in the neighborhood, safety and size of closest city) and extra-familial care (by relatives, by non-relative or in formal-care).

The lagged dependent variable refers to the respective test score in 1997.

[†] 10% significance level.

** 5% significance level.

*** 1% significance level.

Table 5
Maternal work conditions and children's behavioral development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Internal behavioral problems				
Log wage	-0.102** (0.0487)	-0.076 (0.047)	-0.062 (0.043)	-0.112*** (0.041)
Hours worked	0.001 (0.002)	0.002 (0.002)	0.001 (0.002)	-0.002 (0.002)
Hazards	0.038 (0.029)	0.033 (0.030)	0.024 (0.026)	0.027 (0.028)
Stress	0.058** (0.027)	0.058** (0.027)	0.055** (0.025)	0.048* (0.025)
Panel B: External behavioral problems				
Log wage	-0.125*** (0.041)	-0.068 (0.042)	-0.040 (0.038)	-0.047 (0.038)
Hours worked	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	-0.003* (0.001)
Hazards	0.017 (0.027)	-0.000 (0.029)	-0.002 (0.025)	0.011 (0.026)
Stress	-0.011 (0.028)	-0.027 (0.027)	-0.025 (0.024)	0.007 (0.024)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1630	1630	1630	3260
# of individuals	1630	1630	1630	1630

Note: The displayed coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996.

Further control variables are child characteristics (gender, age, race, health status at birth and birth weight), mothers' characteristics (age at child birth, education, single mother and verbal skills), fathers' characteristics (age at child birth, education and labor force status), household characteristics (number of siblings, presence of grandparents, logarithm of family income, savings, stock holdings and assets), neighborhood characteristics (length of residence in the neighborhood, safety and size of closest city) and extra-familial care (by relatives, by non-relative or in formal-care).

The lagged dependent variable refers to the respective behavioral problems in 1997.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

Table 6
Maternal work conditions and maternal total time.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Log wage	0.833 (0.789)	0.936 (0.842)	0.934 (0.842)	0.246 (1.005)
Hours worked	-0.061 (0.039)	-0.062 (0.0415)	-0.050 (0.0410)	-0.096** (0.039)
Hazards	-1.325*** (0.502)	-1.315** (0.524)	-1.271** (0.532)	-0.839 (0.779)
Stress	-1.652*** (0.494)	-1.797*** (0.503)	-1.786*** (0.504)	-1.100* (0.671)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1039	1039	1039	2078
# of individuals	1039	1039	1039	1039

Note: The displayed coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996.

Further control variables are child characteristics (gender, age, race, health status at birth and birth weight), mothers' characteristics (age at child birth, education, single mother and verbal skills), fathers' characteristics (age at child birth, education and labor force status), household characteristics (number of siblings, presence of grandparents, logarithm of family income, savings, stock holdings and assets), neighborhood characteristics (length of residence in the neighborhood, safety and size of closest city) and extra-familial care (by relatives, by non-relative or in formal-care).

The lagged dependent variable refers to the respective maternal time investment in 1997.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

Table 7
Maternal work conditions and maternal time (disaggregated).

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Structured time				
Log wage	0.305 (0.187)	-0.032 (0.183)	-0.025 (0.183)	0.056 (0.169)
Hours worked	-0.008 (0.007)	-0.005 (0.008)	-0.005 (0.008)	0.003 (0.007)
Hazards	-0.056 (0.105)	0.092 (0.109)	0.102 (0.108)	-0.115 (0.131)
Stress	-0.209* (0.119)	-0.194* (0.111)	-0.195* (0.111)	-0.036 (0.113)
Panel B: Unstructured time				
Log wage	-0.698 (0.579)	-0.099 (0.599)	-0.067 (0.590)	-0.239 (0.721)
Hours worked	-0.018 (0.025)	-0.019 (0.026)	-0.015 (0.026)	-0.044 (0.028)
Hazards	-0.192 (0.358)	-0.472 (0.371)	-0.496 (0.369)	-0.727 (0.558)
Stress	-0.735** (0.357)	-1.066*** (0.370)	-1.063*** (0.368)	-0.621 (0.481)
Panel C: Educational time				
Log wage	0.602** (0.258)	0.488* (0.259)	0.479* (0.259)	0.244 (0.309)
Hours worked	-0.019 (0.014)	-0.017 (0.015)	-0.016 (0.015)	-0.003 (0.012)
Hazards	-0.207* (0.118)	-0.128* (0.066)	-0.118* (0.066)	-0.319 (0.189)
Stress	-0.294 (0.196)	-0.246 (0.196)	-0.258 (0.197)	-0.282 (0.206)
Panel D: Social time				
Log wage	0.193 (0.305)	0.134 (0.363)	0.028 (0.359)	-0.643* (0.333)
Hours worked	-0.005 (0.015)	-0.006 (0.017)	-0.003 (0.017)	-0.024* (0.013)
Hazards	-0.226 (0.196)	-0.230 (0.204)	-0.216 (0.205)	0.074 (0.258)
Stress	-0.224* (0.131)	-0.131* (0.075)	-0.106* (0.062)	-0.213* (0.122)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1039	1039	1039	2078
# of individuals	1039	1039	1039	1039

