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PARENTAL TIME AND CHILD OUTCOMES. DOES GENDER MATTER?

by Daniela Del Boca* and Anna Laura Mancini+

Abstract

Using different econometric specifications this paper analyzes the relationship between the time parents spend with their children, child-related expenditure and the results obtained by them, with particular attention to gender differences. The authors use PSID-CDS data from 1997 to 2007 and consider separately boys' and girls' test scores in reading and writing and math and logical reasoning. The amount of time mothers spend with children is always greater than fathers but changes over the life cycle of the children. In fact, the time mothers spend with children decreases as the child grows up and is greater with daughters, while the reverse is true of fathers. The estimates show that the impact of mothers' and fathers' time with children varies considerably with respect to the two cognitive tests, and is considerably greater in the case of highly-educated parents.

JEL Classification: J13, D1.
Keywords: time-use, cognitive ability, child development.

Contents

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1 Introduction[1]

The growth in labor market participation of women with young children has raised concerns about the potential negative impact of the mother's absence from home on child outcomes and has stimulated several contributions in the economics literature. A coherent interpretation of the determinants of children's well being has been provided by the production function approach developed by Todd and Wolpin (Todd and Wolpin, 2003, 2007). Within this framework, researchers draw an analogy between the knowledge acquisition process of individuals and the production process of firms. Most of the existing studies of the determinants of children's outcomes are based on the assumption that the inputs into the child outcome production process are subject to choices made by the parents (and other institutions such as schools). Empirical estimates of educational production functions, however, provide little consensus about the magnitude or even the direction of the impact of family inputs on children's development. Reasons for the diversity of these results may include the wide range of specifications that have been estimated, as well as the common limitation of failing to control for potential biases that may arise due to the endogeneity of parental time and other inputs included in the analyses.

The goal of this research is to estimate a model of the cognitive development process of children as outcome of parental time, expenditures and school inputs, with particular attention to gender differences. The PSID-CDS gives a vast amount of useful information on relevant factors such as parental time with children, parents' hours of work, children-related expenditures as well as several indicators of children cognitive outcomes (reading and applied problem). The initial survey of the PSID-CDS was conducted in 1997 with two follow-ups, the first in 2002 and the second in 2007. Differently than in most previous studies, which focused only on mothers' time, this paper explores the impact of both parents' time (in terms of quantity and in terms of quality) and expenditures, taking into account indicators of past investments as well as school quality.

The empirical results show that the impact of mothers' and fathers' time is significant only for highly educated parents. The authors also find some evidence that mothers' time is more relevant for daughters and fathers' time for sons. However, the differences between mother's and father's time on sons' and daughters' cognitive

[1]A previous version of paper was presented at the conference Women and the Italian Economy organized by the Bank of Italy, held in Rome on March 7th, 2012. The views expressed therein are those of the authors and do not necessarily reflect those of the Bank of Italy. This research has been supported by the Collegio Carlo Alberto Grant Parental and Public Investments and Child outcomes 2010-2013

outcomes are not statistically significant. While there is a strong persistence across time in the cognitive test, the school quality indicator used in the paper does not appear to be a significant determinant of child cognitive outcomes.

The remainder of the paper is organized as follows. Section 2 presents a short literature review, section 3 introduces the human capital production function approach and section 4 illustrates our estimation strategy. Section 5 describes the data and section 6 presents the estimation results. Section 7 concludes.

2 Literature

There is an extensive literature on parental and public investment in children and children's outcomes. Inputs applied by families as well as other environmental factors during the early childhood play a very significant role in later cognitive, social, and behavioral outcomes (Carneiro and Heckman, 2003). Several empirical studies analyzing the relationship between parent's inputs and child outcomes have focused on maternal employment as indicator of time with children (see Haveman and Wolfe, 1995, and Ermisch and Francesconi, 2005). However, parental employment is not a direct input of the production function and working time, namely, is only one of the components of the total time endowment (leisure, working time, housework time and time invested in the child). A priori, it is not necessarily true, in fact, that an higher amount of time spent on working activities implies a lower amount of time devoted to the child (Mancini and Pasqua, 2012, and Huston and Aronson, 2005). A working mother, by reducing her own leisure, could invest in her child the same amount of time of a not working mother. Moreover since working mothers are on average more highly educated than non working mothers they may dedicate to children higher quality time.

Very few studies insofar have used direct measures of parental time to examine the relationship between parental investments and child cognitive development. Booth et al (2002) analyze time diaries administered to mothers from the NICHD Study of Early Child Care and find that the amount of time mothers spend with their young children is not significantly correlated with measures of cognitive skills when they are toddler. Huston and Aronson (2005) find that mothers' time even relates negatively to child language skills. However, these studies do not take into consideration fathers' input in the child development process. While mother's time is widely recognized as a crucial input in the production process of child outcomes, father's time may be equally productive especially in some stages of child life. In the last few decades, fathers' time has increased remarkedly, partly offsetting the decline in mother's time (Gauthier et al., 2004). Averett et al. (2005) show that fathers' care for infants is no

better or worse than other types of arrangements while Yeung et al. (1999) and Ruhm (2002) that there is a long term benefit of paternal involvement. A greater proportion of fathers' time, relative to mothers' time, is spent in playing and teaching activities (such as helping with homework), as opposed to physical care such as bathing and feeding (Robinson, 1989, Yeung et al., 2001).

Del Boca et al. (2010) show that both parents' inputs are important for child cognitive development, but they have different impacts across different phases of the child's life. While mothers' time is important for younger children, fathers' time become more important when the child grow up. The implication of their results is that policy makers should carefully consider both parents' responses when designing programs to improve child cognitive outcomes.

