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Abstract

Birth Order and Child Outcomes: Does Maternal Quality Time Matter?

Chiara Monfardini and Sarah Grace See

Higher birth order positions are often associated with poorer outcomes, possibly due to fewer resources received within the household. Using a sample of PSID-CDS children from 5 to 18 years old, we investigate whether the birth order effects in their outcomes are due to unequal allocation of the particular resource represented by maternal quality time. OLS regressions show that the negative birth order effects on various test scores are only slightly diminished when maternal time is included among the regressors. This result is confirmed when we account for unobserved heterogeneity at the household level, exploiting the presence of siblings in the data. Our evidence therefore suggests that birth order effects are not due to differences in maternal quality time received. The negative birth order effects in verbal outcomes are also found to diminish, but the one in problem solving is found to worsen through time.

The Riskiest of Them All: Examining Adolescent Behaviors on Parental Time Inputs

Sarah Grace See

Individuals with higher parental supervision are less likely to engage in teenage risky behaviors. Using a quantitative measurement of parental supervision instead of proxies, I confirm this negative relationship with a sample of teenagers from 10 to 18 years old from the PSID-CDS. Using lagged measurements of time supervision (observed at 5 to 12 years old), OLS results show negative results on maternal time for risky behaviors engaged recently (i.e. smoked cigarettes in the past month, drank alcohol at least once a week in the past year). With a household fixed effects estimation that removes unobserved family-specific heterogeneity, the paternal role emerges among health risky behaviors measured over the long span. A separate estimation that allows for non-linear effects of parental time shows the negative influence of parents are present among those who have received the most amount of time supervision during the pre-adolescent period.

A Fractional Multinomial Logit Analysis of Children's Time Use Allocation

Sarah Grace See

When time is considered as a resource input, spending more time on developmental activities is believed to improve children outcomes. Given a 24-hour-a day time endowment that may also be a constraint, higher engagement in one activity reduces the chance for participating in others. This paper explores

how children of 10 to 12 years old interviewed within the PSID-CDS allocate their time, focusing on supervised and unsupervised developmental activities. The main hypothesis is that children born into families of varying characteristics put different values/weights to the importance of human capital formation, and thus allocate their time accordingly. If children spend more time doing developmental activities, in what activities do they spend less time? Using an econometric share equation, the findings support the hypothesis that children of better-educated parents spend more time on developmental activities, but spend less time on chores and non-developmental activities.

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Co-authored Work

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Chapter 1

Introduction

Cognitive and non-cognitive outcomes observed early in life such as achievement test scores and delinquent behaviors are found to be highly correlated with later ones, making the former good predictors of the latter. For instance, Currie and Thomas (1999) use the British National Child Development Survey and find that test scores at age 7 are correlated with adult educational and labor market outcomes. Inequalities such as those based on birth order positions are likewise found to persist through time. The first-born advantage seen during the high school age last until adulthood, wherein first-borns perform academically better and earn higher average income earnings (Kantarevic and Mechoulan 2005). Behaviors such as smoking, crime, and delinquency are also found to have a persistent effect. For instance, early smokers are found to perform academically worse than their non-smoking counterparts (Ellickson, Tucker, and Klein 2008). Moreover, those with earlier initiation to smoking and drinking tend to have more difficulty stopping (Becker and Murphy 1988; Auld 2005).

Factors that determine behaviors and labor market performances (also called "abilities" or "skills endowments" in the literature) are not simply inherited, but are created. It has been suggested that they are formed by age 8, and would have been already fixed by age 16 to 18 (Keane and Wolpin 1997, 2001; Cameron and Heckman 1998; Cunha and Heckman 2006). In the case of cognitive ability, IQ scores are stabilized by age 10 (Hopkins and Bracht 1975). Cunha and Heckman (2010) go further to emphasize that interventions in the form of investments are more effective when applied at the early stage of development, such that skills in one period persist on to future periods. This is called "self-productivity," which is complemented by "dynamic complementarity" (Flouri and Buchanan 2002 and references therein; Borghans et al. 2008; Carneiro et al. 2008; Coneus and Laucht 2008; Cunha and Heckman 2010). The latter is characterized by the abilities effectively supporting cognitive skills development during the early stage, and that skills at one period increases the productivity of investment in future periods. There is then an equity-efficiency trade-off between early and late development of these factors that is more dramatic for cognitive skills than for non-cognitive ones, leading to the importance of the optimal timing of investment (Cunha, Heckman, and Schennach 2010). When combined, self-productivity and dynamic complementarity create multiplier effects of developing skills and abilities. Among the proxy variables meant to capture these abilities, self-discipline (Duckworth and Seligman 2005), motivation (Shiner et al. 2003), attention span (Duncan et al. 2007), good temperament (Martin et al. 1994; Deal et al. 2005), and extraversion (Shirley et al. 2000) are some that positively affect

educational attainment, test scores, employment, and wages; and negatively affect substance use and delinquent behavior. Household conditions and parental investments then do not merely serve as direct resource inputs (Leibowitz 1974, 1977), but when applied at the optimal age, the household conditions and parental investments may serve as crucial factors that can mitigate inequalities (Cunha and Heckman 2010).

This dissertation consists of three empirical studies that are believed to provide new contributions to the literature exploring the determinants of children/adolescents achievement test scores (Chapter 2), adolescent health risk behaviors (Chapter 3), and children time use patterns (Chapter 4). The second and third studies look at the separate roles of fathers and of mothers in influencing outcomes, wherein parental time is the resource input of interest quantitatively measured and directly derived from time diaries. The last chapter looks at the time allocation of children and how it varies according to child and household characteristics.

To fit this project along the literature of applied economics[1], this chapter starts with some review of the research concerning three major topics, which I enumerate in order of presentation. The first section discusses the determinants in the production of (cognitive) achievement, which is the underlying model in Chapter 2. Because children outcomes in Chapter 2 are investigated in line with birth order effects, the second section of this chapter provides possible explanations on how and why birth order effects occur, with particular focus on intra-household allocation of resources. The third section presents the determinants of teenage health risk behaviors, relevant for Chapter 3. The fourth section discusses how children allocate their time and how such allocation varies according to gender and parental characteristics, which is the main research question in Chapter 4. Then, the fifth section gives a description of the dataset used in the ensuing empirical studies, as well as the respective contributions of each study to the literature.

1.1 Achievement Production

In the so-called "cognitive achievement production function," a given outcome is a result of the combination of the child's genetic endowment and a cumulative process of investment inputs of material and time resources by the parents (Leibowitz 1974; Todd and Wolpin 2007):

$$A_{ija} = A_a(\mathbf{Z}_{ij}(a), \mu_{ij0}) \tag{1.1}$$

where A_{ija} is the achievement outcome of a child i of household j at age a, $\mathbf{Z}_{ij}(a)$ is a vector of inputs applied at any time until age a, and μ_{ij0} indicates the child's endowed mental capacity.

Empirically estimating this production function proves to be a great difficulty. This is because of the presence of unobserved characteristics such as heritable endowments that influence the achievement outcome, the lack of appropriate datasets (i.e. datasets with incomplete information on the input resources), and the non-randomness or endogeneity of inputs with respect to the unobservables.

Assuming that the production function is linear in the inputs and in the unobservables, and inputs

[1] household, education, health, population, and demographic economics

depend on the age at which they were received, an empirical specification can be given by:

$$T_{ija} = \alpha_1 X_{ija} + \alpha_2 X_{ija-1} + ... + \alpha_a X_{ij1} + \beta_a \mu_{ij0} + \rho_1 \upsilon_{ija-1} + ... + \rho_a \upsilon_{ij1} + \epsilon_{ija} \tag{1.2}$$

where T_{ija} is the observed test score outcome, ϵ_{ija} is a measurement error, X_{ija} and υ_{ija} are observed and unobserved inputs at age a, respectively.

Ideally, the empirical specification of the achievement production function should include all current and past inputs and information on the child's heritable endowments that are coined as "cognitive ability" or "skill endowment" in the literature (Borghans et al. 2008; Heckman, Stixrud, and Urzua 2006). Leibowitz (1974, 1977) has put particular focus on home investments at early years. But due to the shortcomings previously mentioned, particularly that some inputs are not directly observable, early home environment is generally proxied by parental and household characteristics.

Family income is a straightforward measurement of the household socio-economic status. However, in the absence of a reliable and accurate reporting of this variable, child-related goods in the home or labor-saving capital goods can serve as proxies because of their correlation with family income. They also capture household beliefs and parenting skills, given their correlation with the parents' attributes (Leibowitz 1977). Children from better socio-economic statuses are found to perform better in cognitive tests than those from poorer socio-economic classes (Brooks-Gunn and Duncan 1997). This could be because parents who earn more have the financial capability to provide more resources to facilitate the learning process of their offspring or because higher income parents are more likely to be better educated.

Parental education may sometimes proxy for the household socio-economic status, genetics, and attitudes. It also provides a direct indication of the family's intellectual quality, which has a prominent role in the literature exploring intergenerational transmission mechanism (Anger and Heineck 2009). Parental education also captures how parents allocate resources (such as quality of time) among their offspring, as higher-educated parents are believed to allocate their time more efficiently (Leibowitz 1974) and opt to spend time with their children doing activities that contribute to the latter's development (Guryan, Hurst, and Kearney 2008).

Time as a resource input from the parents has been implicitly explored by Bernal (2008) and Bernal and Keane (2007, 2009, 2010), among others, by using parental employment status and number of working hours (Ruhm 2004; James-Burdumy 2005) as proxy measurements. But because not all non-working time is spent with the child, wherein employed mothers are found to decrease their own leisure time, so that employed and unemployed mothers spend approximately the same amount of child care time (Huston and Aronson 2005), researches exploring child outcomes and parental employment have ambiguous results. A direct measurement of time input is ideal (Blau and Grossberg 1992; Todd and Wolpin 2003), and this is made possible with the recent availability of time diaries survey data. Compared to the proxies, time diaries provide a more precise measurement of time inputs, and the literature has explored several different definitions such as total time (Hsin 2007), engaged time (Hsin 2007), and quality time (Leibowitz 1974; Price 2008).

When considering the effect of family income or genetic stock, the relative role of mothers and fathers in influencing the child outcome should be equal, since financial resource or genetics provided

by the father is similar to that provided by the mother. But with respect to the production nature in affecting child quality, mothers are believed to play a more significant role (Leibowitz 1977). Coupled with increased female labor force participation and child care choices (Bernal 2008; Bernal and Keane 2009, 2010), the interest in maternal time input is even more emphasized. Nevertheless, there is some literature on fathers, investigated in relation to changing family structure (i.e. single-parent households) and changing family dynamics (i.e. female household head). An example is Cobb-Clark and Tekin (2011).

Empirically, data limitations and the presence of unobservable child-specific and household-specific characteristics that may be correlated with the time input and/or the outcome have prompted researchers to use different estimation techniques. For instance, lack of information on historical input measures can be addressed by the so-called "value-added specification." It estimates the current test score as a function of a lagged test score, wherein the latter is assumed to sufficiently capture all historical inputs and heritable endowments. Cunha and Heckman (2003) and Cunha et al. (2006) use this specification to model cognitive and non-cognitive skills.

Similarly, the household fixed effects estimation procedure has been commonly used to address the problem of missing family inputs and to purge out unobservables (time-invarying household-specific heterogeneity) among children of the same family that may bias the results. Rosenzweig and Wolpin (1994) and Altonji and Dunn (1996) are two of the researches that used this estimation procedure. Decomposing endowment into family-specific (μ_0^f) and child-specific (μ_0^c) components gives:

$$T_{ija} = \alpha_1 X_{ija} + \alpha_2 X_{ija-1} + ... + \alpha_a X_{ij1} + \beta_a \mu_0^f + \beta_a \mu_0^c + \epsilon_{ija} \tag{1.3}$$

where the error term ϵ_{ija} includes the effect of unobservable current and lagged inputs. Given two siblings (i and i'), differencing the above equation will result in:

$$T_{ija} - T_{i'ja} = \alpha_1 (X_{ija} - X_{i'ja}) + ... + \alpha_a (X_{ij1} - X_{i'j1}) + [\beta_a (\mu_{ij0}^c - \mu_{i'j0}^c) + \epsilon_{ija} - \epsilon_{i'ja}] \tag{1.4}$$

To obtain consistent estimation using ordinary least squares, the inputs are assumed to be orthogonal to child-specific characteristics. This specification allows the inputs to be affected by family components, such that parents of high-ability children may differ in input choices with other parents, but not by child ability.

1.2 Birth Order Effects

Inequalities in outcomes based on birth order positions have been evidenced in the literature, wherein first-borns are found to have higher intellectual and educational attainments (Blake 1981; Black, Devereux, and Salvanes 2005; Kantarevic and Mechoulan 2005; Booth and Kee 2009), score higher in tests (Conley, Pfeiffer, and Velez 2007; Heiland 2009), and receive higher income earnings (Behrman and Taubman 1986). Similarly, those with higher birth order positions are more likely to engage in risky behaviors of smoking and drinking (Argys et al. 2006).

From the sociological perspective, this can be due to cultural and legal factors, as when there is

land or an estate to be passed on and inheritance customs favor the first-born. If older siblings are expected to assume more responsibility in assisting with younger siblings, this training may lead them to perform more responsibly at school and become higher achievers. Such are related to the different roles played (i.e. first-borns are surrogate parents) or different identities portrayed by each child (i.e. sibling de-identification).

Birth order effects are coursed through the intellectual environment that parents provide through their resources and is translated to the children's intellectual attainment, as theorized by the confluence model (Zajonc 1976). The intellectual environment is characterized by a function of the absolute levels of the intellectual abilities of all the family members, so that the greater is the intellectual development of the family members, the better are the child's cognitive abilities. According to this framework, the more children born into the family, the lower is the intellectual environment, with the latter-born children growing in a depleted intellectual environment. An exception may rest in large families, wherein a latter-born child has elder siblings who contribute positively to the intellectual environment.

Meanwhile, an argument that is consistent with the discussion on achievement production is that birth order effects can be caused by different parental investments on each child, with the first-borns as being more heavily invested upon, as proposed by the family dynamics model (Sulloway 2007), or by how the household resources are allocated within the family (Becker 1974; Becker and Tomes 1976). Although parents may in principle learn with practice and experience, and hence, later children might be advantaged relative to earlier ones (Rosenzweig and Zhang 2009), Price (2008) has shown that higher birth order children receive less parental time endowments at the same age than their lower birth order counterparts.

One of such investment input is time resource. In the context of children, it is especially important to look at the allocation within the household, which is also in line with the crucial role of household investment in the early life of the child, as discussed previously. Price (2008) looks at the quality time received by first-borns and second-borns from fathers and mothers. He concludes that parents provide approximately the same amount of time to their offspring at a given period. But because the second-borns are younger, they receive less time when they reach the same age as the first-borns resulting in less cumulative time. He pointed out that this could explain the differences in outcomes observed in siblings, though the paper does not explicitly prove this. Argys et al. (2006) is the only study to my knowledge that tests for birth order differences in outcomes due to differences in time, focusing on teenage risky behaviors.

A significant issue when investigating birth order effects is the presence of confounding factors. Because higher birth order children are more likely to be born in bigger family sizes, looking at the former brings with it the study of the latter. With respect to parental decision-making process, a quantity-quality trade-off may result (Becker and Lewis 1973, Hanushek 1992, Price 2008), given that household resources are limited and dividing them among a greater number of children results in a smaller share per child. There are also differing physical characteristics among the children, i.e. first-borns are healthier and have heavier birth weight. Another confounding factor is provided by maternal age at childbirth, since mothers having higher birth order children are older than when they have lower birth order children. Older mothers are more likely to have lower birth weight children and since birth weight is

correlated with ability and/or access to resources, then later children may fare worse. Failure to control for such important variables results in biased estimates of the birth order effects. If the confounders are at the household level, using a within-family or sibling-difference approach will improve the estimates (Kantarevic and Mechoulan 2005).

1.3 Teenage Health Risk Behaviors

The economic research interest in teenage health risk behaviors has been growing rapidly because the period of adolescence is one of increased vulnerability and susceptibility to societal influences. The latter is evident in the literature exploring positive network effects from peers (Clark and Lohéac 2005), siblings (Altonji, Cattan, Ware 2010; Bard and Rodgers 2003), and parents (Bantle and Haisken-DeNew 2002). Here, the fixed effects approach is used as an identification strategy in the literature to prove the causality of this relationship. For instance, the (older) sibling influence in smoking and drinking behaviors is shown by Ouyang (2004) by using the timing patterns of sibling behaviors, under the assumption that the past behavior of the older sibling influences the current behavior of the younger sibling.

The persistent effect of teenage health risk behaviors has also been examined in line with their correlation to educational, cognitive, and economic outcomes (Chatterji 2006; Cook and Moore 1993; Morin et al. 2011; Ellickson, Tucker, and Klein 2008). Drinking problems are found to be related to low work involvement (Brook and Newcomb 1995), unstable career (Ronka and Pulkkinen 1995), and unemployment (Sanford et al. 1994). Balsa, Giuliano, and French (2011) related alcohol consumption and grade point average, and found a negative effect among male students. Meanwhile, female students reported increased level of academic difficulty. Though estimates are smaller in magnitudes, the results hold with fixed effects.

In a way, the negative influence of such behaviors in outcomes may be coursed through the physical channel by affecting brain development and learning mechanism such as concentration (Renna 2008). Or, as discussed earlier, behaviors and outcomes are both inherently determined by non-cognitive skills and abilities developed in the early stages of life (Cunha and Heckman 2010), which emphasize the importance of household investments.

In this case, the role of parents is not only to provide the home environment and resource inputs to develop non-cognitive skills that will affect behaviors, but also to mitigate engagement in health risk behaviors. Because higher parental supervision decreases the teenage self-care time, this reduces the teenage offspring's exposure to external influences. However, like the case with parental time input in achievement production, existing literature has seen parental supervision as largely proxied by parental employment status and number of working hours, with the addition of dichotomous indicators of parental supervision. Nevertheless, results point out that unsupervised children and youths (or those with higher self-care dosages) are more likely to engage in risky behaviors such as skipping school, getting drunk/high, stealing something, and hurting someone (Fletcher et al. 1995; Amato and Rivera 1999; Amato and Fowler 2002; Aizer 2004; Browning et al. 2005; Averett, Argys, and Rees 2011). Similarly, higher levels of family support are associated with better behavioral outcomes (Barnes and Farrell 1992).

Methodological issues faced in estimating the effect of parental time supervision is similar to the case of the achievement production discussed earlier. The datasets have missing information, and some unobservables may be correlated with how parents allocate their time supervision among offspring. If the said variables are at the family level, household fixed effects estimation can serve as an identification strategy.

1.4 Children Time Use Patterns

Time use studies using children samples either have not differentiated the company the child is with when performing the activities (e.g. Hofferth and Sandberg 2001), or have only considered time spent with parents or time spent supervised (e.g. Price 2008). This is driven by the role of parental time input in determining children outcomes (Carneiro and Rodrigues 2009; Hsin 2009), and by the fact that children spend majority, if not all, of their time supervised anyway. The scarcity in the literature is aggravated for samples of older children and teenagers, who have more independence and spend more time away from home/parents. The fact that they have more power in the decision-making process (Dauphin et al. 2011) puts more weight in the importance of looking at their time use patterns, especially when left unsupervised. The relative role of the child's own time as an input with respect to the parents' when the former is older, and the relative role of the parents' time with respect to the child's own time as an input when the latter is younger is examined and confirmed by Del Boca, Monfardini, and Nicoletti (2012).

The activities performed by children are found to vary according to child- and family-specific characteristics. For instance, male children spend less time doing household chores (Bonke 2010), and more time studying, doing sports, and performing (active) leisure activities (Hofferth and Sandberg 2001). Children of higher-educated parents spend more time studying and reading (Cardoso, Fontainha, and Monfardini 2008; Mancini, Monfardini, and Pasqua 2011), which may reflect the parents' beliefs and priorities (Wight et al. 2009).

What the available literature has not considered much is that each person is constrained to 24 hours in a given day, such that spending more time on one activity ultimately reduces the available time to perform other activities. Addressing this adding-up constraint has led to the use of econometric share equation techniques in time use studies (Cardoso, Fontainha, and Monfardini 2010; Mullahy and Robert 2010). Though focusing on health outcomes of an adult sample, Mullahy and Robert (2010) look at time spent on physical activities with respect to other activities. They conclude that higher-educated individuals spend more time on physical activities, and less on sleep and non-physical leisure activities. Cardoso, Fontainha, and Monfardini (2010), in turn, use youth samples from France, Germany, and Italy to explore time spent studying and reading, socializing, and watching television within the context of child development.

1.5 Data Description

The investigation of what determines individual outcomes, both cognitive and non-cognitive, has long been prevalent in the medical sciences and the other fields of the social sciences. The relatively recent

surge of theoretical and empirical economic interest has seen the formulation of different subfields in economics: education, health, household, population, and demographic economics, which are interrelated and can be traced to Becker (1965, 1974, 1976, 1981). Empirically, studies focusing on children outcomes remain relatively scarce, mostly due to data limitations. Available datasets at the child level are few and may not contain the needed information. This last point has prompted the researchers to use proxy variables of parental employment status and number of working hours. Even with the availability of an appropriate dataset, consistent and unbiased estimates of the coefficients of interest remain a methodological concern. Nevertheless, results shed some light on the role of parents in influencing the cognitive and behavioral outcomes of their offspring, and may give some insights with respect to intergenerational transmission, child care choices, and labor market policy implications.

This project centers on time as a resource input, which serves as a great advantage in contributing to the rather limited available literature: the role of parental time inputs measured quantitatively in a child cognitive and in a health risk behavior outcome equation, and how children allocation time. The quantitative measurements of time are observed from the child's point of view and are derived from time diaries. Compared to the previously used proxies to parental input, the quantitative time provides a more precise measurement. The studies also exploit the presence of biological sibling pairs in the Child Development Supplement of the Panel Study of Income Dynamics (PSID-CDS) and use the household fixed effects (or similarly, sibling difference) approach as an identification strategy which address the issues explained earlier.

The Panel Study of Income Dynamics is primarily sponsored by the National Science Foundation, the National Institute of Aging, and the National Institute of Child Health and Human Development and is conducted by the University of Michigan. The study is a longitudinal data of United States individuals, with information regarding their economic, demographic, sociological, psychological status, and well-being. The interview started in 1968, with the initial sample of 4,800 families coming from a cross-sectional national sample drawn by the Survey Research Center (SRC) and a national sample of low-income families from the Survey of Economic Opportunity (SEO) conducted by the Bureau of the Census for the Office of Economic Opportunity. The succeeding interviews followed the original sample through the years. As of 2001, there are more than 7,000 interview families in the dataset. The latest available wave of the PSID is of year 2007.