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 6.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

and safer neighborhoods – are less likely to work under strenuous conditions. Yet, the socio-economic background seems to play less of a role for mothers' exposure to stress.

While white mothers are less likely to work under hazardous conditions, black and Hispanic mothers are more likely to be exposed to hazards. Hispanic mothers are, however, less likely to be exposed to stress at work.

The mutual correlations between work-related stressors reveal an interesting pattern: it seems that there is a trade-off between work-related hazards and stress. Women who work under hazardous conditions seem to be less likely to be exposed to stress, and vice versa. The level of stress is, however, positively related to working hours and wages.

The trade-off between work-related stressors becomes furthermore apparent when analyzing the correlations between changes in women's professional and personal

conditions over time. When changing into an occupation involving more hazards, women reduce the level of stress, and vice versa. Improvements in women's working conditions are strongly correlated with their partner's situation. When the partner completes further education or starts working, women change into a less hazardous job. The opposite is true in case of marital status.

5.2. Maternal work conditions and child development

How do maternal work conditions relate to their children's development? Table 4 displays the results of the different estimations – no control variables, selection-on-observables, value added approach and fixed effects – linking maternal work conditions to children's cognitive development. Table 5 displays the results for children's socio-behavioral outcomes.

Table 8
Maternal time and children's cognitive development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Letter word score				
Total time	0.005** (0.002)	0.004 (0.002)	0.003 (0.002)	0.001 (0.001)
Structured time	0.033*** (0.011)	0.012 (0.010)	0.013 (0.009)	0.010 (0.008)
Unstructured time	−0.008** (0.003)	−0.006** (0.003)	−0.003 (0.003)	−0.001 (0.002)
Educational time	0.022** (0.007)	0.017** (0.007)	0.010* (0.005)	0.007* (0.004)
Social time	0.011 (0.007)	0.007 (0.007)	0.004 (0.006)	−0.000 (0.004)
Panel B: Passage comprehension score				
Total time	0.004* (0.002)	0.002 (0.002)	0.001 (0.002)	−0.0017 (0.001)
Structured time	0.027*** (0.009)	0.006 (0.008)	0.007 (0.007)	0.006 (0.008)
Unstructured time	−0.006** (0.003)	−0.004 (0.003)	−0.003 (0.003)	−0.001 (0.002)
Educational time	0.018*** (0.007)	0.010 (0.007)	0.006 (0.007)	0.005 (0.005)
Social time	0.013** (0.005)	0.011** (0.005)	0.010** (0.005)	0.005 (0.004)
Panel C: Applied problem solving score				
Total time	0.003 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.001)
Structured time	0.041*** (0.012)	0.011 (0.011)	0.009 (0.010)	0.013* (0.008)
Unstructured time	−0.009** (0.003)	−0.006** (0.003)	−0.005 (0.003)	−0.001 (0.002)
Educational time	0.024*** (0.007)	0.015** (0.007)	0.011* (0.006)	0.007* (0.004)
Social time	0.013** (0.003)	0.011* (0.001)	0.011* (0.001)	0.003 (0.001)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1039	1039	1039	2078
# of individuals	1039	1039	1039	1039

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 4.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

Mothers' wages, work hours and physical hazards, on the one hand and children's cognitive development, on the other hand, are significantly correlated (see Table 4, column 1). As expected maternal wages are positively correlated with all measures of children's cognitive development, ranging from an increase in cognitive skills by 0.01 s.d. (passage comprehension score and applied problem solving score) to 0.02 s.d. (letter word score) in exchange for an increase in wages by 10%. Work hours and physical hazards are negatively correlated with children's cognitive development: an increase in work hours by 1 h per week is associated with a decrease by 0.01 s.d. in all disciplines, and an increase in physical hazards by one s.d. is associated with a decrease by 0.11 s.d. in all disciplines. Interestingly, exposure to psychological stress at work does not correlate with children's cognitive outcomes.