Moreover the cognitive achievement production function changes with the age of the child. When considering not only the inputs which reflect decisions by schools and families but also the inputs reflecting the decisions of the children themselves, it is shown that the time investments by children during adolescence affect their test scores much more than the time input by their mother. On the contrary, the time input by their mother during childhood matters more than the time inputs by the children (Del Boca et al., 2012).

On a methodological ground, some of the earlier literature fails to control for unobserved heterogeneity, leading to potential bias if the same unobserved factors that determine parental time decisions also influence children's outcomes. For example, children may differ in their initial endowments such as innate cognitive ability, health and physical development. Mothers may respond to observed difficulties faced by children by spending more time with them. Recently Hsin (2009), using Child Development Supplement of the PSID, investigates the effect of maternal involvement during pre-school years on children's cognitive outcomes controlling for characteristics of children that may bias estimates of maternal time. She finds a positive and persistent effect of the time mothers spend with children on children's language development, but only among children who spend time with verbally skilled mothers. Her findings suggest that maternal time may differentially affect children because women differ in their ability to influence their children's cognitive development. Fiorini and Keane (2011), using the Longitudinal Study of Australian Children, analyze the effects of both parents time allocation on children's cognitive and non cognitive outcomes taking into consideration a wide array of child and family characteristics. Their results suggest that time spent with both parents, particularly on educational activities, is an important input in the production function of child cognitive skills but play no role for non cognitive skills. They also find some evidence that that parental time is more productive for girls than for boys. Other studies explore po-

tential differences across parents' and child gender. Hofferth (2003) and Hofferth and Sandberg (2001) found that child gender had no effect on fathers' total engagement time with children. Pleck and Masciadrelli (2004) note "It is possible that child gender exerts less influence on paternal involvement today than in previous decades". In a recent study Lundberg et al. (2006), using data from the American Time Use Survey and with the NLSY79, show that highly-educated parents devote more child-care time to sons than daughters. However, whether same sex parent-child time has a stronger effect on child development remains unclear. This research investigates the differences in the impacts of parental time on daughters' and sons' cognitive outcomes controlling for unobserved heterogeneity and potential endogeneity of parental time.

3 The human capital production function

The human capital production function approach is based on the idea that, as in a firm production process, children's quality, normally proxied with children's schooling level or cognitive achievements, is the result of a cumulative process of knowledge acquisition, fostered by both family and school inputs, and of child specific endowment. Becker and Tomes (1989) were the first who built a model on the effects of family and social variables on child life. The relation between child development and household resources is given by the specification of a household production function that explains how parental and social inputs translate into child outcomes. In their model, childhood is represented as a single period of life, impling that the returns to family and social investment on child human capital do not depend on the timing of the investment itself. The implicit assumption of Becker and Tomes model is that inputs at different stages of childhood are perfect substitutes.

Todd and Wolpin (2003, 2007) relaxed this assumption by allowing the impact of both family and school inputs to change according to the child's age. Their human capital production function could be written as:

$$T_{ija} = T_a(H_{ij}(a), S_{ij}(a), \mu_{ij0}, \varepsilon_{ija}) \tag{1}$$

where T_{ija} is a measure of cognitive achievement of child i in household j at age a, μ_{ij0} is child's ability endowment, $H_{ij}(a)$ is the vector of past and current family inputs up to age a, $S_{ij}(a)$ is the vector of present and past school inputs up to age a and ϵ_{ija} is the measurement error of the cognitive achievement. T_a, the function that translates family and school inputs into children's outcomes, is allowed to depend on child's age a. Therefore, in Todd and Wolpin model, the timing of the

investment matters since the same investment made at different ages could lead to different results. However, acquired skills are stable over time and investments made in different periods do not interact with each others.

Recently, Cunha and Heckman (2007, 2009) took a step further by building a theoretical model of skills formation in which skills evolve over time also due to parental and social investments. In this model, inputs in different stages of the life cycle are dynamic complements and skills obtained in one stage augment the productivity of later stages. According to their results, early child care intervention is then more effective than later intervention.

Both Todd and Wolpin and Cunha and Heckman models point out that when school-aged children are considered, it is important to take explicitly into account both inputs, the family and the school. However, empirically it seldom happens. Exceptions are Liu et al (2009) who consider the school inputs and Del Boca et al (2012) who consider the family, the school as well as the investments of children in themselves.

The estimation of the child production function implies two main problems. On one side, family inputs H are mostly chosen by the family itself also in response to child achievements and child quality, and therefore are endogenous. On the other side, many aspects entail in both H and S, as well as child ability μ, are unobservable by the researcher, generating a missing variables issue. To solve the second problem, a common approach consists in including in the regression a wide array of child and family characteristics. Another empirical strategy, that implies higher data requirements, is to use a fixed effect estimator, either at the child or at the family level, in which all relevant characteristics, either observed or unobserved, are controlled for. A commom solution to the endogeneity problem, that can be also combined with the previous ones, uses proxies related to the family inputs but not directly entering the production function (instrumental variable estimator). However, if the chosen instruments are related to both observed and unobserved inputs, their inclusion could confound the interpretation of the included variables.

The estimation of the true production function or of the related reduced-form demand functions needs information on the full vector of relevant prices and individual-specific production shocks plus the vector of all relevant inputs. Most of these information are normally not available to researchers; consequently, empirical studies mostly rely on the so-called "hybrid equation" (Rosenzweig and Schultz, 1983), that embodies both the technological properties of the production function and the characteristics of unobserved household preferences or production shifters (Ruhm, 2004). For example, child outcomes depend both on the quality and the quantity of parental time, but also on type of nonparental care available. The availability and the qual-

ity of nonrelative care can change the time parents spend with their children and its effect on child development. A fully specified model would account for the relationships between these environmental aspects and parents decisions but the hybrid equation does not. An implication is that limited information is provided on how the same variable, like parental time, will affect child outcomes in different institutional environments.