The CDS dataset was funded by the National Institute of Child Health and National Development (NICHD), with the first interview in 1997. The second wave is in 2002/03, and the third is in 2007. The CDS-I contains 3,563 children of 0 to 12 years old belonging to 2,394 families (88%). The CDS-II successfully re-interviewed 2,907 children from 2,019 families (91%), with ages 5 to 18, while the CDS-III has 1,506 children (90%) re-interviews, of 10 to 19 years old. Children from the original sample of 18 years or above are included in the Transition into Adulthood (TA) dataset. The supplement looks into the human capital development of the interviewed children, with measures such as home environment, family processes, time diaries, school environment, and measures of cognitive, emotional, and physical performance. Information for up to two randomly-chosen eligible children in a family are available in each wave, which allows for the use of household fixed effects as an identification strategy. The time diaries contain detailed information about the activities performed by each interviewed child on a

representative weekday and a representative weekend, how long the activities were performed, and with whom (i.e. 'Who was doing this activity with the child?', 'Who (else) was there but not directly involved in the activity?').

1.6 Research Contribution

1.6.1 Birth Order and Child Outcomes: Does Maternal Quality Time Matter?

This chapter is a joint work with Chiara Monfardini, where we look at whether birth order effects in children outcomes observed between 5 to 18 years old are due to unequal allocation of parental quality time input, as supported by the intra-household resource allocation theory. It starts by looking at the intra-household allocation of maternal and paternal time input according to birth order position. We use the quality time definition of Price (2008), which consists of activities wherein the child is the main focus of the activity or there is a reasonable amount of interaction. We aggregate quality time into a weekly measurement, and find a negative birth order pattern not just at the same age, as claimed by the equity heuristic theory in Price (2008), but also at the same period of observation. We then look at three cognitive test outcomes (letter word, passage comprehension, and applied problem) and one subjective non-cognitive outcome (behavioral problem index) and establish again a negative birth order pattern. We then test for the role of maternal/paternal quality time in affecting the negative birth order effects in outcomes by way of a horse race regression, where we estimate the child outcome equation excluding and including the maternal quality time input. We find that including maternal/paternal quality time as a regressor diminishes the magnitudes of the negative birth order effects in an OLS estimation approach. Interestingly, the negative birth order pattern is retained even after controlling for household-specific heterogeneity, leading us to conclude that maternal quality time is not the driving force behind the birth order pattern. Because the maternal/paternal quality time variable loses its significance with the household fixed effects approach, we also conclude that this variable is more a household-level input than an individual-level one.

We went a step further and asked how birth order effects behave across time: do birth order effects persist, diminish, or vanish? The longitudinal aspect of the dataset allows us to investigate this question, which is also a novelty. We answered this question by interacting the birth order variables with a period indicator dummy variable. Our results show that the negative birth order effect eases out with verbal outcomes, while the effect worsens with the problem solving outcome.

The main contribution of this research lies in being the first empirical study to (dis)prove that birth order effects occur because of the allocation of a quantitatively measured maternal/paternal time resource within the household, and to look at the birth order effects in the same outcomes across time.

1.6.2 The Riskiest of Them All: Examining Adolescent Behaviors on Parental Time Inputs

This chapter is partly motivated by the (non-significant) result on maternal quality time coefficient in the previous chapter, in the sense that I look at the effect of parental role in shaping teenage health risk

behaviors observed between 10 to 18 years old. Because the parental role of interest is supervision, I use the total amount of time that adolescents spend with each parent, aggregated again into a weekly measurement. Moreover, I look at the relative importance of the parents by simultaneously considering each parent in a teenage outcome equation. The questionnaire also allows to define different measurements of risky behaviors based on the period of engagement covered, i.e. long-term (ever smoked cigarettes, ever smoked marijuana, ever drank alcohol, ever had sex) or short-term (smoked cigarettes at least once over the past month, smoked marijuana over the past year, drank alcohol over the past year, drank alcohol at least once a week over the past year). The results indicate that higher maternal time supervision negatively affects health risk behaviors, but only on those measured over the past recent period (short-term, i.e. smoked cigarettes in the past month, drank alcohol at least once a week in the past year). However, similar with the result in the previous chapter, this significance disappears with household fixed effects. What emerges instead is the significance of paternal time supervision on health risk behaviors measured over the long span. The importance of fathers highlights previous results found in the literature. A separate estimation that allows for non-linear effects of parental time shows that the negative influence of parents are present among those who have received the most amount of time supervision during the pre-adolescent period. The evidence also reinforces the conclusion that maternal time is more a household-level input than an individual-level one and at the same time point out the need to account for unobserved heterogeneity when establishing the parental influence in the outcomes of their offspring.

1.6.3 A Fractional Multinomial Logit Analysis of Children's Time Use Allocation

When time is considered as a resource input, increased engagement on developmental activities is believed to improve children outcomes. Given a 24-hour-a day time endowment that may also be a constraint, higher engagement in one activity reduces the chance for participating in others. This chapter explores the time use patterns of older children between 10 to 12 years old, which is a period when they are gaining more independence in making decisions as they spend more time at school or with other people and less time with parents. The novelty lies in: (1) the usage of an econometric share equation to address the adding-up constraint given by 24 hours a day, and (2) the disaggregation of supervised and unsupervised time in performing developmental and non-developmental activities, which are both discretionary.

I categorized the exhaustive list of activities into non-discretionary, family, developmental, and non-developmental, separating weekday and weekend observations. If children spend more time doing developmental activities, in what activities do they spend less time? The main hypothesis is that children of varying characteristics (child's gender, parental education, and parental employment) put different values/weights to the importance of human capital formation, and thus allocate their time accordingly. Using an econometric share equation, results show that weekdays see a much larger share of non-discretionary time (i.e. at school, babysitter), which may account for the less significant results. Children of employed mothers are found to spend particularly more non-discretionary time than those with unemployed mothers, which is supported by the literature exploring maternal employment and child care choices. As far as the weekend findings are concerned, children of black race spend more time

doing non-developmental activities. Male children and those with higher-educated parents are at an advantage, allowing them to perform more developmental activities (or similarly, less non-developmental activities). Meanwhile, children of employed fathers spend more time on family activities (such as household chores). Those with higher educated mothers spend less time on family and supervised non-developmental activities, and more time on developmental activities. The results confirm the significant role of child and family characteristics in influencing time use allocation decisions.

Chapter 2

Birth Order and Child Outcomes: Does Maternal Quality Time Matter?

2.1 Introduction

Inequalities among individual outcomes have recently been examined in line with the evolution of household conditions, as family sizes become smaller, and as more women enter the labor force and decide to bear children at later years. A growing literature investigates the link between family size and birth order on the one side, and inequalities in achievements and outcomes on the other side. Though pioneer studies fall under the fields of psychology and sociology, economic research is rapidly catching up, focusing on education and income outcomes, among others. Results predominantly show that individuals from larger family sizes have lower adult educational attainment and earnings (Black, Devereux, and Salvanes 2005; Gary-Bobo, Prieto, and Picard 2006; Sandberg and Rafail 2007), since family resources have to be divided among a greater number of offspring. And because those of higher birth order positions are born into larger family sizes, they are likewise found to have worse outcomes than those of lower birth order positions (Kantarevic and Mechoulan 2005). This birth order effect is seen not only among adults, but also among children (Kantarevic and Mechoulan 2005; Conley, Pfeiffer, and Velez 2007).

A possible link between birth order and children outcomes may lie on parental investments on their offspring. Successfully establishing the existence of this link may not only provide a possible answer to overcome birth order effects, if present, but also lend a better explanation to the mechanism of intergenerational transmission. Financial, material, and time resources may be considered as investments into the child quality production (Becker 1974). Parental investments on their children, in turn, not only differ according to family finances and parental characteristics such as educational attainment, but also according to child-specific characteristics such as gender, birth order position, and number of children born in the family. For instance, a larger family size leads to a smaller share of resources per child, given that family resources have to be divided among a greater number of children, assuming parents aspire to provide equally among their children. Birth order effects could favor the children with lower birth order positions essentially because they were born earlier and have received more resources from the parents.

Among the resources allocated by parents to children, time investment, and particularly that of the mother, is believed to be a crucial factor that contributes to the improvement of child educational and

human capital outcomes. In the framework of the analysis of the intra-household allocation of resources, Price (2008) showed that while parents provide roughly equal time to each child at a given point in time, birth order effects come about due to the decreasing time that parents spend with their children as both get older. The result is that first-born children receive more cumulative quality time from the parents as compared to their second-born counterparts. This brings forth the argument that birth order effects in children outcomes may be due to differences in time resources received from parents.

This paper provides the first empirical assessment of the above argument. Do birth order effects mask differences in parental quality time received by the child? To answer this question we bridge two streams of literature: that on the child production function and that on the intra-household allocation of resources, and use data from the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). This supplement contains a longitudinal survey on socio-economic conditions of interviewed families and individuals. It includes a time diary that contains information on how children spend their time on a representative weekday and weekend, how long they do certain activities, and with whom, including their parents. We focus on maternal time, in line with the emphasis of the existing literature, but check that findings for paternal time are similar. The nature of the dataset also allows us to investigate the persistence of birth order effects through time: Do birth order effects persist, diminish, or vanish through time?

Our results, in line with the literature, show a negative relationship between child cognitive test scores and birth order. We also find a negative relationship between maternal quality time and birth order, similar to Price (2008). However, the explanation for this pattern does not seem to rest on equity heuristic, since mothers are found to provide unequal time allocation to children of different birth order positions at each point in time. To test whether the birth order effect is also capturing different allocation of time resources, birth order and maternal time are both inserted as regressors in a child outcome equation. Ordinary least squares regression results show significant negative birth order effects and positive maternal time effects, with the magnitude of the birth order coefficients slightly diminished with the inclusion of maternal time. Once unobserved household-specific heterogeneity is controlled for with a household fixed effects approach, the coefficients of the birth order variables remain negative and statistically significant (and maternal quality time loses its significance). We therefore conclude that birth order effects do not mask differences in maternal quality time received.

The resulting significance of the coefficients of the birth order variables induced us to examine how this birth order effects behave through time. We tested for this dynamics by interacting the birth order variables with the period of observation dummy indicators. The results show that the coefficients for verbal outcomes are positive and statistically significant, while those for problem solving are negative and also statistically significant. This leads us to conclude that the negative birth order effects in verbal outcomes show some improvements through time, while that for the applied problem worsens as the children get older.

The paper is organized as follows. Section 2 presents existing evidence for birth order effects. Section 3 describes the sample selection and the variables used. Section 4 illustrates the methodology, while section 5 discuses the descriptive and empirical results. Lastly, Section 6 concludes.

2.2 Background

Research on the child production function, initially developed by Becker and Tomes (1976), looks at child outcomes as resulting from a combination of inputs such as material/financial and time. More inputs invested will produce children with better achievements. In empirical studies, material and financial inputs have for a long time been proxied by family income and parental education, while attempts on considering the temporal resources have started out with the usage of proxies such as parental employment and weekly work hours (Blau and Grossberg 1992; Todd and Wolpin 2003; Bernal 2008). More recently, the availability of time diaries data has brought in a significant improvement in the analysis of time inputs. The proxy variables only represent a measure of the maximum amount of time not spent with children, since non-working time of parents are not necessarily and entirely used together with their children. Time diaries, on the other hand, provide the amount of time that parents are actually with their children, as well as information on the activities performed together. A limited literature has recently looked at time inputs as determinants of child outcomes, mostly using the PSID-CDS. Hsin (2007) examines how different measures of maternal care (i.e. total quantity, engaged, quality time) affect children's test scores. She found within an OLS approach that more time spent with mothers has a positive effect on the verbal skills of the children, but only among the children whose mothers have high verbal abilities. Applying a generalized propensity score, Carneiro and Rodrigues (2009) concluded that more time spent with mothers leads to better cognitive test outcomes of the children, at least for the younger ones. Meanwhile, Del Boca, Flinn, and Wiswall (2010) estimated a structural model of the cognitive developmental process of the children, nested within the life cycle behavior of the household, and showed that parental active time is a productive input for young children, though with declining effect.

Existing literature on the so-called "birth order effects" has for a long time been prevalent in the field of psychology (Zajonc 1976; Kidwell 1982; Sulloway 2007). Here, differences in outcomes such as intellectual attainments and personalities are explained either by the differing intellectual environments experienced by the children in the so-called confluence model (Zajonc 1976), or by the distinct roles that each child plays in the family, as suggested in the family dynamics model (Sulloway 2007). Adoption into the field of economics remains relatively new, and focuses mainly on inequalities in human capital and labor market outcomes measured in terms of educational attainment (Blake 1981; Black, Devereux, and Salvanes 2005; Kantarevic and Mechoulan 2005; Booth and Kee 2009), test scores (Leibowitz 1974; Blake 1981; Conley, Pfeiffer, and Velez 2007), and income earnings (Behrman and Taubman 1986; Kantarevic and Mechoulan 2005). Although there are some studies that claim little or no birth order effects (e.g. Hauser and Sewell 1985), most empirical findings in the economic literature show negative or U-shaped results (Hanushek 1992). Among those that looked at birth order effects in educational outcomes, Heiland (2009) finds that U.S. first-borns of the 1979 cohort of National Longitudinal Survey of Youth (NLSY79) have higher scores in the Peabody Picture Vocabulary Test-Revised (PPVT-R), a standardized test of early verbal ability. Conley, Pfeiffer, and Velez (2007) find that among a PSID-CDS children sample, first-borns generally perform better in Woodcock-Johnson Revised (WJ-R) Tests of Achievement than their younger siblings. Meanwhile, Black, Devereux, and Salvanes (2007) find that lower birth order children have higher scores in intellectual quotient with a Norwegian sample.

Kantarevic and Mechoulan (2005) use a PSID sample and claimed that a first-born advantage in terms of educational attainment is already evident as early as high school age, and it persists until the professional life as measured by income earnings. All the above-mentioned studies exploit the presence of siblings in the data and adopt the family fixed effect estimation to identify birth order effects net of unobserved confounders at the household level. The last study is the only one to our knowledge that considers the evolution of the birth order effects, although implicitly, by looking at different measures (educational attainment and income earnings) observed at different periods of time.

The negative relationship between birth order and outcomes is explained by the mechanism of resource allocation within the household. Maintaining the assumption that provision of greater resources improves children outcomes, a family with a greater number of children lets each child receive a smaller share of the family resources, as compared to a child born in a smaller family (Becker 1974; Becker and Tomes 1976). As higher birth order children are more likely to be born in bigger families, a latter-born child will also receive fewer resources, since the resources have already been previously allocated to the earlier-born children. Becker and Lewis (1973) proposed a quantity-quality trade-off in the family, saying that larger family sizes produce lower quality children since more people have to share the available resources. Siblings with a smaller age gap also are also exposed to sibling competition for parental resources more than siblings with a larger age gap, hence the former are more likely to receive less resources and experience birth order effects. Even if parents decide to allocate resources more equally among the children, the result still creates a cumulative inequality. This is the so-called equity heuristic model proposed by Hertwig, Davis, and Sulloway (2002). Compared to the first-borns who enjoy being the only child when the younger siblings are not yet born, and the last-born children who become the only child when the older siblings leave the household, middle-born children never have the opportunity of being the only child in the family. As such, middle-born children always share the parental resources with other siblings and always receive lesser cumulative shares of the resources. Unlike the earlier-born children, latter-born children experience a poorer resource environment, such as less parental time during the child's early years. One reason for birth order effects within the equity heuristic framework is that they may be more of a function of perception than actual, such that children perceive themselves as being treated unequally, even though they are treated equally. Parents may also have a different definition of "equality" from the children's. Nevertheless, the equity heuristic explanation shows that birth order effects may occur even though parents aim to be equal at all times. With a neighbor-matching estimation that allows for the comparison of first-borns and second-borns from similar two-children households of American Time Use Survey (ATUS) respondents, Price (2008) finds that parents provide approximately equal amounts of quality time to their children at each point in time, but spend less time with each child as they both get older, resulting in less cumulative parental quality time by second-born children.

2.3 Sample Selection and Description of Variables

Our empirical strategy relies on both streams of literature described above. Exploiting information on both children time use and test scores contained in the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID), we are able to estimate birth order effects in a child outcome

equation with or without conditioning for parental time. The longitudinal aspect of the dataset that has repeated observations of the same individual allows to investigate the evolution of the birth order effects through time.

The analysis uses a pooled sample consisting of 533 PSID-CDS sibling pairs (1066 children) from 5 to 18 years old, with the average at 12 years, who are living in intact families[1] of two to five children. There are 120 sibling pairs who are observed in both waves, which is used to examine the evolution of birth order effects.

2.3.1 Outcome Measures

The achievements explored in our analysis are three cognitive outcomes in age-standardized and raw formats and one non-cognitive outcome in raw format. The cognitive measures are test components in the Woodcock Johnson Revised (WJ-R) Test of Achievement. Raw scores are essentially the number of items completed in the test, while the standardized scores are obtained standardizing the raw scores according to the respondent's age[2]. Verbal outcomes are measured by the letter word and passage comprehension test components. The letter word test assessment measures symbolic learning (matching pictures with words) and reading identification skills (identifying letters and words). It starts from the easiest items (identification of letters and pronunciation of simple words), progressing to the more difficult items, such that college students and adults would start on a different item than do pre-school children. The passage comprehension assessment measures comprehension and vocabulary skills using multiple-choice and fill-in-the-blank formats. The applied problem test measures mathematical skill in analyzing and solving practical problems. The non-cognitive outcome is a behavioral problem index measuring the incidence and severity of child behavior problems, according to the responses of the primary caregiver. While there are two components to the index, externalizing and internalizing, only the total raw score is considered here.

2.3.2 Parental Time

We rely on a direct measure of maternal time with children. The availability of time diaries represents a significant advantage with respect to proxies such as employment status or weekly work hours. Indeed, the latter has been found to have ambiguous effects on children outcomes (Blau and Grossberg 1992; James-Burdumy 2005), since maternal non-working time is not necessarily entirely spent with the children.[3].

The PSID-CDS provides detailed information on children's time use on a random representative weekday and a random representative weekend. Information is available for up to two children in a family, specifying the type of activity performed, the amount of time spent on each activity over a 24-hour period, and the company involved in performing the activity (i.e. 'Who was doing this activity with the child?', 'Who (else) was there but not directly involved in the activity?'). Parental time is believed to

[1] Intact families are two-parent households, wherein parents and children are biologically related to each other.

[2] The age standardization process allows for comparison of children of the same age, eliminating the discrepancy in the results due to different ages.

[3] For instance, employed mothers may compensate for work hours by spending more of their available time with their children and less time on other activities such as leisure (Huston and Aronson 2005)

be a crucial input for a child's outcome and various definitions and measurements have been considered in the existing literature, e.g. Hsin (2007) looks at time in terms of total quantity, active engagement, and selected activities. Although time inputs from both parents are important in the child's development process, the literature has given emphasis on the role of maternal time, largely due to the increasing incidence of maternal employment that serves as a trade-off for child care time. Therefore, we refer to maternal time throughout the analysis, but we conduct a parallel analysis using paternal time[4]. For the sake of comparability, specific activities performed with the parents are selected to replicate a quality time aggregate as defined by Price (2008). Quality time is composed of activities that the children perform with each parent, in which either the child was the primary focus of the activity or there was a reasonable amount of interaction.

Table 2.1 lists the categories of activities as defined by Price (2008), with s the average minutes spent on each category on a representative weekday, on a representative weekend, on a representative week; and whether the mother is actively engaged or just around while the child was doing the activity. Quality time is categorized into four groups, with each category including specific activities. Category A includes reading, playing, doing homework, talking, teaching, and doing arts and crafts. Category B is eating, while Category C are playing sports, attending performing arts, and participating in religious practices. Category D refers to looking after and physical care. The total averages indicate that a mother spends more time being passively around the child on a weekday than being actively engaged. This is particularly true for Category A activities. Comparing the average minutes by activity categories, a mother spends more time actively engaged with the child doing all the rest of the quality time activities (Categories B to D). We also see lower averages in the 2002 wave than in the 1997 wave, which is likely due to the aging process. When aggregated into a weekly measure by multiplying the weekday amount by five, multiplying the weekend amount by two, and getting the summation of the two products, maternal quality time for the pooled sample averages at 1,407 minutes, and averages at 1,716 and 831 minutes for 1997 and 2002, respectively. For ease of interpretation, quality time is aggregated into an hours-per-week measure for the econometric analysis.

2.4 Empirical Strategy

2.4.1 Birth Order and Maternal Quality Time

In order to test whether birth order effects in children outcomes are coursed through maternal quality time, we first establish the relationship between birth order and maternal quality time by running the following OLS regression:

$$Time_{ijt} = \beta_0 + \beta_1 BO_i + \beta_2 FS_j + \beta_3 T2_t + \beta_4 \mathbf{X}_{ijt} + \beta_5 \mathbf{X}_i + \beta_6 \mathbf{Z}_j + \epsilon_{ijt} \tag{2.1}$$

[4]Analysis of paternal time uses information with respect to fathers, i.e. birth order and number of children according to the father. Results are appended at the end of the chapter. Meanwhile, a specification of combining both parents is problematic, as information from the parents may not coincide, e.g. a child can be considered a second-born from the mother, but a first-born from the father.

Table 2.1: Averages of Maternal Quality Time Activities in Minutes

	Pooled Sample	**1997**	**2002**
Weekday			
Engaged A	25.1904	32.8493	9.0842
Engaged B	38.6839	43.9391	29.3474
Engaged C	6.0206	7.4937	3.1360
Engaged D	14.6651	23.8116	1.1536
Engaged Total	84.5600	108.0937	42.7211
Around A	64.0929	78.5140	38.8855
Around B	16.7514	20.5034	8.9951
Around C	5.5985	8.7604	1.2114
Around D	2.2280	3.5246	0.6106
Around Total	88.6708	111.3024	49.7025
Weekend			
Engaged A	28.9325	37.9488	14.5881
Engaged B	56.6098	60.2096	44.3513
Engaged C	32.5141	36.9188	26.0235
Engaged D	19.2083	28.4841	5.9119
Engaged Total	137.2645	163.5613	90.8748
Around A	95.4972	101.2271	74.1614
Around B	18.2251	21.0580	12.2417
Around C	15.9400	18.6222	7.1115
Around D	3.5178	5.1411	0.4129
Around Total	133.1801	146.0483	93.9276
Weekly			
Engaged A	183.8171	240.1440	74.5969
Engaged B	306.6388	340.1149	235.4393
Engaged C	95.1313	111.3063	67.7270
Engaged D	111.7420	176.0261	17.5920
Engaged Total	697.3293	867.5912	395.3552
Around A	511.4589	595.0243	342.7505
Around B	120.2073	144.6328	69.4589
Around C	59.8724	81.0464	20.2799
Around D	18.1754	27.9053	3.8787
Around Total	709.7140	848.6088	436.3679
Engaged+Around	1407.0433	1716.2000	4831.7231

A=Reading; Playing, not sports; Helping with homework; Helping, Teaching; Arts and crafts;
B=Meals;
C=Playing sports; Attending performing arts; Participating in religious activities;
D=Recipient of personal care; Organizing and planning; Attending events

The dependent variable $Time_{ijt}$ stands for the quality time a child i born in family j receives from the mother observed at each period t; $T2_t$ is a dummy variable that indicates the period of observation (i.e. 2002 versus 1997); BO_i is a set of dummy variables indicating the birth order position of the child; FS_j is the set of dummy variables indicating the number of children born to the parent; $\mathbf{X}_{ijt}$ is a vector of child- and household-specific time-varying characteristics such as the child's age; $\mathbf{X}_i$ stands for the observable individual variables such as child's birth weight, race, gender, and maternal childbirth age; and $\mathbf{Z}_j$ is a vector of household-specific characteristics including parental years of education, and parental employment status.