The described correlations are, however, significantly weaker once we control for the extensive set of control variables (see Table 4, column 2). The impact of earnings only

survives with respect to children's vocabulary, but loses in magnitude (an increase in wages by 10% is now associated with an increase in children's letter word score by 0.01 s.d.); the association between hazards and children's cognitive outcomes remains significant across all measured dimensions, but is also reduced by almost half (an increase in physical hazards by one s.d. is associated to a deterioration in children's verbal and analytical skills by 0.06 s.d.); only the link between maternal work hours and children's cognitive skills remains unchanged and amounts to a decrease by 0.01 s.d. in all three cognitive measures for each hour worked per week.

Once, we take children's past cognitive development into account, the observed associations between maternal earnings and work hours, vanish completely (see Table 4, column 3). Only the association between mothers' exposure to physical hazards remains unchanged, both in terms of magnitude and significance. It also does so when considering any type of unobservable time constant determinants

Table 9
Maternal time and children's behavioral development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Internal behavioral problems				
Total time	–0.002 (0.002)	–0.003 (0.002)	–0.002 (0.002)	–0.001 (0.001)
Structured time	–0.015 (0.010)	–0.009 (0.010)	–0.008 (0.009)	0.002 (0.009)
Unstructured time	0.002 (0.003)	0.001 (0.003)	0.000 (0.003)	–0.001 (0.002)
Educational time	0.007 (0.006)	0.008 (0.006)	0.011* (0.006)	0.006 (0.005)
Social time	–0.014* (0.006)	–0.012* (0.006)	–0.010* (0.005)	–0.008* (0.004)
Panel B: External behavioral problems				
Total time	–0.004* (0.002)	–0.004** (0.002)	–0.004** (0.002)	–0.002 (0.001)
Structured time	–0.009 (0.010)	0.010 (0.010)	0.005 (0.010)	–0.008 (0.008)
Unstructured time	0.006* (0.003)	0.002 (0.003)	–0.001 (0.003)	–0.003 (0.002)
Educational time	–0.008 (0.006)	–0.002 (0.006)	0.004 (0.005)	0.004 (0.004)
Social time	–0.017*** (0.006)	–0.015** (0.006)	–0.013*** (0.005)	–0.005 (0.004)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1039	1039	1039	2078
# of individuals	1039	1039	1039	1039

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 5.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

of children's cognitive development (see Table 4, column 4). In this set of regressions, the influence of mothers' absence due to work on children's cognitive development becomes again apparent: 10 h more work per week relates to a reduction in children's cognitive skills by 0.05 s.d. across different test dimensions, an effect which is comparable to an increase in mothers' exposure to hazards by one s.d.

Moving to the results regarding children's socio-behavioral outcomes, we observe a slightly different pattern (see Table 5). First of all, children's feelings regarding themselves or others, measured by the internal behavioral problem score, are significantly correlated with mothers' earnings and work-related psychological stress, not, however, with the amount of hours worked nor the exposure to physical hazards at work. The magnitude of these correlations remains basically constant across all specifications: while an increase in mothers' hourly wage by 10% relates to a reduction in children's internal behavioral problems by 0.01 s.d. (this coefficient gets, however, reduced by 25% and 30% in the selection-on-observable approach and the valued-added approach, respectively), an increase in the exposure to psychological stressors by one s.d. is associated with a worsening of children's internal behavioral problems by 0.05–0.06 s.d. Children's external behavioral problems, such as sudden mood changes, anxiousness, and meanness towards others seem to be completely unrelated to mothers' work conditions.

5.3. Maternal work conditions and maternal time

Do maternal work conditions influence children's development by reducing maternal time investments? Table 6 displays the results regarding the correlations between maternal work conditions and mothers' overall time dedicated to their children. Table 7 goes one step further and distinguishes between the different aspects of maternal time investments.

