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Research fields

Family Economics, Economics of Education, Labour Economics, Public Economics

Education

Université Panthéon Sorbonne and Paris School of Economics **2015-2019 (exp.)**
PHD in Economics
Supervisors : **Hippolyte D'Albis** (CNRS, PSE) et **Arnaud Lefranc** (Université Cergy-Pontoise)
Title : The Influence of Family Structure on Child Development

Université Panthéon Sorbonne and Paris School of Economics **2015**
Master Analysis and Politicy in Economics *Cum Laude*

Université Paris I Panthéon - Sorbonne **2015**
Magistère in Economics *Cum laude*

IAE de Nantes **2013**
Bachelors in Economics *Summa cum laude*

Working papers and Work in Progress

Working papers

- **Family Structure, Children's Time-Use and Parental Times, 2019**
  While many studies report a negative effect of parental separation on child development, little attention has been paid to the channels of this effect. This paper shows that child and parental time investment may be one of the driving channels at stake. Using detailed time-use diaries from the PSID-Child Development Supplement, I estimate an individual fixed-effects model and find that being in a single parent family has a negative impact on time spent with at least one parent present. Time with parents together and alone with fathers is greatly affected, but mothers compensate partially for this decrease. In the second part, to see if this matters for child development, I estimate cognitive and non-cognitive skills production functions using a number of specifications. I shed light on the heterogeneity of parental time investment for cognitive and non-cognitive skills. Child and parental time investment appear to be a possible driving channel for the effect of parental separation, especially important for children whose parents separate in their early childhood and children with more highly educated parents.
- **Effect of Parental Separation on Children's Achievement, Evidence from France, 2018**
  This paper investigates the impact of parental separation on children's achievement in their adulthood, and its heterogeneity. Using a French dataset "French Education-Training-Employment" (INSEE), the differences in age of the children at divorce, within a family, are examined in order to identify causal effects of parental separation. The main interest of the paper lies in three particular outcomes : the number of years of schooling, return to schooling, and earnings. The results show that individuals whose parents separated have about one semester of schooling less than the children of non-divorced families, they also have lower quality of education and earn between 5% and 11% less than individuals who grew up with their two parents. All these effects remain negative and significant after controlling for divorced family selection. Parental separation is more harmful when the child has a step-parent or parents of higher education. The study finds no differential effects of gender or alternating custody, and no evidence of a stigmatisation effect.

Work in Progress

- **Family Size and the Formation of Non-cognitive Skills: Evidence from Cohort Data, with Simon Briole and Anthony Lepinteur, 2019**
  Though it is largely admitted that non cognitive skills matter a lot for adult outcomes, there is still scarce evidence on how they are affected by the family environment. In this paper, we use a recent longitudinal dataset on British children (Millennium Cohort Study) to study the effect of family size on socio-emotional and behavioural skills. To account for the endogeneity of fertility decisions, we take a well-known instrumental approach that exploits parents' preference for children's gender diversity. We show that an increase in family size strongly and negatively affects the non cognitive skills of the two first children. Nevertheless, a heterogeneity analysis reveals that this negative effect is entirely driven by girls, while boys seem to be unaffected by the birth of an additional child. This result contrasts with the recent literature based on instrumental strategies which provides few evidence of a causal effect of family size on children cognitive development.

Conferences and Seminars

Conferences and Workshops

Royal Economic Society Annual Conference: Warwick, United Kingdom *2019*
ADRES Doctoral Conference: Aix-Marseille School of Economics, France *2019*
Journées d'Aussois: France *2018*
European Association of Labour Economics (EALE): Lyon, France *2018*
Journées de Microéconomie Appliquée (JMA): Bordeaux France *2018*
Journées d'Aussois: France *2017*
European Association of Labour Economics (EALE): Saint Gall, Switzerland *2017*
Journées de Microéconomie Appliquée (JMA): Le Mans, France *2017*
Workshop on Labour Economics: IAAEU, Trier, Germany *2017*

Seminars

PSI-PSE - Petit Séminaire Informel de la Paris School of Economics *2018*
Paris School of Economics: Labour and Public Economics seminar *2018*
Université de Cergy Pontoise: PHD Seminar *2018*
Swedish Institute for Social Research (SOFI) (Stockholm): Brown Bag Seminar *2018*
Paris School of Economics: Work In Progress seminar *2018*
French Ministry of Education (DEPP) *2017*
National Institute of Demographic Studies (INED) *2017*
Paris School of Economics: Applied Economics Seminar *2016*

Research Grants

Mobility Grant from Paris Jourdan School of Economics: *2018*
Mobility Grant from Université Paris I Panthéon - Sorbonne: *2018*
PHD Fellowship from Université Paris I Panthéon - Sorbonne (3 years): *2015*
with Paris School of Economics

Teaching Experience

Université Paris I Panthéon Sorbonne **2018-2019**
Assistant Lecturer (ATER)

Université Paris I Panthéon Sorbonne **Since 2015**
Teaching Assistant in Macroeconomics (Undergraduate)
Professors : Jean-Olivier Hairault et Elisabeth Cudeville

Université Paris I Panthéon Sorbonne **Since 2015**
Teaching Assistant in Econometrics (Undergraduate)
Professors : Catherine Doz

Institut Catholique de Paris **2015**
Teaching Assistant in History of Economic Thought (Undergraduate)

Other Research Activities

Co-organizor of the EAYE Workshop at PSE **2018-2019**
Topic : "Humanizing Social Networks"

Swedish Intitute of Social Research (SOFI) at Stockholm **2018**
Visiting stay, hosted by Pr Markus Jäntti

Paris School of Economics **2017-2018**
Research Assistant, with Elena Stancanelli

Paris School of Economics **2014**
Research Assistant, with Jean-Olivier Hairault

LEMNA **2013**
Research Assistant, with Robert F. Owen, Nantes

Languages

French: Native

English: Fluent

Spanish: Good command

Computer Skills

Econometrics: Stata, Eviews

Numerical Resolution: Matlab, Dynare

Statistics: Sphinx

Other: Pack Office, Latex

References

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Time investments as a driving channel for the effect of parental separation on child development

Hélène Le Forner *†

2019

Abstract

While many studies report a negative effect of parental separation on child development, little attention has been paid to the channels of this effect. This paper shows that child and parental time investment may be one of the driving channels at stake. Using detailed time-use diaries from the PSID-Child Development Supplement, I estimate an individual fixed-effects model and find that being in a single parent family has a negative impact on time spent with at least one parent present. Time with parents together and alone with fathers is greatly affected, but mothers compensate partially for this decrease. In the second part, to see if this matters for child development, I estimate cognitive and non-cognitive skills production functions using a number of specifications. I shed light on the heterogeneity of parental time investment for cognitive and non-cognitive skills. Child and parental time investment appear to be a possible driving channel for the effect of parental separation, especially important for children whose parents separate in their early childhood and children with more highly educated parents.

JEL classification: I21, J12, J13, J24

Keywords: Child Development; Child's Time Investments; parental time investment; Family Structure; Cognitive Skills; Non-cognitive Skills.

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1 Introduction

This paper analyses whether child and parental time investment are a driving channel for the negative effect of parental separation on child development. Though it is largely admitted that parental separation negatively impacts child development (see Ermisch and Francesconi 2001 [10]; Frimmel et al. 2016 [13]; Gruber 2004 [15]; Francesconi et al. 2010 [12]; Clark et al. 2015 [6]; and Ribar et al. 2017 [24]), little is known about the possible channels for this effect. I focus here on child and parental time investment. This analysis is in two parts. First, it estimates how family structure impacts child and parental time investment. This is useful for estimating whether parental time is a complement or substitute. The substitution of time with the non-custodial parent is a key element in this analysis. Second, using cognitive and non-cognitive skills production functions, I estimate what activities are relevant for a child's cognitive and non-cognitive skills, and whether this is affected by the presence or the involvement of parents. Since parental time composition is likely to be highly affected by being in a single parent family, this paper investigates whether it is of equal value to spend time with the mother alone rather than with the father or both parents together. I also allow for production functions to vary across gender, family background and age.

This paper offers three main contributions. First, it investigates the driving forces of the effect of parental separation on child development. Second, it extends the parental time literature (see Fiorini and Keane 2014 [11]; Del Bono et al. 2016 [9]; Funk and Kemper 2016 [14]; Del Boca et al. 2017 [8]) to time spent with fathers and with both parents, two key variables for understanding the impact on parental time investment of being in a single parent family. I also provide evidence that parental time is a substitute rather than complement. Third, this paper improves the understanding of cognitive and non-cognitive skill production functions by exploring the possible heterogeneity of parental time.

I use the Panel Study of Income Dynamics - Child Development Supplement (PSID-CDS). It provides time-use diaries for 2,600 children first interviewed in 1997 and followed up in 2002 and 2007. It collects the activity, the duration, and who was present or involved during the activity. Cognitive and non-cognitive skills are also available. I consider five activities: (house)work, personal needs and care, education, active and passive leisure. Within time with at least one parent, we can distinguish time with the mother alone, the father alone and both parents together. I use an individual fixed-effect model to estimate the impact of being in a single parent family on child and parental time investment. In the second part of the study, to account for child's unobserved characteristics in the cognitive and non-cognitive skill production functions, I consider three strategies commonly adopted: the value-added, the fixed-effect model and the cumulative value-added model. I also use the GMM framework to account

for the presence of feedback effects.

I draw attention to two new findings. First, being in a single parent family has a negative impact on time with at least one parent present; substitution between parental time is not perfect. The composition of parental time is highly affected. Second, all parental time does not have the same impact on reading and non-cognitive skills: time spent with both parents together does not have the same impact as time spent with the mother. Also, results suggest that the effect of time investments on child development vary across gender and parents' education.

Therefore, based on the empirical evidence gathered here, it appears that time investment could be a driving channel for the effect of parental separation on child development. On the one hand, the decrease in the accessible time of parents may explain the negative effect on non-cognitive skills. Also, the channel of time allocation may be of particular importance for children whose parents separate in their early childhood. On the other hand, the change in the composition of parental time may be a driving channel for the effect of parental separation on the three skills, especially for children with more highly educated parents.

The remainder of the paper proceeds as follows. Previous related literature is presented in the next section. In Section 3, a description of data, main variables and some descriptive statistics are provided. The identification strategy is explained in Section 4. Section 5 shows the main results. Further evidence are reported in Section 6. Section 7 concludes.

2 Previous Findings

Parental separation seems to negatively impact child development. Separation is costly for parents, it involves losing the production and consumption complementarity or risk pooling achieved as a couple. Parental separation can also have a psychological impact on children. However, parental separation is probably correlated with parent's unobserved characteristics, the main example being the level of conflict between parents. Researchers have employed several methods to handle this selection issue: sibling-differences, instrumental variables, control for conflicts. Some studies still find a negative effect even after taking into account the endogeneity problem (see Ermisch and Francesconi 2001 [10]; Frimmel et al. 2016 [13]; Gruber 2004 [15]; Francesconi et al. 2010 [12]; Clark et al. 2015 [6]; and Ribar et al. 2017 [24]). However, not much is known about the channels for this negative effect.

Becker and Tomes (1965, 1979) [3] [4] have pointed out the importance of parental time in determining child attainment. Yet there are surprisingly few empirical studies that analyse the effect of time allocation and parents' time investment on child's human capital. Many of the existing findings are

based on the mother's employment used as a proxy for maternal time. A burgeoning literature attempts to fill this gap using time diary data or at least direct measures of parental time. Using time diaries from LSAC[1], Fiorini and Keane (2014) [11] find that educational activities, particularly with parents, are the most productive input for cognitive skills. Non-cognitive skills seem insensitive to differences in time allocation. Del Bono et al. (2016) [9] show that maternal time is a productive input for both cognitive and non-cognitive skills, especially in early childhood. They note a feedback effect, meaning that mothers invest less on time inputs when children are doing well cognitively; maternal time has a long-term impact.

Other studies focus also on child's own time investments. Using time-use diaries from the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS), Funk and Kemper (2016) [14] note the effect of listening to music and learning for both math and reading skills. Del Boca et al. (2017) [8] show that time input production functions vary across age: maternal time matters in childhood, but the child's own time investment is more productive during adolescence.

This paper aims to bridge the gap between these two strands of the literature, examining how child and parental time investment can be a channel for the negative effect of divorce. Using the United States and United Kingdom Time-Use Surveys (ATUS and UKTUS), Kalenkoski et al. (2007) [18] show that single parents spend more time with their children, when observed selection is controlled. Kendig and Bianchi (2008) [19] and Le Bourdais and Rapoport (2001) [20] find similar results for the United States and Canada respectively. Mencarini et al. (2014) [22] is the closest paper to this one. Instrumenting single parent families by parents' religious practice, they find that being in a single parent household reduces the amount of time spent reading and studying; this effect is driven by poorer families, only children and boys.

Most studies focus on maternal time. Paternal time and time spent with both parents together are two key missing variables in these analyses, although they are highly affected by parental separation. Responses by the custodial parent are uncertain. She may compensate for the decrease in the other parent's time investments. Hsin and Felfe (2014) [17] suggest that working mothers protect productive maternal time. Clark et al. (2015) [7] find little evidence of an effect of early maternal employment on a child's emotional outcomes; fathers may compensate with an increase in their own time investments, or parents may adopt alternative childcare arrangements. On the other hand, Pailhé and Solaz (2004) [23] find evidence of complementarity of leisure time; parents have a preference for spending leisure time together with children.

Besides, if there is total substitution, we may ask if all parental time investment have the same impact

[1]Longitudinal Study of Australian Children

on child development. Spending one hour with parents together may have the same impact as one hour with each parent if it is the time spent with the parent that matters rather than time spent in a particular activity, or even more valued if family time matters.

3 Data

The Panel Study of Income Dynamics began in 1968 in the United States with a nationally representative sample. Information on these individuals and their descendants has been collected continuously. We have been able to recover inter-generational information for all families.

The PSID - Child Development Supplement (PSID-CDS) follows 2,650 children first interviewed in

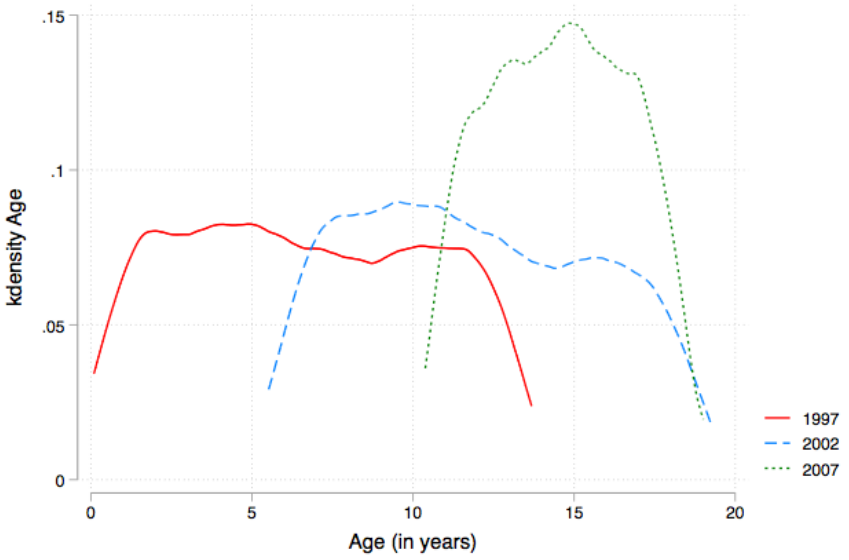


Fig. 1. Age distribution for each wave

1997, then in 2002 and 2007. Figure 1 shows that children are between 0 and 14 years old in the first wave, 4 and 19 in the second wave (2002), and between 10 and 19 in the third wave (2007). A large number leave the sample in the third wave due to the age limit (they are above the age of 19, see Figure 1).[2] The sample is not large, but the survey does collect a rich set of information about children's cognitive skills, non-cognitive skills, demographics and parental background, along with time-use diaries for two days, one during the week and one at the weekend. The child fills in the time diary where possible, and the primary care giver if necessary. Time diaries provide information on the activity, where the activity took place, and with whom. As far as we know, the only panel data with time-use diaries is the Longitudinal Study of Australian Children (LSAC). Despite the larger sample of the LSAC,

[2]A more detailed description of attrition is done in Section 5.3

and the advantage of being biannually surveyed, there is no distinction between parent and step-parent in the time use diary, which makes the CDS a more appropriate dataset for studying the channels for the effect of parental separation.