4 Estimation strategy

The authors assume, as most of the empirical studies based on the production function approach, that T_a is an additive separable function of parental time, family characteristics, child characteristics and an i.i.d. disturbance. The education production function could, then, be written as:

$$k_{ija} = H_{ija} + S_{ija} + \mu_{ij} + \varepsilon_{ija}$$

where k_{ija} is a measure of cognitive achievement of child i in household j at age a, namely a test score in our case, μ_{ij} is the child ability endowment, H_{ija} is the vector of past and current family inputs up to age a, S_{ija} is the vector of present and past school inputs up to age a and ε_{ija} is the measurement error of the cognitive achievement.

Most of the studies described in section 2 considered a commonly used regression specification of child's quality at time t, k_t[2], on contemporaneous mother's time h_{mt}[3]:

$$k_t = \beta_0 + \beta_1 h_{mt} + \varepsilon_t$$

Related to the omitted variables problem previously discussed, this simple specification presents several issues. First, it considers only one current input ignoring other important variables in the production function. Consequently the error term, ε_t, and the mother's hours, h_{mt}, are correlated, that is $\text{Cov}(h_{mt}, \varepsilon_t) \neq 0$ since ε_t includes all other inputs not included in the regression. In this specification, for example, the error term includes the effects of other contemporaneous inputs of the child's production function, like father's time, h_{ft}, and monetary investments, exp_t.

$$k_t = \beta_0 + \beta_1 h_{mt} + \beta_2 h_{ft} + \beta_3 exp_t + \varepsilon_t \tag{2}$$

[2]The i subscript is omitted for convenience

[3]Generally proxied by mother's working time

A second problem has to do with the omitted quality of contemporaneous inputs. Some of the characteristics of the parents and of the household may change the effect of parental time on child quality. For example, time of more educated parents could be more valuable for the child production function (Hsin, 2007). Higher educated parents may be able to understand the child needs more, to better organize their time and to communicate more useful inputs. The interaction between parents education, e_m and e_f, and parental time could be an indicator of the quality of the inputs parents provide. Moreover, the impact of parental time could be correlated to other family factors, F. As an example, parents adapt their time allocation to the number of children (Price, 2008). However, large families foster socialization as well as spillovers between siblings and increase the possibility of receiving direct inputs (from parents but also from siblings).

$$k_t = \beta_0 + \beta_1 h_{mt} + \beta_2 h_{ft} + \beta_3 exp_t + \beta_4 h_{mt} e_m + \beta_5 h_{ft} e_f + \beta_6 F + \varepsilon_t \tag{3}$$

This specification corresponds to the contemporaneous specification in Todd and Wolpin (2007, 2009). The critical assumptions underlying this specification are:

1. only current inputs matter;
2. current inputs capture the entire history of inputs;
3. current inputs are unrelated with child initial endowment.

Assumptions a) and b) are very restrictive, beacuse the current output of the production process is likely to depend also on the history of previous inputs as well as on child initial endowment. By including in the estimated equation the past output k_{t-1} of the child production function, we control implicitly for the set of past inputs as well as for the child initial endowment.

$$k_t = \beta_0 + \beta_1 h_{mt} + \beta_2 h_{ft} + \beta_3 exp_t + \beta_4 h_{mt} e_m + \beta_5 h_{ft} e_f + \beta_6 F + \beta_7 k_{t-1} + \varepsilon_t \tag{4}$$

None of the previous specifications explicitly take into account contemporaneous schooling inputs, S_t. There is wide consensus in the literature that better school quality improves child attainments. Moreover, the error term ε_t and both mother's and father's time, h_{mt} and h_{ft}, could be correlated if school inputs affect both child achievements and parental time allocation. Parents, in fact, could react to different school inputs (number of pupils within the class, teacher's quality, curricula activities) by adjusting the quantity and the quality of time dedicated to their children.

$$k_t = \beta_0 + \beta_1 h_{mt} + \beta_2 h_{ft} + \beta_3 exp_t + \beta_4 h_{mt} e_m + \beta_5 h_{ft} e_f + \beta_6 F + \beta_7 k_{t-1} + \beta_8 S_t + \varepsilon_t \quad (5)$$

This specification is known in the literature as the Value-added specification. The baseline achievement is taken to be a sufficient statistic for inputs histories as well as the child initial endowment. This specification is a major improvement with respect to the contemporaneous specification. Nontheless it imposes some strong assumptions on the underlying production technology (see Todd and Wolpin (2003, 2007) for details):

1. the effects of inputs (observed and unobserved) decline with age at a constant rate;

2. also the effect of child initial endowment declines with age at a constant rate.

Even after controlling for the past inputs, for child initial endowment and for current school inputs, the estimated effect of contemporaneous parental time on the child outcome could be incorrect, namely it could be both biased and inconsistent due to endogeneity issues. Mothers' and fathers' time, in fact, may depend on the parents' perception of the child needs, as proxied by the child achievements. If the child shows poor outcomes parents might react by spending more time with her/him. On the other side, parents might allocate more time to talented children to boost even more her/his achievements. To address this endogeneity issue, the authors use an istrumental variable approach for both mothers' and fathers' time.