Overall, we can see that work-related stressors significantly and negatively correlate with maternal time investments (see Table 6, column 1). This is equally true for work-related hazards and stress: an increase by one s.d. is associated with a decrease in maternal time by 1.33 h per week and 1.66 h per week, respectively. Work hours and wages do not correlate significantly with mothers' time devoted to their children. Neither observable differences in mothers' individual and family background (see Table 6, column 2) nor children's past performance in the respective test (see Table 6, column 3) can explain this negative correlation. Only differences in mothers' unobservable preferences or attitudes (see Table 6, column 4) partially reduce this negative correlation. Specifically, we see that once we employ a fixed effect method the coefficient of hazards turns insignificant and is reduced by 30%. The correlation between psychological stress at work and maternal time also decreases by 30%, but remains significant at the 10% significance level: mothers who are exposed

Table 10
Work conditions, children's cognitive development and time as a mediator.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Letter word score				
Log wage	0.226*** (0.048)	0.084 [†] (0.044)	0.055 (0.040)	0.004 (0.035)
Hours worked	-0.006** (0.002)	-0.005** (0.002)	-0.003* (0.002)	-0.005*** (0.001)
Hazards	-0.095*** (0.029)	-0.041 (0.029)	-0.027 (0.026)	-0.054** (0.024)
Stress	0.008 (0.027)	0.010 (0.027)	0.002 (0.024)	0.013 (0.022)
Educational time	0.018*** (0.007)	0.014** (0.007)	0.007 (0.006)	0.008* (0.004)
Panel B: Passage comprehension score				
Log wage	0.121*** (0.043)	0.005 (0.039)	0.005 (0.036)	-0.017 (0.038)
Hours worked	-0.005** (0.002)	-0.004 [†] (0.002)	-0.003 (0.002)	-0.004*** (0.001)
Hazards	-0.083*** (0.030)	-0.051 [†] (0.029)	-0.036 (0.027)	-0.048* (0.026)
Stress	0.038 (0.026)	0.030 (0.025)	0.029 (0.023)	0.005 (0.024)
Educational time	0.016** (0.007)	0.011 (0.007)	0.007 (0.007)	0.005 (0.005)
Panel C: Applied problem solving score				
Log wage	0.192*** (0.057)	0.029 (0.055)	0.001 (0.051)	-0.053 (0.036)
Hours worked	-0.006*** (0.002)	-0.005** (0.002)	-0.003 (0.002)	-0.005*** (0.001)
Hazards	-0.095*** (0.030)	-0.059** (0.028)	-0.036 (0.026)	-0.047* (0.025)
Stress	-0.022 (0.027)	-0.021 (0.025)	-0.025 (0.023)	-0.026 (0.023)
Educational time	0.021*** (0.007)	0.015** (0.007)	0.011 (0.007)	0.008* (0.004)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1630	1630	1630	3260
# of individuals	1630	1630	1630	1630

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 4.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

to one more s.d. stress at work provide their children with 1.10 h per week less total care. Comparing the coefficient of stress to the coefficient of working hours may offer some intuition about the effect of work-related stress: 11 h of work have the same impact on mothers' time investments per week as a one s.d. increase in work-related stress.

Physical hazards and psychological stress relate, however, to very different aspects of maternal time investments. As we can see in Table 7 column 1, mothers' who work in hazardous jobs spent less time in educational activities, while mothers who work in stressful jobs reduce their time spent in structured activities, but also in unstructured and social activities. The correlation between physical hazards and educational time remains significant when controlling for any observable as well as unobservable time constant characteristics of mothers and families. Specifically, we find that a one s.d. increase in physical hazards is associated with a reduction of 0.32 h per week spent in educational activities (see Table 7, column 4). The

correlations between psychological stress and maternal time investments turn, however, insignificant once we employ the fixed effect method. The only exception is social time: a one s.d. increase in stress is associated with a reduction in social activities by 0.21 h per week.

Taken together, mothers who are exposed to certain stressors at work spent significantly less time with their children doing educationally and socially orientated activities.

5.4. Maternal time and child development

To what extent do these activities matter for children's development? Tables 8 and 9 display the results regarding the impact of mothers' overall time and different maternal time investments on children's cognitive and socio-behavioral development, respectively.