3.1 Time investment variables

Children fill in the time-use diary for one day during the week and one day at the weekend, picked randomly at the beginning of the survey; no substitution is possible. They fill in the time diary on a 24-hour continuous basis, to avoid measurement errors. The child has to provide the activity, the duration, the location, who was present at the moment of the activity and who was involved. This can be used to measure time investments in each activity for a representative week (in hours), using a weighted average of time investments during the week and at the weekend.

I use five categories: Work and housework; Personal needs and care including sleeping time; Education including reading time; Active leisure (sports, dance, going to the theatre) and Passive Leisure (Watching TV, Arguing). Figure 2 shows how children spend their week in these five categories. Note that the study focuses on the primary activity. Children spend a small part on housework and work activities. They spend half the day on personal needs and care (including sleeping). The rest of the representative day is divided between educational activities, active and passive leisure.

For each activity, time is distinguished between that spent alone, with the mother only, with the father

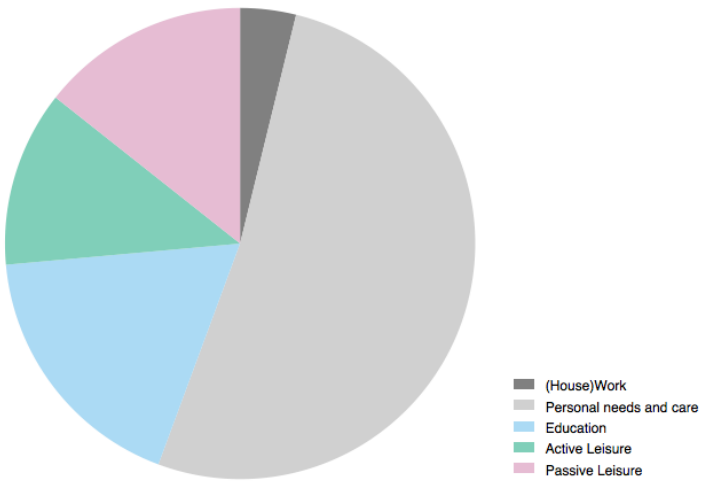
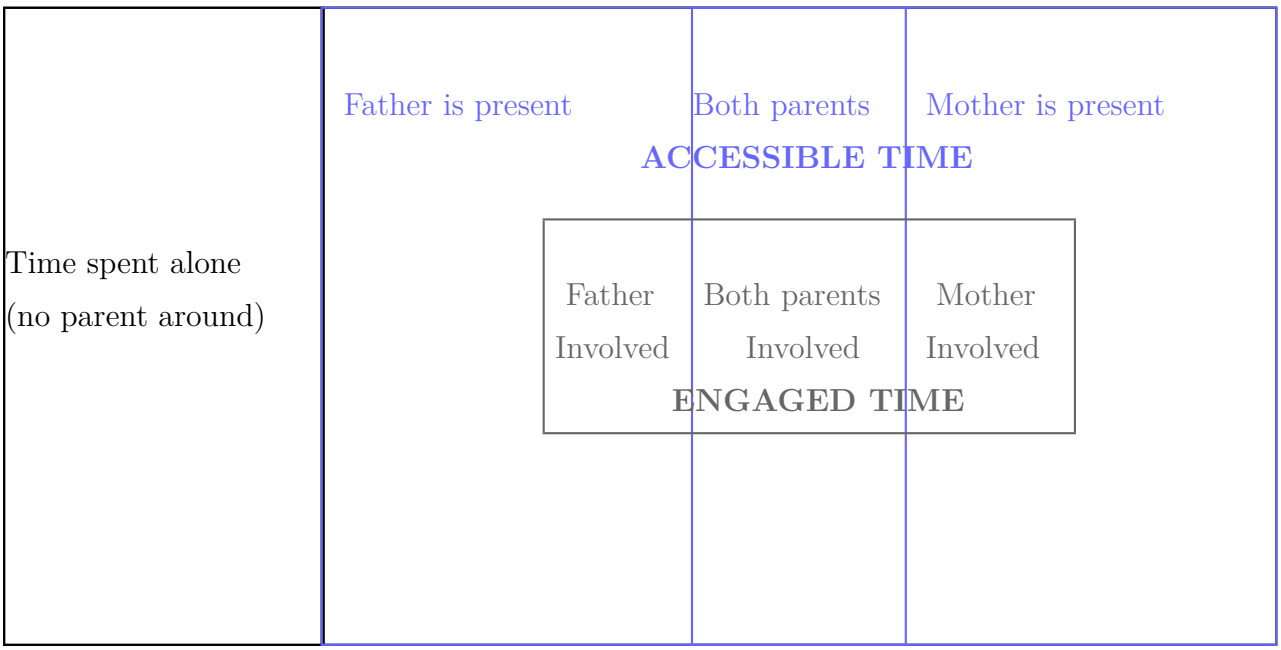


Fig. 2. Breakdown of Time Allocation into 5 activities

only and with both parents. We also consider time spent with at least one parent. We analyse time spent with a parent involved in the activity (engaged time) and also present during the activity (accessible time) (see Hofferth and Sandberg (2001) [16]). Before looking at parental time investment, I first look

at time investments whoever is with the child. Then, among time investments, I distinguish time spent alone from time with at least one parent, the latter can be broken down again into three different types of parental time: time with the mother only, time with the father only and time with parents together. Time with other adults, such as step-parents and grand parents, is also measured. The diagram below shows the breakdown of parental time.



As far as we know, this is the first study analysing time spent with parents together. Not much attention has previously been paid to paternal time either. Figure 3 shows the breakdown of time according to who is involved in the activity. The first graph shows the breakdown of time for a representative day. "Not relevant" means that the child is assumed to do the activity on their own. The child may be doing the activity alone, with at least one adult, or with someone else ("other"): a sibling, a half-sibling, other relative or non-relative. I exclude this latter category in the rest of the study because we do not have much information (age, sex, etc.) on these individuals. In the second graph, we can see the breakdown of time with at least one adult. It is mainly time with at least one parent, time with grand-parent (only) or time with one parent and someone else (grand-parent or step-parent). The last graph shows the breakdown of time with at least one adult. More than half of parental time investment is time with the mother only, and more than 75% of the time with at least one parent is time with at least the mother. In the rest of the paper, we exclude other parental time (time spent with at least one parent and someone else), because we do not have much information on the effect of time spent with a step-parent on child development.

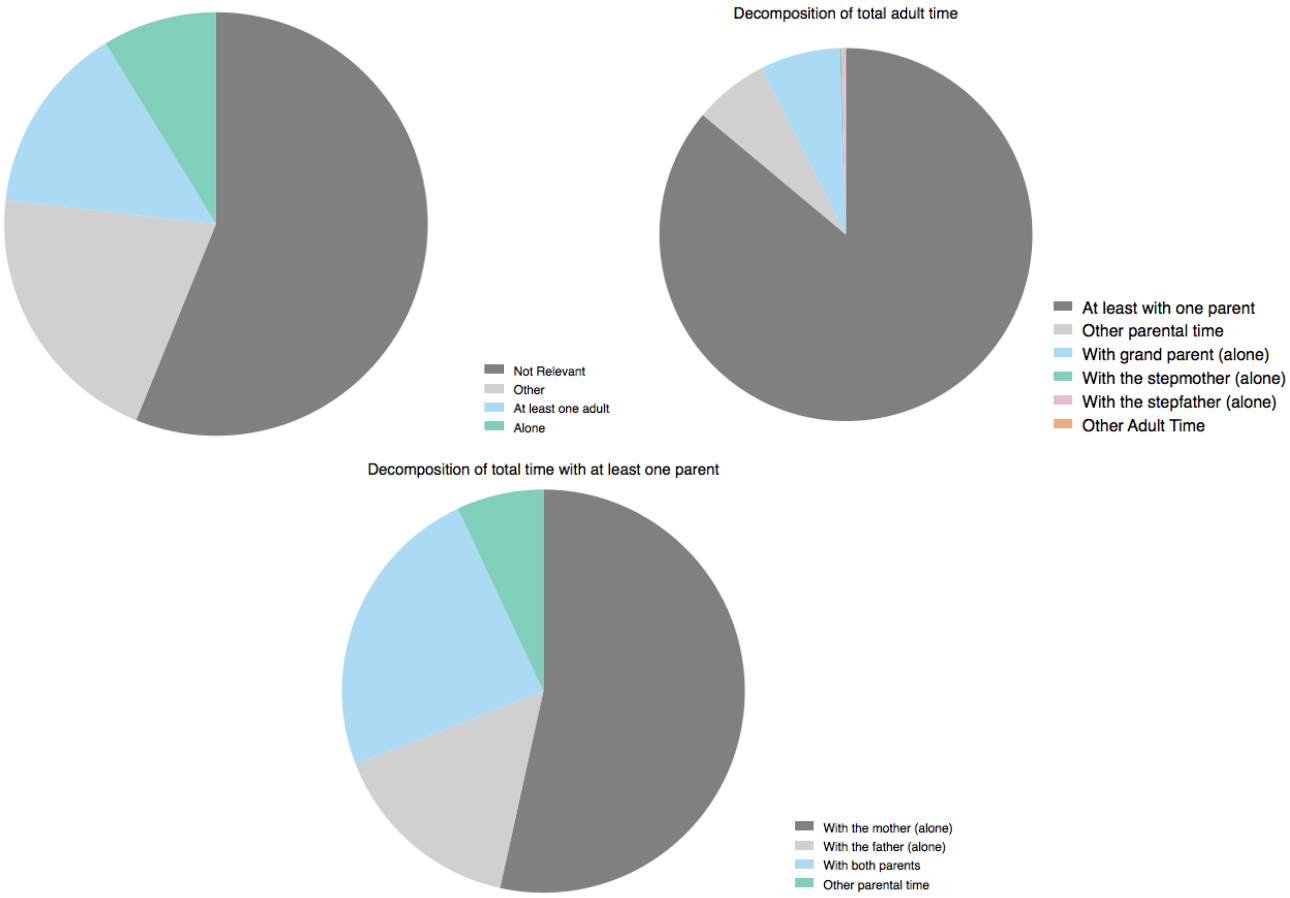


Fig. 3. Breakdown of Time Investments (engaged time)

3.2 Child development measures

Cognitive skills. Cognitive skills measure the ability to perform mental activities. Cognitive tests come from the Woodcock-Johnson Revised Tests of Achievement (WJ-R). These go from the easiest question to the most difficult. The PSID-CDS dataset provides two tests of reading and verbal abilities and another test of logical abilities. Scores on the Letter-Word Identification test (from the age of three) and the Passage Comprehension test (from the age of six) give the Broad Reading test score. The Broad Math test score is the score on the Applied Problem Test, administered from the age of three. The scores are available in four formats: raw score, standardized score on the national average for an age group with a mean of 100 and a standard deviation of 15, W score that accounts for the difficulty of the question, and the percentile rank. The standardized test scores are used in the rest of this analysis.

Non-Cognitive skills. Non-cognitive skills are other skills including emotional maturity, empathy, non-verbal communication, and social behaviour. To measure the non-cognitive skills, I use the Behavior Problems Index (BPI), designed by Peterson and Zill (1986) to measure the frequency and type of

childhood behaviour problems for children aged 3 and older. The BPI is based on responses from the primary care giver about the child's behaviour and feelings. The BPI can be divided into two parts: internalizing BPI (goes from 0 to 14 initially) and externalizing BPI (goes from 0 to 17 initially). The former accounts for how the child feels and takes into account problems of self-esteem, reveals feelings of not feeling loved, feeling anxious, easily confused, feeling inferior, depressed, too dependent or if they worry too much; while the latter accounts for how child behaves, taking into account nervousness, arguing or lying, concentration problems, social problems, and hyper-activity. For ease of the interpretation, scales have been reversed: a positive effect on this re-scaled BPI means higher non-cognitive skills. I only report results on Total BPI, denoted as "non-cognitive skills" is the rest of the paper.

All the child development variables are standardized to a mean of 0 and a standard deviation of 1.

3.3 Family Structure

For family structure, I use five family types: children who are living with both parents; with their mother only; with their mother who has a partner living or not with the child; with their father and others (child does not live either with their mother, or with their father). Dummies are also included to control for the absence of father at birth and for the death of parents. But there are too few observations for these latter variables to be able to draw any conclusion.

Table 1 shows the transition matrices for family structure from Wave 1 to Wave 2, and from Wave 2 to Wave 3. All the families who remain single mother families with a step-parent or not, or single father families or others (on the diagonal) are excluded from the fixed-effect analysis. The rest of the observations are used to identify the effect of family structure.

3.4 Other controls

Controls on individual's and family's characteristics are included. Sex, Age, Ethnicity, Primary Care Giver (PCG)'s employment status, education and earnings; and Number of siblings. Table 2 shows the summary statistics for these control variables for the whole sample, for each wave. The average age is around 6 years old, 12 years old and 14.5 years old for each wave, respectively. Half of the sample is white. The proportion of children who are living with both parents is around 64% in the first wave and decreases across waves; on the other hand, the proportion of children living with their single mother increases.

Table 1. Transition in family structures from 1997 to 2002 and from 2002 to 2007

		Family structure in wave 2						
Family structure in wave 1		Two parents	Single Mother	Single Mother with SP	Single Father	Other	Attrition	Total
	Two parents	1131	132	29	21	10	350	1673
	Single Mother	34	299	81	7	18	204	643
	Single Mother with a step parent	7	25	41	1	6	49	129
	Single Father	3	0	4	19	6	17	49
	Other	2	12	11	5	28	42	100
	New individuals	86	76	13	9	13		197
	Total	1263	544	179	62	81	662	2791
		Family structure in wave 3						
Family structure in wave 2		Two parents	Single Mother	Single Mother with SP	Single Father	Other	Attrition	Total
	Two parents	569	63	6	10	10	605	1263
	Single Mother	18	199	38	3	10	276	544
	Single Mother with SP	2	15	54	0	6	102	179
	Single Father	3	2	0	17	3	37	62
	Other	0	10	5	2	23	41	81
	Unknown (A_13)	56	45	18	6	14		139
	New individuals (A_3)	15	15	3	1	3		37
	Total	663	349	124	39	69	1061	2305

Table 2. Summary Statistics

	1st wave				2nd wave				3rd wave			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
Age	6.63	3.77	0	14	11.92	3.67	6	19	14.55	2.16	10	19
Female	0.49	0.50	0	1	0.50	0.50	0	1	0.49	0.50	0	1
White	0.50	0.50	0	1	0.51	0.50	0	1	0.50	0.50	0	1
African american	0.37	0.48	0	1	0.36	0.48	0	1	0.37	0.48	0	1
Hispanic	0.08	0.26	0	1	0.08	0.27	0	1	0.08	0.27	0	1
Asian Pacific	0.02	0.13	0	1	0.02	0.13	0	1	0.02	0.14	0	1
American Indian	0.00	0.06	0	1	0.00	0.05	0	1	0.00	0.03	0	1
Other	0.03	0.18	0	1	0.03	0.18	0	1	0.03	0.16	0	1
Two Parents	0.64	0.48	0	1	0.59	0.49	0	1	0.53	0.50	0	1
Single Mother	0.25	0.43	0	1	0.26	0.44	0	1	0.28	0.45	0	1
Single Mother (step-parent)	0.05	0.22	0	1	0.08	0.28	0	1	0.10	0.30	0	1
Single Father	0.02	0.14	0	1	0.03	0.17	0	1	0.03	0.17	0	1
Other	0.04	0.19	0	1	0.04	0.19	0	1	0.06	0.23	0	1
PCG - Worker	0.63	0.48	0	1	0.73	0.45	0	1	0.78	0.41	0	1
PCG - Looking for work	0.08	0.26	0	1	0.05	0.21	0	1	0.05	0.22	0	1
PCG - Housewife	0.25	0.43	0	1	0.19	0.40	0	1	0.15	0.35	0	1
PCG - Student	0.04	0.18	0	1	0.02	0.13	0	1	0.01	0.12	0	1
PCG - Other	0.01	0.09	0	1	0.02	0.12	0	1	0.00	0.07	0	1
Earnings	9.47	1.04	3	13	9.79	0.98	4	13	9.79	1.30	2	12
Observations	2594				2129				1244			

4 Estimation

4.1 Estimating the effect of family structure on children's and parents' time investment

I estimate the impact of family structure on child and parental time investment using an individual fixed-effect analysis. A common identification problem comes from the correlation between family structure and unobserved variables that may affect child and parental time investment. Selection into separation has long been recognized as an estimation issue by economists (see Section 2). A fixed-effect model copes with selection, since it removes all time-invariant variables, observed or not.