5 Data and variables

The paper relies on the three existing waves of the Child Development Supplement (CDS), a supplement of the Panel Study of Income Dynamics (PSID)[4]. In 1997, CDS interviewed up to two children for a subsample of PSID families with children under the age of 13. CDS is designed to study a broad array of developmental outcomes including physical health, emotional well-being, intellectual achievement, and social relationships with family and peers. All households and parental variables included in PSID are also available for the CDS subsample. The CDS-I successfully completed

[4]The PSID is a USA longitudinal study that began in 1968 with a nationally representative sample of about 5,000 American families, with an oversample of black and low-income families. It collects information on economic, demographic and sociological status of the families on a yearly basis.

interviews with 2,394 families, providing information on 3,563 children. In 2002-2003, CDS-II successfully re-interviewed 2,019 families (91%) who provided data on 2,907 children and adolescents aged 5-18 years. During 2007 and 2008, 1,506 children aged 10-19 were again successfully re-interviewed (90%) for CDS-III (see CDS user guide for details).

5.1 Parental inputs

The objective of this research is to analyze the relationship between parental investments and child outcomes focusing on gender differences. The authors consider two types of investments: the time parents spend with the child and the child-related expenditures. Information on parents' time use allocation can be reconstructed from the child time diary. Namely, every child fills a detailed time diary in two randomly selected days, one weekday and one weekend day, that reports on a 24 hours basis every activity, depicting the type of the activity, where it took place and if the child was either alone or in the presence of somebody not actively participating or in the presence of somebody actively participating. The child time diary, then, allows to contruct a weekly[5] measure of the time parents spend with each child, separating passive from active time. It is also possible to separate parental time with the child in basic and quality childcare[6]. The positive relationship between the frequency of both basic and quality activities, such as reading and playing on one side or eating on the other side, and child outcomes is well documented in the literature (see Price, 2008, and Mancini et al., 2011). The positive productivity of mother's and father's active time has also been documented by Del Boca et al. (2010). In this article the authors do not distinguish between basic and quality childcare and, therefore, use the overall active time each parent spend with the child, which includes all the activities in which either the child is the primary focus or there is a sufficient interaction between the parent and the child. To capture sistematic differences in time quality, mothers' and fathers' active time is interacted with their level of education.

For the instrumental variable estimation, it is necessary to find good instruments, meaning related to the child outcome only through their effect on parental time and un-correlated with the error term ε_t, for mothers' and fathers' active time as well as their interactions with parents' education. Three different types of instruments have

[5]The weekly measure is obtained multiplying by five the week-day time, and summing the result with the weekend-day time multipied by two.

[6]Basic care includes all activities related to the child essential needs (feeding, dressing, bathing and so on) while quality care refers to activities related to children educational, cultural and emotional development.

been chosen. First, the grandparents level of education (more than high school degree) is used. The identifying assumption is that grandparents education influences directly parents' outcomes (like education and income as well as preferences) but not their grandchildren's outcomes. Moreover, any genetic correlation between grandparents and grandchildren as well as between parents and children is captured by the baseline child test score. Second, the authors control for the current mother working condition (working full time and irregular working schedule), for the current father working condition (irregular working schedule[7]) and for the time parents spent doing household chores. All these variables represent current constraints on the parental time allocation and it is assumed that once the income effect they could generate is taken into account (through expenditures) they do not have a direct effect on child outcomes. Third, past parental time inputs were included in the analysis assuming that they are uncorrelated with the current error term and that any possible direct effect on contemporaneous outcomes is captured by the past test score.

The second type of investment considered is the monetary investment. Information on the expenditures made for the targeted child are collected on CDS-II and CDS-III. The two waves include a set of detailed questions concerning the amount of money the family pays for various items of the target child consumption over the past 12 months. These items include tuition, tutoring programs, lessons, school supplies, sports, toys or presents, vacation and clothes or shoes. The paper uses, then, an indicator of the direct expenses[8] made by the family for the targeted child.

In their empirical investigation the authors also control for the child current health status and ethnicity as well as for the number of siblings.

5.2 Cognitive outcomes

The children cognitive skills are assessed using the Woodcock-Johnson Revised Tests of Achievements (WJ-R).The WJ-R contains nine subtests measuring different aspects of accademic achievement. The CDS includes in all waves three of those subtests as a measure of reading and math achievements: the Letter-Word, the Passage Comprenhension and the Applied Problem tests. The Letter Word and the Applied Problem were administered to all children older than 3 while the Passage Comprehension was additionally admistered only to children older than 6. The interviewer adjusted the difficulty of the test to the age of the respondent. The Letter-Word Score

[7]The authors do not control for the working time of the father because almost all fathers work full time in our sample

[8]Given that not all items were repeated in both waves, we were able to include toys, school supplies, food and clothes. All monetary values are deflated in 1997 dollars.

measures symbolic learning[9] as well as reading identification skills[10]. The Passage-Comprehension Score assesses comprehension and vocabulary skills. The Applied Problem Score evaluates the performance on mathematical calculations and quantitative ability (Woodcock and Johnson, 1989). The test scores are available either in raw (mainly the number of correctly answered items) or in standardized format. The WJ-R standardized scoring protocols allow the comparison of the targeted child reading and math abilities to the national average for the child's age (see CDS user guide for details). In this empirical analysis the authors rely on the standardized version of the three test scores.