Column 1 in Table 8 shows that both overall time and the different activities are significantly correlated with all

Table 11
Work conditions and children's behavioral development and time as a mediator.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Internal behavioral score				
Log wage	-0.100** (0.048)	-0.068 (0.048)	-0.0580 (0.043)	-0.114*** (0.041)
Hours worked	0.001 (0.002)	0.002 (0.002)	0.001 (0.002)	-0.002 (0.002)
Hazards	0.035 (0.029)	0.026 (0.030)	0.020 (0.026)	0.027 (0.028)
Stress	0.051* (0.027)	0.051* (0.027)	0.046* (0.025)	0.045* (0.025)
Social time	-0.013** (0.006)	-0.013** (0.006)	-0.011** (0.005)	-0.004 (0.005)
Panel A: External behavioral score				
Log wage	-0.120*** (0.040)	-0.059 (0.042)	-0.032 (0.037)	-0.049 (0.038)
Hours worked	0.0010 (0.002)	0.002 (0.002)	0.001 (0.002)	-0.003* (0.001)
Hazards	0.008 (0.028)	-0.007 (0.028)	-0.007 (0.025)	0.011 (0.026)
Stress	-0.019 (0.028)	-0.032 (0.027)	-0.028 (0.024)	0.007 (0.024)
Social time	-0.016*** (0.006)	-0.016*** (0.006)	-0.014*** (0.005)	-0.004 (0.004)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	1630	1630	1630	3260
# of individuals	1630	1630	1630	1630

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 5.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

three measures of children's cognitive development. The picture, however, changes as soon as we control for the comprehensive set of current and past background characteristics (see Table 8, column 2). When looking at children's abilities with respect to vocabulary, passage comprehension and applied problem solving skills, maternal time does not seem to have a noteworthy effect. Only educationally and socially orientated activities seem to matter for children's cognitive development. The same results hold true once we include lagged test scores in the regression: a 1-h increase in educational time relates to a 0.01 s.d. increase in all three dimensions of children's cognitive skills, while a 1-h increase in social time only relates to a 0.01 s.d. increase in children's passage comprehension and applied problem solving score, not, however, in children's letter word score. Finally, the results of the fixed effect approach in column 4 reveal that educational time is positively correlated with the letter word score and the applied problem solving score and that structured time is positively associated with the applied problem solving score.

For children's behavior, only socially orientated activities of the mother matter (see Table 9). The correlations between social activities and children's internal and external behavioral problems amount to 0.1 s.d. and 0.02 s.d., respectively. When controlling for any observable differences as well as for the score in the respective test, the correlations remain significant and maintain basically the same magnitude. Only when considering

additionally any time constant unobservable determinants of children's behavior, the correlation between mothers' socially oriented activities and children's behavior loses precision and magnitude: in the case of children's internal behavioral problem the coefficient of socially orientated activities amounts to 0.01 s.d. and is significant at the 10% significance level; in the case of external behavioral problems none of the time investments seem to matter.

5.5. Maternal time as a mediator

The findings so far suggest that educational time may act as a channel through which mothers' exposure to physical hazards at work may affect their children's cognitive development and social time may act as a channel through which mothers' exposure to psychological stress at work may affect their children's behavior. Nevertheless, the magnitude of our estimates also highlights the fact that the mediating effect of maternal time is rather small. Specifically, educational time may explain 5% of the negative correlation between mothers' exposure to work related hazards and children's cognitive development. Likewise, social time may at most explain 4% of the positive correlation between mothers' exposure to work related stress and children's behavioral development.

In another effort to quantify the mediating effect of maternal time, we re-estimate the models predicting the effect of work conditions on children development but

Table 12
Maternal work conditions and paternal time.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Structured time				
Log wage	−0.025 (0.286)	−0.281 (0.293)	−0.279 (0.288)	−0.287 (0.239)
Hours worked	0.003 (0.008)	0.007 (0.011)	0.004 (0.010)	−0.004 (0.010)
Hazards	−0.190 (0.143)	−0.036 (0.132)	−0.044 (0.130)	−0.174 (0.200)
Stress	−0.163 (0.171)	−0.187 (0.158)	−0.197 (0.155)	−0.318* (0.180)
Panel B: Unstructured time				
Log wage	−0.894 (0.723)	−0.518 (0.708)	−0.259 (0.624)	−0.828 (0.798)
Hours worked	0.02 (0.031)	0.018 (0.033)	0.009 (0.031)	−0.012 (0.034)
Hazards	−0.191 (0.489)	−0.103 (0.483)	−0.145 (0.457)	−0.592 (0.666)
Stress	−0.415 (0.461)	−0.486 (0.474)	−0.514 (0.446)	0.211 (0.601)
Panel C: Educational time				
Log wage	0.400 (0.268)	0.182 (0.288)	0.181 (0.290)	0.251 (0.347)
Hours worked	0.007 (0.016)	0.003 (0.018)	0.002 (0.018)	0.003 (0.015)
Hazards	−0.243 (0.193)	−0.138 (0.191)	−0.132 (0.191)	−0.230 (0.290)
Stress	−0.376 (0.252)	−0.306 (0.258)	−0.305 (0.257)	−0.485* (0.261)
Panel D: Social time				
Log wage	0.031 (0.350)	−0.084 (0.410)	−0.118 (0.409)	−0.310 (0.380)
Hours worked	0.005 (0.017)	0.008 (0.019)	0.008 (0.019)	−0.001 (0.016)
Hazards	−0.076 (0.210)	−0.046 (0.239)	−0.044 (0.241)	−0.208 (0.317)
Stress	0.259 (0.241)	0.318 (0.234)	0.335 (0.232)	0.287 (0.286)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	734	734	734	1468
# of individuals	734	734	734	734