OLS results contained in Table 2 show a negative and significant relationship between birth order and maternal quality time, with the magnitudes increasing with each higher birth order position. At the same age, higher birth order children receive less time as compared to their first-born counterparts. Second-born children receive a relative average of 2.22 hours per week less maternal quality time, third-born children receive 4.06 weekly hours less than their first-born counterparts, while fourth-born and fifth-born children receive 5.42 weekly hours less. The family size dummy variables, although positive, are not statistically significant. These results are consistent with the evidence in Price (2008). However, we find that a negative birth order pattern exists in the parental time received by the child at each age (not only in the cumulative amount of time received at each period). A similar negative and significant pattern is found between birth order and paternal quality time, with increasing absolute magnitudes for each higher increment of birth order position.

Table 2.2: OLS Results for Maternal Quality Time

Variables	**Time**
$BO2$	-2.22***
	(0.67)
$BO3$	-4.06***
	(1.25)
$BO45$	-5.42**
	(2.24)
$FS3$	0.81
	(1.03)
$FS45$	2.47
	(1.71)
$Constant$	43.49***
	(4.19)
R^2	0.3989
N	1062
Controls	Child, Family, T2

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, and a dummy variable for black race. Family controls include mother's age at childbirth, mother's education level in years, and mother's employment status. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

2.4.2 The Child Outcome Equation

The results of the previous section show that children with higher birth order positions receive less maternal quality time at each age, and provides evidence on the presence of inequality in the intra-household allocation of resources. In order to spot the role of the particular resource represented by maternal quality time in determining birth order effects, we adopt a reduced-form child production function model, in which past and current child and family characteristics, as well as input measures, produce the child test score output (see Todd and Wolpin 2007). Birth order variables are inserted on the right-hand side of the equation, together with the quality time input in a horse race regression to test for the extent to which time input explains the birth order effects. Due to a small sample size, the model is estimated pooling the two years of observation (2002, 2007).

$$Test_{ijt} = \gamma_0 + \gamma_1 BOFS_i + \gamma_3 Time_{it-1} + \gamma_4 T2_t + \gamma_5 \mathbf{X}_{ijt} + \gamma_6 \mathbf{X}_i + \gamma_7 \mathbf{Z}_j + \epsilon_{ijt} \tag{2.2}$$

The dependent variable $Test_{ijt}$ stands for the different test outcomes observed at each period t (2002, 2007) of a child i born in family j, and include letter word (LW), passage comprehension (PC), applied problem (AP), and behavioral problem index (BPI). $BOFS_i$ is the family-specific birth order position of a child in his own family. This specification differentiates the birth order effects by family size. For instance, a second-born of a 2-children family is differentiated from the second-borns of the 3-children and of the 4-to-5-children families. The time input is measured as the maternal quality time received at the previous period, $Time_{it-1}$. We prefer this lagged measurement over the contemporaneous one, in order to mitigate the simultaneity issue that arises when a contemporaneous outcome is regressed on a contemporaneous input. The child and family characteristics we insert as control, $\mathbf{X}_{ijt}$, $\mathbf{X}_i$, $\mathbf{Z}_j$ have already been defined above. Birth weight is likely to be highly correlated with family size and birth order[5]. Male children generally have lower verbal and reading achievement test scores, hence an expected negative correlation with letter word and with passage comprehension test scores. Non-white children are also expected to score lower than white children[6].

A parallel specification considers instead independent effects of the birth order position (BO_i) and the family size (FS_i):

$$Test_{ijt} = \beta_0 + \beta_1 BO_i + \beta_2 FS_j + \beta_3 Time_{it-1} + \beta_4 T2_t + \beta_5 \mathbf{X}_{ijt} + \beta_6 \mathbf{X}_i + \beta_7 \mathbf{Z}_j + \epsilon_{ijt} \tag{2.3}$$

In both models, ϵ_{ijt} is thought of as a three-way error component:

$$\epsilon_{ijt} = \alpha_i + \psi_{j(t)} + \rho_{ijt}$$

including a child-specific time-constant unobserved heterogeneity term (α_i), a household-specific unob-

[5]For instance, a latter-born child from a larger family size is more likely to have a lower birth weight due to being born to an older mother (Rosenzweig and Zhang 2009).

[6]Family income is not included as a regressor, because of a sample size issue due to a significant number of families with missing data.

served heterogeneity component that is possibly time-varying ($\psi_{j(t)}$), and an idiosyncratic error (ρ_{ijt}).

We estimate the birth order and time use variable effects, γ_1 and γ_3 in model (2) (β_1 and β_3 in model (3)), with the following approaches:

1. **Pooled Ordinary Least Squares**, which provides consistent estimates of the above coefficients of interest only under the assumption that all the right-hand side variables, including the inputs, are orthogonal to α_i and $\psi_{j(t)}$;

2. **Household Fixed Effects or Sibling Difference**, which is useful to identify birth order and time use variable effects net of unobserved family-specific components, possibly correlated with the observed regressors, under the assumption of time-constant family unobserved heterogeneity, i.e. $\psi_{j(t)} = \psi_j$;

$$\Delta_j Test_{it} = \gamma_1 \Delta_j BOFS_i + \gamma_3 \Delta_j Time_{it-1} + \gamma_4 \Delta_j T2_t + \gamma_5 \Delta_j \mathbf{X}_{ijt} + \gamma_6 \Delta_j \mathbf{X}_i + \Delta_j \epsilon_{ijt} \quad (3.1a)$$

$$\Delta_j Test_{it} = \beta_1 \Delta_j BO_i + \beta_3 \Delta_j Time_{it-1} + \beta_4 \Delta_j T2_t + \beta_5 \Delta_j \mathbf{X}_{ijt} + \beta_6 \Delta_j \mathbf{X}_i + \Delta_j \epsilon_{ijt}; \quad (3.2a)$$

In order to implement this estimation strategy, the sibling difference is taken at each time period (2002, 2007), before the pooling of the two years of observations.

2.4.3 The Persistence of Birth Order Effects

To examine how the birth order effects behave across time, we interacted the birth order variables with the period of observation indicator $T2_t$, allowing for time-varying birth order effects, then applied a time-and-sibling difference approach. This specification assumes that the family-specific heterogeneity evolves with a linear trend, i.e. $\psi_{jt} * t = \psi_j * t = \psi_t * T2_t$. The double difference removes this unobserved heterogeneity together with the time-constant child-specific unobserved heterogeneity α_i but retains the birth order variables. Both latent components are allowed to be correlated with observed regressors:

$$\Delta_j \Delta_t Test_i = \gamma_1 \Delta_j BOFS_i + \gamma_3 \Delta_j \Delta_t Time_{ij} + \gamma_5 \Delta_j \Delta_t \mathbf{X}_{ijt} + \Delta_j \Delta_t \epsilon_{ijt} \quad (3.1b)$$

$$\Delta_j \Delta_t Test_i = \beta_1 \Delta_j BO_i + \beta_3 \Delta_j \Delta_t Time_{ij} + \beta_5 \Delta_j \Delta_t \mathbf{X}_{ijt} + \Delta_j \Delta_t \epsilon_{ijt} \quad (3.2b)$$

2.5 Results

2.5.1 Descriptive Analysis

The Sample

The summary statistics of the relevant variables in our sample are shown in Table 2.3. Half of the sample are males, and 18% are Blacks. First-born children occupy 36% of the sample, second-borns comprise 43%, third-borns are 17%, and 4th- and 5th-borns are 5%. Meanwhile, the pooled sample has

an average of 2.8 children in the family. Almost half of the sample are 2-children families, at 42%; 41% are 3-children families, 17% are families with 4 to 5 children. The distribution of ages by birth order positions are in the graphs at the end of the chapter (Figures A1 and A2), showing that the sample contains variation in ages in each birth order position, an important requirement not to confuse birth order effects for age effects.

The letter word standardized score of the pooled sample averages at 106.73 with a standard deviation of 16.90 points, while the raw test score averages at 44.69, with a standard deviation of 8.46 points. The sample average of the passage comprehension standardized score is at 105.66, with a standard deviation of 15.40 points, while the raw score averages at 26.26, with a standard deviation of 6.76. Applied problem averages at 107.20 and 38.14 for standardized and raw, with standard deviations of 15.97 and 8.11, respectively. The behavioral problem index averages at 13.87, with a standard deviation of 11.02.

Sibling Correlation

If the observed outcome of each child in a family is thought of as including an error term with individual-specific and family-specific components, the variance of this term can be decomposed into between-family and within-family variations. The sibling correlation coefficients of the test scores and maternal quality time for interviewed sibling pairs shown in Table 2.4 correspond to the share of variance that is attributable to the family background effects. The higher the sibling correlation coefficients, the higher is the share of the variance that is due to the family-specific components. The sibling correlations for the standardized cognitive test scores are approximately between 0.45 to 0.55. That for maternal quality times are at 0.35 and 0.28 for lagged and contemporaneous, respectively. This provides evidence on the existence of variation within the family on which we base our identification strategy.

Child Outcomes and Birth Order

Figure 2.1 exhibits the average test scores for each birth order position, with a decreasing pattern of average cognitive test scores for each higher birth order position. The pattern for the non-cognitive score shows a positive birth order effect; however, birth order effects for the behavioral problem index are expected to be inconclusive because of the nature of its measurement. Unlike the cognitive test scores, which are objectively evaluated, the behavioral problem index is derived from a subjective evaluation of the child's behavior by the primary caregiver.

Child Outcomes and Maternal Quality Time

Table 2.5 shows the average standardized test scores by the amount of maternal quality time received. The sample is divided into two groups, based on the average quality time of the sample: those who received less than the average quality time and those who received greater than or equal to the average time in the pooled sample. It is evident that receipt of maternal quality time greater than the average is associated with better performance in the test outcomes. The differences are statistically significant, as shown by the mean comparison tests.

Table 2.3: Summary Statistics

Variables	**Pooled Sample** Mean (Std.Dev.)	**2002** Mean (Std.Dev.)	**2007** Mean (Std.Dev.)
Child-specific Characteristics			
Child's age	11.6088	10.9723	13.1753
	3.1868	3.3502	2.0231
Child's gender (Male=1)	0.4944	0.4868	0.5130
Child's race (Black=1)	0.1764	0.1768	0.1753
Child's birth weight, pounds	7.1088	7.1464	7.0162
	1.2853	1.2478	1.3708
Family-specific Characteristics			
Mother's age at childbirth	28.2073	28.2322	28.1461
	5.1635	5.0064	5.5394
Maternal education in years, lagged	13.3752	13.3509	13.4351
	2.5168	2.4940	2.5751
Maternal employment status, lagged (employed=1)	0.6023	0.5989	0.6104
Birth Order and Family Size Variables			
1st-born, $BO1$	0.3555	0.3443	0.3831
2nd-born, $BO2$	0.4334	0.4261	0.4513
3rd-born, $BO3$	0.1660	0.1768	0.1396
4th-5th born, $BO45$	0.0450	0.0528	0.0260
2-children families, $FS2$	0.4240	0.4195	0.4351
3-children families, $FS3$	0.4071	0.4011	0.4221
4-5 children families, $FS45$	0.1689	0.1794	0.1429
1st of 2 children, $BO1FS2$	0.2120	0.2098	0.2175
2nd of 2 children, $BO2FS2$	0.2120	0.2098	0.2175
1st of 3-children, $BO1FS3$	0.1098	0.1029	0.1266
2nd of 3-children, $BO2FS3$	0.1773	0.1728	0.1883
3rd of 3-children, $BO3FS3$	0.1201	0.1253	0.1071
1st of 4-5 children, $BO1FS45$	0.0338	0.0317	0.0390
2nd of 4-5 children, $BO2FS45$	0.0441	0.0435	0.0455
3rd of 4-5 children, $BO3FS45$	0.0460	0.0515	0.0325
4th-5th of 4-5 children, $BO45FS45$	0.0450	0.0528	0.0260
Parental Time Inputs, lagged			
Maternal quality time, lagged $QualT_{t-1}$	23.4507	26.6790	15.5058
	14.6964	15.2181	9.4422
Child Outcomes			
Letter word standardized score, $LWSS$	106.7317	107.2586	105.4351
	16.9024	17.3061	15.8173
Letter word raw score, $LWRAW$	44.6914	43.5079	47.6039
	8.4590	9.1671	5.3890
Passage comprehension standardized score, $PCSS$	105.6604	107.2995	101.6266
	15.3965	15.09831	15.4040
Passage comprehension raw score, $PCRAW$	26.2561	25.4697	28.1916
	6.7579	7.1932	5.0553
Applied problem standardized score, $APSS$	107.1979	107.1016	107.4351
	15.9724	16.3151	15.1189
Applied problem raw score, $APRAW$	38.1360	36.9895	40.9578
	8.1086	8.4762	6.3004
Behavioral Problem Index, BPI	13.8687	7.6755	29.1104
	11.0224	6.0154	2.1142
Number of observations	1066	758	308

Table 2.4: Sibling Correlations of Test Scores and Maternal Quality Time

Variables	**Sibling Correlations**
Letter Word	0.5459
Passage Comprehension	0.4485
Applied Problem	0.4894
Behavioral Problem Index	0.0906
Maternal Quality Time, lagged	0.3560
Maternal Quality Time, contemporaneous	0.2803

Pooled Sample. This table contains results for the one-way analysis of variance of the respective variables. Sibling correlations refer to intraclass correlation

Figure 2.1: Average Standardized Scores by Birth Order

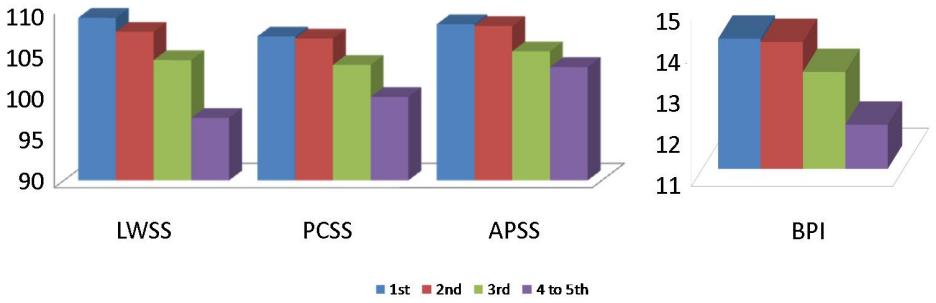

Table 2.5: Average Standardized Scores by Maternal Quality Time

	Letter Word	**Passage Comp**	**Applied Prob**	**Behavior**
$< AveTime$	104.7697	102.971	105.9791	16.8309
$>= AveTime$	109.4697	109.4135	108.8989	9.7348
Mean Comparison Test	-4.6999***	-6.4425***	-2.9198**	13.8687***

Pooled Sample. This table contains the results for the mean comparison test of test scores between the children who have received maternal quality time less than the average and those who have received maternal quality time equal to or greater than the average.

2.5.2 Does Maternal Quality Time Explain Birth Order Effects?

We provide in this section the results on the estimated child outcome equation. We take both the standardized and the raw test scores as dependent variables. The latter is a reasonable measure once we control for age in our regressions. The first set of results is obtained using the OLS, with standard errors corrected for the correlation of error terms among siblings.

Tables 2.6 to 2.9 show the estimation results for the four outcomes using our preferred model of specification (2), i.e. using family-specific birth order effects, with the first-borns as the benchmark. Results for model (3), i.e. using straightforward birth order positions of each child, are included at the end of the chapter. Each column shows the result for a different model estimation approach. The first two columns contains standard pooled OLS coefficients on interviewed sibling pairs, excluding and including lagged maternal quality time. These are comparable to the sibling difference approach on the next two columns, again excluding and including maternal quality time. We report regressions for the Behavioral Problem Index for the sake of completeness, but are aware that the interpretation requires some caution, since it is a self-reported measure. Moreover, such a non-cognitive outcome may require a different production function to that of cognitive outcomes considered in our analysis.

The pooled OLS birth order estimated effects exhibit statistically significant negative patterns, with the magnitudes increasing for each higher birth order position of each family size. For instance, the second-born of a two-children family scores 3.79 points less in the letter word standardized test than a first-born child of any family size does, a difference of less than one-fourth of a standard deviation. The maternal quality time shows a positive and statistically significant coefficient only for the letter word outcome, and decreases the magnitudes of the negative birth order variables. Likewise, the magnitudes of the negative birth order effects are bloated when maternal quality time is not accounted for. The non-cognitive outcome shows some significance for some birth order positions of family sizes of 3 or more children. This suggests that children from larger families have more behavioral problems. Results for fathers show a similar negative birth order pattern. The coefficient for lagged paternal quality time is never significant.

OLS estimations are however criticized to provide biased estimates. With respect to birth order and family size, unmeasured parental endowments and family size preferences are potential sources of unobserved heterogeneity affecting child development outcomes. If parents with below-average resources also have fewer children, then children with lower birth order positions are more likely to have poorer outcomes compared to their higher birth order counterparts. The opposite is also true, if parents with above-average resources prefer to have children of better abilities by foregoing a larger family size. The sibling difference approach allows us to control for unobserved household-specific characteristics that may contribute to the above-mentioned bias. The results again show a general negative and increasing magnitude pattern for the birth order variables, particularly for smaller family sizes and especially for the raw scores. Including the lagged maternal quality time within the sibling difference approach does not bring significant changes to the coefficients of the negative birth order variables. Notice also that once time-constant family-specific unobserved heterogeneity is controlled for, maternal quality time variable is no longer statistically significant, suggesting that this variable is important as a family-level rather than an individual input. As far as the non-cognitive outcome is concerned, the sibling difference

Table 2.6: Regression Results for Letter Word Test Scores, Mother (Family-Specific Birth Order Positions)

	Standardized Scores				**Raw Scores**			
	Pooled OLS, siblings		**Sibling Difference**		**Pooled OLS, siblings**		**Sibling Difference**	
	BO	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**
$BO2FS2$	-3.79***	-3.47***	-2.96*	-2.97*	-1.12**	-1.01**	-1.09*	-1.09*
	(1.28)	(1.28)	(1.58)	(1.59)	(0.43)	(0.43)	(0.62)	(0.62)
$BO2FS3$	-3.70**	-3.57**	-1.27	-1.19	-1.38***	-1.33**	-1.03	-1.02
	(1.67)	(1.67)	(2.11)	(2.10)	(0.52)	(0.52)	(0.75)	(0.75)
$BO3FS3$	-6.62***	-6.19***	-3.62	-3.54	-2.58***	-2.44***	-2.47**	-2.46**
	(1.80)	(1.80)	(3.07)	(3.07)	(0.63)	(0.64)	(1.15)	(1.15)
$BO2FS45$	-2.85	-2.97*	-4.62	-4.50	-0.77	-0.81	-1.67	-1.65
	(1.80)	(1.76)	(3.06)	(3.07)	(0.71)	(0.69)	(1.21)	(1.22)
$BO3FS45$	-5.22**	-5.15**	-3.20	-3.02	-1.63**	-1.61**	-1.87	-1.84
	(2.21)	(2.21)	(4.24)	(4.22)	(0.79)	(0.79)	(1.77)	(1.78)
$BO45FS45$	-9.16***	-8.90***	-4.37	-4.22	-3.68***	-3.60***	-3.41	-3.38
	(2.83)	(2.81)	(5.03)	(5.05)	(0.99)	(0.99)	(2.15)	(2.15)
$QualT_{t-1}$		0.09*		-0.05		0.03*		-0.01
		(0.05)		(0.08)		(0.02)		(0.03)
$Constant$	94.28***	88.12***			-14.56***	-16.62***		
	(7.75)	(8.71)			(3.02)	(3.26)		
R^2	0.2017	0.2053	0.0219	0.0227	0.6484	0.6500	0.6377	0.6378
N	1066	1066	533	533	1066	1066	533	533
Controls	Child, Family, T2		Child, T2		Child, Family, T2		Child, T2	

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Table 2.7: Regression Results for Passage Comprehension Test Scores, Mother (Family-Specific Birth Order Positions)

	Standardized Scores				**Raw Scores**			
	Pooled OLS, siblings		**Sibling Difference**		**Pooled OLS, siblings**		**Sibling Difference**	
	BO	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**
$BO2FS2$	-1.88	-1.66	-2.06	-2.06	-0.84**	-0.78**	-1.22**	-1.23**
	(1.15)	(1.16)	(1.52)	(1.52)	(0.37)	(0.37)	(0.53)	(0.53)
$BO2FS3$	-3.08**	-2.98**	-4.37**	-4.36**	-1.15**	-1.13**	-1.85***	-1.84***
	(1.40)	(1.40)	(2.05)	(2.05)	(0.45)	(0.46)	(0.67)	(0.67)
$BO3FS3$	-5.89***	-5.60***	-6.36**	-6.35**	-2.31***	-2.22***	-3.24***	-3.23***
	(1.69)	(1.68)	(3.08)	(3.10)	(0.53)	(0.53)	(1.01)	(1.02)
$BO2FS45$	-2.99	-3.07	-1.81	-1.79	-1.36**	-1.38**	-1.16	-1.14
	(2.03)	(1.99)	(2.28)	(2.28)	(0.65)	(0.64)	(0.85)	(0.86)
$BO3FS45$	-2.85	-2.80	-1.32	-1.29	-1.17*	-1.15*	-0.86	-0.84
	(2.31)	(2.30)	(3.55)	(3.59)	(0.69)	(0.68)	(1.35)	(1.37)
$BO45FS45$	-5.13*	-4.95*	-3.08	-3.06	-2.15**	-2.10**	-1.85	-1.82
	(2.90)	(2.91)	(4.41)	(4.41)	(0.95)	(0.95)	(1.63)	(1.63)
$QualT_{t-1}$		0.06		-0.01		0.02		-0.01
		(0.04)		(0.07)		(0.01)		(0.02)
$Constant$	102.34***	98.15***			-16.76***	-17.96***		
	(7.35)	(8.18)			(2.53)	(2.76)		
R^2	0.2355	0.2375	0.0485	0.0486	0.5947	0.5956	0.5546	0.5547
N	1066	1066	533	533	1066	1066	533	533
Controls	Child, Family, T2		Child, T2		Child, Family, T2		Child, T2	