Let TI_{it}^{k} be a vector of time inputs measured by the total amount of time spent on activity k at time t (no matter who was there); and PTI_{it}^{kP} a vector of parental time inputs spent with parent P on activity k. These two variables are standardized to a mean of 0 and a standard deviation of 1. FS_{it}^{k} is a set of dummies indicating family structure at time t. Z_{it} denotes all control variables described above. The individual fixed-effect is denoted α_i. The effect of family structure can be estimated following this equation:

$$(P)TI_{it}^{k} = \delta_1 FS_{it} + \delta_2 X_{it} + \alpha_i + \epsilon_{it} \tag{1}$$

where δ_1 measures the effect of a change in the family structure on the amount of time spent on the activities.

The fixed-effect model rules out endogeneity issues due to correlation between family structure and invariant variables. It relies on these assumptions: **i)** parental separation is not due to an unobserved change in one of the parents' or child's behaviour or characteristics; **ii)** child's time investments follow the same trend in all family structures.[3]

Once we estimate the effect of family structure on child and parental time investment, we examine if these changes matter for the child's development.

[3]To check this assumption, I compare children living with both parents with children whose parents separate between the second and the third wave. Until separation, results show that time investments follow the same trend in these two groups.

4.2 Estimating Time Input Production Functions and the effect of the presence or involvement of parents

I estimate time input production functions using the approach developed by Todd and Wolpin (2003, 2007) [25] [26], and also applied by Fiorini and Keane (2014) [11], Del Bono et al. (2016) [9], and Del Boca et al. (2017) [8]. The aim of this analysis is to look at the importance of time spent with parents, and to assess the possible heterogeneity among parental time investments, seeing if the child's development depends on who is involved or present during the activity. One of our main interests is to look at time spent with both parents together.

Simple correlations between time inputs and child outcomes are difficult to disentangle from causal relations. According to Fiorini and Keane (2014) [11], endogeneity can come from three sources: a) omitted variables such as unobserved child ability; b) reverse causality, spending more time reading may foster a child's reading test score, but higher abilities in reading may also lead to a greater interest in reading; and c) measurement errors in outcomes and amount of time spent in the activity. The latter could come from recall errors, or self-report bias, children may lie about the amount of time spent on homework or overestimate activities that they consider as more socially valuable. In addition, we only have time diaries for two days in a week, picked randomly in a year, and these measures are subject to transitory shocks. If the family planned to go to Disneyland that day, it is unlikely to be representative of the child's daily time-use.

I deal with omitted variable bias by controlling for past test score. Reverse causality would be a problem if an increase in reading test score triggered an increase in time spent in reading, which cannot be excluded [4]. Using time diaries avoids measurement error; indeed we may assume that children are less willing to overestimate the amount of time they spend on more socially valuable activities. Still, they may lie about the time they spend studying if they fear that their parents will check their answers. Moreover, we are aware that two days picked randomly may lead to measurement error, similar to the measurement errors described in income literature when current earnings are used instead of permanent earnings, but unfortunately, there are only two panel data sets in the world that provide time diaries filled in by children, and no one provides more detailed information. Obviously, asking for more frequent surveys would decrease the number of respondents willing to be surveyed, which leads to greater attrition.

I start by presenting the cumulative value-added model. Let Y_{it} be the outcome of individual i in wave t. I consider three particular outcomes: Broad Reading test score, Math test score, Non Cognitive

[4] I handle this issue in Section 6.3 using a GMM model.

Skills (Total Behavior Problem Index). As mentioned before, TI_{it}^{k} and PTI_{it}^{kP} are the vectors of total time inputs (whoever was present) and parental time inputs respectively. Let PTI_{it-1}^{kP} be the vector of parental time inputs in previous wave $t-1$. Putting aside the role of other conditioning variables for the sake of simplicity, the time input production function can be written as

$$Y_{it} = \beta_0 + \Sigma_1^K \gamma_1^k TI_{it}^k + \Sigma_1^K \gamma_2^{kP} PTI_{it}^{kP} + \Sigma_1^K \gamma_3^k TI_{it-1}^k + \Sigma_1^K \gamma_4^{kP} PTI_{it-1}^{kP} + \lambda Y_{it-1} + \epsilon_{it} \tag{2}$$

Y_{it-1} is the individual's outcome in the previous wave. It captures learning persistence, and is also a proxy for unobserved ability. γ_1^k measures the impact of spending 1 standard deviation more on activity k. γ_2^{kP} captures the effect of the presence or the involvement of a parent during the activity. γ_3^k and γ_4^{kP} measure the effect of child's and parents' time investments in the previous wave. In the main body of the paper, we assume $\gamma_3^k = \gamma_4^{kP} = 0$, this model is known as the value-added model.
I also estimate a fixed-effect model:

$$Y_{it} = \Sigma_1^K \gamma_1^k TI_{it}^k + \Sigma_1^K \gamma_2^{kP} PTI_{it}^{kP} + \alpha_i + \epsilon_{it} \tag{3}$$

These models rely on different assumptions. In the value-added model, we assume **i)** the measurement errors in the child's skills are uncorrelated with inputs and unobserved ability; **ii)** any omitted input is uncorrelated with included input; **iii)** the production function is non-age-varying ($\gamma_3 = \gamma_4 = 0$); **iv)** the effect of inputs (observed or not) declines with age at a constant rate λ; **v)** such as the effect of unobserved abilities. In the Fixed-effect model, we assume **i); ii), iii)**; assumptions **iv)** and **v)** are replaced by **iv)** the effect of inputs (observed or not) is constant by age; **v)** such as the effect of unobserved abilities. In the Cumulative Value-Added model, assumptions **iii)** and **iv)** are relaxed. For a better understanding of these assumptions, see Todd and Wolpin (2007) [26]. All models have the advantage of controlling for the subjectivity of the Primary Care Giver providing the non-cognitive skills assessment; captured by Y_{it-1} in the Value Added Model and cancelled out in the Fixed Effect Model. Several specifications are estimated. In the most precise specification, three types of parental time are distinguished: time with at least one parent, paternal time, and time with both parents are included, maternal time is omitted and is the reference category.

$$Y_{it} = \beta_0 + \Sigma_1^K \gamma_1^k TI_{it}^k + \Sigma_1^K \gamma_2^{k,OP} PTI_{it}^{k,OP} + \Sigma_1^K \gamma_2^{k,F} PTI_{it}^{k,F} + \Sigma_1^K \gamma_2^{k,BP} PTI_{it}^{k,BP} + \lambda Y_{it-1} + \epsilon_{it} \tag{4}$$

This specification is intended to estimate whether who is involved or present during the activity matters for children. $\gamma_2^{k,OP}$ measures the effect of one minute more with at least one parent, and $\gamma_2^{k,F}$

and $\gamma_2^{k,BP}$ measure the effects of spending one minute with the father only or with both parents on the activity k respectively, rather than with the mother only.

In all these models, controls Z_{it} are included such as individual's sex, ethnicity, age, Primary Care Giver (PCG)'s employment status, education and earnings, family structure, and the number of siblings. Time with step-parent and grand-parents are also controlled for in Models 2, 3 and 4. Family structure, denoted FS_{it}, is a set of dummies indicating if the child lives only with their mother; only with their mother who has a partner, living or not with the child; only with their father, or others (meaning that the child does not live with either of their parents). The reference category is the two-parents family. Dummies are included indicating if the child had a father at birth or a deceased parent.

5 Main results

5.1 Effect of family structure on children's and parents' time investments

In Table 3, we examine whether a change in family structure affects child and parental time investments. Standard errors are clustered at the individual level. Models include individual fixed effects, and controls such as age, number of siblings, primary care giver's education, employment status and earnings. Dummies indicating if the child had a father at birth or a deceased parent are included. Amounts of time are standardized to a mean of 0 and a standard deviation of 1. Panel A of Table 3 shows the estimation results for total child time investments, Panels B and C show the estimation results for parental time investments measured as time spent with at least one parent considering accessible time (Panel B), when parent is present during the activity and engaged time (Panel C), when the parent is involved during the activity.

Estimations of Panel A of Table 3 show that a child's total time investments (whoever is present or involved) are not affected by family structure, children spend the same amount of time on the activities considered. We did not expect children to change their habits after a parental separation, although parents may be more time-constrained. So, is time with at least one parent affected by a change in family structure? Panels B and C show a decrease in time spent with at least one parent present in all activities, except active leisure time, especially in single mother families. Being in a single mother family leads to a decrease of 30% of a standard deviation in the time spent with at least one parent present. However, this decrease in accessible time does not reflect a decrease in engaged time. Estimation results on engaged time (Panel C) reveal a small impact of a change in family structure. Estimated coefficients are negative, but not significant even at a 10% level, except time spent on (house)work with at least

one parent involved.

To clarify these findings, I report the breakdown of this impact into time spent with the mother only, the father only and both parents together. Figures 4 and 5 show the breakdown of accessible and engaged parental time, respectively. One pattern emerges from these results. The custodial parent increases the time spent alone with the child, but does not manage to compensate for the double decrease in time the child spent with their parents together, and time spent only with the non-custodial parent. Looking at accessible time, time spent with the custodial parent actually decreases since she does not perfectly compensate for the decrease in time with parents together. It means that the custodial parent spends less time at home. A possible explanation is the budget constraint of single families that triggers custodial parents to increase their number of working hours to cope with the cost of separation. Another explanation is the existence of a complementarity effect. One parent increases (decreases) the time spent with the child if the other parent increases (decreases) theirs. For example, instead of going to the supermarket as a family, the custodial parent may prefer to go on her own and leave the child at home or with another adult.

The breakdown of time with at least one parent engaged in the activity reveals that custodial parents aim to compensate at least for the time that was spent with both parents, especially on activities considered as determinants for child development such as personal needs and care and education. Single father families do not show exactly the same pattern; however, there are not enough observations in this group to draw any strong conclusions.

Estimation results do not show any impact of family structure on total child time investments, nor any clear effect on time spent with at least one parent involved; but they do show a decrease in time with at least one parent present. In addition, the breakdown of accessible and engaged parental time is greatly affected; time spent on main activities with both parents together and alone with the non-custodial parent decrease. But are these changes reflected in poorer child development? To address this question, I consider time input production functions, and examine whether parental time investments matter in the production of a child's cognitive and non-cognitive skills. I also see if who is present or involved matters for the child.

Table 3. Effect of Family Structure on Child and Parental Time Investments

Panel A : Total Time (whoever was present)

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.02	0.08	−0.14	0.15	−0.09
	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)
Single Mother (step-parent)	−0.05	−0.06	0.15	0.08	−0.19
	(0.16)	(0.16)	(0.13)	(0.16)	(0.14)
Single Father	−0.01	0.14	−0.00	−0.02	−0.12
	(0.18)	(0.17)	(0.20)	(0.21)	(0.17)
Other	−0.12	0.36+	−0.29	0.18	−0.14
	(0.22)	(0.19)	(0.21)	(0.24)	(0.20)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.25*	−0.14+	−0.22*	0.01	−0.24*
	(0.12)	(0.08)	(0.11)	(0.10)	(0.10)
Single Mother (step-parent)	−0.27	−0.19	−0.29*	−0.21	−0.48***
	(0.17)	(0.16)	(0.15)	(0.13)	(0.14)
Single Father	−0.15	−0.58***	−0.11	0.11	−0.15
	(0.21)	(0.17)	(0.18)	(0.21)	(0.16)
Other	−0.28	−0.40+	−0.47***	−0.09	−0.44*
	(0.18)	(0.21)	(0.13)	(0.17)	(0.18)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.20+	−0.02	0.03	0.04	−0.05
	(0.12)	(0.09)	(0.08)	(0.09)	(0.09)
Single Mother (step-parent)	−0.22	−0.07	−0.04	0.02	−0.12
	(0.15)	(0.13)	(0.12)	(0.14)	(0.13)
Single Father	−0.20	−0.61**	−0.11	0.01	−0.15
	(0.23)	(0.19)	(0.13)	(0.23)	(0.18)
Other	−0.39*	−0.23	−0.12	−0.10	−0.31**
	(0.17)	(0.18)	(0.17)	(0.21)	(0.11)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Individual Fixed-Effect Model. Time variables are standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with dummies indicating if the child had a father at birth or a deceased parent.

Source : PSID - CDS, waves 1997, 2002 and 2007

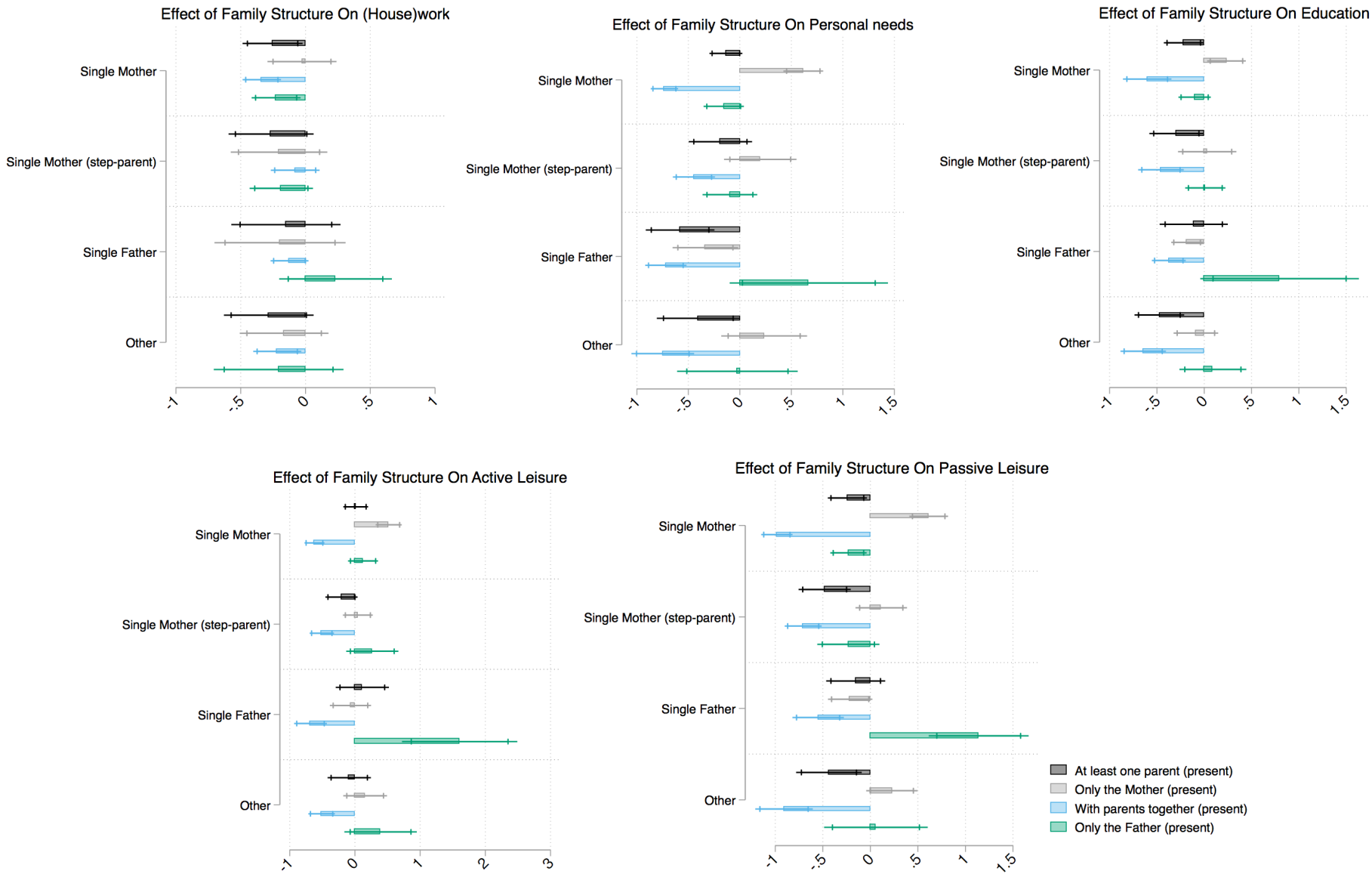


Fig. 4. Breakdown of time with at least one parent (accessible)