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additional draw on observations from year 1997/1996. Controls variables are as in Table 6.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

include maternal time investments as further control variables. To be more precise, in the regressions where children's cognitive development is the dependent variable, we include educationally orientated time as an additional control variable because educational time is significantly correlated with all three measures of cognitive development (see Table 10). In regressions where children's socio-behavioral development is the dependent variable we include socially orientated time as a control variable because we find that socially oriented time is significantly correlated to behavioral outcomes (see Table 11). The relative change in the effect of work conditions once the relevant measures of maternal time investment is included gives us some insight into how much of the effect of work conditions is mediated by maternal time.

The correlations between maternal exposure to work-related hazards and children's cognitive development are

only marginally reduced when taking into account mothers' educational time. The result in presented in column 1 in Table 10 show that the coefficient of physical hazards is reduced by 10–15% (in the case of the letter-word score and the applied problem solving score, respectively). Yet, fixed effect results in column 4 show that educational time may at most be able to explain 2% of the influence of mothers' exposure to hazards on children's cognitive development.

In the case of children's behavior, maternal time also does not seem to act as the main mediator. When assessing the correlation between maternal work conditions and children's socio-behavioral development and controlling additionally for socially orientated interactions between mother and child, we can observe that the correlation between mothers' exposure to psychological stress at work and children's internal behavioral problems is reduced by 12% (see Table 11, column 1). Fixed effect results reveal,

Table 13
Paternal time and children's cognitive development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Letter word score				
Structured time	0.023* (0.012)	0.012 (0.011)	0.023** (0.011)	0.011 (0.010)
Unstructured time	-0.008*** (0.003)	-0.009*** (0.003)	-0.004 (0.003)	-0.000 (0.003)
Educational time	0.018** (0.009)	0.013 (0.008)	0.008 (0.008)	-0.004 (0.007)
Social time	0.021* (0.011)	0.014 (0.011)	0.011 (0.010)	0.006 (0.006)
Panel B: Passage comprehension score				
Structured time	0.027*** (0.010)	0.011 (0.009)	0.006 (0.009)	0.011 (0.011)
Unstructured time	-0.005 (0.003)	-0.005* (0.003)	-0.005* (0.003)	0.002 (0.003)
Educational time	0.015* (0.008)	0.008 (0.008)	0.005 (0.007)	-0.003 (0.007)
Social time	0.019** (0.006)	0.017** (0.008)	0.014** (0.007)	0.009 (0.007)
Panel C: Applied problem solving score				
Structured time	0.023* (0.013)	0.008 (0.011)	0.010 (0.012)	0.009 (0.010)
Unstructured time	-0.006* (0.004)	-0.008* (0.004)	-0.004 (0.004)	-0.003 (0.003)
Educational time	0.022** (0.008)	0.013 (0.008)	0.009 (0.007)	-0.001 (0.007)
Social time	0.025** (0.007)	0.018** (0.007)	0.017*** (0.006)	0.002 (0.007)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	734	734	734	1468
# of individuals	734	734	734	734

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additionally draw on observations from year 1997/1996. Controls variables are as in Table 4.

* 10% significance level.

** 5% significance level.

*** 1% significance level.

however, a smaller mediating effect (see Table 11, column 4). Specifically, the positive correlation between mothers' exposure to psychological stress at work and their children's internal behavioral problems can only be reduced by 6%.

Taking together, mothers' time investments into their children seem to be significantly associated with both maternal work conditions as well as with their children's development. The observed correlations are, however, not strong enough to explain a substantial fraction of the observed association between maternal work conditions and children's development.