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Table 2.8: Regression Results for Applied Problem Test Scores, Mother (Family-Specific Birth Order Positions)

	Standardized Scores				**Raw Scores**			
	Pooled OLS, siblings		**Sibling Difference**		**Pooled OLS, siblings**		**Sibling Difference**	
	BO	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**BO**	**BO+Time**
$BO2FS2$	-0.92	-0.96	-1.89	-1.89	-0.79*	-0.78*	-1.57***	-1.58***
	(1.21)	(1.21)	(1.74)	(1.74)	(0.42)	(0.42)	(0.61)	(0.61)
$BO2FS3$	-2.93**	-2.95**	-3.51	-3.48	-1.23***	-1.23***	-1.75**	-1.73**
	(1.28)	(1.27)	(2.13)	(2.15)	(0.48)	(0.48)	(0.73)	(0.73)
$BO3FS3$	-4.10**	-4.15**	-6.33*	-6.30*	-1.76***	-1.74***	-3.16***	-3.14***
	(1.77)	(1.77)	(3.52)	(3.53)	(0.62)	(0.62)	(1.20)	(1.21)
$BO2FS45$	-2.80	-2.79	-0.25	-0.21	-1.51**	-1.52**	-0.75	-0.73
	(2.30)	(2.29)	(2.83)	(2.81)	(0.75)	(0.75)	(1.05)	(1.05)
$BO3FS45$	-2.24	-2.24	2.17	2.24	-1.22	-1.22	0.10	0.13
	(2.39)	(2.39)	(4.57)	(4.56)	(0.92)	(0.92)	(1.81)	(1.80)
$BO45FS45$	-2.38	-2.41	0.56	0.62	-0.71	-0.70	0.05	0.09
	(1.74)	(1.75)	(5.08)	(5.08)	(0.68)	(0.68)	(1.92)	(1.92)
$QualT_{t-1}$		-0.01		-0.02		0.00		-0.01
		(0.04)		(0.08)		(0.01)		(0.03)
$Constant$	58.95***	59.64***			-15.93***	-16.15***		
	(5.83)	(6.83)			(2.14)	(2.52)		
R^2	0.2794	0.2795	0.0586	0.0587	0.6428	0.6428	0.5514	0.5515
N	1066	1066	533	533	1066	1066	533	533
Controls	Child, Family, T2		Child, T2		Child, Family, T2		Child, T2	

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Table 2.9: Regression Results for Behavioral Problem Index, Mother (Family-Specific Birth Order Positions)

	Pooled OLS, siblings		**Sibling Difference**	
	BO	**BO+Time**	**BO**	**BO+Time**
$BO2FS2$	0.18	0.09	1.42**	1.42**
	(0.40)	(0.40)	(0.67)	(0.67)
$BO2FS3$	0.55	0.52	0.97	0.95
	(0.41)	(0.41)	(0.72)	(0.73)
$BO3FS3$	1.46**	1.34**	2.98**	2.97**
	(0.59)	(0.60)	(1.20)	(1.20)
$BO2FS45$	1.65**	1.68**	1.78	1.76
	(0.75)	(0.75)	(1.14)	(1.15)
$BO3FS45$	0.00	-0.02	3.36*	3.34*
	(0.89)	(0.89)	(1.74)	(1.74)
$BO45FS45$	1.19	1.12	5.18**	5.16**
	(1.10)	(1.10)	(2.02)	(2.02)
$QualT_{t-1}$		-0.02		0.01
		(0.02)		(0.02)
$Constant$	9.50***	11.21***		
	(2.66)	(2.92)		
R^2	0.7837	0.7843	0.0333	0.0334
N	1066	1066	533	533
Controls	Child, Family, T2		Child, T2	

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Table 2.10: Results of Second Difference Using Time-and-Sibling Difference, Mother (Family-Specific Birth Order Positions)

	Standardized				Raw		
Variables	**Letter Word**	**Passage Comp**	**Applied Prob**	**Behavior**	**Letter Word**	**Passage Comp**	**Applied Prob**
$BO2FS2 * T2$	3.01	2.26	-5.98*	-0.16	2.89*	2.13*	-1.28
	(3.44)	(3.61)	(3.57)	(1.31)	(1.57)	(1.2)	(1.19)
$BO2FS3 * T2$	3.17	0.62	-1.94	0.16	1.74	0.92	-0.46
	(3.94)	(3.63)	(3.57)	(1.53)	(1.8)	(1.36)	(1.12)
$BO3FS3 * T2$	6.44	1.81	-2.98	0.79	4.84*	3.28	-1.14
	(5.78)	(5.71)	(6.35)	(3.45)	(2.72)	(2.05)	(2.07)
$BO2FS45 * T2$	4.51	-4.76	-10.81***	-2.14	4.72*	1.11	-2.73**
	(6.9)	(5.16)	(4.08)	(1.96)	(2.72)	(1.89)	(1.24)
$BO3FS45 * T2$	8.21	-6.86	-20.47*	-5.33	7.37*	1.92	-5.38
	(8.75)	(8.55)	(11.92)	(4.64)	(4.31)	(3.4)	(3.61)
$BO45FS45 * T2$	5.25	-5.99	6.52	-1.89	6.94	2.63	2.33
	(9.48)	(11.65)	(13.03)	(5.49)	(4.6)	(4.48)	(3.81)
$QualT_{t-1}$	0	0.13	-0.09	-0.02	0.01	0.06	-0.03
	(0.12)	(0.12)	(0.11)	(0.04)	(0.05)	(0.04)	(0.04)
R^2	0.0213	0.0766	0.1433	0.0278	0.5775	0.4356	0.4889
N	120	120	120	120	120	120	120
Controls				Child			

Pooled Sample. Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

approach entails a positive coefficient for the latter-born of each family size, i.e. second-born of two-children; third-born of three-children; third-born, fourth- and fifth-born of four- to five-children families. This pattern suggests that the significance of the coefficients of the family-specific birth order variables in the pooled OLS is driven by confounding unobserved factors at the household level. Controlling for them reveals the underlying negative birth order effects, with higher birth order children having more behavioral problems. Similar to the findings for the cognitive outcomes, maternal time does not appear to be the channel through which birth order positions exert their effect[7]. The results with respect to the fathers hold a similar negative birth order pattern, even after removing the family-level unobserved heterogeneity. That for the non-cognitive outcome of BPI also reveal the confounding factor provided by the family size variables.

In summary, pooled OLS results show negative and statistically significant coefficients for the birth order variables, with the magnitudes slightly diminished after the inclusion of the maternal quality time in the regression. The coefficients of birth order variables remain generally negative and statistically significant when family heterogeneity is controlled for (while maternal quality time loses its significance). We therefore conclude that birth order effects on children outcomes do not mask differences in maternal quality time received, as suggested by Price (2008). Although we confirm his finding about the existence of a negative birth order effect in parental quality time, our evidence indicates that birth order position is likely to convey information about resources received by the child other than parental time.

With time-varying birth order effects, the negative birth order effects in verbal outcomes of raw letter word and passage comprehension scores show improvements through time - as the children grow older, the negative birth order effects in these outcomes diminish. This is consistent with the weaker negative birth order effects in income earnings (with respect to educational attainment) found by Kantarevic and Mechoulan (2005). The result for the applied problem raw and standardized scores has the opposite pattern: the negative birth order effects become worse. Again, results with respect to the fathers have the same pattern as the ones for the mothers.

2.6 Conclusions

Children of higher birth order positions are found to have poorer outcomes. Literature suggests that inequalities in children outcomes based on the respective birth order positions could be due to differences in resources received. This paper focuses on the role of a particular resource received from parents - maternal quality time, although we have done a similar set of empirical exercise for paternal quality time and find similar results. It investigates whether birth order effects in children outcomes are due to differences in quality time received, by looking at the relationship between children's birth order position, maternal quality time input, and children's cognitive and non-cognitive outcomes.

Using data from the Child Development Supplement of the Panel Study of Income Dynamics, we find a negative relationship between birth order and all the available test scores, which is consistent with the findings of Black, Devereux, and Salvanes (2005, 2007), Kantarevic and Mechoulan (2005), and

[7] As a robustness check, specifications that use both lagged and contemporaneous maternal quality time were also estimated for all outcomes. Only the lagged measurement turned out to be statistically significant in the OLS estimation. As with the cases presented above, the coefficient loses its significance with the application of the sibling difference approach.

Heiland (2009), among others. A negative relationship is also found between birth order and maternal quality time, partly consistent with Price (2008).

We estimate horse race regressions to test whether the birth order effects on children outcomes resist to the inclusion of maternal quality time among its determinants. Exploiting the presence of siblings in the data, we are able to remove potential bias arising from unobserved household-specific heterogeneity, and find negative and significant birth order effects for both cognitive and non-cognitive outcomes, with and without controlling for maternal quality time. These results suggest that maternal quality time is not the driving factor behind birth order effects: to the extent that birth order effects are the outcome of the mechanism of intra-household allocation of resources, they must be explained by other resources differently allocated to each offspring. We also find that the birth order effects in verbal outcomes diminish through time, while that in problem solving increase.

Figure A1. Histogram of Children's Ages by Birth Order Positions, 2002

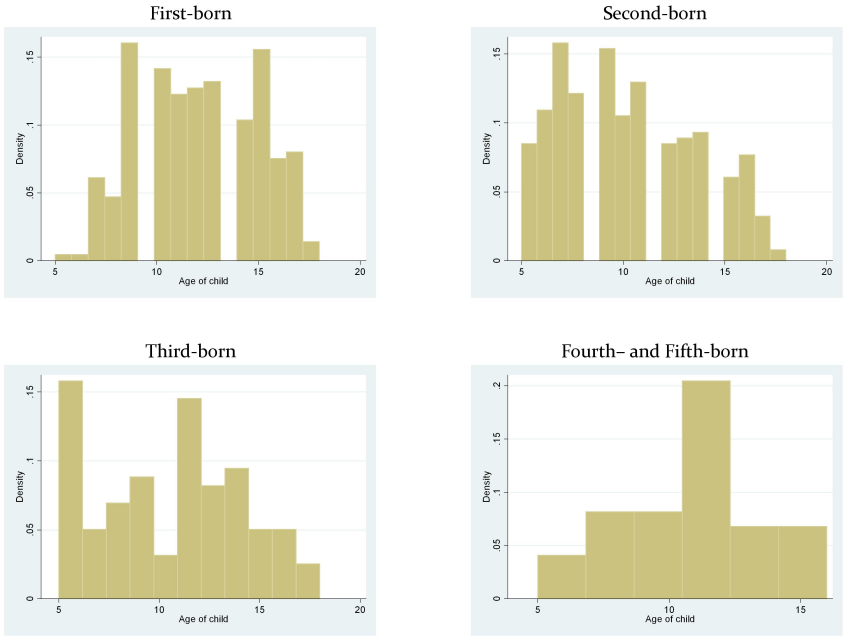

Figure A2. Histogram of Children's Ages by Birth Order Positions, 2007

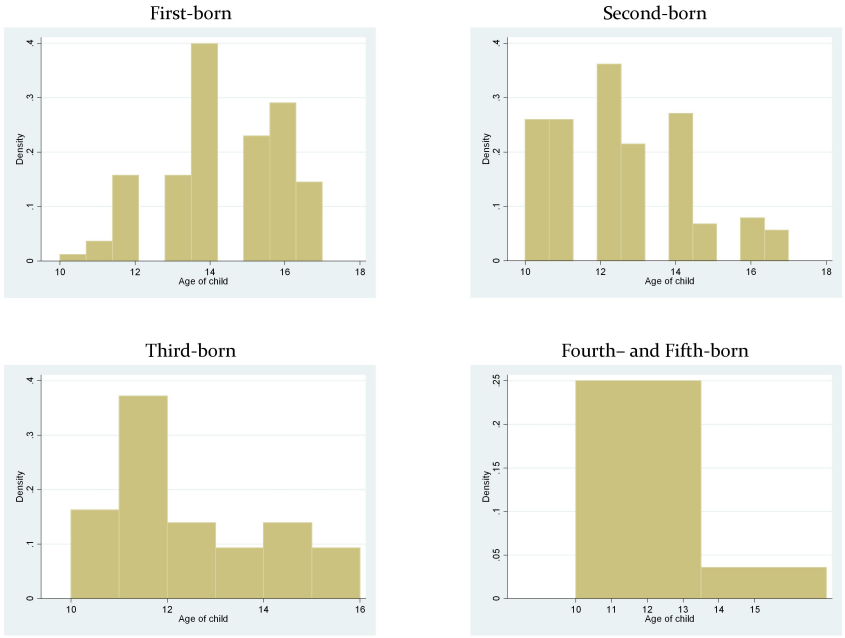

Table 2.11: Regression Results for Letter Word Test Scores, Mother

	Standardized Scores					Raw Scores				
	Pooled OLS, siblings		Sibling Difference		Double Diff	Pooled OLS, siblings		Sibling Difference		Double Diff
	BO	BO+Time	BO	BO+Time	Time	BO	BO+Time	BO	BO+Time	Time
$BO2$	-3.68***	-3.48***	-2.51*	-2.48*		-1.18***	-1.11***	-1.11**	-1.10**	
	(1.16)	(1.16)	(1.44)	-1.44		(0.37)	(0.37)	(0.56)	(0.56)	
$BO3$	-6.58***	-6.15***	-4.00	-3.94		-2.36***	-2.22***	-2.34**	-2.33**	
	(1.68)	(1.67)	(2.74)	-2.73		(0.59)	(0.58)	(1.07)	(1.07)	
$BO45$	-11.11***	-10.57***	-4.45	-4.39		-4.41***	-4.23***	-3.63**	-3.62**	
	(3.28)	(3.26)	(4.49)	-4.5		(1.13)	(1.13)	(1.83)	(1.83)	
$FS3$	-0.15	-0.27				-0.24	-0.28			
	(1.41)	(1.40)				(0.43)	(0.43)			
$FS45$	2.03	1.68				0.71	0.59			
	(1.95)	(1.91)				(0.64)	(0.63)			
$QualT_{t-1}$		0.08*		-0.04	0.01		0.03*		-0.01	0.01
		(0.05)		(0.08)	(0.12)		(0.02)		(0.03)	(0.05)
$Constant$	93.07***	87.22***				-14.85***	-16.82***			
	(8.05)	(8.96)				(3.07)	(3.31)			
R^2	0.2029	0.2063	0.0182	0.0188	0.0094	0.6490	0.6505	0.6370	0.6371	0.5360
N	1066	1066	533	533	120	1066	1066	533	533	120
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.12: Regression Results for Passage Comprehension Test Scores, Mother

	Standardized Scores					Raw Scores				
	Pooled OLS, siblings		Sibling Difference		Double Diff	Pooled OLS, siblings		Sibling Difference		Double Diff
	BO	BO+Time	BO	BO+Time	Time	BO	BO+Time	BO	BO+Time	Time
$BO2$	-2.48**	-2.34**	-2.74*	-2.73*		-1.01***	-0.97***	-1.39***	-1.38***	
	(1.01)	(1.02)	(1.42)	(1.43)		(0.32)	(0.32)	(0.49)	(0.49)	
$BO3$	-5.06***	-4.76***	-4.58*	-4.56*		-1.95***	-1.87***	-2.54***	-2.53***	
	(1.68)	(1.68)	(2.70)	(2.71)		(0.51)	(0.51)	(0.92)	(0.93)	
$BO45$	-5.72*	-5.35*	-5.74	-5.72		-2.25**	-2.15**	-3.13**	-3.12**	
	(3.14)	(3.16)	(4.25)	(4.26)		(1.03)	(1.04)	(1.49)	(1.49)	
$FS3$	-0.26	-0.35				-0.12	-0.15			
	(1.20)	(1.20)				(0.37)	(0.37)			
$FS45$	0.49	0.25				0.06	-0.01			
	(1.68)	(1.65)				(0.53)	(0.53)			
$QualT_{t-1}$		0.06		-0.01	0.14		0.02		-0.01	0.06
		(0.04)		(0.07)	(0.11)		(0.01)		(0.02)	(0.04)
$Constant$	102.00***	97.95***				-16.78***	-17.96***			
	(7.49)	(8.27)				(2.56)	(2.78)			
R^2	0.2338	0.2358	0.0438	0.0438	0.056	0.5936	0.5944	0.5511	0.5512	0.4118
N	1066	1066	533	533	120	1066	1066	533	533	120
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.13: Regression Results for Applied Problem Test Scores, Mother

	Standardized Scores					Raw Scores				
	Pooled OLS, siblings		Sibling Difference		Double Diff	Pooled OLS, siblings		Sibling Difference		Double Diff
	BO	BO+Time	BO	BO+Time	Time	BO	BO+Time	BO	BO+Time	Time
$BO2$	-1.77*	-1.80*	-2.12	-2.11		-0.98***	-0.97***	-1.49***	-1.48***	
	(0.94)	(0.93)	(1.57)	(1.58)		(0.35)	(0.35)	(0.55)	(0.55)	
$BO3$	-2.77	-2.82*	-4.08	-4.06		-1.27**	-1.25**	-2.45**	-2.44**	
	(1.69)	(1.68)	(3.10)	(3.12)		(0.61)	(0.61)	(1.09)	(1.09)	
$BO45$	-1.87	-1.93	-4.38	-4.36		-0.24	-0.22	-1.92	-1.91	
	(2.51)	(2.51)	(4.64)	(4.65)		(0.90)	(0.90)	(1.65)	(1.66)	
$FS3$	-1.47	-1.45				-0.47	-0.48			
	(1.24)	(1.24)				(0.44)	(0.44)			
$FS45$	-1.04	-1.00				-0.65	-0.67			
	(2.05)	(2.05)				(0.69)	(0.69)			
$QualT_{t-1}$		-0.01		-0.01	-0.08		0.00		-0.01	-0.03
		(0.04)		(0.08)	(0.11)		(0.01)		(0.03)	(0.03)
$Constant$	59.96***	60.59***				-15.33***	-15.61***			
	(5.89)	(6.92)				(2.10)	(2.49)			
R^2	0.2788	0.2788	0.05080	0.0509	0.0413	0.6430	0.6430	0.5470	0.5471	0.4457
N	1066	1066	533	533	120	1066	1066	533	533	120
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.14: Regression Results for Behavioral Problem Index, Mother

	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2$	0.38	0.32	1.30**	1.30**	
	(0.33)	(0.33)	(0.61)	(0.61)	
$BO3$	0.64	0.52	3.19***	3.18***	
	(0.58)	(0.59)	(1.16)	(1.16)	
$BO45$	0.95	0.79	4.94***	4.93***	
	(1.16)	(1.17)	(1.81)	(1.81)	
$FS3$	0.71*	0.74*			
	(0.39)	(0.39)			
$FS45$	0.49	0.60			
	(0.58)	(0.59)			
$QualT_{t-1}$		-0.02		0.01	-0.02
		(0.02)		(0.02)	(0.04)
$Constant$	9.03***	10.73***			
	(2.67)	(2.92)			
R^2	0.7831	0.7838	0.0320	0.0321	0.0020
N	1066	1066	533	533	120
Controls	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include mother's age at childbirth, and mother's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.15: Results of Second Difference Using Time-and-Sibling Difference, Mother

	Standardized				Raw		
Variables	**Letter Word**	**Passage Comp**	**Applied Prob**	**Behavior**	**Letter Word**	**Passage Comp**	**Applied Prob**
$BO2 * T2$	3.29	0.58	-5.20*	-0.35	2.72**	1.51	-1.2
	(2.9)	(2.97)	(2.86)	(1.16)	(1.34)	(1.00)	(0.95)
$BO3 * T2$	6.76	0.56	-7.26	-0.37	5.72**	3.41*	-2.15
	(5.49)	(5.48)	(5.99)	(3.32)	(2.61)	(1.91)	(1.99)
$BO45 * T2$	3.84	1.21	19.73**	3.03	5.30*	4.06	5.55**
	(6.66)	(9.47)	(7.8)	(4.49)	(3.1)	(3.43)	(2.33)
$QualT_{t-1}$	0.01	0.13	-0.1	-0.02	0.02	0.06	-0.03
	(0.12)	(0.11)	(0.11)	(0.04)	(0.05)	(0.04)	(0.04)
R^2	0.0207	0.0645	0.1134	0.0088	0.5725	0.43	0.4782
N	120	120	120	120	120	120	120
Controls				Child			

Pooled Sample. Child controls include child's age squared. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.16: OLS Results for Paternal Quality Time

Variables	**Time**
$BO2$	-1.99***
	(0.47)
$BO3$	-2.82***
	(0.78)
$BO45$	-3.82***
	(1.34)
$FS3$	0.32
	(0.69)
$FS45$	1.80*
	(0.94)
$Constant$	21.12***
	(2.62)
R^2	0.1669
N	1711
Controls	Child, Family, T2

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, father's education level in years, and father's employment status. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.17: Regression Results for Letter Word Test Scores, Father (Family-Specific Birth Order Positions)

	Standardized Scores					**Raw Scores**				
	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**	**Pooled OLS, siblings**		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2FS2$	-3.97***	-3.86***	-3.73**	-3.70**		-1.63***	-1.58***	-1.79***	-1.75***	
	(1.24)	(1.24)	(1.49)	(1.52)		(0.44)	(0.44)	(0.59)	(0.60)	
$BO2FS3$	-3.15*	-3.07*	-0.70	-0.67		-1.40***	-1.37**	-1.16	-1.12	
	(1.71)	(1.71)	(1.90)	(1.91)		(0.54)	(0.54)	(0.73)	(0.73)	
$BO3FS3$	-6.29***	-6.16***	-3.91	-3.86		-2.50***	-2.45***	-2.50**	-2.45**	
	(1.93)	(1.93)	(3.00)	(3.01)		(0.71)	(0.70)	(1.17)	(1.18)	
$BO2FS45$	-0.20	-0.24	-1.50	-1.48		-0.11	-0.13	-0.13	-0.11	
	(2.57)	(2.59)	(3.44)	(3.44)		(0.73)	(0.74)	(1.39)	(1.39)	
$BO3FS45$	-5.14**	-5.10**	-9.17*	-9.17*		-1.86**	-1.85**	-3.46*	-3.46*	
	(2.40)	(2.40)	(4.96)	(4.97)		(0.79)	(0.79)	(1.76)	(1.77)	
$BO45FS45$	-6.63***	-6.64***	-7.12	-7.09		-2.58***	-2.58***	-3.53	-3.50	
	(2.52)	(2.51)	(5.64)	(5.67)		(0.87)	(0.87)	(2.16)	(2.18)	
$QualT_{t-1}$		0.05		0.02	0.05		0.02		0.02	-0.26***
		(0.06)		(0.10)	(0.05)		(0.02)		(0.04)	(0.02)
$Constant$	96.25***	94.58***			0.26**	-14.29***	-14.98***			0.19***
	(7.89)	(8.22)			(0.13)	(2.96)	(2.98)			(0.05)
R^2	0.1663	0.1670	0.0310	0.0310	0.0421	0.6478	0.6482	0.6554	0.6557	0.5877
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.18: Regression Results for Passage Comprehension Test Scores, Father (Family-Specific Birth Order Positions)