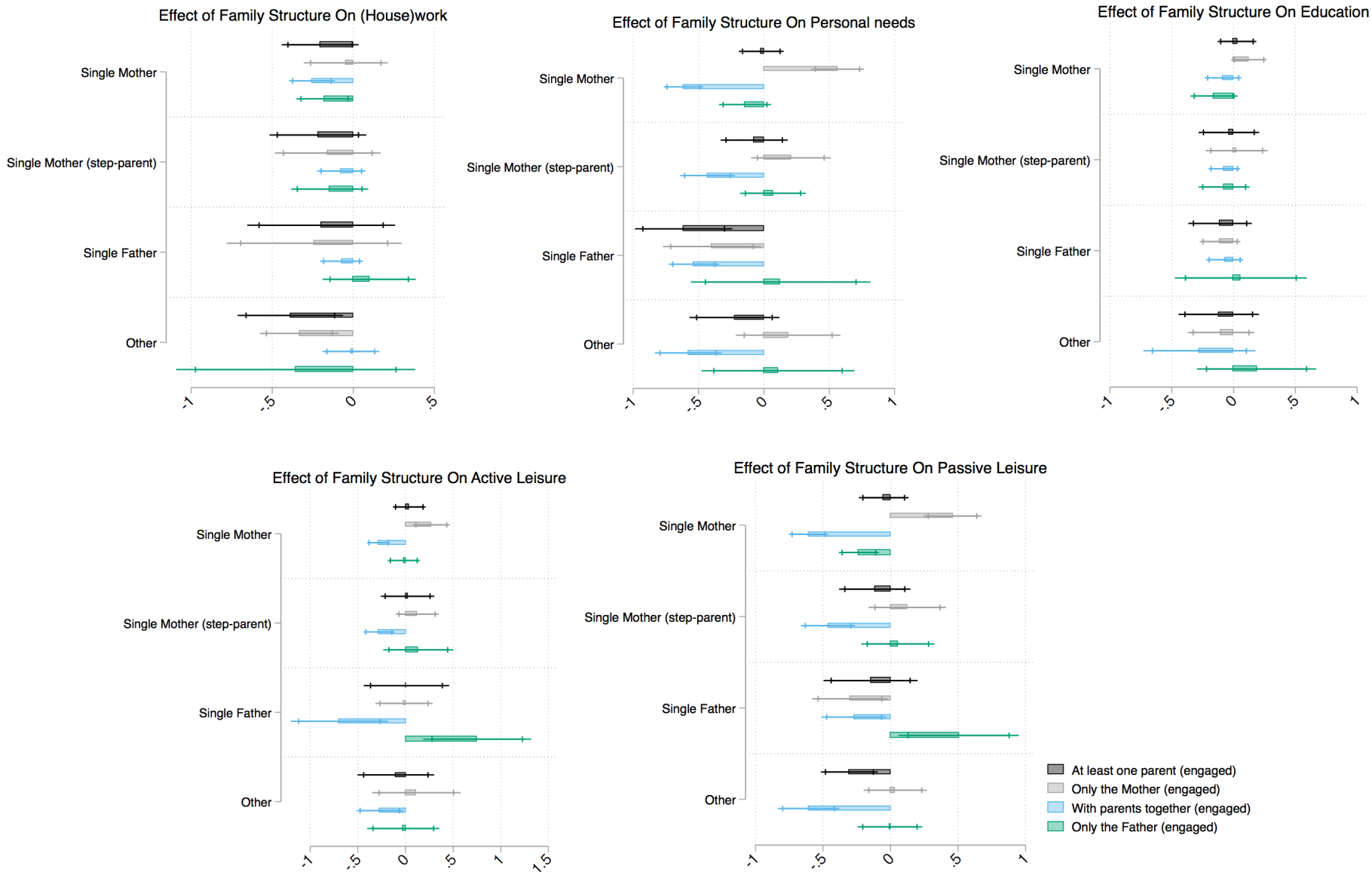


Fig. 5. Breakdown of time with at least one parent (engaged)

5.2 Time Input Production Functions and Parental Time Productivity

Using a Value Added model, Tables 4 - 6 present the estimations of time input production functions for cognitive and non-cognitive skills[5]. Because the five time inputs measured as time spent on activities are collinear, I take time spent in personal needs and care as the omitted category. The effect of the other time inputs should be interpreted as relative to that of personal needs and care. I also consider a fixed-effects model in Tables A3.7 and A3.8 in the Appendix.

Standard errors are clustered at the individual level. As mentioned earlier, models include controls such as sex, ethnicity, age, number of siblings, primary care giver's education, employment status and earnings and family structure, along with dummies indicating if the child had a father at birth or a deceased parent. Amounts of time are standardized to a mean of 0 and a standard deviation of 1.

I first discuss the effect of the total amount of time spent on each activity (Table 4). Next, I consider the effect of the presence of at least one parent (Table 5). In Table 6, I address the question of the heterogeneity of parental time investments, allowing for heterogeneity of productivity in the different parental time investments.

5.2.1 Time Input Production Functions

Table 4 shows the estimated coefficients for the time input production functions considering total time (whoever was present). Active leisure and education activities are ranked highest for both cognitive and non-cognitive skills. For example, an increase of 1 standard deviation in the amount of time spent on educational activities rather than personal needs and care increase the reading test score by 13% of a standard deviation. (House)Work is also found to be preferable to personal needs and care. Results suggest that personal needs and care is at the bottom of the ranking.

I performed a Wald test: the null hypothesis is rejected at a 2% level. Results suggest that the way the child allocates their time is important in the child's development, but is time spent on education more productive when one parent is involved or present? This question is particularly interesting for this study, since we saw earlier that accessible parental time is affected by family structure.

5.2.2 Does the involvement or presence of at least one parent matter?

Table 5 shows the estimated coefficients for the time input productions considering total time (whoever was present) and time spent with parents. Estimated coefficients on the presence of parents capture the effect of an increase of one standard-deviation in time spent while the parent was present during the

[5]Results on Externalizing and Internalizing BPI are available upon request, they go in the same sense as the results on Total BPI, that is why I chose to not report them in the paper.

Table 4. Time Input Production Functions : Total Time (whoever was present)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.09*	0.04+	0.05+
	(0.04)	(0.03)	(0.03)
Education	0.13*	0.09***	0.05*
	(0.06)	(0.03)	(0.03)
Active Leisure	0.12*	0.08**	0.08**
	(0.05)	(0.03)	(0.03)
Passive Leisure	0.04	0.04	0.01
	(0.04)	(0.03)	(0.03)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

activity. In Table 5, we can see that passive leisure is better for child non-cognitive skills if a parent is present. This is likely to reflect the type of passive leisure the child is engaged in. The presence of a parent does not affect the productivity of education activities.[6] On a Wald test, the effect of the presence of parents is significant for the child's non-cognitive skills (at a 8% level)[7].

Results for the effect of the involvement of parents are similar (See Table A3.1 in Appendix). On a Wald Test, the involvement of parents also has a significant effect on the child's non-cognitive skills (at a 10% level).

The small effects of the involvement and presence of parents may be surprising, but since we use a value-added model, the models are estimated only for the second and third waves; the average age of this sample is about 14 years[8]. Parental investments matter but especially in early childhood, so these

[6]Although, these estimations do not take into account that the presence of parents could affect time allocation itself. Children could be more likely to do their housework rather than watching TV if their parents are at home.

[7]The effect of the presence of parents is significant for the child's emotional skills (at a 2% level) and also for their behavioural skills (at a 10% level).

[8]The child must have performed a test in the first wave, he was at least 3 years old for math and non-cognitive skills and 6 years old for reading, thus he is at least 8 and 11 years old in the second wave respectively.

results are not so surprising. Nevertheless, since the breakdown of parental time is highly affected by family structure, we investigate the heterogeneity of parental time. Does one hour with the mother have the same impact as one hour with the father? And is time with both parents more productive for child development?

Table 5. Time Input Production Functions : Effect of the presence of at least one parent

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.07+	0.04	0.05+
	(0.04)	(0.03)	(0.03)
Education	0.12+	0.08**	0.06*
	(0.07)	(0.03)	(0.03)
Active Leisure	0.11*	0.09**	0.09**
	(0.05)	(0.03)	(0.03)
Passive Leisure	0.06	0.06+	−0.03
	(0.06)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	0.00	−0.01
	(0.02)	(0.03)	(0.03)
Education (with at least one parent)	0.03	0.03	−0.02
	(0.03)	(0.03)	(0.02)
Active Leisure (with at least one parent)	0.02	−0.01	−0.01
	(0.03)	(0.02)	(0.03)
Passive Leisure (with at least one parent)	−0.03	−0.03	0.07**
	(0.03)	(0.03)	(0.03)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

5.2.3 Does who is involved or present matter?

Table 6 shows the estimated coefficients for the time input production functions considering total time (whoever was present), time spent with at least one parent, time with father only and time with both parents. Time with at least one parent is the sum of time spent with the mother only, the father only and both parents together. Here, time with mother only is omitted and taken as the reference category.

Table 6. Time Input Production Functions : Does who is present matter? (Accessible Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.08+	0.05	0.05+
	(0.04)	(0.03)	(0.03)
Education	0.12+	0.08**	0.06*
	(0.07)	(0.03)	(0.03)
Active Leisure	0.11*	0.09***	0.09**
	(0.06)	(0.03)	(0.03)
Passive Leisure	0.06	0.06+	−0.03
	(0.06)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.05+	0.02	0.00
	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.00	0.04	−0.02
	(0.05)	(0.04)	(0.03)
Active Leisure (with at least one parent)	−0.02	−0.03	0.01
	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.00	−0.02	0.08*
	(0.04)	(0.03)	(0.03)
(House)Work (with parents together)	−0.05*	−0.01	−0.01
	(0.02)	(0.02)	(0.02)
Education (with parents together)	0.04	−0.01	−0.02
	(0.03)	(0.03)	(0.03)
Active Leisure (with parents together)	0.06*	0.02	−0.00
	(0.03)	(0.03)	(0.03)
Passive Leisure (with parents together)	−0.04	−0.01	0.00
	(0.03)	(0.03)	(0.03)
(House)Work (with father only)	0.01	−0.05*	−0.04+
	(0.03)	(0.02)	(0.02)
Education (with father only)	0.02	0.02	0.03
	(0.02)	(0.02)	(0.02)
Active Leisure (with father only)	−0.00	0.03	−0.04
	(0.02)	(0.02)	(0.02)
Passive Leisure (with father only)	−0.02	−0.00	−0.01
	(0.02)	(0.02)	(0.02)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Thus, the estimated coefficients for time with father only and with both parents capture the difference in the impact of time spent with the father or both parents during the activity, and the impact of time spent with the mother only. Results for engaged time are reported in Appendix (Table A3.2).

No strong heterogeneity in parental time emerges. On a Wald test, the presence of both parents or father has a significantly different impact than only mother's for reading skills (at a 15% level). The presence of both parents has a significantly different impact than only mother's for reading skills (at a 5% level); and the presence of father has a significantly different impact than only father's for math and non-cognitive skills (at a 12% level and a 8% level, respectively).[9]

Looking more precisely at time with parents together, results suggest that it is better to be with the mother when the child is doing work or housework rather than with both parents, but better to be with both parents when the child is doing active leisure for reading skills.[10]

Results also suggest that it is better to be with the mother when the child is doing (house)work and (slightly better) to do (house)work with her rather than with the father for non-cognitive skills and math skills.

Results suggest that time spent with both parents, or father have slightly different impact than time spent with the mother. Nevertheless, since the estimated effect of at least one parent present or involved is small, it is unsurprising to find little evidence of heterogeneity. Again, this only applies to adolescents.

Until now, we have considered a common time input production function for all children. In the next section, we allow differences in the time input production function across gender, PCG's education and age, and we also consider the presence of feedback effects.

6 Further Evidence

In Tables 7 and 8, I allow time input production functions to differ across genders and family background, respectively. Using a CVA (Cumulative Value Added) model in Section 6.2, I consider age-varying time input production functions (Table 9). I account for the presence of feedback effects using an approach based on the GMM framework in Section 6.3.

[9] I recover similar results for engaged time. On a Wald test, the involvement of both parents or father has a significantly different impact than only mother's for reading skills (at a 2% level). The presence of both parents has a significantly different impact than only mother's for reading skills (at a 2% level); and the presence of father has a significantly different impact than only mother's for math and non-cognitive skills (at a 7% level and a 12% level, respectively).

[10] This is also true for engaged time. See Table A3.2

6.1 Heterogeneity of Time Input Production Functions

In Tables 7 and 8, I allow the effect of time input investments to vary across gender and PCG's education respectively[11]. As in the previous section, time input production functions include total time (whoever was involved), time spent with at least one parent, time with father only and time with both parents. In the following tables, the focus is on time when the parents are involved in the activity. The estimated coefficients for interaction terms are reported; they capture the possible differences in the effect of time input for girls, and more highly educated parents. As mentioned before, the estimated coefficients for time with father only and with both parents capture the effect of time spent with the father or both parents during the activity, rather than with the mother only.

Child's gender

Estimation results in Table 7 suggest that engaging in active leisure rather than personal needs and care affects girls' non-cognitive skills less than boys', but affects more their reading skills. The effect of the involvement of both parents rather than mother only seem to benefit boys' reading skills more than girls' when they are doing educational activities, and their math skills when they are engaging in passive leisure, and girls' when they are doing (house)work. The effect of the involvement of father rather than mother seems to benefit girls' reading skills more when they are doing (house)work and educational activities.

There is no evidence of differences in the effect of time with at least one parent present, and not much evidence of differences in the effect of presence of fathers or both parents. (Table A3.3)

I perform a Wald Test to test the hypothesis that the vector of estimated effects of time input production functions of girls is the same as boys' (testing that the vector of interaction terms is jointly equal to 0). We reject the null hypothesis for non-cognitive skills, this comes from the total allocation of time. This suggests that girls' non-cognitive skills may respond differently than boys to the total amount of time spent on each activity. The results suggest also differences in the effect of paternal time investments across genders for reading skills (at a 5% level).

The same results emerge when we consider the presence of parents.

[11] In this section, results on Engaged Time are more relevant, therefore I only report those. Results for Accessible Time are in Tables A3.3 and A3.4 in the Appendix

Table 7. Time Input Production Functions : Does gender matter? (Engaged Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
Female=1 × (House)Work	0.09	0.04	0.06
	(0.08)	(0.06)	(0.06)
Female=1 × Education	0.05	−0.04	−0.08
	(0.12)	(0.06)	(0.05)
Female=1 × Active Leisure	0.15+	0.02	−0.15**
	(0.09)	(0.05)	(0.05)
Female=1 × Passive Leisure	0.06	0.04	−0.07
	(0.09)	(0.05)	(0.06)
Female=1 × (House)Work (with at least one parent)	−0.08	−0.05	−0.00
	(0.05)	(0.05)	(0.06)
Female=1 × Education (with at least one parent)	0.04	−0.07	0.02
	(0.05)	(0.05)	(0.05)
Female=1 × Active Leisure (with at least one parent)	−0.03	0.03	0.07
	(0.05)	(0.06)	(0.06)
Female=1 × Passive Leisure (with at least one parent)	0.02	0.04	0.04
	(0.06)	(0.05)	(0.06)
Female=1 × (House)Work (with parents together)	−0.00	0.07+	0.00
	(0.04)	(0.04)	(0.05)
Female=1 × Education (with parents together)	−0.12*	−0.05	0.03
	(0.05)	(0.06)	(0.04)
Female=1 × Active Leisure (with parents together)	0.03	−0.02	−0.06
	(0.05)	(0.05)	(0.06)
Female=1 × Passive Leisure (with parents together)	−0.00	−0.08+	0.02
	(0.08)	(0.04)	(0.05)
Female=1 × (House)Work (with father only)	0.14+	0.01	−0.00
	(0.08)	(0.05)	(0.04)
Female=1 × Education (with father only)	0.06+	0.01	−0.06
	(0.03)	(0.04)	(0.04)
Female=1 × Active Leisure (with father only)	0.06	0.05	−0.00
	(0.06)	(0.05)	(0.05)
Female=1 × Passive Leisure (with father only)	−0.02	−0.07	−0.04
	(0.05)	(0.04)	(0.05)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Child's Family Background

In this section we examine whether time input production functions are different across family backgrounds. I considered earnings and education to capture family background, taking the variables as continuous or looking at the effect of being above or below the median PCG's earnings or PCG's education. Average PCG's education is around 13 years, the median is also 13, from 0 to 17 (Top 10%). Parents are considered as more highly educated when their education level is greater than 13 years; 45% of children in the sample have a more highly educated PCG. Median log earnings are around 10, log of earnings ranges from 2 to 12.6. For the sake of brevity, I only have reported the results for more highly educated PCGs. Again, I only report the results for parents' involvement.[12]

Results suggest that the non-cognitive skills of children whose PCG is more highly educated respond more to active leisure and education; their reading skills respond more to (house)work. This may reflect different kinds of active leisure or educational activities; or peer effects. More highly educated parents may increase their children's investments in active leisure that plays a greater role in a child's non-cognitive development; also, their children may not read the same books as children whose PCG is less highly educated. Their reading skills respond less positively to (house)work and education activities when at least one parent is involved.