5.6. The role of paternal time

Finally, we examine to what extent fathers' behavior might reinforce or compensate the negative association between mothers' exposure to strenuous work conditions and children's development. For this reason we assess the link between maternal work conditions and fathers' time – to understand whether fathers might adapt their engagement in child care when mothers' are exposed to strenuous work conditions. Additionally, we assess the link between paternal time investments and children's

development – to understand to what extent paternal time investments might offset any negative effect of maternal work conditions on children's development.

Table 12 displays the results of the regressions of paternal time investments on mothers' work conditions employing the different estimation strategies. At first sight, there does not seem to be any relation between mothers' conditions at work and fathers' time devoted to their children. Only when employing fixed effect estimations, we see that there is a negative association between mothers' exposure to stress and fathers' structured as well as educational time (Table 12, column 4). Specifically, a one s.d. increase in mothers' work-related stress is related to a decrease in fathers' structured activities by 0.32 h per week and to a decrease in fathers' educational time by 0.49 h per week. Fathers' unstructured time and social time are positively correlated with mothers' stress at work, the coefficients are, however, not significant at conventional levels.

Turning to the association between fathers' time and children's development, we observe a similar pattern to the impact of mothers' time investment. All activities undertaken by fathers and their children are positively correlated with children's cognitive development, with the exception of unstructured activities (see Table 13,

Table 14
Paternal time and children's behavioral development.

	(1) No controls	(2) Controls	(3) Value added	(4) Fixed effect
Panel A: Internal behavioral problem score				
Structured time	−0.017 [*] (0.010)	−0.018 [*] (0.010)	−0.015 [*] (0.008)	−0.005 (0.011)
Unstructured time	0.003 (0.004)	0.003 (0.004)	0.003 (0.004)	0.001 (0.003)
Educational time	−0.001 (0.007)	−0.002 (0.007)	−0.003 (0.007)	−0.001 (0.007)
Social time	−0.023 ^{**} (0.007)	−0.018 ^{**} (0.007)	−0.020 ^{***} (0.006)	−0.011 [*] (0.007)
Panel B: External behavioral problem score				
Structured time	−0.003 (0.012)	0.008 (0.01)	−0.003 (0.011)	−0.002 (0.010)
Unstructured time	0.000 (0.004)	−0.000 (0.004)	−0.002 (0.003)	−0.002 (0.003)
Educational time	−0.009 (0.007)	−0.005 (0.007)	−0.000 (0.007)	0.005 (0.007)
Social time	−0.018 ^{**} (0.009)	−0.013 (0.009)	−0.015 [*] (0.008)	−0.009 (0.006)
Control variables	No	Yes	Yes	Yes
Lagged outcome	No	No	Yes	No
Fixed effect	No	No	No	Yes
Observations	734	734	734	1468
# of individuals	734	734	734	734

Note: The coefficients stem all from different regressions, in columns (1)–(3) from OLS regression, based on observations from year 2002/2001 and in column (4) from fixed effect regressions where we additionally draw on observations from year 1997/1996. Controls variables are as in Table 5.

^{*} 10% significance level.

^{**} 5% significance level.

^{***} 1% significance level.

column 1). The magnitude of these correlations is similar to the magnitude of the correlations between mothers' time investment and the cognitive development of their children. Nevertheless, once we take into account all observable features as well as time constant unobservable features, all correlations turn insignificant (see Table 13, column 4). Fathers' time investment, conditional on the characteristics of the child, the mother, the father, and the social environment, does not seem to make a difference for children's cognitive development.

The picture is, however, slightly different for children's socio-behavioral development (see Table 14). Pure correlations between paternal time and children's internal behavioral problems reveal that children seem to benefit from the time that fathers spent doing structured or social activities (see Table 14, column 1). An increase in structured or social activities by 1 h is associated with a reduction in children's internal behavioral problems by 0.02 s.d. Yet, when taking into account all observable background characteristics and time constant unobservable characteristics, only the positive correlation between children's behavior and socially orientated activities of the father survive (see Table 14, column 4): one more hour of socially orientated activities is associated with a reduction in children's internal behavioral problems by 0.01 s.d. Similar to mothers' time investments, fathers' time investments do not seem to matter for children's external behavioral problems.

Thus, while men seem to adapt their child care behavior when their wives are exposed to strenuous conditions at work, the dimensions in which these adaptations occur do not seem to matter for children's development. In other

words, while fathers' behavior does not seem to reinforce any of the negative associations between maternal work conditions and children's development, paternal time also does not seem to offset any of these negative associations.