5.3 School inputs

Several indicators for school quality and school resources are used in the literature. One of the most commonly used is the pupil/teacher ratio. It is well know in the literature that a negative relationship between classe size and child learning exists. Teachers in a large class are likely to dedicate less time to each pupil than in a small class. For the pupils, crowded classrooms make it difficult to listen, concentrate on the material and learn. A recent research report of the U.S. Department of Education on the link between class size and educational outcomes reports that "The evidence base on the link between class size and attainment, taken as a whole, finds that a smaller class size has a positive impact on attainment and behaviour in the early years of school, but this effect tends to be small and diminishes after a few years."[11]. In the first wave of CDS-I, a self-administered questionnaire was mailed to the administrator of the school attended by the child (elementary or middle school). The administrator provided information on the characteristics and composition of the school and its student body. This reasearch uses the number of teachers and students reported to compute the pupil/teacher ratio for each child . However, for children younger than 6 in 1997 no information on their actual school environment[12] is available. Therefore, to construct their pupil to teacher ratio the authors had to rely on a different data source. They used the Public Elementary/Secondary School Universe Survey, conducted by the National Center for Education Statistics, that reports the average number of teachers and students in grades 1 to 8 by State[13]. An

[9]Matching pictures with words.

[10]Identifying letters and words.

[11]"Class Size and Education in England Evidence Report", Research Report, DFE-RR169, U.S. Department of Education

[12]The school administrator questionnaire was not repeated in the following waves.

[13]The pupil/teacher ratio used in the empirical analysis is a mix of individual and aggregated data. This is likely not to be a problem for the estimation given that the level of aggregation does

average pupil/teacher ratio[14] was computed at the State level and then associated to each child with no school information according to the State in which he wass living in CDS-II or CDS-III.

5.4 Sample selection

The sample consists of children who have at least two valid test scores [15], aged between 6 and 11 in the second wave. The sample is restriced to children living in intact families[16]. Finally the authors drop those observations for which one or more controls were missing. The final sample consists of 638 observations for the Letter Word test score, 378 observations for the Passage Comprehension test score and 591 observations for the Applied Problem test score.

Table 1 reports descriptive statistics of the sample[17]. On average girls have higher scores than boys in all three tests considered. Looking at the time pattern girls have higher scores at all ages for the Letter word and the Passage comprehension scores but not for the Applied problem test. Mothers spend more time with daughters (7 hours and a half per week) than with sons (7 hours) but the difference is small. The opposite is true for fathers (roughly 2 hours per week with daughters and almost 3 hours with sons). Indipendently from the child gender, mothers' time is always greater than fathers' time but changes with child age, confirming previous results (Del Boca et al, 2010). Figure 1 shows mothers and fathers active time by child's age and gender. Mothers' time with boys declines steadily with the age of the child, while fathers' time tends to increase. Fathers' time with girls, instead, remains stable over time while mothers' time tend to increase till the daugther is about nine years old. Figure 2 reports parental time according to child gender and parental education. College educated fathers spend more time with their sons (3 hours and a half per week) than with their daughters (roughly 2 hours per week). They also spend significantly more time with their sons with respect to less educated fathers

not appear to be an important factor in determining the sign or magnitude of the relationship between school resources and child's outcomes (Card and Krueger,1996)

[14]Other indicators, such as teacher quality, are proved to be very important determinants of student achievements. Unfortunatly the CDS do not have suitable data to include such indicators in the analysis.

[15]To increase sample size all children born in 1990-96 that have vaild test scores either in 1997-2002 or in 2002-2007 were considered. If the child has three valid test scores, the CDS-I and CDS-II waves were used.

[16]Familes whose husbands and wives never changed across the years included in the analysis. The authors consider either biological children -of at least one of the parents- or adoptive children.

[17]For simplicity, for the common variables only descriptives for the Letter Word sample are reported.

(almost one hour more per week). Mothers, instead, allocate more time to daughters than to sons. College educated mothers, in particular, spend almost 8 hours per week with their daughters and only six hours and a half with their sons. Finally, on average both boys and girls attend schools in high quality school environments (with a ratio teacher/students not greater than 20 students).

6 Empirical results

This section discusses the results for the different specifications described in section 4 separately for sons and daughters. The first specification, corresponding to equation 3, explores the impact of contemporaneous inputs on the child outcomes controlling for child and family characteristics. In the second specification, equation 4, the past test score is added, that captures the combined effects of past family investments and child initial endowment. In the third specification, equation 5, the authors control also for school inputs.

The paper performs separate estimations for the three test scores for both boys and girls. However, the Chow test on the difference between the time coefficients estimated using either Letter Word or Passage Comprehension does not reject the null of the equality of those coefficients at standard level of significance[18]. Therefore, table 2 reports the results for Letter Word and Passage comprehension and table 3 for Applied problem scores respectively. The estimates are based on ordinary least squares method taking into account the correlation of the error terms between siblings.

Child health does not appear to be related to test scores, while ethnicity is negatively and significantly related. Mothers' and fathers' time appear to be significantly related to children's scores only in the case of Applied Problem with a negative sign. The coefficient of parents' time interacted with college degree is positive and significant. These two results support the previous findings of the positive effect only of parents' quality time (Hsin, 2007). While the coefficient of mothers' time is significant for girls, the coefficient of fathers's time is significant for boys. However, according to the Wald test on the equality of the time coefficients across child gender, the null hypothesis is not rejected for both reading and math abilities. Parents' expenditures are positively related to girls' tests in the combined Letter Word and Passage Comprehension. Past tests scores are important and significant determinant of present test scores. Finally, school quality does not appear to matter. The Wald

[18]It rejects, instead, the equality of the time coefficients when Letter Word and Passage Comprehensions are compared with Applied Problem.

test on the joint significance of the augmented model (specification 3) supports the inclusion of the past test score and the school inputs in the model specification.