Math skills respond more to the involvement of fathers in education activities rather than mothers when the PCG is more highly educated. This may reflect differences in parent's skills, since the husband is generally more highly educated than the wife in American households. The main finding is that children's cognitive skills respond more positively to the involvement of both parents in education rather than mother only; results suggest the opposite effect on non-cognitive skills. This last finding suggests a trade-off between cognitive and non-cognitive skills when both parents are involved in educational activities.

Performing a Wald Test to test if children with a more highly educated PCG respond differently to time inputs, we reject the null hypothesis (equality of all coefficients) for reading skills and non-cognitive skills at 5% level. Parental time inputs appear to make the difference, in particular time with both parents. Indeed, the involvement of both parents has a significant different effect if parents are more highly educated for the three outcomes (below the 5% level for reading and non-cognitive skills, and at a 10% level for math skills). The presence of parents does not have a different effect if the parents are more highly educated (See Table A3.4 in Appendix).

No such evidence shows up when we look at education as a continuum; the effect of PCG's education is

[12]See Table A3.4 in Appendix for results on the presence of parents

Table 8. Time Input Production Functions : Does Primary Care Giver's Education matter? (Engaged Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
Higher_educated=1 × (House)Work	0.18*	0.00	0.07
	(0.08)	(0.06)	(0.06)
Higher_educated=1 × Education	0.16	0.02	0.13*
	(0.12)	(0.06)	(0.06)
Higher_educated=1 × Active Leisure	0.14	0.02	0.13*
	(0.10)	(0.05)	(0.06)
Higher_educated=1 × Passive Leisure	0.09	−0.00	0.07
	(0.10)	(0.06)	(0.06)
Higher_educated=1 × (House)Work (with at least one parent)	−0.10*	−0.02	0.02
	(0.05)	(0.05)	(0.06)
Higher_educated=1 × Education (with at least one parent)	−0.10+	−0.06	−0.01
	(0.06)	(0.05)	(0.05)
Higher_educated=1 × Active Leisure (with at least one parent)	0.01	0.03	−0.08
	(0.05)	(0.06)	(0.06)
Higher_educated=1 × Passive Leisure (with at least one parent)	−0.07	−0.01	0.09
	(0.07)	(0.06)	(0.06)
Higher_educated=1 × (House)Work (with parents together)	−0.01	0.03	−0.07+
	(0.04)	(0.04)	(0.04)
Higher_educated=1 × Education (with parents together)	0.08**	0.12*	−0.07*
	(0.03)	(0.05)	(0.03)
Higher_educated=1 × Active Leisure (with parents together)	−0.02	−0.01	0.08
	(0.05)	(0.05)	(0.06)
Higher_educated=1 × Passive Leisure (with parents together)	0.15*	0.03	−0.00
	(0.06)	(0.05)	(0.05)
Higher_educated=1 × (House)Work (with father only)	0.10+	0.02	−0.02
	(0.06)	(0.04)	(0.04)
Higher_educated=1 × Education (with father only)	0.02	0.08*	0.07
	(0.04)	(0.04)	(0.05)
Higher_educated=1 × Active Leisure (with father only)	−0.00	−0.04	0.03
	(0.06)	(0.05)	(0.05)
Higher_educated=1 × Passive Leisure (with father only)	−0.01	−0.00	−0.06
	(0.05)	(0.04)	(0.05)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

not linear. Also, there is little evidence of an effect of PCG's earnings.
These results suggest that even adolescents benefit more from time spent with parents who are more highly educated. This does not seem to come from differences in earnings since we do not find an evidence of differences in the effects of time input across earnings. This may reflect differences in the type of activities. For example, listening to music or going to the theatre may not have the same effect as other type of active leisure. Parenting style and parents' skills are also very likely to explain these differences.

Time input production functions vary across gender and family background. Results suggest that girls' non-cognitive skills seem to be more sensitive to time allocation in total. Girls' reading skills respond more to time with fathers. There is no evidence of an own-gender effect where time with fathers benefits boys more and time with mothers benefits girls more. Time input production functions vary also according to PCG's education. Active leisure and education activities are more productive if the PCG is more highly educated. Involvement of both parents benefits children more when the PCG is more highly educated for cognitive skills, but less for non-cognitive skills. The first effect may reflect differences in parents' verbal skills. The second may simply reflect differences in parenting style.
Results suggest that girls and children with more highly educated parents are more likely to be affected by a separation, since they benefit more from paternal time and time with both parents. We also address the differences of time input production functions across age. According to Del Boca et al. (2017) [8], parental time investments matter in childhood but own investments matter in adolescence. We use a CVA model to address this question.

6.2 Cumulative Value Added Model Time Input Production Functions

As mentioned in Section 4, the CVA model relies on the following assumptions: **i)** the measurement errors in child's skills are uncorrelated with inputs and unobserved ability; **ii)** any omitted input is uncorrelated with included input; **v)** the effect of unobserved ability declines with age at a constant rate λ. As mentioned earlier, it relaxes assumptions **iii)** and **iv)** in the Value Added Model. It allows for age-varying time input production functions; the effect of time with parents or own time investments are allowed to vary by age and the effect may decline at a non-constant rate.
For the sake of brevity, time input production functions include total time (whoever was present) and time spent with at least one parent at time t and $t-1$. Estimated coefficients on the contemporaneous presence or involvement of parents capture the same effect as explained before. Estimated coefficients

Table 9. Cumulative Value Added Time Input Production Functions (Accessible Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.08+	0.05+	0.05
	(0.04)	(0.03)	(0.03)
Education	0.12+	0.09***	0.06*
	(0.06)	(0.03)	(0.03)
Active Leisure	0.11*	0.10***	0.09**
	(0.06)	(0.03)	(0.03)
Passive Leisure	0.06	0.08*	−0.03
	(0.06)	(0.03)	(0.03)
L.(House)Work	0.01	0.05	−0.04
	(0.04)	(0.04)	(0.05)
L.Education	−0.04	0.01	−0.01
	(0.05)	(0.03)	(0.03)
L.Active Leisure	−0.07	0.02	−0.03
	(0.04)	(0.03)	(0.03)
L.Passive Leisure	−0.02	0.01	0.05+
	(0.04)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.01	−0.01
	(0.02)	(0.03)	(0.03)
Education (with at least one parent)	0.03	0.03	−0.03
	(0.03)	(0.03)	(0.02)
Active Leisure (with at least one parent)	0.01	−0.01	−0.01
	(0.03)	(0.02)	(0.03)
Passive Leisure (with at least one parent)	−0.03	−0.03	0.07*
	(0.03)	(0.03)	(0.03)
L.(House)Work (with at least one parent)	−0.02	−0.05	0.03
	(0.04)	(0.04)	(0.05)
L.Education (with at least one parent)	0.01	0.02	0.03
	(0.02)	(0.02)	(0.02)
L.Active Leisure (with at least one parent)	0.06	0.03	0.05+
	(0.04)	(0.03)	(0.03)
L.Passive Leisure (with at least one parent)	−0.01	−0.04	−0.07*
	(0.03)	(0.03)	(0.03)
Observations	1320	1596	1674
N_clust	1207.00	1281.00	1341.00

Cumulative Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent. "L." denotes the one-period lag of the variable.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

on the lagged inputs measure the effect of an increase of about 1 standard deviation in the activity five years ago on the current input. In this sample, the child was on average 9 years old five years ago.
Table 9 shows the results for accessible time. Coefficients for current time inputs are not much affected. The presence of parents in earlier childhood does not seem to have a persistent effect. Results suggest that passive leisure in a previous period is slightly worse for child development if a parent is present. Active leisure with one parent present benefits the child's non-cognitive skills.
Table A3.5 shows the results for engaged time. Coefficients on contemporaneous time inputs are not affected by the introduction of lagged time inputs. Previous own child time inputs do not seem to affect a child's current test score. However, results suggest that past educational activities with one parent involved benefit the child's non-cognitive skills.
Estimation results suggest that early parental time inputs are more productive ($\gamma_3 > \gamma_2$) for children's behaviour. On a Wald Test to test the null hypothesis that coefficients of allocation of time are jointly equal to zero, results suggest that a child's time allocation matters for all outcomes, the presence of parents matters for non-cognitive skills (at a 5% level); and involvement of parents matters for reading (at a 9% level) and non cognitive skills (at a 6% level).
Heterogeneity of parental time is also investigated in the CVA model. The null hypothesis assumes that time with father and time with both parents together have the same impact as maternal time. We reject the null hypothesis for reading skills at a 5% level for the involvement of parents.
Del Boca et al. (2017) [8] test this model's assumptions. To test assumption **i)**, they use an analytic correction formula and do not find evidence of any bias caused by measurement errors. To test assumption **ii)**, they add school inputs, early childhood inputs and children's health shocks, but results are not affected.

6.3 Feedback Effects

In the previous section, we documented the effect of current and past parental time investments on the child's development. The Value-Added Model and the Cumulative Valued-Added Model differences out the child's unobserved ability that might be correlated with the time input (the more I am good at reading, the more I spend time on reading), but it does not difference out the heterogeneity in the learning speed. Parents and children may adapt their time investments to the child's learning speed. This is what Del Bono et al. (2016) [9] refer to as feedback effects. Besides, the measurement error in the child's outcome may bias the results.[13]

[13]See Andrabi et al. (2011) [1] for more details.

Table 10. Time Input Production Functions and Feedback Effects: Does who is present matter? (Accessible Time)

	Reading Skills		Math Skills		Non-Cognitive Skills	
	VA	GMM	VA	GMM	VA	GMM
(House)Work	0.06	0.13	0.03	0.06	0.01	−0.19
	(0.06)	(0.12)	(0.04)	(0.10)	(0.05)	(0.12)
Education	0.11	0.28	0.07+	−0.06	0.06	0.01
	(0.10)	(0.17)	(0.04)	(0.07)	(0.04)	(0.06)
Active Leisure	0.14+	0.35+	0.10**	0.05	0.07+	0.06
	(0.08)	(0.19)	(0.04)	(0.07)	(0.04)	(0.06)
Passive Leisure	0.07	0.23	0.08+	−0.04	−0.03	−0.12
	(0.08)	(0.18)	(0.04)	(0.10)	(0.04)	(0.08)
(House)Work (with at least one parent)	0.04	0.22+	0.02	0.05	0.02	0.27*
	(0.03)	(0.12)	(0.04)	(0.10)	(0.05)	(0.12)
Education (with at least one parent)	−0.02	−0.15	−0.01	−0.05	−0.07	−0.12
	(0.05)	(0.11)	(0.04)	(0.07)	(0.05)	(0.09)
Active Leisure (with at least one parent)	−0.02	−0.02	−0.04	−0.14+	−0.04	−0.14+
	(0.04)	(0.13)	(0.04)	(0.08)	(0.04)	(0.09)
Passive Leisure (with at least one parent)	−0.02	−0.07	−0.04	0.04	0.09+	−0.00
	(0.05)	(0.13)	(0.04)	(0.08)	(0.05)	(0.08)
(House)Work (with parents together)	−0.07*	−0.21*	−0.04	−0.13*	−0.02	−0.11+
	(0.03)	(0.09)	(0.03)	(0.06)	(0.04)	(0.06)
Education (with parents together)	0.07*	0.15+	0.04	0.07	0.00	0.00
	(0.04)	(0.09)	(0.04)	(0.06)	(0.04)	(0.07)
Active Leisure (with parents together)	0.05	0.19+	0.02	0.07	0.05	0.21**
	(0.03)	(0.10)	(0.04)	(0.07)	(0.04)	(0.07)
Passive Leisure (with parents together)	−0.01	−0.12	−0.02	−0.15*	−0.01	0.03
	(0.04)	(0.10)	(0.03)	(0.07)	(0.04)	(0.08)
(House)Work (with father only)	0.04	−0.00	−0.07*	−0.05	−0.05+	−0.09
	(0.04)	(0.09)	(0.03)	(0.07)	(0.03)	(0.06)
Education (with father only)	0.02	0.12	0.05*	0.17**	0.06*	0.08
	(0.03)	(0.08)	(0.02)	(0.05)	(0.03)	(0.06)
Active Leisure (with father only)	−0.03	0.03	0.02	0.03	−0.03	−0.01
	(0.03)	(0.10)	(0.03)	(0.05)	(0.03)	(0.06)
Passive Leisure (with father only)	0.02	−0.03	0.02	0.02	−0.02	−0.04
	(0.02)	(0.07)	(0.02)	(0.05)	(0.03)	(0.06)
L.Reading Score	0.34***	0.16				
	(0.06)	(0.12)				
L.Math Score			0.39***	0.38***		
			(0.03)	(0.09)		
L.Non Cognitive Skills					0.43***	0.40***
					(0.03)	(0.09)
Constant	−0.75**	−0.82*	−0.56*	−0.32	−1.37***	−1.57***
	(0.29)	(0.36)	(0.25)	(0.27)	(0.31)	(0.33)
Observations	786	786	1013	1013	1047	1047
N_clust	673.00		698.00		714.00	

See previous Tables for the description of the variables and the controls. For each outcome, the first column shows the results of the Value-Added Model previously estimated, the second column shows GMM estimates. "L." denotes the one-period lag of the variable.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007. Balanced Panel.

To account for the existence of feedback effects, we follow the method used by Del Bono et al. (2016) [9] based on 'levels and differences' generalised method of moments (GMM) framework. This method has been introduced by Arellano and Bover (1995) [2], and extended by Blundell and Bond (1998) [5]. Andrabi et al. (2011) [1] applied it to study the effect on child's achievement of being in a private school. Del Bono et al. (2016) [9] use it in the estimation of the impact of maternal time on child development. This GMM framework estimates a system of two simultaneous equations.

$$Y_{it} = \beta_0 + \Sigma_1^K \gamma_1^K TI_{it}^k + \Sigma_1^K \gamma_2^{k,OP} PTI_{it}^{k,OP} + \Sigma_1^K \gamma_2^{k,F} PTI_{it}^{k,F} + \Sigma_1^K \gamma_2^{k,BP} PTI_{it}^{k,BP} + \lambda Y_{it-1} + \epsilon_{it} \quad (5)$$

$$\Delta Y_{it} = \Sigma_1^K \gamma_1^k \Delta TI_{it}^k + \Sigma_1^K \gamma_2^{k,OP} \Delta PTI_{it}^{k,OP} + \Sigma_1^K \gamma_2^{k,F} \Delta PTI_{it}^{k,F} + \Sigma_1^K \gamma_2^{k,BP} \Delta PTI_{it}^{k,BP} + \lambda \Delta Y_{it-1} + \Delta v_{it} \quad (6)$$

where $\epsilon_{it} = \alpha_i + v_{it}$, ΔX_{it} denotes the first difference in X_{it}. γ_j measures the input effect constant over time. Following Del Bono et al. (2016) [9], my instruments are past inputs for **(5)** and Y_{t-2} along with past inputs for **(6)**.

Table 10 shows the results on the balanced panel for each of the three outcomes. Columns 1, 3 and 5 report the Value-Added Model estimates on the balanced panel. Columns 2, 4 and 6 report the results with the GMM model.

Consider the differences between the Value Added Model and the GMM, results on reading skills and non-cognitive skills suggest the presence of strong feedback effects. The persistence coefficient (λ) goes down from 0.34 to 0.16, and from 0.43 to 0.40 for reading skills and non-cognitive skills, respectively. Time investments coefficients increase. Presence of both parents seem to benefit more than only mother's when the child is doing education activities (15% of a SD for reading skills) or active leisure (20% for reading skills and non-cognitive skills). No strong evidence of feedback effects appears for math skills.

On a Wald test, the presence of at least one parent has a significant impact on non-cognitive skills. Considering the heterogeneity in the parental time, the presence of both parents or father has a significantly different impact than only mother's for math skills and non-cognitive skills. In particular, the presence of both parents has a significantly different impact than only mother's for reading skills (at a 6% level), math skills (at a 4% level) and non-cognitive skills (at a 2% level). The presence of father has a significantly different impact than only mother's for math skills.

Estimation results on engaged time are different. Looking at each coefficient, no strong effect of parental time appears, and no strong evidence of heterogeneity either (see Table A3.6). Performing a Wald Test, we recover that the effect of at least one parent involved in the activity matters for the child's non-cognitive skills; the involvement of both parents has a significantly different impact than only mother's

for math skills.