6. Conclusion

This paper examines the association between maternal work conditions and children's development and seeks to determine to what extent parental time investments mediate this association. We first establish the correlations between mothers' exposure to physical hazards and psychological stressors and their children's development. We then investigate whether these work-related stressors affect parents' time investments in children and whether time investments in turn predict children's cognitive and socio-behavioral development.

We analyze the 1997 and 2002 waves of the Child Development Supplement of the Panel Study of Income Dynamics, which provides us with detailed time diary data and child outcomes, and link it to the O*Net, which offers us detailed information on occupational characteristics. In order to address potential endogeneity problems, we employ various techniques including OLS with extensive controls, a value added approach and individual fixed effects models.

In sum, the results of the first part of our analysis show that exposure to work-related stressors is related to a reduction in child outcomes. In particular, work-related hazards are related to worse cognitive outcomes. Likewise, work-related stress negatively correlates to children's

socio-behavioral development. The second part of our analysis reveals two important findings. First, mothers' exposure to work-related stressors negatively correlates with maternal time investments. Specifically, we find that exposure to physical hazards is related to a reduction in educational time and exposure to stress is related to a reduction in social time. Second, both educational and social time that children spend with mothers positively predict children's development: educational time positively correlates with children's cognitive development, and social time positively correlates with children's behavioral outcomes. However, while we find that maternal time does mediate the effect of work conditions on child development, we also find that maternal time investments can only explain a small fraction of the observed negative correlations between maternal work conditions and child outcomes.

We also consider the ways in which fathers' time investments might mediate the effect of maternal work conditions. Our findings show that despite being influential for children's development, in particular in terms of children's behavioral outcomes, father's time investments neither reinforce nor compensate for the negative association between maternal work conditions and children's development.

Some caveats apply to our study. First, while we use various estimation techniques and extensive current and lagged characteristics to account for both observable sources and time invariant sources of endogeneity, we cannot control for unobserved time-varying maternal or child characteristics that might bias our estimates. Unexpected leaps or lags in children's development, for instance, might cause mothers to adjust their work situation and their parenting behavior. If this were true, our estimates for the impact of mothers' exposure to work-related stress on mother-child interactions might represent an overestimate.

The use of time diary measures of parental time investments may introduce two limitations. First, while our measures of time investments are more reliable and less susceptible to social desirability bias in contrast to retrospective reports of time use,¹¹ bias in reporting may still present a problem. For example children may overstate activities that are perceived as fun or "cool", such as structured play, and under-report activities that are less desirable such as educational time. Misreporting of this type would however, only lead to a bias in case it is simultaneously correlated with maternal work conditions and child outcomes. Second, time diaries, which are based on 24-h recalls of a random weekday or weekend, poorly capture activities that are not routine (Juster, 1985; Robinson, 1985). This issue is particularly problematic for measures

of children's time with fathers because children tend to spend less time in daily routines with fathers than with mothers. We address this issue by restricting our analyses to only children who reside with both parents and exclude children who have non-resident fathers. However, given that mothers remain the primary caregiver of children, time diaries are likely to be less accurate measures of children's time with fathers than of children's time with mothers. If children's time with fathers is measured with more noise, the estimated effects of fathers' time are likely to be biased. This issue may explain our results for fathers' time – father's time, particularly in educational and structured play, is positively associated with child outcomes but these associations are not statistically significant at any conventional levels. Therefore, additional care should be given when interpreting our results for fathers.

These caveats notwithstanding our findings contribute to the extensive literature on the effects of maternal employment by examining a critical mechanism that is widely speculated to mediate the relationship between maternal work conditions and child outcomes. That our findings suggest that the mediating role of parental time is significant but small suggests that future work should investigate alternative channels through which work conditions might affect children. These alternative channels might include warmth and affect, accessibility of parents, responsiveness and verbal stimulation.

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¹¹ Time diaries focus on capturing the chronology of events over a short period of time. This approach has been shown to be more reliable and less subject to social desirability bias than data collected from traditional, survey-based questions that ask individuals how much time they spend performing specific activities (PSID-CDS User Guide, 1997). While there are no baseline studies that have tested the consistency, validity, and reliability of time use reports from survey-based methods, substantial research has shown the time diary approach to be reliable and valid (Juster, 1985; Robinson, 1985).

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