The empirical results on the effect of parental time investment on child outcomes could be potentially biased and inconsistent if parental time is itself a function of the child achievement. To run an instrumental variable estimation (IV), it is needed to find valid instruments, meaning instruments that are relevant in explaining the endogenous regressors once the exogenous regressors are accounted for and that are uncorrelated with the error. As first step a test on the validity of the instruments is performed. Given the overidentified nature of our model, it is possible to run a Hansen-Sargan test on the validity of the instruments. Then, a Hausman test for the endogeneity of the variables of interest is performed. If the variable is exogenous, in fact, IV is likely to be much less efficient than OLS. the authors run IV separatly on reading abilities and math abilities. To increase sample size (and consequently mitigate the finite-sample bias) and considering the results of the Wald test on the equality of time coefficients across gender, in both cases a pooled sample of boys and girls is used, including child gender among the controls. The test of overidentifying restrictions[19] confirms the exogeneity of instruments for both mother's and father's time. Looking at the endogeneity test, it confirms, at 5% level, the endogeneity of the mother's time in the Letter Word and Passage Comprehension specification and at 10% level of father's time in the Applied problem specification. The endogeneity of mother's time on math abilities and of father's time on reading abilities is rejected. Then, in these two cases OLS estimates are consistent and efficient. Finally, to be valid the instruments have to be relevant in explaining the time variables. Weak instruments lead to lower estimation precision and worsen the IV finite-sample bias (Murray, 2006). In case of weak instruments, alternative estimators to the commonly used two stages least squares (2SLS) that have better finite sample properties (like Limited-Information Maximum Likelyhood or Fuller estimator) are suggested by the literature. The authors test the weakness of their set of instruments in the case of mother's time on reading abilities and of father's time on math abilities using Hausman test. In both cases they can't reject the null of weak instruments, particularly for fathers' time. Therefore, the article report IV estimates using both 2SLS and LIML estimators.

Tables 4 and 5 report IV results (and OLS results for the pooled sample for comparison) for endogenous maternal time on reading abilities and endogenous fathers'

[19]The authors also perform two different under-identification tests. For mothers' time they always reject strongly the null that the model is under-identified. For fathers' time, the Kleibergen-Paap statistic fails to reject the under-identification, while the Anderson-Rubin Wald test in the Letter Word - Passage comprehension case successfully confirms that the model is identified.

time on math abilities respectively. Results on ethnicity and past tests score are widely confirmed. College graduated mothers' time is still positive and significant on reading abilities using both 2SLS and LIML. Fathers' time of college graduated has also a positive effect on math abilities but it remains significant only under 2SLS. The negative effect of mothers' and fathers' time on applied problem looses its statistical significance using IV estimation. The gender coefficient is not statistically different from zero.

7 Conclusions

This paper analyzes the link between parental time and child outcomes, with particular attention to gender differences, using PSID-CDS data from 1997 to 2007. Descriptive statistics show that mothers' and fathers' time with children have different patterns. Mothers' time declines with the age of the child and is always greater with daughters, while fathers' time tends to increase with the child's age and is greater with sons. In line with other existing studies on the subject, this paper estimates show that parents' time with children has a positive impact on child outcomes only for highly educated. Moreover, the impacts of mothers' and fathers' time are different for reading and math scores and for girls and boys. However, tests statistics indicate that the differences linked to the child gender are not statistically significant.

Finally while there is a strong persistence in the cognitive test, indicating the importance of parents' past inputs, the indicator of school quality used in this paper does not appear to be a significant determinant of child cognitive outcomes. This results can be viewed as a potentially interesting first step in exploring the relationship between parental investments and the child development process, conditional on other environmental characteristics, that can be used in designing social and family policies.

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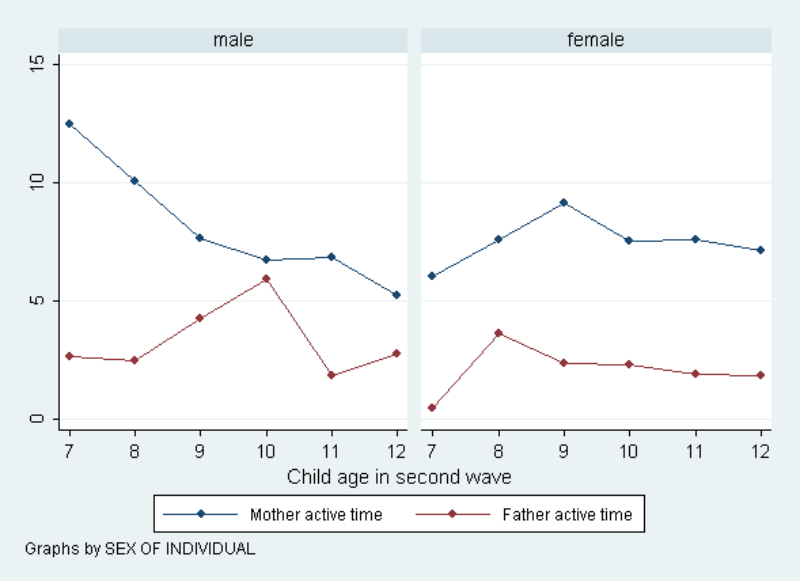