These findings confirm the impact of the presence of at least one parent for non-cognitive skills, and the heterogeneity of parental time, especially for time with parents together rather than mother alone. Therefore, these results suggest that the change in the breakdown of parental time could be a driving channel for the effect of parental separation on child development (for all skills).

6.4 Robustness checks

6.4.1 Omitted Variables

We test the model with more controls. Controlling for parenting style variables or neighbourhood safety, results remain similar.[14]

6.4.2 Attrition

Table 11. Attrition across waves

	wave		
	1997	2002	2007
A_123	903	903	903
A_1	523		
A_12	1029	1029	
A_13	139		139
A_2		32	
A_3			37
A_23		165	165
Total	2594	2129	1244

Table 11 shows the number of observations in each wave and when these leave the sample. The balanced panel includes 949 observations. No Attrition (A_123) means that the child is observed in the three waves. A_1, A_2 and A_3 means that the child was present only in the first, second and third wave. A_12 means that they leave the sample in the third wave; A_13 that they were observed only in the first and the third waves; A_23 that they were observed only in the second and third waves. Table A3.9 in Appendix reports the summary statistics; where these are available for more than one different waves, the first wave is considered. Children observed in all waves are younger, are more likely to be living with both parents, to be White and to have a primary care giver who is a housewife.

Table 12 shows how attrition is explained, using logit regressions. Results are in odds ratio. The probability of leaving the sample is higher when the child is older, especially for attrition on the third

[14]For the sake of brevity, results are not reported, but are available upon request.

Table 12. Attrition - Logit regression

	(1) Attrition	(2) A_1	(3) A_12	(4) A_13
main				
Age	1.793***	1.121***	1.820***	0.803***
	(0.0553)	(0.0208)	(0.0526)	(0.0274)
Single Mother	1.811**	1.960***	1.146	0.749
	(0.380)	(0.308)	(0.217)	(0.234)
Single Mother (step-parent)	4.287***	2.207**	1.531	2.287+
	(1.811)	(0.577)	(0.418)	(1.083)
Single Father	1.940	1.859	1.340	3.239*
	(1.199)	(0.729)	(0.582)	(1.723)
Other	6.582***	3.595***	1.834	1.860
	(3.441)	(1.136)	(0.734)	(1.092)
African american	1.079	1.007	0.953	1.305
	(0.214)	(0.150)	(0.168)	(0.320)
Hispanic	0.665	0.464*	1.470	1.232
	(0.247)	(0.173)	(0.439)	(0.514)
Asian Pacific	2.013	0.509	0.906	1.791
	(1.816)	(0.540)	(0.548)	(1.503)
American Indian	1.125	3.469	1	1
	(1.364)	(2.700)	(.)	(.)
Other	2.428*	1.338	2.667*	0.278
	(1.036)	(0.432)	(1.107)	(0.288)
PCG - Looking for work	1.105	1.544	1.367	2.852**
	(0.418)	(0.434)	(0.541)	(1.134)
PCG - Housewife	2.047*	1.450	1.792+	1.106
	(0.720)	(0.399)	(0.591)	(0.460)
PCG - Student	0.682	0.625	4.010*	0.604
	(0.432)	(0.355)	(2.822)	(0.643)
PCG - Other	5.112+	3.092+	1.256	1
	(4.688)	(1.935)	(0.924)	(.)
Female	0.858	0.799+	1.006	0.994
	(0.147)	(0.105)	(0.145)	(0.209)
Earnings (log)	1.078	1.047	1.052	1.189
	(0.103)	(0.0784)	(0.0910)	(0.144)
Observations	1663	1630	1525	1411
Pseudo R^2	0.590	0.068	0.420	0.090

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Logit regressions (Odd ratio). Attrition is a dummy equals to 1 if the child leave the sample at any wave. A_1 means that the child was present only in the first. A_12 means that they leave the sample in the third wave; A_13 that they were observed only in the first and the third waves.

Source : PSID - CDS.

wave, and also when the PCG is a housewife. Family structure explains attrition in the second wave. Attrition is difficult to address in this case, because it is explained by time-varying variables, and we do not know how these variables change in the second wave. For example, children who are living with their mother in the first wave may leave the sample because they live with their single mother or because the mother has met someone and moved in with him. An Inverse Probability Weighting cannot be used here, because attrition is explained mainly by time-varying variables. Also, looking at age, we could explain attrition by year of birth, but here we do not want to over-weight individuals who are older because they are not children any more, and in addition, attrition concerns all individuals that are more than 19 years old. To check if attrition affects the results, the model is run on the balanced sample. Results are very similar for the balanced panel. Some coefficients are not significant any more, since we lose in precision by having a smaller sample, but the magnitude is quite close. Results are shown in Tables A3.10 to A3.11.

6.4.3 Outliers

Individuals with a high variation in their cognitive or non-cognitive skills are excluded: we compute the variation in the cognitive and non cognitive skills between 2 consecutive waves, and exclude the 2% who have the lowest variation, and the 2% who have the highest variation for one of the three outcomes. 241 children (618 observations) are concerned. Tables A3.13 and A3.14 show the results when outliers are excluded: they are similar. The effect of doing house(work) is not statistically significant different from personal needs and care, and reading skills seem poorly explained by the allocation of time when outlier are excluded. There are few changes when we look at the effect of the presence of parents: the positive effect of the presence of parents in passive leisure for non-cognitive skills remains, and the effect of the involvement of parents in education becomes statistically significant.

7 Concluding Discussion

In this paper, I examine if parental time investments may be a driving channel for the effect of parental separation on child development. The paper also extends the literature on parental time to time with father and with both parents together.

First, the paper examines whether family structure impacts child and parental time investments. Second, it models time input production functions with a value added specification, considering a possible heterogeneity in the effect of parental time investments according to child's gender and PCG's education. It also uses a cumulative value added model, allowing for the effect of time inputs to vary across age;

and a GMM framework to account for feedback effects.

Estimating the impact of family structure on child time investments, I draw attention to three findings. First, family structure does not have any impact on total child time investments (whoever is present). However, time with at least one parent present decreases. Estimations do not suggest strong effect on time with at least one parent involved. Second, the breakdown of accessible and engaged parental time is highly affected. Time with both parents together and alone with the non-custodial parent decreases in most activities. The custodial parent compensates partially for the decrease in time spent with the non-custodial parent, and seeks to maintain the amount of qualitative time. Third, this shows a small complementarity between father and mother time in these families. But, since substitution is high when we look at involvement of parents, the custodial parent's time constraints may be a better explanation for this partial substitution.

Estimating the effect of time allocation on a child's cognitive and non-cognitive skills, I draw attention to one main finding and other substantial findings. My main finding is that cognitive and non-cognitive skills production functions show that not all parental time investments have the same impact on child development, meaning the time spent with the mother does not have the same impact as time spent with father or both parents. If no clear evidence appears, a Wald test shows that time with both parents is not equivalent to time with mother regarding reading skills, and time with father is not equivalent to time with mother for math and non-cognitive skills. The cumulative value-added model and the GMM model confirm these last findings. GMM estimates suggest that the presence of both parents has a significantly different impact than only mother's for the three outcomes.

The way children allocate their time matters for both cognitive and non-cognitive skills; leisure and educational activities rank highest. The CVA results are consistent with Del Boca et al. (2017) [8], previous own child time inputs do not seem to affect a child's current test score; however, past education with one parent benefits for the child's non-cognitive skills.

Estimation results suggest that girls' non-cognitive skills may respond differently than boys to the total amount of time spent on each activity, and girls' reading skills seem to respond differently to time with fathers. Finally, children with more highly educated parents respond more to active leisure and education activities. This is consistent with Del Bono et al. (2016) [9]'s results. This may reflect differences in the type of activities. Parenting style and parents' skills are also very likely to explain these differences.

From these results, it appears that parental time investments may be a driving channel for the effect of parental separation. On one hand, the decrease in the accessible time of parents may explain a negative effect on non-cognitive skills. On the other hand, the change in the breakdown of parental time; in

particular, the decrease in time spent with both parents may be one the driving channels for the effect of parental separation. Children with more highly educated parents and girls are likely to be more highly affected. Also, the time channel may be of particular importance for children whose parents separated in their early childhood, especially for their reading skills.

This study is one of the first attempts to estimate the heterogeneity of parental time investments; there are desirable extensions that rely on data improvements, especially in collecting information about early childhood both on cognitive and non-cognitive skills and on child and parental time investments. Models of production functions require a lot of data, especially on past inputs: if we wish to study the time input production functions for young children, we need data on their skills when they were even younger.

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Appendix

A1 Descriptive Statistics: Effect of Family Structure

Table A1.1 shows that children who are not living with both parents have lower scores in Math and Reading and greater behaviour problems. Table A1.2 shows demographic differences between the two groups. Children who are not living with both parents are less likely to be White, Hispanic or Asian and more likely to be African American or American Indian. Their Primary Care Givers (PCG) is less likely to be a housewife, and more likely to be looking for work or a student.

Tables A1.3 to A1.7 show the effect of family structure on child allocation of time. Children who are not living with both parents spend on average less time on personal needs and care and active leisure, and much more time on educational activities and passive leisure. They spend less time on educational activities and active leisure with nobody else involved in the activity; and more time on passive leisure and (house)work with nobody else involved. They spend slightly more time with nobody around, on (house)work, personal needs and care, and passive leisure.

They spend on average less time with at least one parent, involved or present, on all activities. When we look at the breakdown of parental time, their mother (alone) spends more time with them involved in personal needs and care and passive leisure; and she is more present when they are engaging in personal needs and care, educational activities or leisure. On the other hand, fathers, generally the non-custodial parent, are less involved and less present in all activities. Children also spend less time with both parents together involved in the activity or present.

Table A1.1. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
Reading Score	-0.25	0.18	-0.435**
			(0.03)
Math Score	-0.28	0.20	-0.476**
			(0.03)
Non Cognitive Skills	-0.19	0.14	-0.329**
			(0.03)
Internalising BPI	-0.14	0.10	-0.237**
			(0.03)
Externalising BPI	-0.20	0.15	-0.350**
			(0.03)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

Table A1.2. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
Age	10.74	9.79	0.944**
			(0.13)
Female	0.49	0.49	-0.007
			(0.01)
White	0.29	0.64	-0.350**
			(0.01)
African american	0.61	0.21	0.406**
			(0.01)
Hispanic	0.04	0.10	-0.055**
			(0.01)
Asian Pacific	0.01	0.02	-0.016**
			(0.00)
American Indian	0.01	0.00	0.005**
			(0.00)
Other	0.04	0.03	0.010*
			(0.00)
PCG - Worker	0.70	0.69	0.006
			(0.01)
PCG - Looking for work	0.11	0.03	0.075**
			(0.01)
PCG - Housewife	0.15	0.25	-0.097**
			(0.01)
PCG - Student	0.03	0.02	0.016**
			(0.00)
PCG - Other	0.01	0.01	-0.000
			(0.00)
Earnings (log)	9.66	9.66	-0.006
			(0.03)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

Table A1.3. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
(House)Work	6.42	6.46	-0.038
			(0.23)
Personal needs and care	85.63	87.91	-2.286**
			(0.42)
Education	31.13	29.40	1.733**
			(0.47)
Active Leisure	18.60	21.38	-2.778**
			(0.34)
Passive Leisure	26.10	22.80	3.299**
			(0.34)
(House)Work (alone)	1.23	0.99	0.238**
			(0.06)
Personal needs and care (alone)	1.39	1.38	0.007
			(0.07)
Education (alone)	1.97	2.34	-0.372**
			(0.12)
Active Leisure (alone)	3.53	4.51	-0.977**
			(0.17)
Passive Leisure (alone)	6.48	5.46	1.020**
			(0.21)
(House)Work (alone) (presence)	0.34	0.26	0.076*
			(0.03)
Personal needs and care (alone) (presence)	0.29	0.22	0.069*
			(0.03)
Education (alone) (presence)	0.46	0.43	0.037
			(0.06)
Active Leisure (alone) (presence)	0.68	0.74	-0.068
			(0.08)
Passive Leisure (alone) (presence)	1.69	1.22	0.468**
			(0.11)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

Table A1.4. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
(House)Work (with at least one parent)	2.19	3.51	-1.317**
			(0.12)
Personal needs and care (with at least one parent)	4.27	6.75	-2.483**
			(0.15)
Education (with at least one parent)	0.87	1.17	-0.295**
			(0.07)
Active Leisure (with at least one parent)	2.66	5.11	-2.448**
			(0.17)
Passive Leisure (with at least one parent)	5.77	7.79	-2.016**
			(0.18)
(House)Work (with at least one parent) (presence)	3.01	4.44	-1.422**
			(0.14)
Personal needs and care (with at least one parent) (presence)	5.28	8.28	-3.005**
			(0.16)
Education (with at least one parent) (presence)	1.89	3.05	-1.162**
			(0.12)
Active Leisure (with at least one parent) (presence)	7.08	12.25	-5.174**
			(0.27)
Passive Leisure (with at least one parent) (presence)	11.70	14.73	-3.037**
			(0.27)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

Table A1.5. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
(House)Work (with mother only)	1.86	2.04	-0.186^{+}
			(0.10)
Personal needs and care (with mother only)	3.55	3.11	0.438**
			(0.13)
Education (with mother only)	0.78	0.81	-0.032
			(0.06)
Active Leisure (with mother only)	1.96	1.98	-0.021
			(0.12)
Passive Leisure (with mother only)	4.75	3.51	1.245**
			(0.14)
(House)Work (with mother only) (presence)	2.48	2.23	0.243*
			(0.11)
Personal needs and care (with mother only) (presence)	4.36	3.21	1.153**
			(0.12)
Education (with mother only) (presence)	1.58	1.36	0.225**
			(0.09)
Active Leisure (with mother only) (presence)	5.60	4.78	0.830**
			(0.20)
Passive Leisure (with mother only) (presence)	9.74	5.77	3.965**
			(0.22)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. $+ \ p < 0.1$, $^{*} \ p < 0.05$, $^{**} \ p < 0.01$, $^{***} \ p < 0.001$.

Source : PSID - CDS.

Table A1.6. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
(House)Work (with father only)	0.20	0.59	-0.392**
			(0.05)
Personal needs and care (with father only)	0.35	0.79	-0.439**
			(0.05)
Education (with father only)	0.07	0.23	-0.158**
			(0.03)
Active Leisure (with father only)	0.53	1.33	-0.804**
			(0.08)
Passive Leisure (with father only)	0.66	1.71	-1.051**
			(0.08)
(House)Work (with father only) (presence)	0.24	0.59	-0.347**
			(0.05)
Personal needs and care (with father only) (presence)	0.37	0.68	-0.304**
			(0.04)
Education (with father only) (presence)	0.12	0.31	-0.196**
			(0.04)
Active Leisure (with father only) (presence)	0.86	1.62	-0.754**
			(0.10)
Passive Leisure (with father only) (presence)	0.93	1.78	-0.847**
			(0.10)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

Table A1.7. Summary Statistics by Family Structure

	Not with two parents	Two Parents	b/se
(House)Work (with parents together)	0.14	0.87	-0.740**
			(0.05)
Personal needs and care (with parents together)	0.37	2.85	-2.482**
			(0.07)
Education (with parents together)	0.03	0.13	-0.105**
			(0.02)
Active Leisure (with parents together)	0.18	1.80	-1.623**
			(0.08)
Passive Leisure (with parents together)	0.36	2.57	-2.210**
			(0.09)
(House)Work (with parents together) (presence)	0.29	1.61	-1.318**
			(0.07)
Personal needs and care (with parents together) (presence)	0.55	4.40	-3.854**
			(0.09)
Education (with parents together) (presence)	0.19	1.38	-1.192**
			(0.07)
Active Leisure (with parents together) (presence)	0.61	5.86	-5.250**
			(0.15)
Passive Leisure (with parents together) (presence)	1.03	7.18	-6.154**
			(0.16)
Observations	5967		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

A2 Not *yet* separated as a control group

A2.1 Descriptive statistics

Here we look at the differences between two groups : those in the sample whose parents will never separate (before the age of 19), and those whose parents will separate later, but the separation has not happened yet. It can be used to compare children from separated parents but who have been not affected by the separation yet, since it has not occurred. It gives some idea of the selection.

Table A2.1 shows descriptive statistics for children whose parents are going to separate (but are not separated yet) compared with those whose parents will never separate. The former group has lower cognitive and non-cognitive skills. Their primary care giver is more likely to be a student.

Figure A2.1 shows differences in allocation of time between the two groups. Children whose parents are going to separate spend on average more time on educational activities and passive leisure and less time in active leisure. They spend on average less time with both parents present or involved. They spend less time with at least one parent. These statistics suggest that both parents spend already less time together and are less present at home when a separation is about to occur. This could be the reason why they separate or a reflection of the couple's troubles.