	Standardized Scores					**Raw Scores**				
	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**	**Pooled OLS, siblings**		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2FS2$	-1.93*	-1.99*	-2.46	-2.53*		-1.09***	-1.10***	-1.51***	-1.51***	
	(1.14)	(1.13)	(1.51)	(1.51)		(0.37)	(0.37)	(0.54)	(0.54)	
$BO2FS3$	-2.76**	-2.80**	-3.44*	-3.50*		-1.09**	-1.10**	-1.60**	-1.60**	
	(1.40)	(1.39)	(1.86)	(1.86)		(0.46)	(0.46)	(0.65)	(0.65)	
$BO3FS3$	-6.30***	-6.37***	-6.15**	-6.25**		-2.37***	-2.38***	-3.01***	-3.00***	
	(1.72)	(1.71)	(3.10)	(3.09)		(0.56)	(0.56)	(1.08)	(1.07)	
$BO2FS45$	-0.90	-0.88	0.73	0.69		-0.91	-0.91	0.03	0.03	
	(2.98)	(2.98)	(3.05)	(3.04)		(0.79)	(0.79)	(1.13)	(1.13)	
$BO3FS45$	-1.43	-1.45	-3.18	-3.18		-0.69	-0.70	-0.93	-0.93	
	(2.32)	(2.32)	(4.36)	(4.36)		(0.65)	(0.65)	(1.56)	(1.56)	
$BO45FS45$	-2.65	-2.64	-2.77	-2.82		-1.28	-1.28	-1.33	-1.33	
	(2.60)	(2.60)	(5.28)	(5.29)		(0.85)	(0.85)	(1.89)	(1.90)	
$QualT_{t-1}$		-0.02		-0.04	0.11*		0.00		0.00	-0.16***
		(0.05)		(0.10)	(0.06)		(0.02)		(0.03)	(0.02)
$Constant$	101.51***	102.36***			0.11	-16.97***	-16.86***			0.12**
	(7.21)	(7.49)			(0.13)	(2.43)	(2.50)			(0.05)
R^2	0.2014	0.2016	0.0452	0.0456	0.0424	0.5921	0.5921	0.5633	0.5633	0.4372
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.19: Regression Results for Applied Problem Test Scores, Father (Family-Specific Birth Order Positions)

	Standardized Scores					**Raw Scores**				
	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**	**Pooled OLS, siblings**		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2FS2$	-1.55	-1.52	-2.30	-2.31		-1.03**	-1.03**	-1.62***	-1.63***	
	(1.25)	(1.25)	(1.73)	(1.76)		(0.43)	(0.44)	(0.62)	(0.62)	
$BO2FS3$	-2.49*	-2.47*	-2.37	-2.38		-0.97**	-0.97**	-1.31*	-1.32*	
	(1.28)	(1.29)	(2.04)	(2.06)		(0.47)	(0.47)	(0.70)	(0.71)	
$BO3FS3$	-4.39**	-4.36**	-5.49	-5.51		-1.83***	-1.83***	-2.89**	-2.91**	
	(1.89)	(1.90)	(3.52)	(3.55)		(0.66)	(0.66)	(1.24)	(1.24)	
$BO2FS45$	-0.63	-0.64	1.76	1.75		-0.94	-0.94	-0.08	-0.09	
	(2.73)	(2.73)	(3.65)	(3.66)		(0.88)	(0.88)	(1.37)	(1.37)	
$BO3FS45$	-1.73	-1.72	-0.21	-0.21		-0.84	-0.84	-0.70	-0.70	
	(2.31)	(2.32)	(5.19)	(5.19)		(0.90)	(0.90)	(2.02)	(2.02)	
$BO45FS45$	-2.18	-2.18	0.20	0.19		-0.53	-0.53	-0.26	-0.27	
	(1.96)	(1.96)	(5.90)	(5.93)		(0.74)	(0.74)	(2.22)	(2.23)	
$QualT_{t-1}$		0.01		-0.01	-0.10**		0.00		-0.01	-0.15***
		(0.05)		(0.11)	(0.05)		(0.02)		(0.04)	(0.01)
$Constant$	60.03***	59.61***			0.00	-15.65***	-15.65***			0.00
	(5.35)	(5.72)			(0.11)	(1.90)	(2.05)			(0.03)
R^2	0.2473	0.2473	0.0490	0.0490	0.0310	0.6359	0.6359	0.5536	0.5536	0.4424
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.20: Regression Results for Behavioral Problem Index, Father (Family-Specific Birth Order Positions)

	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2FS2$	0.4	0.36	1.91***	1.94***	
	(0.43)	(0.43)	(0.70)	(0.70)	
$BO2FS3$	0.21	0.17	0.46	0.49	
	(0.42)	(0.43)	(0.76)	(0.75)	
$BO3FS3$	1.57**	1.52**	3.15**	3.20***	
	(0.62)	(0.63)	(1.23)	(1.23)	
$BO2FS45$	1.21	1.23	1.78*	1.80*	
	(0.74)	(0.75)	(1.01)	(1.01)	
$BO3FS45$	1.18	1.16	4.63***	4.63***	
	(0.88)	(0.88)	(1.62)	(1.62)	
$BO45FS45$	0.40	0.40	3.78*	3.80*	
	(0.93)	(0.94)	(1.96)	(1.96)	
$QualT_{t-1}$		-0.02		0.02	0.00
		(0.02)		(0.03)	(0.02)
$Constant$	9.56***	10.29***			0.02
	(2.62)	(2.70)			(0.05)
R^2	0.7795	0.7798	0.0542	0.0548	0.0017
N	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.21: Results of Second Difference Using Time-and-Sibling Difference, Father (Family-Specific Birth Order Positions)

	Standardized				Raw		
Variables	**Letter Word**	**Passage Comp**	**Applied Prob**	**Behavior**	**Letter Word**	**Passage Comp**	**Applied Prob**
$BO2FS2 * T2$	5.76	3.55	-8.01	-2.71	6.53***	4.06**	-2.3
	-5.51	-5.89	-4.99	-2.81	-2.42	-1.85	-1.61
$BO2FS3 * T2$	5.1	3.94	-2.3	-2.74	5.85**	3.96**	-0.68
	-5.7	-5.54	-5.67	-2.49	-2.34	-1.94	-1.67
$BO3FS3 * T2$	11.36	6.94	-10.15	-2.97	11.18***	7.62**	-3.72
	-10.15	-11.07	-10.1	-5.77	-3.81	-3.37	-3.23
$BO2FS45 * T2$	17.52	0.13	-5.72	-5.98**	10.44*	3.14	-1.7
	-13.22	-9.24	-7.09	-2.4	-5.58	-3.61	-2.17
$BO3FS45 * T2$	13.79	1.37	-17.05	-7.4	15.45***	8.15*	-4.72
	-14.71	-12.48	-10.45	-4.76	-5.48	-4.33	-3.03
$BO45FS45 * T2$	38.40**	15.98	-43.98***	-3.31	23.14***	12.84**	-11.24***
	-16.96	-15.24	-12.29	-6.25	-6.36	-4.98	-3.61
$QualT_{t-1}$	0.16	0.11	0.08	-0.06	0.17***	0.11	0
	-0.16	-0.22	-0.16	-0.06	-0.06	-0.08	-0.04
R^2	0.1087	0.1289	0.1454	0.0832	0.6065	0.4688	0.5281
N	70	70	70	70	70	70	70
Controls				Child			

Pooled Sample. Child controls include child's age squared. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.22: Regression Results for Letter Word Test Scores, Father

	Standardized Scores					Raw Scores				
	Pooled OLS, siblings		Sibling Difference		Double Diff	Pooled OLS, siblings		Sibling Difference		Double Diff
	BO	BO+Time	BO	BO+Time	Time	BO	BO+Time	BO	BO+Time	Time
$BO2$	-3.34***	-3.25***	-2.54*	-2.52*		-1.42***	-1.38***	-1.46***	-1.42**	
	(1.14)	(1.14)	(1.36)	(1.37)		(0.37)	(0.38)	(0.55)	(0.55)	
$BO3$	-6.58***	-6.43***	-6.11**	-6.08**		-2.56***	-2.50***	-3.04***	-2.99***	
	(1.81)	(1.81)	(2.83)	(2.86)		(0.66)	(0.65)	(1.10)	(1.10)	
$BO45$	-9.02***	-8.89***	-4.83	-4.78		-3.49***	-3.44***	-3.41*	-3.35*	
	(3.04)	(3.04)	(4.71)	(4.76)		(1.02)	(1.02)	(1.81)	(1.83)	
$FS3$	0.12	0.09				0.07	0.06			
	(1.49)	(1.5)				(0.47)	(0.47)			
$FS45$	2.63	2.48				1.01*	0.95			
	(2.05)	(2.06)				(0.61)	(0.61)			
$QualT_{t-1}$		0.04		0.02	0.05		0.02		0.02	-0.26***
		(0.06)		(0.10)	(0.05)		(0.02)		(0.04)	(0.02)
$Constant$	95.83***	94.28***			0.26**	-14.44***	-15.09***			0.19***
	(8.07)	(8.38)			(0.13)	(2.96)	(2.98)			(0.05)
R^2	0.1666	0.1673	0.0223	0.0224	0.0421	0.6478	0.6482	0.6526	0.6528	0.5877
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.23: Regression Results for Passage Comprehension Test Scores, Father

	Standardized Scores					**Raw Scores**				
	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**	**Pooled OLS, siblings**		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**	**BO**	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2$	-2.13**	-2.17**	-2.57*	-2.63*		-1.06***	-1.07***	-1.43***	-1.43***	
	(0.98)	(0.97)	(1.39)	(1.39)		(0.32)	(0.32)	(0.50)	(0.50)	
$BO3$	-4.92***	-5.00***	-5.51*	-5.59*		-1.91***	-1.92***	-2.68***	-2.68***	
	(1.74)	(1.73)	(2.89)	(2.89)		(0.55)	(0.55)	(1.01)	(1.01)	
$BO45$	-4.21	-4.27	-5.19	-5.30		-1.66*	-1.67*	-2.94*	-2.93*	
	(3.09)	(3.08)	(4.69)	(4.71)		(1.01)	(1.01)	(1.64)	(1.64)	
$FS3$	-0.58	-0.57				-0.08	-0.08			
	(1.26)	(1.26)				(0.40)	(0.40)			
$FS45$	1.48	1.56				0.39	0.40			
	(1.99)	(2.00)				(0.59)	(0.59)			
$QualT_{t-1}$		-0.02		-0.04	0.11*		0.00		0.00	-0.16***
		(0.05)		(0.10)	(0.06)		(0.02)		(0.03)	(0.02)
$Constant$	101.69***	102.52***			0.11	-16.91***	-16.81***			0.12**
	(7.28)	(7.54)			(0.13)	(2.44)	(2.51)			(0.05)
R^2	0.199	0.1992	0.0426	0.0429	0.0424	0.5905	0.5905	0.5609	0.5609	0.4372
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.24: Regression Results for Applied Problem Test Scores, Father

	Standardized Scores					Raw Scores				
	Pooled OLS, siblings		Sibling Difference		Double Diff	Pooled OLS, siblings		Sibling Difference		Double Diff
	BO	BO+Time	BO	BO+Time	Time	BO	BO+Time	BO	BO+Time	Time
$BO2$	-1.77*	-1.75*	-2.03	-2.03		-0.97***	-0.97***	-1.40**	-1.41**	
	(0.97)	(0.98)	(1.58)	(1.61)		(0.35)	(0.36)	(0.56)	(0.57)	
$BO3$	-3.44*	-3.41*	-4.73	-4.73		-1.47**	-1.47**	-2.67**	-2.67**	
	(1.84)	(1.85)	(3.24)	(3.28)		(0.66)	(0.66)	(1.17)	(1.18)	
$BO45$	-3.35	-3.32	-3.92	-3.93		-0.65	-0.65	-1.98	-1.99	
	(2.78)	(2.79)	(5.12)	(5.20)		(0.98)	(0.98)	(1.84)	(1.86)	
$FS3$	-0.91	-0.92				-0.17	-0.17			
	(1.29)	(1.29)				(0.46)	(0.46)			
$FS45$	0.96	0.92				0.08	0.08			
	(2.15)	(2.14)				(0.71)	(0.71)			
$QualT_{t-1}$		0.01		0.00	-0.10**		0.00		0.00	-0.15***
		(0.05)		(0.11)	(0.05)		(0.02)		(0.04)	(0.01)
$Constant$	60.34***	59.94***			0.00	-15.49***	-15.50***			0.00
	(5.40)	(5.78)			(0.11)	(1.90)	(2.06)			(0.03)
R^2	0.2472	0.2472	0.0455	0.0455	0.0310	0.6355	0.6355	0.5512	0.5512	0.4424
N	1024	1024	512	512	113	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.25: Regression Results for Behavioral Problem Index, Father

	Pooled OLS, siblings		**Sibling Difference**		**Double Diff**
	BO	**BO+Time**	**BO**	**BO+Time**	**Time**
$BO2$	0.31	0.27	1.41**	1.44**	
	(0.34)	(0.34)	(0.63)	(0.63)	
$BO3$	1.07*	1.01*	3.91***	3.95***	
	(0.59)	(0.60)	(1.20)	(1.20)	
$BO45$	-0.04	-0.10	3.09*	3.15*	
	(1.04)	(1.05)	(1.77)	(1.77)	
$FS3$	0.53	0.55			
	(0.41)	(0.41)			
$FS45$	0.63	0.70			
	(0.63)	(0.64)			
$QualT_{t-1}$		-0.02		0.02	0.00
		(0.02)		(0.03)	(0.02)
$Constant$	9.10***	9.84***			0.02
	(2.62)	(2.69)			(0.05)
R^2	0.7797	0.78	0.0453	0.0459	0.0017
N	1024	1024	512	512	113
Controls	Child, Family, T2		Child, T2		Child

Child controls include child's age, child's age squared, birth weight, gender, dummy variable for black race. Family controls include father's age, and father's education level in years. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Table 2.26: Results of Second Difference Using Time-and-Sibling Difference, Father

	Standardized				Raw		
Variables	**Letter Word**	**Passage Comp**	**Applied Prob**	**Behavior**	**Letter Word**	**Passage Comp**	**Applied Prob**
$BO2 * T2$	3.81	0.83	0.24	-0.85	3.54***	1.93*	0.39
	(2.70)	(3.09)	(2.87)	(1.33)	(1.26)	(1.06)	(0.95)
$BO3 * T2$	3.87	0.40	-1.77	-1.03	6.42***	4.34**	-0.38
	(5.87)	(6.39)	(6.30)	(3.22)	(2.39)	(2.04)	(2.05)
$BO45 * T2$	26.23***	11.53	-24.09***	3.47	12.30***	7.38***	-5.45**
	(7.80)	(8.65)	(7.92)	(4.04)	(3.16)	(2.68)	(2.60)
$QualT_{t-1}$	0.26**	0.11	0.00	0.03	0.20***	0.12**	0.00
	(0.13)	(0.13)	(0.11)	(0.05)	(0.05)	(0.05)	(0.03)
R^2	0.0722	0.0511	0.0502	0.0133	0.6317	0.4637	0.4604
N	113	113	113	113	113	113	113
Controls				Child			

Pooled Sample. Child controls include child's age squared. Standard errors are shown in parentheses, followed by indicators of significance levels (*** significant at 1% level, ** significant at 5% level, * significant at 10% level).

Chapter 3

The Riskiest of Them All: Examining Adolescent Behaviors on Parental Time Inputs

3.1 Introduction

Teenage health risk behaviors are found to be important determinants to the the future well-being, education, and labor market outcomes of individuals (Heckman, Hse, and Rubinstein 2000; Heckman, Stixrud, and Urzua 2006; Barnes et al. 2007; Balsa, Giuliano, and French 2011). For instance, early smokers are found to perform academically worse than their non-smoking counterparts (Ellickson, Tucker, and Klein 2001). An earlier initiation to such behaviors is also related with higher persistence and state dependence, such that those who started smoking earlier are more likely to continue smoking (Gruber 2001). Coincidentally, adolescence is believed to be a crucial period, as it is also characterized by vulnerability and susceptibility to societal influences such as parents (Bantle and Haisken-DeNew 2002), siblings (Bard and Rodgers 2003; Altonji, Cattan, and Ware 2010), and peers (Clark and Lohéac 2005).

In the household context, parental supervision is one factor commonly suggested to mitigate teenage engagement in risky behaviors (Aizer 2004). Taken with the issue of parental labor force conditions, the role of parents in influencing their offspring provide important labor and child care policy implications, concerning for example parental incentives and flexible working hours. Existing research points out that unsupervised children and youths are more likely to engage in risky behaviors such as skipping school, getting drunk/high, stealing something, and hurting someone (Aizer 2004; Averett, Argys, and Rees 2011), not to mention that higher levels of family support are associated with better behavioral outcomes (Barnes and Farrell 1992).

While there exists a general negative impact of parental supervision on health risk behaviors in the literature, the findings are based on measures of parental supervision such as parental employment status, number of working hours, or a dichotomous indicator of parental presence during particular periods of the day. However, it can be argued that these measures are imprecise proxies for parental time supervision. For instance, non-working time of the parents may not be entirely spent with the child. Another

common denominator among the existing literature is the use of contemporaneous measurements of risky behaviors and parental time input, which raises the issue of simultaneity: do teenagers engage in risky behaviors as a consequence of the time spent with parents, or do parents spend time with their teenage offspring based on the latter's behaviors? The collection of time diaries, especially that taking the point of view of the child instead of the parents, provides a breakthrough in the availability of a direct quantitative measure of parental time supervision and makes it possible to derive new insights into the relationship between parental time and teenage health risk behaviors.

This research tests the relationship between parental supervision and some adolescent health risk behaviors: cigarette smoking, marijuana smoking, alcohol drinking, and sexual engagement, using a sample of 10- to 18-year old adolescents from the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). It represents an improvement on the existing evidence on the effect of parental supervision on risky behavior for a number of features. First, I use a sample with an age group characterized by increasing independence and social influences. Second, I consider a quantitative amount of total time that the teenagers are with their fathers and with their mothers, which I derived from the time diaries and aggregated into weekly hours. This provides a much more accurate measure of parental supervision as compared to its proxy counterparts. Third, parental time from fathers and mothers is looked at separately, disentangling the paternal role from the maternal role. This allows me to investigate which parental role matters more in determining the teenage behavior. Fourth, this analysis addresses the potential issue of simultaneity between contemporaneous behaviors and supervision by using the lagged measurements of parental time, a solution also adopted in Zick, Bryant, and Osterbacka (2001). Fifth, the research explores and compares various definitions of riskiness – Is risk measured over the long span (i.e. over the full lifecourse) more meaningful than the one over the short span (i.e. over the recent past period)? Lastly, the identification strategy relies on a household fixed effect approach that is made possible due to the observation of siblings in the dataset.

The OLS linear probability results on risky behavior outcomes show negative and statistically significant coefficients of maternal time supervision for cigarette smoking and alcohol drinking over the recent period, and on paternal time supervision for marijuana smoking also over the recent period. Once unobserved household-specific heterogeneity is controlled for with a household fixed effect approach, the relative role of the father in mitigating teenage health risk behaviors measured over the long span emerges, while the impact of the mother's time loses its significance. This points to the relative importance of paternal time supervision with respect to mothers.

My fixed effects results provide new evidence on the importance of taking into account unobserved family-specific characteristics in examining the effect of parental supervision on teenage behaviors, as well as on the sensitivity of the results to the adopted measurement of risky behavior.

The paper is organized as follows. Section 2 presents existing studies on parental supervision and adolescent health risk behaviors. Section 3 illustrates the data and sample selection, and Section 4 provides the estimation strategy used. Section 5 shows the descriptive and empirical results. Lastly, Section 6 concludes.

3.2 Parental Supervision and Teenage Health Risk Behaviors

Aside from their detrimental effects to the body and mind, health risk behaviors (e.g. smoking and drinking) are found to be negatively correlated with education and economic outcomes (Flouri and Buchanan 2002; Desimone 2010; Balsa, Giuliano, and French 2011). Alcohol use and underage drinking are found to negatively influence educational attainment and years of completed schooling (Cook and Moore 1993; Mullahy and Sindelar 1994; Chatterji 2006), though the magnitudes are smaller after taking into account unobserved individual heterogeneity. Alcohol drinking is found to affect brain development and learning mechanisms (Renna 2008), which may then affect academic and cognitive achievements.

One determinant of engagement in health risk behaviors is increased self-care. Given that adolescence is considered a period of vulnerability and susceptibility to societal influences, increased self-care creates the opportunity for peer or sibling (Bard and Rodgers 2003; Fagan and Najman 2003) effects in smoking and drinking behaviors, as evident in the growing literature exploring this subject. Results have shown consistent positive (older) sibling and peer influence on drinking and unprotected sex (Duncan et al. 2005; Gardner and Steinberg 2005; Card and Giuliano 2011), substance use (Clark and Loheac 2005; Powell, Tauras, and Ross 2005), being overweight (Trogdon, Nonnemaker, and Pais 2008), and truancy (Duarte, Escario, and Molina 2007).

With respect to older sibling influence, the analysis brings with it the need to differentiate birth order positions. To illustrate, those with older siblings (i.e., those with higher birth order positions) are more likely to engage in health risk behaviors such as smoking and drinking (Averett, Argys, and Rees 2011), as well as delinquency (Fagan and Najman 2003). Latter-borns are also more likely to start smoking at an earlier age than their earlier-born counterparts. Bard and Rodgers (2003) propose that this phenomenon, especially the significant role of sisters, is not due to the fact that older siblings act as role models or they provide the opportunities to younger siblings (as proposed by the social learning mechanisms of modeling and opportunity Presti, Ary, and Litchenstein 1992), but is originated from the biasing process of the younger in recalling and reporting, known as telescoping. Even with data limitations and the issue of shared unobserved factors between siblings, there have been attempts to illustrate the causal effect of older sibling influence through fixed effects and instrumental variable approaches, as seen in Altonji, Cattan, and Ware (2010) and Ouyang (2004). By exploring the timing patterns of choices between siblings in the National Longitudinal Survey of Youth 1997, Ouyang (2004) shows that the probability of younger siblings smoking or drinking increases dramatically when the older siblings smoke or drink as well.