Figure 1: Parental time by child age and gender

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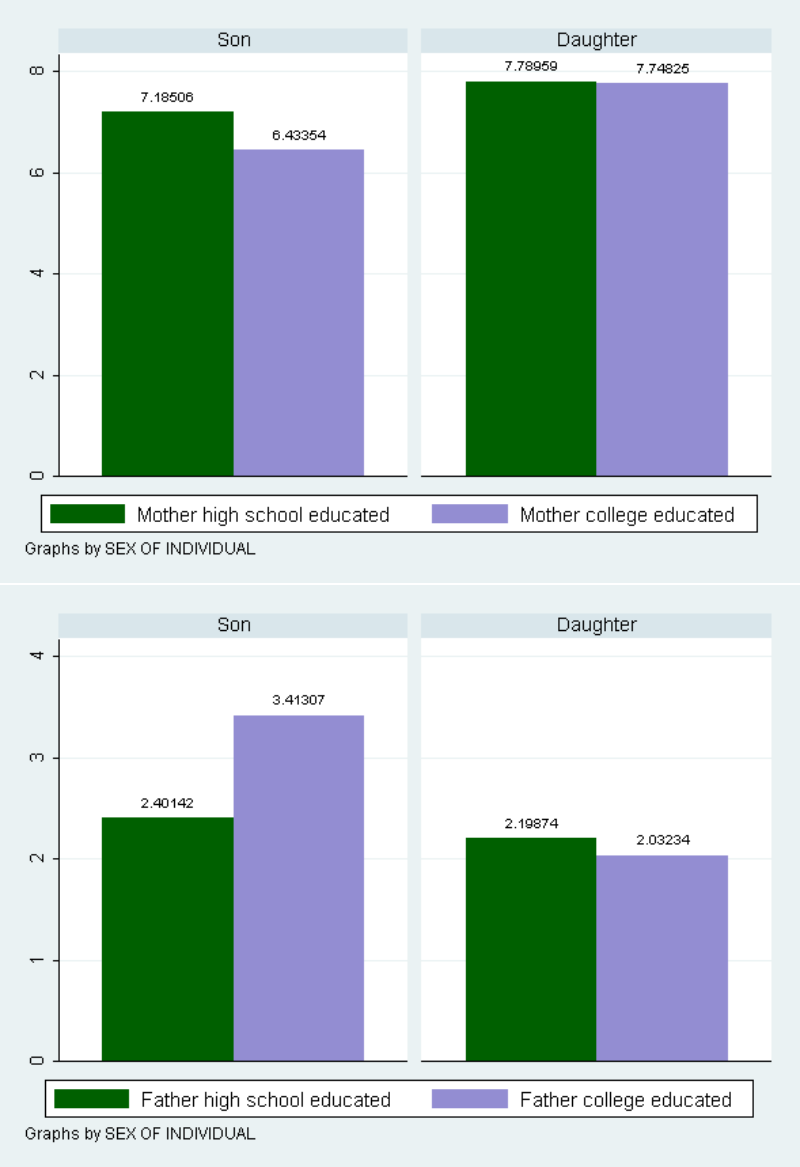

Figure 2: Parental time by child gender and parental education

Table 1: Descriptive statistics

Variable	Boys			Girls		
	N	mean	sd	N	mean	sd
Present test score						
Letter word standardized	329	106,35	15,54	309	108,37	13,98
Passage comprehension standardized	180	104,96	15,50	198	109,05	13,83
Applied problem standardized	329	106,30	15,85	305	108,45	14,04
Lagged test score						
Letter word standardized	308	104,18	16,47	285	110,12	15,26
Passage comprehension standardized	170	106,98	17,11	187	113,94	14,64
Applied problem standardized	307	104,13	16,48	282	110,05	15,26
Parental investements						
Mother time (active only)	329	7,09	8,35	309	7,64	8,65
Father time (active only)	329	2,99	5,01	309	2,18	3,87
Log expenditures for the kid (present)	329	6,82	1,37	309	6,96	1,21
Child and family characteristics						
Child age (present)	329	10,34	1,36	309	10,53	1,28
Child health (present)	329	0,58	0,49	309	0,63	0,48
Black or Hispanic	329	0,27	0,44	309	0,24	0,43
Mother has college degree	329	0,36	0,48	309	0,38	0,49
Father has college degree	329	0,31	0,46	309	0,37	0,48
School characteristic						
Pupil to teacher ratio (present)	329	20,70	4,78	309	20,60	4,64

Table 2: OLS estimation results - Letter word and Passage Comprehension

	Girls			*Boys*		
VARIABLES	1 spec	2 spec	3 spec	1 spec	2 spec	3 spec
Child health (present)	2.415*	1.672	1.670	0.320	-0.0241	-0.0212
	(1.461)	(1.281)	(1.298)	(1.693)	(1.551)	(1.548)
Black or Hispanic	-4.005**	-4.007**	-4.013**	-6.677***	-6.520***	-6.586***
	(1.982)	(1.692)	(1.702)	(1.863)	(1.610)	(1.611)
Mother time (active only)	0.0390	-0.0304	-0.0304	0.000951	0.0760	0.0798
	(0.111)	(0.0876)	(0.0872)	(0.121)	(0.117)	(0.116)
Father time (active only)	0.0605	0.213	0.213	-0.129	-0.0845	-0.0748
	(0.201)	(0.176)	(0.176)	(0.198)	(0.152)	(0.156)
Log expenditures for the kid (present)	1.081*	1.505***	1.505***	0.0516	-0.0788	-0.0585
	(0.555)	(0.425)	(0.427)	(0.703)	(0.580)	(0.571)
Number of siblings	-0.490	-0.117	-0.116	-0.644	0.268	0.258
	(0.897)	(0.762)	(0.765)	(0.698)	(0.675)	(0.678)
Mother time x mother college degree	0.277*	0.277**	0.277**	0.256§	0.0954	0.0956
	(0.156)	(0.128)	(0.128)	(0.167)	(0.150)	(0.149)
Father time x father college degree	0.592**	0.359	0.359	0.568**	0.343*	0.328*
	(0.297)	(0.259)	(0.258)	(0.232)	(0.193)	(0.196)
Past test score		0.296***	0.296***		0.367***	0.369***
		(0.0443)	(0.0444)		(0.0520)	(0.0517)
Pupil to teacher ratio (present)			-0.00252			-0.112
			(0.146)			(0.144)
Constant	98.59***	63.24***	63.30***	106.1***	67.37***	69.32***
	(4.269)	(6.121)	(7.025)	(5.214)	(7.166)	(8.027)
Observations	476	476	476	480	480	480
R-squared	0.089	0.243	0.243	0.070	0.222	0.223