Figures A2.2 and A2.3 show the distribution of time spent with father only, and with both parents together involved and present among the two groups. Children whose parents are going to separate are more likely to declare spending time with their father only than those whose parents will never separate; on the other hand, they are less likely to declare spending time with their two parents. The separation may therefore not affect time with parents together who already avoid each other before the separation.

A2.2 Results: Effect of Family Structure on Time Investments

In Table A2.2, we test another method for controlling for family structure endogeneity. We control for the group whose parents are not separated yet, but are going to separate. The "Not yet broken up" indicate the selection of separation, while the other coefficients will capture a causal effect. This method is similar to a difference-and-difference.

These results confirm the previous results found with the individual fixed-effects model. There is poor evidence of an effect of family structure on the total allocation of time. Children living in single-parent families spend less time with at least one parent present. However, in this model, I find a decrease in time spent with at least one parent involved in the activity.

Table A2.1. Descriptive statistics: Children whose parents will not separate / whose parents are going to separate

	Future separation		
	Not yet break up	Never break up	b/se
Reading Score	-0.115	0.212	-0.327**
			(0.065)
Math Score	-0.217	0.245	-0.462**
			(0.058)
Non Cognitive Skills	-0.062	0.161	-0.223**
			(0.052)
Internalising BPI	-0.013	0.111	-0.125*
			(0.052)
Externalising BPI	-0.093	0.176	-0.268**
			(0.053)
PCG - Worker	0.685	0.694	-0.009
			(0.023)
PCG - Looking for work	0.043	0.029	0.015+
			(0.009)
PCG - Housewife	0.222	0.252	-0.030
			(0.022)
PCG - Student	0.050	0.013	0.037**
			(0.007)
PCG - Other	0.000	0.012	-0.012*
			(0.005)
Earnings (log)	9.658	9.665	-0.007
			(0.067)
Observations	3599		

The two first columns show the mean for each group, the third column shows a T-Test for the difference between the two groups. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS.

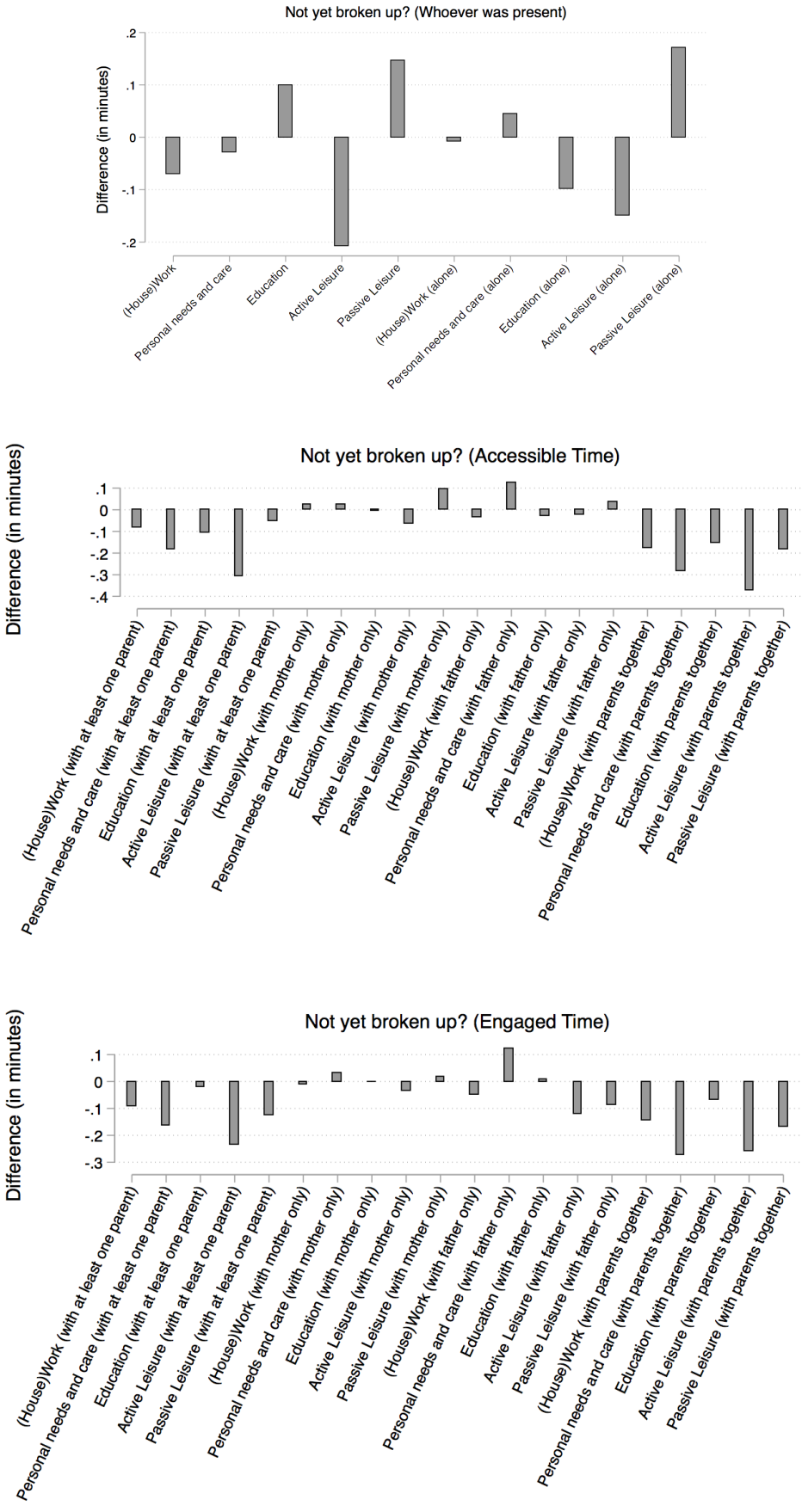

Fig. A2.1. T-tests on Time Investments

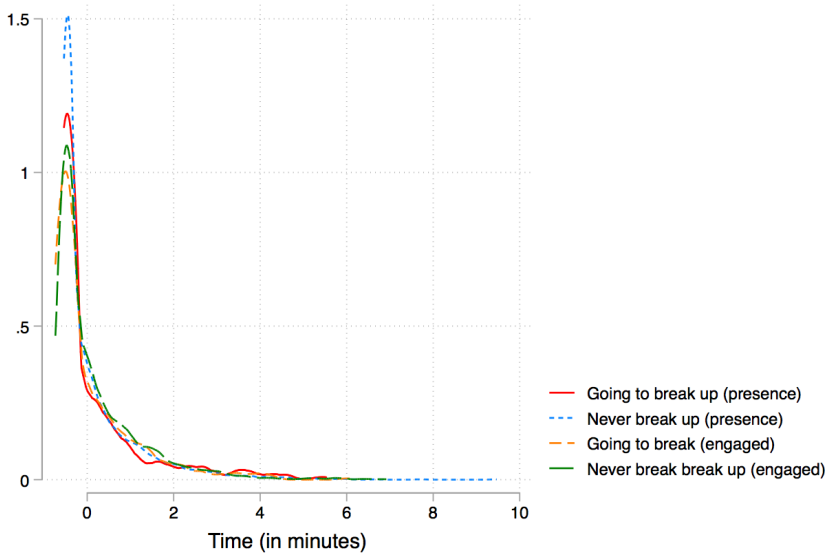

Fig. A2.2. Distribution of time with father (involved or present) among fathers who will separate / never separate

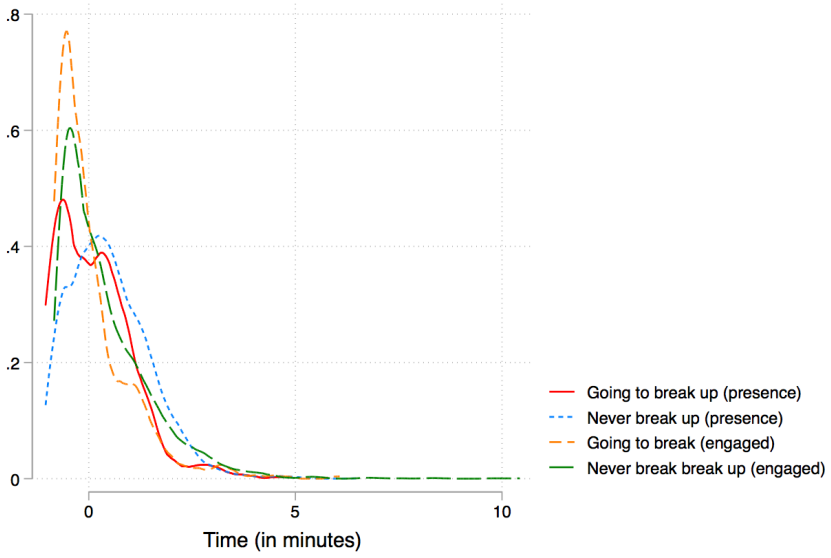

Fig. A2.3. Distribution of time with time with parents together (involved or present) among parents who will separate / not separate

Table A2.2. Effect of Family Structure on Total Allocation of Time

Panel A : Overall Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.05	−0.10	0.01	−0.01	0.08
	(0.06)	(0.07)	(0.06)	(0.06)	(0.07)
Single Mother (step-parent)	−0.05	−0.07	0.18**	−0.16*	−0.00
	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)
Single Father	−0.07	−0.06	0.09	0.03	−0.07
	(0.14)	(0.11)	(0.13)	(0.12)	(0.11)
Other	−0.13	0.14	−0.25*	0.23+	−0.06
	(0.13)	(0.13)	(0.13)	(0.12)	(0.12)
Not yet broken up	−0.04	−0.09	0.10	−0.05	0.05
	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)
Observations	2962	2962	2962	2962	2962

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.16**	−0.36***	−0.19**	−0.25***	−0.27***
	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)
Single Mother (step-parent)	−0.21**	−0.40***	−0.23***	−0.52***	−0.52***
	(0.07)	(0.10)	(0.07)	(0.06)	(0.07)
Single Father	−0.32**	−0.49***	−0.37***	0.02	−0.39***
	(0.11)	(0.09)	(0.09)	(0.14)	(0.11)
Other	−0.43***	−0.74***	−0.53***	−0.48***	−0.84***
	(0.09)	(0.11)	(0.07)	(0.09)	(0.11)
Not yet broken up	−0.02	−0.11+	−0.10	−0.14*	−0.02
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
Observations	2962	2962	2962	2962	2962

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.16*	−0.24***	−0.05	−0.29***	−0.22***
	(0.07)	(0.05)	(0.05)	(0.06)	(0.06)
Single Mother (step-parent)	−0.21**	−0.36***	−0.04	−0.38***	−0.33***
	(0.06)	(0.08)	(0.08)	(0.07)	(0.07)
Single Father	−0.34**	−0.41***	−0.15+	−0.01	−0.19
	(0.11)	(0.10)	(0.08)	(0.13)	(0.12)
Other	−0.44***	−0.58***	−0.24**	−0.32**	−0.74***
	(0.08)	(0.10)	(0.08)	(0.11)	(0.08)
Not yet broken up	−0.02	−0.07	−0.07	−0.19**	−0.05
	(0.07)	(0.06)	(0.05)	(0.06)	(0.06)
Observations	2962	2962	2962	2962	2962

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Random Effect Results. Time variables are standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with dummies indicating if the child had a father at birth or a deceased parent. I add another control group who has not *yet* broken up.

Source : PSID - CDS, waves 1997, 2002 and 2007

A3 Additional Tables

Table A3.1. Time Input Production Functions : Effect of the involvement of at least one parent

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.07+	0.05	0.04
	(0.04)	(0.03)	(0.03)
Education	0.13*	0.09**	0.05+
	(0.06)	(0.03)	(0.03)
Active Leisure	0.12*	0.08**	0.09**
	(0.05)	(0.03)	(0.03)
Passive Leisure	0.05	0.04	−0.01
	(0.05)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.01	0.02
	(0.02)	(0.02)	(0.02)
Education (with at least one parent)	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.00	−0.01	−0.03
	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	−0.04	−0.00	0.05*
	(0.03)	(0.02)	(0.02)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.2. Time Input Production Functions : Does who is involved matter? (Engaged Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.08+	0.05+	0.04
	(0.04)	(0.03)	(0.03)
Education	0.13*	0.09**	0.05+
	(0.06)	(0.03)	(0.03)
Active Leisure	0.12*	0.09**	0.09***
	(0.05)	(0.03)	(0.03)
Passive Leisure	0.05	0.04	−0.01
	(0.05)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.05*	0.00	0.03
	(0.03)	(0.02)	(0.03)
Education (with at least one parent)	−0.02	−0.03	−0.03
	(0.03)	(0.03)	(0.03)
Active Leisure (with at least one parent)	−0.01	−0.04	−0.04
	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.03	0.00	0.07*
	(0.03)	(0.03)	(0.03)
(House)Work (with parents together)	−0.05**	0.00	−0.01
	(0.02)	(0.02)	(0.02)
Education (with parents together)	−0.01	0.04	0.01
	(0.02)	(0.03)	(0.02)
Active Leisure (with parents together)	0.05+	0.02	0.02
	(0.03)	(0.03)	(0.03)
Passive Leisure (with parents together)	−0.03	−0.01	−0.02
	(0.04)	(0.02)	(0.02)
(House)Work (with father only)	−0.00	−0.04*	−0.03
	(0.03)	(0.02)	(0.02)
Education (with father only)	0.03	0.02	0.03
	(0.02)	(0.02)	(0.02)
Active Leisure (with father only)	−0.04	0.03	−0.01
	(0.03)	(0.02)	(0.02)
Passive Leisure (with father only)	0.01	0.01	−0.04
	(0.02)	(0.02)	(0.02)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.3. Time Input Production Functions : Does gender matter? (Accessible Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
Female=1 × (House)Work	0.08	0.00	0.08
	(0.09)	(0.06)	(0.07)
Female=1 × Education	0.04	−0.05	−0.08
	(0.13)	(0.06)	(0.05)
Female=1 × Active Leisure	0.15	0.02	−0.16**
	(0.10)	(0.06)	(0.06)
Female=1 × Passive Leisure	0.10	0.07	−0.04
	(0.10)	(0.06)	(0.07)
Female=1 × (House)Work (with at least one parent)	−0.09	−0.01	−0.05
	(0.06)	(0.06)	(0.08)
Female=1 × Education (with at least one parent)	0.06	−0.01	0.09
	(0.09)	(0.08)	(0.07)
Female=1 × Active Leisure (with at least one parent)	−0.02	0.04	0.11
	(0.07)	(0.07)	(0.07)
Female=1 × Passive Leisure (with at least one parent)	−0.03	−0.04	0.03
	(0.07)	(0.06)	(0.07)
Female=1 × (House)Work (with parents together)	0.07	0.07	0.03
	(0.05)	(0.04)	(0.05)
Female=1 × Education (with parents together)	−0.07	−0.01	−0.05
	(0.07)	(0.06)	(0.06)
Female=1 × Active Leisure (with parents together)	0.05	−0.06	−0.06
	(0.06)	(0.06)	(0.06)
Female=1 × Passive Leisure (with parents together)	−0.08	−0.05	−0.00
	(0.06)	(0.05)	(0.05)
Female=1 × (House)Work (with father only)	0.13+	0.01	0.02
	(0.07)	(0.05)	(0.05)
Female=1 × Education (with father only)	0.07	−0.00	−0.07
	(0.04)	(0.05)	(0.05)
Female=1 × Active Leisure (with father only)	−0.05	−0.04	0.00
	(0.04)	(0.05)	(0.05)
Female=1 × Passive Leisure (with father only)	0.00	−0.01	−0.06
	(0.04)	(0.04)	(0.04)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.4. Time Input Production Functions : Does Primary Care Giver's Education matter? (Accessible Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
Higher_educated=1 × (House)Work	0.18*	0.05	0.03
	(0.09)	(0.06)	(0.07)
Higher_educated=1 × Education	0.14	−0.01	0.12*
	(0.13)	(0.06)	(0.06)
Higher_educated=1 × Active Leisure	0.19+	0.06	0.12*
	(0.11)	(0.05)	(0.06)
Higher_educated=1 × Passive Leisure	0.17	0.01	0.06
	(0.12)	(0.07)	(0.07)
Higher_educated=1 × (House)Work (with at least one parent)	−0.11+	−0.09	0.10
	(0.06)	(0.06)	(0.07)
Higher_educated=1 × Education (with at least one parent)	0.02	0.07	0.07
	(0.09)	(0.08)	(0.07)
Higher_educated=1 × Active Leisure (with at least one parent)	−0.11	−0.02	−0.03
	(0.07)	(0.07)	(0.07)
Higher_educated=1 × Passive Leisure (with at least one parent)	−0.15+	−0.01	0.07
	(0.08)	(0.07)	(0.07)
Higher_educated=1 × (House)Work (with parents together)	0.04	0.07	−0.07
	(0.05)	(0.04)	(0.05)
Higher_educated=1 × Education (with parents together)	0.05	0.05	−0.05
	(0.07)	(0.06)	(0.06)
Higher_educated=1 × Active Leisure (with parents together)	0.06	−0.02	0.04
	(0.06)	(0.06)	(0.06)
Higher_educated=1 × Passive Leisure (with parents together)	0.07	0.02	−0.02
	(0.06)	(0.05)	(0.06)
Higher_educated=1 × (House)Work (with father only)	0.09	−0.01	−0.04
	(0.06)	(0.05)	(0.05)
Higher_educated=1 × Education (with father only)	−0.01	−0.01	−0.01
	(0.05)	(0.04)	(0.05)
Higher_educated=1 × Active Leisure (with father only)	−0.04	−0.03	0.06
	(0.05)	(0.05)	(0.05)
Higher_educated=1 × Passive Leisure (with father only)	0.03	−0.02	−0.05
	(0.04)	(0.04)	(0.05)
Observations	1349	1669	1761
N_clust	1235.00	1349.00	1423.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.5. Cumulative Value Added Time Input Production Functions (Engaged Time)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.07+	0.05+	0.03
	(0.04)	(0.03)	(0.03)
Education	0.13*	0.10***	0.05+
	(0.06)	(0.03)	(0.03)
Active Leisure	0.12*	0.10***	0.09***
	(0.05)	(0.03)	(0.03)
Passive Leisure	0.05	0.05+	−0.01
	(0.05)	(0.03)	(0.03)
L.(House)Work	0.02	−0.00	−0.04
	(0.04)	(0.04)	(0.04)
L.Education	−0.03	0.02	−0.01
	(0.05)	(0.03)	(0.03)
L.Active Leisure	−0.05	0.03	−0.01
	(0.04)	(0.03)	(0.03)
L.Passive Leisure	−0.04	−0.01	0.02
	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.04*	−0.01	0.02
	(0.02)	(0.02)	(0.03)
Education (with at least one parent)	−0.01	−0.02	−0.01
	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	−0.00	−0.02	−0.05*
	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	−0.04	0.00	0.06*
	(0.03)	(0.02)	(0.02)
L.(House)Work (with at least one parent)	−0.02	−0.00	0.03
	(0.03)	(0.04)	(0.04)
L.Education (with at least one parent)	−0.03	−0.00	0.04*
	(0.02)	(0.02)	(0.02)
L.Active Leisure (with at least one parent)	0.03	0.00	0.02
	(0.03)	(0.02)	(0.02)
L.Passive Leisure (with at least one parent)	0.02	−0.00	−0.00
	(0.03)	(0.02)	(0.02)
Observations	1320	1596	1674
N_clust	1207.00	1281.00	1341.00