Given the evidence that latter-borns are also less supervised than the first-borns (Price 2008), the difference in risk behaviors across siblings is suggested to be due to differences in parental control (Begue and Roche 2005) and supervision (Averett, Argys, and Rees 2011). Using a survey questionnaire, Begue and Roche (2005) find that middle-borns are more likely to be involved in delinquent behaviors and are also less supervised than the first-borns, and they conclude that differential parental control partly explains the role of ordinal position in delinquent behavior.

Decreased parental supervision and increased self-care may be seen as two sides of the same coin. Indeed, parental supervision is believed to serve as a mitigating factor in health risk behaviors, as it may check the teenagers' engagement to risky activities and decrease the susceptibility of adolescents to

societal influences and the opportunity to partake in these activities. Parenting style may also matter, but the literature provides conflicting evidence on how it may affect children outcomes (see Cosconati 2011). For instance, Bronte-Tinkew, Moore, and Carrano (2006) find that an authoritative father increases the child's engagement in delinquent activities and substance use, whereas Ginsburg et al. (2009) conclude that strict parenting decreases the likelihood that adolescents drinking or using the mobile phone while drinking. A reconciliation is found in partial sheltering as the optimal parenting style (Lizzeri and Siniscalchi 2008).

Despite that (1) outcomes observed in adolescence are related to and may serve as good predictors of adult outcomes such as education, labor market, and earnings (e.g. Flouri and Buchanan 2002) and that (2) non-cognitive and behavioral outcomes play an important role on the future well-being and life prospects of the individual (Heckman et al. 2000), there are surprisingly relatively few studies examining how parental practices affect the relationship between self-care and adolescence behavior (Gruber 2001), not to mention how parental time supervision affects non-cognitive and behavioral outcomes of their teenage offspring. Researches on parental role in shaping children outcomes have mainly focused on parental time investments as inputs in the cognitive, achievement, and education production of their offspring (Leibowitz 1974; Todd and Wolpin 2007). Among the available handful of researches, parental supervision has been looked at using parental employment status and number of working hours; dichotomous self-reported indicators of being able to go out at night without the parents, respect of curfew, not telling parents where one is going to be (Begue and Roche 2005); or dichotomous or categorical indicators of parental presence during different periods of the day (Aizer 2004). It can be argued that these measurements are imprecise proxies for parental time inputs. For instance, non-working time of the parents may not be entirely spent with the child.

The findings in the literature suggest that higher parental supervision, or even participation in adult-supervised after-school activities, are associated with decreased incidence of engagement in teenage risky behaviors (Amato and Rivera 1999; Amato and Fowler 2002; Browning et al. 2005) due to limited opportunities and incentives. Children who do not receive adult supervision after school, also called "latchkey children", are found to be the ones to most likely engage in substance use and other risky behaviors including sex (Coley, Medeiros, and Schindler 2008), are more likely to have behavior problems (Vandell and Ramanan 1991), and are also more likely to experience depression and score lower academically (Richardson et al. 1993), as compared to those who arrive home with the mother or other adults present. Eighth-graders who participated in adult-supervised after-school activities are also found to use drugs significantly less often than those who are not involved in such activities (Jenkins 1996). The empirical findings are in line with Hirschi's social control theory of delinquency (Barnes et al. 2007), which assumes that deviant behaviors occur when the bond of the individual to conventional society (which includes the parents) is weak or broken.

With the recent changes in household structure (Hofferth 2006), increased female labor force participation, maternal work schedules (Richardson et al. 1993), and child care choices (Aizer 2004), there have been studies looking at the separate roles of fathers and mothers in determining the outcomes of their offspring. Maternal role has been relatively more explored in cognitive and educational outcomes, while paternal role has been investigated with respect to behavioral and non-cognitive outcomes. For

instance, Cobb-Clark and Tekin (2011) use the National Longitudinal Survey of Adolescent Health to compare the influence of biological and residential stepfathers on their offspring. They find that adolescent boys without father figures are more likely to engage in delinquent behaviors, pointing out the important role of fathers in the behavioral outcomes of teenagers.

3.3 Sample Selection and Description of Variables

The empirical strategy requires information of siblings' time use and health risk behaviors, which are available in the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). Using the time diaries, I am able to estimate the effect of parental time supervision in determining adolescent health risk behaviors.

The analysis uses a pooled sample of 996 biological siblings 10 to 18 years old born in intact families with two to five offspring. A teenager is observed only once in this pooled sample, and hence can only be present in one wave. Among this sample, 582 are from the 2002 wave, while 414 are from the 2007 wave. The younger adolescents that are observed in both 2002 (10 to 14 years old) and 2007 (15 to 18 years old) are included by only taking in the 2002 wave to provide a balance between the samples from the two waves.

3.3.1 Health Risk Behaviors

The health risk behaviors explored here are dichotomous measurements of: cigarette smoking over the full lifetime up to the survey date (smokelife), cigarette smoking over the past month (cigs), marijuana smoking over the full lifetime until the survey date (evermarijuana), marijuana smoking over the past year (marijuana), alcohol drinking over the full lifetime until the survey date (everdrank), alcohol drinking over the past year (alcohol), alcohol drinking at least once a week over the past year (drinks), and engagement in sexual activity over the full lifetime (eversex). Risky behaviors are first asked to respondents from 10 years onwards, and are available from the 2002 wave.

3.3.2 Parental Time

The quantitative measurement of parental supervision is calculated directly from the time diaries, which serves as a significant advantage over dichotomous measurements of parental supervision, number of working hours, or employment status. The latter variables are proxy measurements that provide imprecise information of parental time supervision, as non-working time of the parents are not entirely spent with the offspring (Huston and Aronson 2005). The nature of the time diaries also allow for the differentiation between the amount of supervision from fathers and from mothers separately, which allows me to compare the relative importance of each parent in determining their teenage offspring's behavior.

While the survey provides information about the time with whom the child interacted with, the research focuses only on parental time, which is believed to be crucial for a child's outcome (Aizer 2004; Price 2008). When proxied with parental employment, parental time has been found to have ambiguous effects on children outcomes (Blau and Grossberg 1992; James-Burdumy 2005). This is due to the fact that parental non-working time is not necessarily entirely spent with the children. Using

parental employment and work hours as measures is misleading if the employed parents are able to provide similar amounts of quality time with respect to the unemployed parents. For instance, employed mothers may compensate for work hours by spending more of their available time with their children and less time on other activities such as leisure (Huston and Aronson 2005). Time diary measures considered here instead allows for disentangling the work hours from the actual time spent with the children.

Active and passive participation are also differentiated in the time diaries of the CDS, wherein the latter connotes physical presence but not active engagement. The available literature has considered general parental supervision, as well as paternal role. Therefore, I consider parental supervision from both fathers and mothers separately in the analysis, disentangling their relative roles. To test for the role of parental time supervision, I use a weekly measurement of the total amount of time the child spend with each individual parent in lagged form to address the issue of simultaneity. Behavioral outcomes surveyed during ages 10 to 18 have the corresponding parental time supervision received during age 5 to 12. Even with the long-term health risk outcomes (i.e. ever smoked a cigarette, ever drank alcohol, ever smoked marijuana, ever had sex), the age when parental time supervision is measured and the initial age of engaging in the said behaviors are not in conflict. The former occurs before the latter, and this is confirmed from the comparison of the two ages for each sampled child. For the purpose of capturing a better measurement for parental supervision, it is reasonable to use the total parent-child time instead of other definitions of time such as quality or active engagement, given that supervision calls for the presence and may not necessarily need the engaged attention of the parent or the performance of specific activities.

3.3.3 Household Characteristics

Household characteristics include (1) family income in logarithmic form, (2) maternal age at childbirth, (3) parent's completed years of education in the previous period, (4) parental lagged employment status, (5) total number of children in the family, and (6) corresponding parent's behavior if available. These could be correlated to the child's risky behavior, to the household environment, and parental time to the child. For instance, family income and parental employment may influence the parents' decision on how much time to spend with their children as a result of the income or substitution effects of work and leisure. Parental education may be correlated with time and parenting skills. A family with more offspring may limit parents' ability to supervise. Lastly, those with parents who smoke are also more likely to smoke, having a role model in the parents (e.g. Bantle and Haisken-DeNew 2002).

3.3.4 Child-Specific Characteristics

Child-specific characteristics include an age group dummy variable indicating if the child is between 15 to 18 years old, a male gender indicator, a dummy variable for black race, and a variable indicating whether the child has an older sibling to control for birth order. Older individuals are predicted to be more risky and are more likely to engage in risky behaviors. This is true for males, as well as for latter-born offspring (e.g. Averett, Argys, and Rees 2011). A lagged behavioral problem index is also included as a regressor to capture the child character, i.e. those with higher behavioral problem index are expected

to more likely engage in risky behaviors. This attempts to capture the child-specific behavior that may be correlated with the decision of parents on how to allocate their time to different offspring.

3.4 Empirical Strategy

To test for the role of parental time supervision in determining teenage health risk behaviors, I consider a reduced-form child production function model (Becker and Tomes 1976; Aizer 2004), in which a family maximizes utility that is a function of various inputs, one of which is parental time devoted to the child. To increase the sample size, the model is estimated on the sample pooling over the two periods of observation (2002, 2007) controlling for child- and household-specific characteristics at child's birth and at one-period lag (1997 controls for outcomes are observed in 2002, and 2002 controls for outcomes observed in 2007):

$$Risk_{ijt} = \beta_0 + \beta_1 Time_{it-1} + \beta_2 T2_t + \beta_3 \mathbf{X}_{ijt} + \beta_4 \mathbf{X}_i + \beta_5 \mathbf{Z}_j + \epsilon_{ijt} \tag{3.1}$$

where the dependent variable $Risk_{ijt}$ stands for the different risky behaviors observed at each period t of a child i born in family j; $Time_i$ is the parental time received by the child in lagged $(t-1)$ measures; $T2_t$ is a dummy variable that indicates the period of observation; $\mathbf{X}_{ijt}$ is a vector of child- and household-specific time-varying characteristics such as the child's age; $\mathbf{X}_i$ stands for the observable individual variables including child's race, gender, and maternal childbirth age; and $\mathbf{Z}_j$ is a vector of household-specific characteristics including family size, parental years of education, and lagged parental employment status.

To allow for parental time input to have a non-linear effect on the teenage risky behavior, a specification that considers the time information by way of categorical dummy variables is also estimated. The dummy variables are created by getting the percentile distribution of total time and separating in 3 groups. The lowest 33% of the distribution serves as the benchmark in the following model:

$$Risk_{ijt} = \gamma_0 + \gamma_{1b} TimeB_{it-1} + \gamma_{1c} TimeC_{it-1} + \gamma_2 T2_t + \gamma_3 \mathbf{X}_{ijt} + \gamma_4 \mathbf{X}_i + \gamma_5 \mathbf{Z}_j + \epsilon_{ijt} \tag{3.2}$$

In both models, the error term ϵ_{ijt} is a two-way component:

$$\epsilon_{ijt} = \psi_j + \rho_{ijt}$$

with a household-specific unobserved heterogeneity (ψ_j) and an idiosyncratic heterogeneity component (ρ_{ijt}).

I estimate the effect of parental time supervision, β_1 in model (1) (γ_{1b} and γ_{1c} in model (2)) using the following approaches:

1. **Pooled Ordinary Least Squares** on the above equations, where all the right-hand side variables are assumed to be orthogonal to $\psi_{j(t)}$
2. **Household Fixed Effects or Sibling Difference**, which allows for the identification of the effect of parental time supervision net of unobserved family-specific components that are possibly cor-

related with the observed regressors, while the idiosyncratic error is still assumed to be orthogonal to the inputs and that there is time-constant family unobserved heterogeneity, $\psi_{j(t)} = \psi_j$:

$$\Delta_j Risk_{it} = \beta_1 \Delta_j Time_{it-1} + \beta_2 \Delta_j \mathbf{X}_{ijt} + \beta_3 \Delta_j \mathbf{X}_i + \Delta_j \epsilon_{ijt} \tag{3.1a}$$

$$\Delta_j Risk_{it} = \gamma_{1b} \Delta_j TimeB_{it-1} + \gamma_{1c} \Delta_j TimeC_{it-1} + \gamma_2 \Delta_j \mathbf{X}_{ijt} + \gamma_3 \Delta_j \mathbf{X}_i + \gamma_j \epsilon_{ijt} \tag{3.2a}$$

3.5 Results

3.5.1 Descriptive Analysis

The Sample

The summary statistics of the relevant variables for the sample are shown in 3.Table 1. Half of the sample are males; 23% are Blacks. Around 40% of the sample are in the older age group of 15-18 years old, while 65% have older siblings. Out of the full sample, 29% has ever tried smoking cigarettes, and 8.4% has smoked in the past 30 days prior to the interview date. A little over one-third (at 36.4%) has ever drank alcohol, 29% has drank in the past year, while 3.1% has drank alcohol at least once per week in the past 12 months. Less than one-fifth (at 16%) has ever tried smoking marijuana, with 5.4% having smoked in the past month. Lastly, 23.5% has ever had sexual intercourse.

Lagged maternal time supervision averages at 37.70 hours a week, with a standard deviation of 15.85, while lagged paternal time supervision at a lower average of 25.16 hours a week and a standard deviation of 15.30.

Sibling Correlation

As discussed in the previous section, the observed behavioral outcome of each adolescent in a family is assumed to include an error term with individual-specific and family-specific components. The variance of this error term can be decomposed into within-family and between-family components. Table 3.2 shows the sibling correlation coefficients of health risk behaviors and time supervision with each parent, which correspond to the share of variance attributable to the family background effects. A higher sibling correlation coefficient means a higher share of variance due to family-specific components. For instance, the sibling correlation for cigarette smoking for the full lifetime and for the past 30 days is 0.25 and 0.29, respectively. That for lagged maternal and paternal time supervisions are 0.66 and 0.77, respectively.

Teenage Health Risk Behaviors and Parental Time Supervision

Table 3 shows the t-test results for the differences in health risk behaviors according to the parental supervision received. Both lagged maternal and paternal time supervisions are considered, as well as the different definitions of risky behaviors. The sample is divided based on the average parental time supervision: those who received less than the average time supervision and those who received greater than or equal to the average time supervision in the pooled sample. Receipt of maternal time supervision less than the average is associated with a higher share of cigarette smoking in the past month, drinking

Table 3.1: Summary Statistics

Variables	**Pooled Sample** Mean (Std.Dev.)
Child-specific Characteristics	
Older age group, 15 to 18 years old	0.3916
Child's gender (Male=1)	0.4920
Child's race (Black=1)	0.2319
With older sibling	0.6536
Behavioral Problem Index, lagged	7.533
	(5.7409)
Family-specific Characteristics	
Mother's age at childbirth	28.2651
	(4.9689)
Mother's education in years, lagged	13.2048
	(2.5728)
Mother's employment status, lagged	0.6707
Whether mother smokes	0.1823
Whether mother drinks	0.6623
Father's education in years, lagged	13.2380
	(2.8106)
Father's employment status, lagged	0.9384
Whether father smokes	0.1849
Whether father drinks	0.6753
Number of children in the family	2.7279
	0.8128
Family income in log	11.1300
	(0.7767)
Parental Time Inputs, lagged	
Total time with mother, weekly (MomTime)	37.6981
	(15.8543)
Total time with father, weekly (DadTime)	25.1606
	(15.2953)
Risky Behaviors	
Smoked cigarettes in full lifetime (smokelife)	0.2880
Smoked cigarettes in past 30 days (cigs)	0.0837
Drank alcohol in full life (everdrank)	0.3642
Drank alcohol in past 12 months (alcohol)	0.2873
Drank alcohol at least once a week in past 12 months (drinks)	0.0313
Smoked marijuana in full lifetime (evermarijuana)	0.1571
Smoked marijuana in past 30 days (marijuana)	0.0545
Ever had sexual intercourse (eversex)	0.2350
Number of observation	996

Table 3.2: Sibling Correlations of Health Risk Behaviors and of Parental Time Supervision

Variables	**Sibling Correlations**
Ever smoked cigarettes	0.2542
Smoked cigarettes in the past month	0.2907
Ever smoked marijuana	0.0660
Smoked marijuana in the past year	0.1153
Ever drank alcohol	0.1657
Drank alcohol in the past year	0.1907
Drank at least once a week in the past year	0.0000
Ever had sex	0.1891
$MomTime_{t-1}$	0.6604
$DadTime_{t-1}$	0.7713

alcohol, and engaging in sexual activities. Receipt of paternal time supervision does not seem to have a relationship with health risk behaviors.

Table 3.3: Participation in Risky Behaviors by Receipt of Parental Supervision

	smokelife	**cigs**	**evermarijuana**	**marijuana**
$< AveMomTime_{t-1}$	0.3060	0.1020	0.1663	0.0563
$>= AveMomTime_{t-1}$	0.2698	0.0645	0.1478	0.0527
Mean Comparison Test	0.0362	0.0375**	0.0186	0.0036
$< AveDadTime_{t-1}$	0.2843	0.0849	0.1547	0.0543
$>= AveDadTime_{t-1}$	0.2920	0.0816	0.1597	0.0549
Mean Comparison Test	-0.0077	0.0036	-0.0049	-0.0006
	everdrank	**alcohol**	**drinks**	**eversex**
$< AveMomTime_{t-1}$	0.3880	0.3026	0.0500	0.2525
$>= AveMomTime_{t-1}$	0.3401	0.2718	0.0181	0.2175
Mean Comparison Test	0.0479**	0.0308	0.0319***	0.0351*
$< AveDadTime_{t-1}$	0.3610	0.2876	0.0328	0.2431
$>= AveDadTime_{t-1}$	0.3676	0.2869	0.0356	0.2262
Mean Comparison Test	-0.0066	0.0007	-0.0027	0.0169

3.5.2 Does Higher Parental Supervision Mitigate Adolescent Health Risk Behaviors?

To answer whether teenage risky behaviors are indeed influenced by parental time supervision, the dichotomous measurements of risky behaviors are regressed on lagged measurements of time spent with each parent. The distinction of time with fathers and with mothers allows for the determination of the relative role of each parent in influencing health risk behaviors. The first set of results is obtained using OLS, with standard errors corrected for the correlation of error terms among siblings.

Table 3.4 shows the estimation results of health risk behaviors on lagged linear parental time supervision. The coefficients of both maternal and parental time are negative, but only lagged maternal time supervision is statistically significant for health risk behaviors measured more recently (i.e. cigs, drinks) using OLS. For instance, an additional hour per week with the mothers during pre-adolescence

decreases the probability of cigarette smoking of 0.17 percentage points, from 8.37% to 8.20%. This relationship is consistent with what we have seen in Table 3.3.

The existing literature on parental time inputs and children outcomes is criticized for not taking into account unobserved parent and child characteristics that may be correlated with both variables of interest - parental time to the offspring and the teenage behavior (Gruber 2001; Aizer 2004). If the unobserved household characteristics are correlated with them, using an OLS regression will provide a biased estimate of the effect of parental time on adolescent behavior. The same is true if parental supervision decision is correlated with unobserved household characteristics. As long as parental time allocation to offspring within the family is not correlated with the adolescent's engaging in negative behavior, the estimates from a family fixed effect approach should provide unbiased results.

To account for the possibility that parental supervision may be influenced by unobserved characteristics that are related to the adolescent behaviors, I use a family fixed effect estimation to control for time-invarying family characteristics and avoid omitted variable (or endogeneity) bias. The coefficients of maternal time supervision lose their statistical significance, suggesting that maternal time is more a family-level variable than an individual-level one. Instead, lagged paternal time supervision becomes statistically significant for health risk behaviors measured over the long span (i.e. smokelife, everdrank, eversex) and for marijuana smoking over the past month. To illustrate, an additional weekly hour with the father during pre-adolescent period decreases the overall probability of cigarette smoking over the full lifecourse by 0.58 percentage points, from 28.8% to 28.22%. The emerging result with respect to fathers using household fixed effects emphasize the importance of accounting for unobserved family-specific heterogeneity in estimating the effect of parental time supervision on health risk behaviors.

The bias of OLS may be illustrated with the results of 'marijuana.' The magnitude of the paternal time influence is negative and larger with the fixed effect estimation, suggesting that some unobserved family-specific characteristics related with parental time supervision are causing an upper bias in the OLS estimation.

When lagged time inputs are allowed to have non-linear effects, we observe the same pattern as before. Lagged paternal time supervision is statistically significant for the highest bracket - it only affects teenage health risk behaviors if given at least 30.4 hours a week and to the same risk measures as before. The resulting significant role of fathers in determining their teenage offspring's behavior is consistent with the findings in the literature that explore paternal presence and involvement (e.g. Cobb-Clark and Tekin 2011).

In summary, once unobserved household-specific heterogeneity are accounted for with a family fixed effects estimation procedure, I find a negative relationship between health risk behaviors (smokelife, everdrank, eversex) measured over the full lifetime and lagged paternal time, and not with the maternal time. This suggests that the (maternal) time influence observed in the OLS results are simply driven by unobserved family-specific characteristics and causes the overestimated and biased result.