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1, § p<0.15

Table 3: OLS estimation results - Applied Problem Test Score

	Girls			*Boys*		
VARIABLES	1 spec	2 spec	3 spec	1 spec	2 spec	3 spec
Child health (present)	0.122	-1.115	-1.070	2.072	0.666	0.656
	(0.312)	(0.513)	(0.494)	(1.332)	(0.429)	(0.432)
Black or Hispanic	-10.05	-8.938§	-8.795§	-12.53**	-7.147§	-7.170§
	(2.477)	(1.450)	(1.556)	(0.384)	(1.328)	(1.314)
Mother time (active only)	-0.171*	-0.193**	-0.192**	-0.141	-0.0815**	-0.0813**
	(0.0210)	(0.00739)	(0.00579)	(0.0389)	(0.00312)	(0.00329)
Father time (active only)	-0.343**	-0.212§	-0.214§	-0.198	-0.107	-0.104
	(0.0137)	(0.0360)	(0.0374)	(0.231)	(0.0897)	(0.0839)
Log expenditures for the kid (present)	-0.409	-0.630	-0.618	0.497	-0.00989	-0.00412
	(0.257)	(0.327)	(0.332)	(0.522)	(1.001)	(0.995)
Number of siblings	1.201	1.104	1.093	-0.535	-0.445§	-0.457
	(0.727)	(0.431)	(0.432)	(0.222)	(0.0992)	(0.115)
Mother time x mother college degree	0.542*	0.513**	0.513**	0.415	0.267	0.269
	(0.0760)	(0.0283)	(0.0353)	(0.459)	(0.242)	(0.237)
Father time x father college degree	0.491	0.177	0.185	0.733*	0.422§	0.416§
	(0.477)	(0.145)	(0.142)	(0.0838)	(0.0739)	(0.0866)
Past test score		0.361	0.363		0.408*	0.409*
		(0.0981)	(0.0979)		(0.0546)	(0.0522)
Pupil to teacher ratio (present)			0.0589			-0.0459
			(0.0374)			(0.0497)
Constant	112.8**	76.25*	74.73*	109.6*	69.12	69.91
	(1.996)	(7.539)	(8.304)	(8.748)	(16.45)	(17.18)
Observations	282	282	282	309	309	309
R-squared	0.155	0.305	0.306	0.202	0.401	0.401

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1, § p<0.15

Table 4: IV estimation results - Letter word and Passage Comprehension

	OLS	IV	
VARIABLES		2sls	liml
Mother time (active only)	0.0324	0.357	0.440
	(0.0720)	(0.276)	(0.328)
Mother time x mother college degree	0.201**	0.709***	0.745***
	(0.0995)	(0.230)	(0.250)
Child sex	0.793	0.280	0.211
	(0.914)	(1.018)	(1.056)
Child health (present)	0.531	0.471	0.503
	(1.026)	(1.150)	(1.179)
Black or Hispanic	-5.858***	-5.089***	-5.014***
	(1.166)	(1.214)	(1.239)
Log expenditures for the kid (present)	0.477	0.435	0.434
	(0.429)	(0.422)	(0.423)
Number of siblings	0.127	0.316	0.359
	(0.508)	(0.523)	(0.536)
Pupil to teacher ratio (present)	-0.0770	-0.0814	-0.0818
	(0.110)	(0.123)	(0.127)
Father time (active only)	0.0251	0.168	0.192
	(0.115)	(0.143)	(0.152)
Father time x father college degree	0.292*	0.0738	0.0517
	(0.164)	(0.203)	(0.215)
Past test score	0.323***	0.305***	0.303***
	(0.0360)	(0.0376)	(0.0383)
Constant	68.53***	67.35***	66.90***
	(6.307)	(6.530)	(6.648)
Observations	956	950	950
R-squared	0.230	0.120	0.082
Cragg-Donald F stat		4.462	

Endogenous Variables: Mother time and Mother time x mother college degree
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: IV estimation results - Applied Problem Test Score

	OLS	IV	
VARIABLES		2sls	liml
Father time (active only)	-0.141	-0.350	-2.051
	(0.136)	(0.919)	(5.379)
Father time x father college degree	0.361*	1.617**	1.727
	(0.185)	(0.677)	(3.669)
Child sex	-2.545***	-2.228*	-3.422
	(0.979)	(1.180)	(3.510)
Child health (present)	-0.0970	-0.121	0.338
	(1.065)	(1.149)	(1.764)
Black or Hispanic	-7.860***	-7.182***	-7.126***
	(1.390)	(1.438)	(2.726)
Log expenditures for the kid (present)	-0.162	-0.178	0.336
	(0.509)	(0.587)	(1.590)
Number of siblings	0.149	0.0492	0.315
	(0.500)	(0.511)	(0.937)
Pupil to teacher ratio (present)	0.0243	0.0639	0.0759
	(0.115)	(0.121)	(0.180)
Mother time (active only)	-0.142**	-0.0982	-0.208
	(0.0640)	(0.0850)	(0.305)
Mother time x mother college degree	0.392***	0.285**	0.339
	(0.124)	(0.131)	(0.298)
Past test score	0.387***	0.365***	0.371***
	(0.0391)	(0.0421)	(0.0752)
Constant	74.64***	75.18***	76.84***
	(7.190)	(7.349)	(10.08)
Observations	591	587	587
R-squared	0.354	0.308	0.137
Cragg-Donald F stat		1.172	

Endogenous Variables: Father time and Father time x father college degree
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1