Cumulative Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent. "L." denotes the one-period lag of the variable.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.6. Time Input Production Functions and Feedback Effects: Does who is involved matter? (Engaged Time)

	Reading Skills		Math Skills		Non-Cognitive Skills	
	VA	GMM	VA	GMM	VA	GMM
(House)Work	0.05	0.12	0.04	0.07	0.00	−0.13
	(0.06)	(0.14)	(0.05)	(0.09)	(0.04)	(0.09)
Education	0.11	0.26	0.07+	−0.03	0.05	0.01
	(0.10)	(0.18)	(0.04)	(0.07)	(0.04)	(0.06)
Active Leisure	0.13+	0.33+	0.09**	0.01	0.07*	0.07
	(0.07)	(0.18)	(0.04)	(0.07)	(0.03)	(0.06)
Passive Leisure	0.06	0.17	0.05	−0.06	0.02	−0.04
	(0.07)	(0.16)	(0.04)	(0.08)	(0.04)	(0.07)
(House)Work (with at least one parent)	0.06*	0.12	−0.01	−0.07	0.04	0.24**
	(0.03)	(0.11)	(0.03)	(0.09)	(0.04)	(0.08)
Education (with at least one parent)	0.02	−0.17	−0.04	−0.07	−0.04	−0.09
	(0.05)	(0.12)	(0.03)	(0.06)	(0.04)	(0.06)
Active Leisure (with at least one parent)	0.01	0.12	−0.06	0.10	−0.06	−0.09
	(0.04)	(0.16)	(0.04)	(0.10)	(0.04)	(0.10)
Passive Leisure (with at least one parent)	−0.04	−0.00	−0.00	0.05	0.09*	−0.00
	(0.04)	(0.11)	(0.03)	(0.06)	(0.04)	(0.06)
(House)Work (with parents together)	−0.06*	−0.03	0.01	0.01	−0.00	−0.03
	(0.02)	(0.07)	(0.02)	(0.05)	(0.03)	(0.05)
Education (with parents together)	−0.01	0.07	0.07+	0.15*	−0.01	−0.02
	(0.03)	(0.08)	(0.04)	(0.06)	(0.02)	(0.06)
Active Leisure (with parents together)	0.07*	0.14	0.04	−0.07	0.05	0.11
	(0.03)	(0.12)	(0.03)	(0.08)	(0.04)	(0.08)
Passive Leisure (with parents together)	−0.02	−0.14	−0.03	−0.09	−0.05	0.00
	(0.03)	(0.10)	(0.03)	(0.06)	(0.03)	(0.05)
(House)Work (with father only)	0.03	0.22	−0.05*	0.04	−0.04+	−0.13+
	(0.04)	(0.14)	(0.02)	(0.08)	(0.03)	(0.07)
Education (with father only)	−0.01	0.08	0.01	0.02	0.03	0.03
	(0.04)	(0.09)	(0.03)	(0.05)	(0.03)	(0.05)
Active Leisure (with father only)	−0.05	−0.05	0.04	−0.09	0.00	0.03
	(0.03)	(0.12)	(0.03)	(0.06)	(0.03)	(0.06)
Passive Leisure (with father only)	0.04	−0.10	0.03	0.08	−0.05	−0.07
	(0.03)	(0.11)	(0.03)	(0.05)	(0.03)	(0.06)
L.Reading Score	0.37***	0.11				
	(0.06)	(0.15)				
L.Math Score			0.38***	0.33***		
			(0.03)	(0.09)		
L.Non Cognitive Skills					0.43***	0.43***
					(0.03)	(0.08)
Constant	−0.62*	−0.60	−0.55*	−0.36	−1.35***	−1.43***
	(0.29)	(0.38)	(0.25)	(0.28)	(0.31)	(0.33)
Observations	786	786	1013	1013	1047	1047
N_clust	673.00		698.00		714.00	

See previous Tables for the description of the variables and the controls. For each outcome, the first column shows the results of the Value-Added Model previously estimated, the second column shows GMM estimates. "L." denotes the one-period lag of the variable.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007, Balanced Panel

A3.1 Time Input Production Functions: Fixed-Effect Results

Tables A3.7 and A3.8 report the results for the Individual Fixed-Effect model. As mentioned in Section 4, this model relies on different assumptions. Nevertheless, results are qualitatively the same as the Value-Added one's. The effect of allocation of time on cognitive skills is smaller but remains positive. On the other hand, the effect of allocation of time on non-cognitive skills is stronger. Results on the effect of the presence of parents on the child development are similar.

Table A3.7. Time Input Production Functions : Total Time (whoever was present)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.05+	0.01	0.08**
	(0.03)	(0.03)	(0.03)
Education	0.07	0.04	0.07*
	(0.04)	(0.03)	(0.03)
Active Leisure	0.05	0.05+	0.10***
	(0.04)	(0.03)	(0.03)
Passive Leisure	0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)
Observations	2186	2362	2438
N_clust	1354.00	1374.00	1394.00

Individual Fixed-Effects Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A3.8. Time Input Production Functions : Effect of the presence of at least one parent

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.05	0.01	0.10**
	(0.03)	(0.03)	(0.04)
Education	0.06	0.03	0.08*
	(0.05)	(0.03)	(0.03)
Active Leisure	0.05	0.04	0.12***
	(0.04)	(0.03)	(0.03)
Passive Leisure	0.01	0.01	−0.04
	(0.04)	(0.03)	(0.03)
(House)Work (with at least one parent)	−0.00	−0.00	−0.04
	(0.02)	(0.03)	(0.03)
Education (with at least one parent)	0.01	0.01	−0.01
	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.02	0.01	−0.02
	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	0.01	0.02	0.11***
	(0.03)	(0.03)	(0.03)
Observations	2186	2362	2438
N_clust	1354.00	1374.00	1394.00

Individual Fixed-Effects Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source : PSID - CDS, waves 1997, 2002 and 2007

A3.2 Results on the balanced panel

Table A3.9. Attrition : Descriptive statistics

	(1) No Attrition mean	(2) All attrition mean	(3) A_1 mean	(4) A_12 mean	(5) A_13 mean	(6) A_23 mean
Age	3.98	11.45	7.77	8.70	4.33	9.88
Two Parents	0.73	0.56	0.50	0.64	0.65	0.47
Single Mother	0.22	0.28	0.33	0.23	0.22	0.39
Single Mother (step-parent)	0.02	0.09	0.08	0.06	0.05	0.05
Single Father	0.01	0.03	0.02	0.02	0.04	0.03
Other	0.02	0.05	0.07	0.04	0.04	0.05
White	0.55	0.35	0.43	0.50	0.47	0.01
African american	0.32	0.40	0.45	0.37	0.40	0.58
Hispanic	0.08	0.07	0.06	0.08	0.07	0.06
Asian Pacific	0.01	0.02	0.02	0.02	0.04	0.04
American Indian	0.00	0.01	0.01	0.00	0.00	0.00
Other	0.03	0.04	0.04	0.04	0.01	0.04
Inap	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Worker	0.61	0.67	0.57	0.66	0.67	0.73
PCG - Looking for work	0.06	0.07	0.10	0.07	0.12	0.07
PCG - Retired	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Disabled	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Housewife	0.27	0.22	0.28	0.23	0.18	0.18
PCG - Student	0.05	0.02	0.03	0.03	0.02	0.00
PCG - Other	0.01	0.01	0.02	0.01	0.01	0.03
Female	0.48	0.49	0.45	0.51	0.48	0.56
Earnings (log)	9.43	9.75	9.51	9.49	9.55	9.70
Observations	903	1691	523	1029	139	165

Attrition is a dummy equals to 1 if the child leave the sample at any wave. A_1 means that the child was present only in the first. A_12 means that they leave the sample in the third wave; A_13 that they were observed only in the first and the third waves.

Source : PSID - CDS.

Table A3.10. Effect of Family Structure on Time Allocation (Balanced Panel)

Panel A : Total Time (whoever was there)

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.05	0.07	−0.10	0.16	−0.09
	(0.14)	(0.14)	(0.12)	(0.11)	(0.13)
Single Mother (step-parent)	−0.17	−0.08	0.28+	0.11	−0.27
	(0.21)	(0.19)	(0.16)	(0.21)	(0.17)
Single Father	−0.08	0.22	0.07	0.05	−0.27
	(0.24)	(0.19)	(0.24)	(0.25)	(0.22)
Other	−0.40	0.08	−0.25	0.13	0.23
	(0.30)	(0.23)	(0.26)	(0.34)	(0.27)
Observations	1641	1641	1641	1641	1641
N_clust	682.00	682.00	682.00	682.00	682.00

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.33*	−0.16+	−0.19	0.03	−0.26*
	(0.15)	(0.09)	(0.13)	(0.11)	(0.13)
Single Mother (step-parent)	−0.36	−0.30	−0.22	−0.22	−0.54**
	(0.23)	(0.18)	(0.18)	(0.17)	(0.18)
Single Father	−0.16	−0.39*	0.03	0.14	−0.13
	(0.29)	(0.17)	(0.24)	(0.29)	(0.21)
Other	−0.42+	−0.24	−0.49**	−0.20	−0.16
	(0.22)	(0.27)	(0.17)	(0.23)	(0.20)
Observations	1641	1641	1641	1641	1641
N_clust	682.00	682.00	682.00	682.00	682.00

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.31*	−0.03	0.01	−0.04	−0.16
	(0.14)	(0.10)	(0.09)	(0.10)	(0.10)
Single Mother (step-parent)	−0.31	−0.04	0.02	0.02	−0.20
	(0.19)	(0.17)	(0.17)	(0.21)	(0.16)
Single Father	−0.17	−0.38+	−0.05	0.14	−0.11
	(0.31)	(0.20)	(0.10)	(0.25)	(0.23)
Other	−0.53*	−0.06	−0.34+	0.02	−0.29*
	(0.25)	(0.20)	(0.19)	(0.33)	(0.13)
Observations	1641	1641	1641	1641	1641
N_clust	682.00	682.00	682.00	682.00	682.00

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Individual Fixed-Effect Model. Time variables are standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with dummies indicating if the child had a father at birth or a deceased parent.

Source: PSID - CDS, waves 1997, 2002 and 2007, Balanced Panel

Table A3.11. Time Input Production Functions : Total Time (whoever was there) - Balanced Panel

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.07	0.02	0.02
	(0.05)	(0.03)	(0.03)
Education	0.12	0.08*	0.06
	(0.10)	(0.04)	(0.04)
Active Leisure	0.14+	0.09**	0.06+
	(0.08)	(0.03)	(0.03)
Passive Leisure	0.05	0.05	0.03
	(0.06)	(0.03)	(0.04)
Observations	775	1001	1035
N_clust	662.00	686.00	702.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007, Balanced Panel

Table A3.12. Time Input Production Functions : Effect of the presence of at least one parent (Balanced Panel)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.06	0.03	0.01
	(0.06)	(0.04)	(0.05)
Education	0.11	0.07+	0.07+
	(0.10)	(0.04)	(0.04)
Active Leisure	0.15+	0.11**	0.07+
	(0.08)	(0.04)	(0.04)
Passive Leisure	0.06	0.07	−0.02
	(0.08)	(0.04)	(0.04)
(House)Work (with at least one parent)	0.02	−0.01	0.01
	(0.03)	(0.04)	(0.05)
Education (with at least one parent)	0.03	0.03	−0.05
	(0.03)	(0.03)	(0.03)
Active Leisure (with at least one parent)	−0.01	−0.03	−0.02
	(0.04)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.02	−0.04	0.07+
	(0.05)	(0.03)	(0.04)
Observations	775	1001	1035
N_clust	662.00	686.00	702.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007, Balanced Panel

A3.3 Results excluding the outliers

Table A3.13. Time Input Production Functions : Total Time (whoever was there) - Outliers excluded

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.02	0.02	0.02
	(0.02)	(0.02)	(0.03)
Education	0.05+	0.07**	0.04
	(0.02)	(0.03)	(0.03)
Active Leisure	0.02	0.07**	0.05+
	(0.02)	(0.03)	(0.03)
Passive Leisure	−0.01	0.05*	0.00
	(0.02)	(0.02)	(0.03)
Observations	1155	1383	1458
N_clust	1063.00	1122.00	1179.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007, Outliers excluded

Table A3.14. Time Input Production Functions : Effect of the presence of at least one parent (Outliers Excluded)

	(1) Reading Score	(2) Math Score	(3) Non Cognitive Skills
(House)Work	0.01	0.02	0.02
	(0.03)	(0.03)	(0.03)
Education	0.04+	0.07*	0.05+
	(0.02)	(0.03)	(0.03)
Active Leisure	0.01	0.06*	0.06*
	(0.02)	(0.03)	(0.03)
Passive Leisure	−0.01	0.06*	−0.03
	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.02	−0.00	−0.01
	(0.02)	(0.03)	(0.03)
Education (with at least one parent)	0.02	0.00	−0.04+
	(0.02)	(0.02)	(0.03)
Active Leisure (with at least one parent)	0.03	0.00	−0.03
	(0.02)	(0.02)	(0.03)
Passive Leisure (with at least one parent)	−0.00	−0.01	0.05+
	(0.02)	(0.02)	(0.02)
Observations	1155	1383	1458
N_clust	1063.00	1122.00	1179.00

Value Added Model. Cognitive test scores are standardized to the national average by age groups, with a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. Non-cognitive Skills are provided by the Primary Care Giver from the age of 3. Time variables are also standardized to a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnicity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies indicating if the child had a father at birth or a deceased parent.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007, Outliers Excluded