Table 3.4: Regression Results for Teenage Health Risk Behaviors on Lagged Parental Time Supervision (Linear Specification in Time)

	smokelife		**cigs**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTime_{t-1}$	-0.000211	-0.003546	-0.001704**	-0.000762
	(0.001005)	(0.003241)	(0.000681)	(0.001689)
$DadTime_{t-1}$	-0.000574	-0.005828*	-0.000203	-0.001038
	(0.000974)	(0.003507)	(0.000656)	(0.002621)
$Constant$	0.897378***	0.888914	0.334458**	0.533193
	(0.243206)	(0.847691)	(0.144954)	(0.472691)
R^2	0.1757	0.1773	0.0920	0.0479
N	929	929	932	932
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2
	evermarijuana		**marijuana**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTime_{t-1}$	-0.001126	-0.002398	0.000044	0.00079
	(0.000831)	(0.002794)	(0.000546)	(0.00185)
$DadTime_{t-1}$	-0.000229	-0.001668	-0.000957*	-0.004152*
	(0.000814)	(0.003278)	(0.000501)	(0.002173)
$Constant$	0.166298	1.003423	-0.003083	1.005752**
	(0.17608)	(0.677278)	(0.119492)	(0.504722)
R^2	0.1257	0.1423	0.0534	0.0850
N	939	939	936	936
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2
	everdrank		**alcohol**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTime_{t-1}$	-0.000764	-0.000886	-0.00004	-0.002224
	(0.001093)	(0.003514)	(0.00104)	(0.003204)
$DadTime_{t-1}$	0.000103	-0.006739*	-0.000779	-0.004247
	(0.001134)	(0.003919)	(0.001102)	(0.003634)
$Constant$	0.046635	1.695942**	-0.196792	1.420542*
	(0.269162)	(0.794923)	(0.255468)	(0.731537)
R^2	0.1224	0.1091	0.1440	0.1177
N	930	930	928	928
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2
	drinks		**eversex**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTime_{t-1}$	-0.000893**	-0.002688	0.00058	0.001195
	(0.000415)	(0.001801)	(0.000825)	(0.002916)
$DadTime_{t-1}$	0.00038	0.003968	-0.001292	-0.006335**
	(0.000469)	(0.002625)	(0.00088)	(0.003176)
$Constant$	-0.018515	0.516217	0.622936***	3.138838***
	(0.117235)	(0.484296)	(0.220502)	(0.769175)
R^2	0.0478	0.0849	0.2377	0.1899
N	932	932	929	929
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2

Child controls include child's age, gender, dummy variable for black race, dummy variable to indicate having an older sibling, and lagged Behavioral Problem Index. Family controls include log of family income, mother's age at childbirth, parent's lagged education level in years, parent's lagged employment status, total number of children in the family, and parent's risky behavior. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Table 3.5: Regression Results for Teenage Health Risk Behaviors on Lagged Parental Time Supervision (Non-Linear Specification in Time)

	smokelife		**cigs**		**evermarijuana**		**marijuana**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTimeB_{t-1}$	-0.001021	-0.08524	-0.048700**	-0.010236	-0.02657	-0.01925	-0.015834	0.023892
	(0.035643)	(0.089359)	(0.024023)	(0.061968)	(0.030244)	(0.078046)	(0.018459)	(0.045956)
$MomTimeC_{t-1}$	0.029889	-0.114639	-0.044076*	-0.043614	-0.018689	-0.055474	0.009001	0.046146
	(0.037323)	(0.129097)	(0.025154)	(0.072771)	(0.030709)	(0.101087)	(0.020416)	(0.074588)
$DadTimeB_{t-1}$	-0.046419	0.06494	-0.023408	0.056979	-0.009216	-0.000305	-0.005624	-0.086748
	(0.036487)	(0.08774)	(0.022938)	(0.079924)	(0.029151)	(0.081555)	(0.01941)	(0.067802)
$DadTimeC_{t-1}$	-0.025587	-0.141652	-0.010297	0.02984	-0.012038	-0.123611	-0.024648	-0.168421**
	(0.03647)	(0.109299)	(0.023535)	(0.104731)	(0.028441)	(0.095953)	(0.018003)	(0.077281)
$Constant$	0.891627***	0.668409	0.313662**	0.481516	0.146971	0.902436	-0.00728	0.933116*
	(0.245402)	(0.8442)	(0.144637)	(0.470091)	(0.176518)	(0.680391)	(0.118831)	(0.500183)
R^2	0.1778	0.1886	0.0902	0.0530	0.1243	0.1511	0.0531	0.0952
N	929	929	932	932	939	939	936	936
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2
	everdrank		**alcohol**		**drinks**		**eversex**	
	Pooled OLS	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**	**Pooled OLS**	**Fixed Effects**
$MomTimeB_{t-1}$	-0.048911	-0.087765	-0.03491	0.000423	-0.029319*	-0.047362	-0.00451	-0.065071
	(0.038828)	(0.11136)	(0.035705)	(0.094367)	(0.015521)	(0.032627)	(0.0311)	(0.09955)
$MomTimeC_{t-1}$	-0.024505	-0.213173	0.00106	-0.164059	-0.030707*	-0.04827	0.045413	0.039213
	(0.042027)	(0.142314)	(0.039813)	(0.12651)	(0.016365)	(0.042863)	(0.031245)	(0.111786)
$DadTimeB_{t-1}$	0.00651	-0.046917	-0.009547	0.046524	-0.000457	-0.003462	-0.014534	-0.009299
	(0.037474)	(0.097133)	(0.036162)	(0.098195)	(0.015612)	(0.068359)	(0.031437)	(0.095123)
$DadTimeC_{t-1}$	-0.008163	-0.218590**	-0.03549	-0.121979	0.003454	-0.066139	-0.040268	-0.219118**
	(0.040037)	(0.109537)	(0.03822)	(0.10701)	(0.013696)	(0.086457)	(0.031766)	(0.108909)
$Constant$	0.058024	1.392593*	-0.177617	1.202898*	-0.019045	0.505043	0.621859***	2.929683***
	(0.26068)	(0.782675)	(0.251779)	(0.721688)	(0.117735)	(0.457045)	(0.221000)	(0.763924)
R^2	0.1237	0.1316	0.1456	0.1443	0.0484	0.0719	0.2391	0.2125
N	930	930	928	928	932	932	929	929
Controls	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2	Child, Family, T2	Child, T2

Child controls include child's age, gender, dummy variable for black race, dummy variable to indicate having an older sibling, and lagged Behavioral Problem Index. Family controls include log of family income, mother's age at childbirth, parent's lagged education level in years, parent's lagged employment status, total number of children in the family, and parent's risky behavior. Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

3.6 Conclusions

Children who have received higher parental supervision are found to less likely participate in health risk behaviors such as cigarette smoking, marijuana smoking, alcohol drinking, and sexual engagement. This research tests for whether higher parental supervision decreases the likelihood of teenage risky behavior by considering a quantitative measurement of parental time in the pre-adolescence period of 5 to 12 years old.

Using data from the Child Development Supplement of the Panel Study of Income Dynamics, the results confirm the general negative relationship between parental supervision and risky behaviors measured over the past period, consistent with Aizer (2004). OLS results would suggest that maternal time has a significant role in determining behaviors.

Exploiting the presence of biological siblings in the dataset, I am able to remove potential bias from unobserved family-specific characteristics. Results show that maternal time supervision loses its significance. Not only does the importance of paternal time supervision emerge, but it is only significant with risky behaviors measured over the long span. This points to the importance of taking into account unobserved household-specific characteristics in examining the effect of paternal supervision on teenage risk behaviors, and also of disentangling the influence of each parent.

Chapter 4

A Fractional Multinomial Logit Analysis of Children's Time Use Patterns

4.1 Introduction

Time is a resource input that affects cognitive and non-cognitive outcomes. The amount of time spent on an activity reflects the individual's demand of it, such that spending more time on an activity implies greater demand (Becker 1965). In the context of child development, the literature has largely focused on time spent with parents, in relation to the importance of early home investments (Leibowitz 1974), showing that there is an efficiency-equity trade-off between early and late investments (Cunha and Heckman 2010). Existing studies that look at children outcomes as a function of parental time inputs have mainly considered aggregate measurements, such as quality time (Hsin 2009), or specific activities such as watching TV (Brown et al. 2011) or playing video games (Vandewater, Bickman, and Lee 2006) that do not satisfy the adding-up constraint of 24 hours a day. A limited few has considered outcomes as functions of time on all activities performed in a given day. Mullahy (2005) is an example, where he looked at health outcomes as a function of time spent on physical activities.

In their model on skill formation, Cunha and Heckman (2010) point out that not only is early investment crucial, but early investment without follow-up lessens its effectiveness in positively affecting outcomes. Being around the child allows the parent a direct monitoring of the activities performed; hence, parental supervision is not only important during the early years but at later years as well (Wight et al. 2009). Increasing age among children however comes with more independence, as they spend more time with people other than their parents. This has motivated the strand of literature that looks at unsupervised time, which is found to be positively associated with delinquency and risky behaviors (Aizer 2004). Family inputs are taken together with school inputs in cognitive production models calibrated for older children (Carneiro, Cunha, and Heckman 2003), and point out the decreasing effect of such inputs with the child's age.

Even with the higher level of independence of an older child and his role in the household as a decision-maker (Dauphin et al. 2011), the investment role of the child's own time has rarely been considered in the production function. Indeed, "how children spend their time and the activities they participate in most likely have important implications for the type of adults they become" (Sandberg

2011). An exception is Del Boca, Monfardini, and Nicoletti (2012), which investigates precisely this point and looks at the relative importance of the child's own time and the mother's time input. Moreover, studies that look at how older children allocate their time remains limited as well. The handful that do find significant differences in activity engagement according to specific characteristics (Wight et al. 2009), such as parental education, employment, family income (Bianchi and Robinson 1997; Hofferth and Sandberg 2001), as well as child's gender (Bonke 2010). For instance, males, whites, and children with more educated parents generally spend more time doing activities that contribute to their developmental outcomes (e.g. Bianchi and Robinson 1997). These studies, however, do not consider the trade-off that can occur among activities performed in a day, given the adding-up constraint of 24 hours in any given day.

The contribution of this research is as follows: I use the time diary data in the Child Development Supplement of the Panel Study of Income Dynamics to examine children time use patterns, with particular attention on developmental activities believed to promote cognitive and non-cognitive outcomes. The intergenerational transmission literature has shown that children with more educated parents spend more time on developmental activities such as reading (Mancini, Monfardini, and Pasqua 2011). Past research either did not distinguish the company with whom the child is with, or simply focused on supervised time (e.g. time with parents). I differentiate between supervised and unsupervised time, which is a novelty. I also look at how older children's time use differ according to child-specific and parents-specific characteristics, such as child's gender, parental education, and employment. Lastly, I do the analysis addressing the adding-up constraint by considering all activities performed in a given day. The multivariate fractional regression estimation I use indeed allows for an exploration of the trade-off among activity categories.

Given that time is believed to be a crucial input into the achievement production of the child, the understanding of time use patterns provides an insight on how to improve child cognitive and non-cognitive outcomes, which can then influence later outcomes in life. Time use studies allow for the quantitative investigation of how children's time is allocated to different activities, and how the allocation differs according to gender and family conditions. If coded as mutually exclusive events, time use studies allow for the additional advantage represented by the analysis of allocation made for a specific activity (i.e. developmental) versus other activities (i.e. non-developmental). This research can then provide a breakthrough in understanding children time allocation decisions by utilizing (household and education) economic concepts coupled with a quite novel econometric methodology.

The paper is organized as follows. Section 2 provides a review of the literature involving children time use. Section 3 describes the sample selection and description of variables, followed by Section 4 that presents the empirical strategy. Section 5 reports the empirical results, and Section 6 concludes.

4.2 Background

As children grow older, their ability to make decisions for themselves increases, which affects the activities they perform. Deciding how much time to allocate doing certain activities is found to grow rapidly at around 10 to 14 years of age (Lundberg, Romich, and Tsang 2009). Despite this, there is

still a relatively small literature exploring children time use, perhaps mainly due to data limitations. Moreover, the activities that children perform are obviously different from that of adults, hence require a different set of data collection procedure and coding categories (Bianchi and Robinson 1997). The only nationally-representative US dataset with time diary information of children is the Child Development Supplement of the Panel Study of Income Dynamics (PSID-CDS). Other datasets used in the literature are small-scale or restricted according to a specific criteria (see Wight et al. 2009).

The limited literature exploring children time use information has looked at time spent on activities such as housework, studying and doing homework, and watching television by household characteristics (Bianchi and Robinson 1997; Gager, Cooney, and Call 1999). Perhaps because they focus on younger samples, these studies do not differentiate between supervised and unsupervised time while doing the aforementioned activities, which may be due to the fact that the major part of the child's time is spent supervised anyway. This is not applicable to older children, given that they gain more independence and start to spend unsupervised time.

This section reviews the available studies that look at children time use according to activity categories, discussed in line with how children of different characteristics differ in their time use patterns:

4.2.1 Non-discretionary Activities

Time spent on activities that are not under the direct control of the child are referred to as non-discretionary. Activities include schooling, child care (babysitter), sleeping, and personal care.

Children are recommended at least 9 hours of sleep. Less than this amount impedes alertness and have dire consequences not only for cognitive development, but also in physical health (Durmer and Dinges 2005). Lack of sleep is also related to depression, school problems, and increased body mass index that lead to obesity (Snell, Adam, and Duncan 2007).

4.2.2 Family Activities

Housework is believed to develop a child's sense of responsibility and maturity (Smolensky and Gootman 2003), but may also induce stress, anger, and depression for prematurely assuming an adult role (Capizzano, Main, and Nelson 2004). Children/teenagers are found to contribute approximately 9 to 17 hours of housework per week, with female children at a higher average than male children (Capizzano, Main, and Nelson 2004; Gager, Cooney, and Call 1999). This can be because the delegation of housework is sex-typed, such that girls are expected to do more housework than boys (Bianchi and Robinson 1997). Such a stratification should be less pronounced in societies characterized by the preference for equality, as characterized by high labor force participation rates for both mothers and fathers, for instance. Indeed, parental employment decreases the amount of available time that parents can spend with their offspring, though employed mothers may spend the same amount of childcare time as their non-employed mothers by decreasing their own leisure time (Huston and Aronson 2005). This can also mean that children of employed mothers spend more time on housework (Bryant and Zick 1996b), as the responsibility of doing household tasks is delegated to them. But a preference for equality would deter the parents from allocating housework to female children simply because of the latter's gender.

Bonke (2010) finds that even in such a society, as exemplified by Denmark, boys still participate less in housework than girls do.

Eating together is another activity undertaken by the family explored in the literature. Family meals are considered to be an indicator of the household bond, such that children/teenagers who eat with their families more often are physically (Videon and Manning 2003) and emotionally (Eisenberg et al. 2004) healthier, academically better (Eisenberg et al. 2004), and are less likely to engage in teenage health risk behaviors (Cooksey and Fondell 1996).

4.2.3 Developmental Activities

Activities that promote the developmental process of the child include studying, reading, doing homework, and engaging in healthy recreation. Time spent in activities such as studying and unstructured play are associated with better cognitive outcomes (Fuligni 1997; Connolly, Micklewright, Nickel 1992). This can be influenced by parental educational attainment itself (Bianchi and Robinson 1997). The latter may reflect socio-economic status or parental priorities. Similarly, children's reading time can be influenced by parental reading time, as shown in the intergenerational transmission mechanism. Mancini, Monfardini, and Pasqua (2011) find that parents who read in the presence of their children increases the children's reading and studying activities by 10%, in addition to a starting 20% probability of engaging in the said activities. Similarly, Ono and Tsai (2008) find a racial gap in leisure reading and attributes it to parental socio-economic status.

4.2.4 Non-developmental Activities

Activities that do not promote or hinder child development include watching television, using the computer, and playing video games. Increased level of television viewing is found to be associated with more snacking and less physical activity among 6- to 7-year old children, such that for every additional hour of watching the television, the children spend four minutes less in active activities and 0.06 increase in snacking. This translates to an 8% increased probability of being overweight or obese (Brown et al. 2011). Meanwhile, computer use has a more ambiguous relationship with child cognitive development. Ono and Tsai (2008) provide a review of the arguments wherein computer use can prove to be an advantage or a disadvantage to children outcomes. While it is found to be a good predictor of college attendance and cognitive achievement (Golden and Stafford 2011), computer use is also associated with a series of factors that prove detrimental to child development, such as playing video games that take away time from studying (see Ono and Tsai 2008; Wight et al. 2009). Computer use time has increased dramatically between 1997 and 2003 for 6- to 11-year olds of the PSID-CDS children. When subcategorized, children are found to spend most of their computer use time playing or in recreation. The racial gap is found to be largest in computer use for learning. Furthermore, racial gap attributable to socio-economic inequality has decreased, revealing the underlying racial boundaries instead (Ono and Tsai 2008).

4.2.5 Sources of Variation and Crowding Out of Activities

As previously mentioned, children gain more independence in the decision-making process as they grow older. At the same time, the activities they perform are still largely influenced by the parents, according to the latter's belief on what would contribute to the former's achievement and success (Fields et al. 1994; Eccles and Barber 1999; Dodson and Dickert 2004) and to family conditions.

Child's gender may play a role in determining time use patterns as a result of social stratification, for instance, when female children are expected to perform more household chores (Bonke 2010). Male children may also spend more time doing passive leisure activities such as watching TV and playing video games (Bianchi and Robinson 1997), a reason for which is suggested to be biological in nature. Hoeft et al. (2008) claim that the part of the brain that generates rewarding feelings when playing video games is more active for males than for females.

Higher parental education is found to be positively correlated with more studying, less TV, and more reading (Bianchi and Robinson 1997). These activities promote the cognitive development of the child, particularly when watching television is substituted for more productive activities such as studying and reading (e.g. Koolstra and van der Voort 1996). Parental education plays an indirect role in children time use through increased interaction in educational and developmental activities (Leibowitz 1974, 1977). The intergenerational transmission mechanism of reading habits (Mancini, Monfardini, and Pasqua 2011) and educational attainment (Black and Devereux 2010) are evidences of the important role that parental human capital plays on children.

The role of parental employment on children's outcomes is found to be inconclusive. Its relationship with parental time with children goes also both ways, as employed mothers are found to spend the same amount of time with their children as those unemployed mothers do (Bryant and Zick 1996; Huston and Aronson 2005) or may spend quality activities to compensate for less time.

Given that time constraints are binding at 24 hours a day, engaging in a particular activity decreases the available time to perform other activities. If less educated parents put less priority to activities that promote the development of their offspring, the children will engage less in activities such as reading and studying, and more on activities such as housework or watching television. Such a crowding out or trade-off effect is found by Cummings and Vandewater (2007) where children who play video games spen3 30% less time reading and 34% less time doing homework than their counterparts who do not report playing video games.

4.3 Sample Selection and Description of Variables

The research uses a pooled sample from the three waves of the PSID-CDS, composed of 1,133 children of 10 to 12 years old who belong to intact families of not more than 5 children in the household, with non-missing information on the relevant variables. Given that time patterns for weekdays and weekends and expected to be different, I run separate regressions for each, controlling for the day on which the time diary was filled. The unweighted summary statistics of the covariates are shown in Table 4.1.

The distribution is approximately one-third for each of the three ages of 10, 11, and 12. Almost half of the sample are male children, while 29% are of black race. Both parents in the sample are highly

Table 4.1: Summary Statistics

Variable	**Pooled Sample** Mean (Std.Dev.)
Child-specific Characteristics	
Age	
10	0.3124
11	0.3389
12	0.3486
Child's gender (Male=1)	0.4819
Child's race (Black=1)	0.2868
Only child, $onlychild$	0.0635
With older sibling, $woldersib$	0.6399
Family-specific Characteristics	
Mother's age, $momage$	38.8566
	(5.5867)
Mother's education	
less than high school, $momnoHS$	0.1642
high school graduate, $momHSgrad$	0.3027
some college, $momcollege$	0.5331
Father's age, $dadage$	41.0427
	(5.8593)
Father's education	
less than high school, $dadnoHS$	0.143
high school graduate, $dadHSgrad$	0.2657
some college, $dadcollege$	0.5914
Family Income, $faminc$	72008.6
	(77698.69)
Family income in log, $logfaminc$	10.8332
	(0.9316)
Number of observations	1133

educated, with 59% of fathers and 53% of mothers, respectively, having at least some college education.

4.3.1 Explanatory Variables

The CDS has the advantage of being linked to the longitudinal main dataset of the PSID, which contains detailed information of the demographic, education, and employment information of the parents, which I exploit to look at how time use of children varies according to their household structures.

The main household-level covariates are: a dummy indicator for the labor force participation of each parent, a categorical variable that indicates each parent's educational attainment (less than high school, high school graduate, and having reached at least some college), the family income expressed in logarithmic form, the number of children in the family (dummy variable indicating a one-child family), and race (dummy indicator for black). Child-level covariates include: age, and a dummy indicator for male, and a dummy indicator for having an older sibling (representing birth order). Indicators for the representative day of the time diary, as well as the year (2002 or 2007; 1997 as the baseline) are also included.

4.3.2 Time Use

The time diaries of the CDS contain detailed information of the interviewed child's activities on a representative weekday (Monday to Friday) and a representative weekend (Saturday and Sunday). The days were randomly selected when the interviewer made the initial contact with the household. For each active and passive engagement in an activity, the respondent reports the time began and time end, the time span of the activity, and the company the child is with while doing the activity. The last information is used in differentiating supervised and unsupervised time. I define time as unsupervised if the child is not with anyone, and supervised if the child is with someone not differentiating parents from other people. The observations are structured such that the primary activities performed are mutually exclusive, i.e. there is no multi-tasking.

This study considers the time use categories simultaneously, which allows for the possibility to evaluate the trade-off among the different categories defined. The category definitions are based on mutually exclusive activities, the elements of which are enumerated in Table 4.2.

Non-discretionary (NONDISC) time is composed of time spent in school and day care, including traveling to and from school. Personal care time and sleeping are also included here.

Overall discretionary time is divided into: family, developmental, and non-developmental activities. I also differentiate supervised (i.e. alone) and unsupervised (i.e. with company) time for developmental and non-developmental activities.

Family activities (FAMACT) are characterized by those that provide opportunities for children to participate in household routines and can provide training in important skills and responsibilities at a young age. These include housework, household conversations, mealtime with the family, and market work.

Developmental activities (DEVA for unsupervised and DEVS for supervised) are meant to promote children's achievement and behavior, as well as to develop motor skills, initiative, self-regulation, and

Table 4.2: Compositions of the Time Use Categories

Time Use Categories	**CDS Activity Codes**
(1) Non-discretionary Time (NONDISCT)	
Time spent in school and day care	If venue is school or day care
Time spent in school and day care not captured in venue	509 Student (full-time)
	519 Other classes, courses
	568 At daycare or nursery before or after school only
	569 Other education
	487 At babysitters or daycare before or after school
Travel time to and from school	597-599 School-related travel
	329 Personal care, beauty, barber shop
Necessities: Time spent in personal care, eating, sleeping	339 Medical care
	Personal needs and care 407-499 except 439, 448, 449, 482, 483, 486
(2) Family Activities (FAMACT)	
Housework	Household activities 108-197
	Child care 209-299
	Obtaining goods and services 301-399 except 329 and 339
Mealtime	439 Meals at home
Household conversations	963 Conversations with other household members
(3) Developmental Activities (DEV)	
Studying	549 Homework
	Home computer related activities 501-513 except 502, 503, 5390
Outdoor activities, Sports, Playing	Sports and active leisure 801-899
	Active leisure 884
	Lessons in leisure activities 881-888
	Lessons in sports 883
Church-sponsored activities, Visiting	Organizational activities 631-699
	6130 Attending a before or after school club
Art activities	Entertainment or Social activities 709-799
Unspecified indoor and outdoor play	939-959 Reading as passive leisure
	448 Meals away from home eaten at a friend's or relative's home
	449 Meals away from home; eating at restaurants
(4) Non-developmental Activities (NDEV)	
Playing computer games and surfing the Internet	502 Playing computer games
	503 Other recreational computer activities, surfing the net non-games
Other passive leisure including television watching	Passive leisure 909-999 except 939-959
	068 Eating, smoking, drinking as secondary activity
	482 Personal, private, "none of your business"
	483 Making out, sex
	486 Negative emotional affect; crying, moaning
	7730 Recreational alcohol use
	7740 Recreational drug use, smoking marijuana and other drugs
Market Work	011-099 Work

social skills. They include studying, reading, structured and unstructured play, games and outdoor activities, visiting, and participation in social clubs and organizations.

Non-developmental activities (NDEVA for unsupervised and NDEVS for supervised) are those that are hypothesized to provide negative or no positive influence to the child's cognitive and non-cognitive outcome. These include watching the television, playing computer games, and other passive leisure.

The summary statistics of the time variables are shown in Table 4.3. On the average, the sampled children spend 17.5 and 12 non-discretionary hours on a representative weekday and a representative weekend, respectively. Discretionary time activities have higher averages in the weekends than in the weekdays, except for supervised non-developmental activities. It is interesting to note that the average time doing non-developmental activities are higher than the averages for developmental activities regardless of being alone or with company during the weekday, but it is the opposite during the weekend. For instance, the average time for developmental activities during the weekday is at 1.9 and 1.83 hours alone and with company, respectively, in comparison to the 1.96 and 1.58 hours for non-developmental activities. The averages for weekend observations are at 2.92 and 3.56 hours alone and with company, respectively, versus the 2.75 and 2.47 hours for non-developmental activities. The average of supervised time on developmental activities being higher during the weekends than during the weekdays may be due to the fact that weekends see more supervised time in general, which allows for the regulation of the activities performed and steer the children into doing activities that promote the development.

The prevous section has discussed how children time use can differ according to child- and household-specific characteristics. Table 4.4 shows the mean comparison tests of time use categories according to the child and parental characteristics.

As predicted by the available literature, female children spend more time on family activities (that include housework) than male children do. Although the difference is not significantly different for weekday observations, the one for weekend observations of 0.48 hours is at 1% level. There is also significant difference on developmental activities performed by children according to gender, with males having higher averages of developmental activities, regardless of the day. This is consistent with the findings in the literature comparing activities according to gender (e.g. Wight et al. 2009; Bonke 2010). There is also a racial difference in developmental activities for both weekday and weekend observations, as children of African-American descent spend less time on activities such as studying and reading, as compared to their White and Hispanic counterparts.

Meanwhile, children of employed mothers spend more non-discretionary time during the weekdays, at 17.69 hours, as compared to the 17.62 hours of children of unemployed mothers. This difference can be because employed mothers leave their children in schools longer or send them to babysitters. In fact, there is an opposite pattern for the weekend - children of employed mothers spend less non-discretionary time, at 11.97 hours, with respect to the 12.24 hours of children of unemployed mothers.

Children's performing of developmental and non-developmental activities also varies according to maternal education. Those with mothers who have at least reached college spend more time on developmental activities on both weekdays and weekends, and regardless of being supervised or not. The same children spend less time on non-developmental activities of similar cases.

Difference according to paternal characteristics is less obvious. There is a difference in how children

Table 4.3: Summary Statistics of Time Variables, in hours

	Sample						Non-Zero Sub-sample			
Variable	**Mean**	**Share**	**Std. Dev.**	**Min**	**Max**	**0s, percent**	**Mean**	**Std. Dev.**	**Min**	**Max**
Weekday										
Non-discretionary	17.581	73.254	2.4928	5.63	23.67	0	17.581	2.4928	5.63	23.67
Family	1.2336	5.14	1.0388	0	8.00	4.68	1.2941	1.0265	0.05	8.00
Developmental unsupervised	1.675	6.979	1.5402	0	15.5	12.09	1.9054	1.5031	0.05	15.5
Developmental supervised	1.1514	4.7975	1.4501	0	11.25	37.16	1.8326	1.4487	0.05	11.25
Non-developmental unsupervised	1.4549	6.0621	1.6314	0	13.67	24.77	1.9601	1.611	0.03	13.67
Non-developmental supervised	0.904	3.7667	1.3459	0	16.33	42.63	1.5757	1.449	0.02	16.33
Total	24	1								
Weekend										
Non-discretionary	12.0557	50.2321	2.3123	0	23.75	0.26	12.0877	2.2306	1.85	23.75
Family	2.3855	9.9396	1.8678	0	14.00	3.53	2.4728	1.844	0.08	14.00
Developmental unsupervised	2.6604	11.085	2.3663	0	15.67	8.74	2.9151	2.3222	0.07	15.67
Developmental supervised	2.9071	12.1129	2.6302	0	14.42	18.27	3.5569	2.4804	0.05	14.42
Non-developmental unsupervised	2.2434	9.3475	2.2065	0	13.5	18.45	2.7509	2.1386	0.03	13.50
Non-developmental supervised	1.7472	7.28	2.2805	0	24.00	29.3	2.4714	2.3595	0.08	24.00
Total	24	1								

Table 4.4: Average Hours by Child and Household Characteristics

Weekday	**NONDISC**	**FAMACT**	**DEVA**	**DEVS**	**NDEVA**	**NDEVS**
Female	17.6485	1.2509	1.5917	1.0863	1.5018	0.9208
Male	17.5085	1.215	1.7647	1.2215	1.4045	0.8858
Mean Comparison Test	0.1400	0.0359	-0.1730**	-0.1352*	0.0973	0.035
Non-black	17.4808	1.2668	1.7608	1.2156	1.3862	0.8899
Black	17.8304	1.1513	1.4617	0.9918	1.6258	0.9389
Mean Comparison Test	-0.3496**	0.1154**	0.2991**	0.2238**	-0.2397**	-0.0490
Non-only child	17.5710	1.2360	1.6797	1.1573	1.4197	0.9363
Only Child	17.7292	1.1986	1.6069	1.0648	1.9736	0.4269
Mean Comparison Test	-0.1582	0.0374	0.0727	0.0925	-0.5539***	0.5096***
First-born	17.6320	1.2337	1.7218	1.2133	1.3288	0.8703
With older sibling	17.5524	1.2335	1.6487	1.1166	1.5259	0.9229
Mean Comparison Test	0.0796	0.0002	0.0731	0.0967	-0.1970**	-0.0525
Mom less educated	17.6480	1.2123	1.4925	1.0236	1.5718	1.0518
Mom educated	17.5224	1.2522	1.8349	1.2634	1.3525	0.7745
Mean Comparison Test	0.1256	-0.0399	-0.3425***	-0.2398**	0.2193**	0.2773***
Mom unemployed	17.2872	1.2978	1.7804	1.1968	1.3833	1.0545
Mom employed	17.6885	1.2112	1.6277	1.1326	1.4949	0.8452
Mean Comparison Test	-0.4013**	0.0867	0.1526*	0.0642	-0.1116	0.2094**
Dad less educated	17.6213	1.2265	1.5741	1.0849	1.4814	1.0119
Dad educated	17.5533	1.2385	1.7448	1.1974	1.4366	0.8294
Mean Comparison Test	0.068	-0.0121	-0.1707**	-0.1125*	0.0447	0.1826**
Dad unemployed	17.7745	1.1842	1.6911	0.9537	1.1920	1.2045
Dad employed	17.5294	1.2669	1.6913	1.2227	1.4427	0.847
Mean Comparison Test	0.2451	-0.0827	-0.0002	-0.2691**	-0.2507*	0.3576**
Weekend	**NONDISC**	**FAMACT**	**DEVA**	**DEVS**	**NDEVA**	**NDEVS**
Female	12.3609	2.6198	2.366	2.5921	2.2482	1.8117
Male	11.7277	2.1334	2.9768	3.2457	2.2383	1.6779
Mean Comparison Test	0.63313***	0.4862***	-0.6107***	-0.6536***	0.0099	0.1338
Non-black	12.0054	2.4442	2.7286	2.9645	2.1153	1.7411
Black	12.1810	2.2398	2.4907	2.7643	2.5619	1.7623
Mean Comparison Test	-0.1756	0.2044**	0.2378*	0.2003	-0.4466***	-0.0211
Non-only child	12.0476	2.3878	2.6394	2.9269	2.1932	1.8043
Only Child	12.1752	2.3523	2.9685	26148	2.9838	0.9053
Mean Comparison Test	-0.1276	0.0355	-0.3291	0.3121	-0.7906**	0.8991***
First-born	12.0909	2.3564	2.7263	2.9509	2.2044	1.6692
With older sibling	12.0356	2.4019	2.6232	2.8824	2.2654	1.7911
Mean Comparison Test	0.0549	-0.0455	0.1031	0.0685	-0.0610	-0.1219
Mom less educated	12.0711	2.4171	2.4738	2.8092	2.2805	1.9483
Mom educated	12.0423	2.3579	2.8237	2.9928	2.2110	1.5711
Mean Comparison Test	0.0288	0.0592	-0.3499**	-0.1836	0.0695	0.3772**
Mom unemployed	12.2435	2.3970	2.6626	2.8292	2.0652	1.8026
Mom employed	11.9732	2.3765	2.6531	2.9619	2.3226	1.7117
Mean Comparison Test	0.2703**	0.0204	0.0094	-0.1327	-0.2574**	0.0909
Dad less educated	12.0315	2.4128	2.5853	2.8589	2.2287	1.8812
Dad educated	12.0725	2.3667	2.7122	2.9403	2.2536	1.6546
Mean Comparison Test	-0.0410	0.0461	-0.1260	-0.0814	-0.0249	0.2265*
Dad unemployed	11.8678	2.0474	2.7396	3.1463	1.7048	2.4942
Dad employed	12.0301	2.4692	2.6725	2.9573	2.2157	1.6544
Mean Comparison Test	-0.1623	-0.4218**	0.0671	0.1890	-0.5109**	0.8397***

spend their time doing developmental activities according to paternal education, but only for weekday observations, with children of higher educated fathers spending more time on activities such as studying. Children with employed fathers do spend more non-developmental activities alone on both weekday and weekend observations, and less supervised non-developmental activities.

These differences based on child- and family-specific characteristics provide the motivation to examine children time use patterns in a multivariate econometric framework, which will be explored in the next section.

4.4 Empirical Strategy

4.4.1 Limited Dependent Variable Estimation

The time use data of the CDS have mutually exclusive primary activities that complete the 24-hour-a-day (weekday and weekend) information of the children's time use patterns. This satisfies the adding-up constraint:

$$\sum_{m=1}^{M} t_m = T \tag{4.1}$$

where t refers to time use of category m, the sum of all categories of which add up to the total time endowment T (e.g. 24 hours). Therefore, the appropriate tool to investigate time demand functions is represented by econometric share equations. The fraction of allowable contribution that a child i dedicates to each activity category is used as the main dependent variable,

$$s_i^m = \frac{t_i^m}{T_i} \tag{4.2}$$

wherein $0 \leq s_i^m \leq 1$, such that the total time T is normalized to equal 1. Some studies that have used this share equation methodology in exploring time allocation include Mullahy and Robert (2010) and Cardoso, Fontainha, and Monfardini (2010).

4.4.2 Multivariate Fractional Regression

To specify the functional form, a generalization of the fractional logit model (Papke and Woldridge 1996) can be applied. This allows for a joint analysis of the different time shares.

Let the marginal outcomes of interest be:

$$y_{im} = \frac{t_{im}}{T} \tag{4.3}$$

where $m = 1, ..., M$, such that $y_{im} \in [0, 1]$ and $\sum_{m=1}^{M} y_{im} = 1$. The estimation strategy requires two restrictions:

1. $E[y_{im}|\mathbf{x}_i] \in (0, 1)$ for all i;
2. $\sum_{m=1}^{M} E[y_{im}|\mathbf{x}_i] = 1$ for all i;

such that $\mathbf{x}_i$ refers to all relevant exogenous determinants of the conditional means.

The multinomial logit function form accommodates for the above restrictions.

Specifying:

$$\mu_{im}(\mathbf{x}) = E[y_{im}|\mathbf{x}_i] = \frac{exp(\mathbf{x}_i\boldsymbol{\beta}_m)}{\sum_{j=1}^{M} exp(\mathbf{x}_i\boldsymbol{\beta}_j)} = \frac{exp(\mathbf{x}_i\boldsymbol{\beta}_m)}{1+\sum_{j=1}^{M} exp(\mathbf{x}_i\boldsymbol{\beta}_j)}, \tag{4.4}$$

with $\boldsymbol{\beta_1} = \mathbf{0}$ for normalization. The resulting multivariate fractional regression is the multinomial fractional logit model. This can be estimated by a Quasi Maximum Likelihood approach[1] in a straightforward manner using the standard multinomial logit estimation algorithms with some modifications. The reduced form $\mu_{im}(\mathbf{x})$ can be interpreted as the set of time demand or choice functions.

4.4.3 Average Partial Effects

The parameter normalization brings forth the difficulty of interpretation of the parameter point estimates in the multinomial logit-type models. It is typical, instead, to look at average partial effects of the x_{ik} on the conditional means $E[y_{im}|\mathbf{x}_i]$.

$$\widehat{APE}_{mk} = \frac{1}{N}\sum_{i=1}^{N} \frac{\Delta\widehat{E}[y_{im}|\mathbf{x}_i]}{\Delta x_{ik}}, \tag{4.5}$$

where ∂ replaces Δ for continuous x_{ik}. The adding-up constraint is evident in $\sum_{m=1}^{M}\widehat{APE}_{mk} = 0$.

With a dichotomous explanatory variable (i.e. dummy variable x_k), the partial effect is computed as the sample average of the difference, evaluated at $\boldsymbol{\beta} = \widehat{\boldsymbol{\beta}}$:

$$\frac{\Delta E[y_{im}|\mathbf{x}_i]}{\Delta x_{ik}} = \frac{exp(\mathbf{x}_{-k,i})\boldsymbol{\beta}_{m,-k} + \beta_{mk}}{1+\sum_{j=2}^{M} exp(x_{-k,i}\beta_{j,-k} + \beta_{jk})} - \frac{exp(\mathbf{x}_{-k,i}\boldsymbol{\beta}_{m,-k})}{1+\sum_{j=2}^{M} exp(\mathbf{x}_{-k,i})\boldsymbol{\beta}_{j,-k}}, \tag{4.6}$$

where $\mathbf{x}$ is the vector $\mathbf{x}_i$ for observation i with the element k excluded. In the case where $\mathbf{x}$ include dummy variables that are mutually exclusive and exhaustive (except an omitted category), e.g. race, educational attainment, the discrete APE is set up to capture the proper counterfactual by zeroing all of the dummy variables at the baseline (i.e. setting all the group dummies for all observations equal to omitted category) and then setting the variable of interest, x_{ik}, equal to one for all observations .

In the case of continuous x_{ik}, the APE_{nk} is computed as the sample average of the partial derivative evaluated at $\boldsymbol{\beta} = \widehat{\boldsymbol{\beta}}$:

$$\frac{\partial E[y_{im}|\mathbf{x}_i]}{\partial x_{ik}} = exp(\mathbf{x}_i\boldsymbol{\beta}_m) \times \frac{(1+\sum_{j=2}^{M} exp(\mathbf{x}_i\boldsymbol{\beta}_j)) \times \beta_{mk} - \sum_{j=2}^{M} exp(\mathbf{x}_i\boldsymbol{\beta}_j) \times \beta_{jk}}{(1+\sum_{j=2}^{M} exp(\mathbf{x}_i\boldsymbol{\beta}_j))^2} \tag{4.7}$$

The sign of β_{mk} does not necessarily correspond to that of APE_{mk}, as it is in a standard multinomial

[1] Using the multivariate fractional logit avoids the econometric problems associated with other types of analyses. Using the multivariate Tobit estimator requires computational complexity and may result in non-robust to non-homoskedastic-Gaussian or non-Gaussian probability structures. Dirichlet distributions may also be non-robust to distributional departures and may not accommodate the $y = 0$ situation.

logit model. The empirical results shown here report the APEs in natural (hours) units, with their corresponding standard errors, corrected for household-level clustering.

4.5 Results

The estimation results[2] are presented in the following tables, wherein the entries grouped together in each column with each covariate are: the point estimate of the APE and the corresponding standard error.

The comments refer to a comparison to children of female sex, non-black race, with siblings, who are first-borns, with mothers who have less than high school education, and are unemployed, with fathers who have less than high school education, and are unemployed.

Table 4.5 presents the estimated average partial effects of the variables for weekday observations. Although true at a wider 20% level of statistical significance, a racial gap is found in activities performed. Children of black race spend 0.0112 hours (0.672 minutes) less in developmental unsupervised time, and 0.0059 more hours (0.0354 minutes) doing non-developmental activities alone on a weekday. There is also a family size and birth order difference. Only children spend 0.0185 more hours (1.11 minutes) doing non-developmental activities alone on a weekday. Meanwhile, those with older sibling(s) spend 0.0083 less hours (0.498 minutes) on a given weekday doing developmental activities alone, which is transferred to doing non-developmental activities alone (at 0.0088 weekday hours or 0.528 minutes). Maternal education has a positive influence, such that those with mothers who have graduated from high school and those who have college-educated mothers spend 0.0177 (1.062 minutes) and 0.024 more hours (1.44 minutes) doing developmental activities alone. Maternal employment, on the other hand, has a negative relationship with developmental activities. With respect to children who have unemployed mothers, those who have employed mothers spend an average of 0.008 hours (0.48 minutes) less time on developmental unsupervised time, significant at 20%, and 0.0217 hours (1.302 minutes) more time on non-discretionary activities on a weekday, statistically significant at 5%. Non-discretionary time is composed of those spent at school and non-school child care such as babysitter. The positive relationship between maternal employment and the child's non-discretionary time is consistent with the literature, for instance in Coneus, Goeggel, and Muehler (2009). Two possible explanations lie in time inavailability of employed mothers, such that they substitute for formal child care instead, or increased income to afford such a service.

For weekend observations, the results are shown in Table 4.6. Male children prove to be at an advantage, spending 0.0206 (1.236 minutes) and 0.0231 (1.386 minutes) less hours on a given weekend doing family and non-discretionary activities. Instead, they devote more weekend time to developmental activities with and without company, at 0.0341 hours (2.046 minutes) and 0.0215 hours (1.29 minutes), respectively. Children of black race, on the other hand, are at a disadvantage, spending 0.0119 more hours (0.714 minutes) doing non-developmental alone activities during a given weekend. Only children spend 0.0258 more hours (1.548 minutes) doing developmental activities alone, which they take from

[2] An OLS regression is also used to examine the relationship of children's time use pattern with child and parental characteristics, controlling for important covariates. This method, however, do not consider the trade-off or crowding out of activities that may occur due to the adding-up constraint. Results are available upon request.

non-developmental supervised activities (0.0641 hours or 3.846 minutes). Compared to those with unemployed fathers, those with employed fathers spend 0.0375 more hours (2.25 minutes) doing family activities. At close to 20% significance level, the latter also spend 0.0135 more hours (0.81 minutes) on non-developmental alone activities, which is taken from developmental supervised activities (0.0204 hours or 1.224 minutes). The positive relationship with respect to non-developmental activities is not surprising. Sayer, Bianchi, and Robinson (2004) find that when fathers spend time with their children, they do more fun activities, which are considered as non-developmental in this case.

The dichotomous maternal education indicators are statistically significant at 10% significance level for family time, showing that with respect to mothers with less than high school education, children with mothers who have high school and college education spend 0.0244 hours (1.464 minutes) and 0.0191 hours (1.146 minutes) less family weekend time, respectively. Maternal education proves to be a crucial factor in determining how children devote their time, as children of higher educated mothers spend less time on non-developmental activities with company during the weekend – 0.0325 hours (1.95 minutes) for those with mothers who graduated high school and 0.0384 hours (2.304 minutes) for those with college-educated mothers. These, however, are statistically significant at the wider 20% level of significance. At this same level of significance, children of higher educated mothers spend more time on developmental activities, at 0.0291 (1.746 minutes) and 0.0367 (2.202 minutes) more hours for each higher increment of maternal education category. The higher the mother's education is, the higher is her influence in the child devoting less time to non-developmental activities. The results are consistent with Vandewater, Bickman, and Lee (2006), for instance, showing that parental education and the time children spend watching TV are negatively associated.

To the extent that the dummy variables for the year of observation can be interpreted as a trend effect, we see a decline in family activities across time of 0.0085 (0.51 minutes) to 0.0099 hours (0.594 minutes) for the weekday observations, and 0.008 (0.48 minutes) to 0.0094 hours (0.564 minutes) for the weekend observations. This is consistent with Hofferth and Sandberg (2000). There is also a declining trend in developmental supervised activities for weekend observations, by 0.0081 (0.486 minutes) to 0.0215 hours (1.29 minutes). Hofferth and Sandberg (2000) find an increase in time spent studying and reading, and a decrease in sports, but the results are not directly comparable with the one here, given that I have considered all three as developmental activities. I have also separated the observations into weekday and weekend, and into supervised and unsupervised.

The difference between weekday and weekend results can be attributed to the fact that there is significantly less discretionary time during the weekdays than during the weekends. The increased discretionary time during the weekends allow for more variability in the activities performed.

4.6 Conclusions

This paper examined the time use patterns of children 10 to 12 years old, looking at how they differ according to child's gender, parental education, and parental employment status. I put particular focus on developmental activities performed by the child. The data used here is sourced from the Child Developmental Supplement of the Panel Study of Income Dynamics, which provide the necessary information

Table 4.5: Estimated APEs of Weekday Time Use

	NONDISC[1]	**FAMACT**[2]	**DEVA**[3]	**DEVS**[4]	**NDEVA**[5]	**NDEVS**[6]
age	-0.00074	-0.00042	0.0035	-0.0064	0.0012	0.0028
	(0.0376)	(0.0051)	(0.0159)	(0.0424)	(0.0073)	(0.0228)
$male$	-0.0054	-0.0018	0.0067	0.004	-0.0026	-0.00097
	(0.0078)	(0.003)	(0.0055)	(0.0037)	(0.0033)	(0.0062)
$black$	0.0121	-0.0019	-0.0112*	-0.0022	0.0059*	-0.0027
	(0.0101)	(0.0039)	(0.0073)	(0.0036)	(0.0045)	(0.0079)
$onlychild$	0.024	0.0026	-0.0055	-0.0025	0.0185	-0.0371
	(0.0301)	(0.0078)	(0.0091)	(0.0063)	(0.0146)	(0.0302)
$woldersib$	0.00076	0.00094	-0.0083*	-0.00031	0.0088	-0.0019
	(0.0100)	(0.0041)	(0.0058)	(0.0028)	(0.0071)	(0.0075)
$momHSgrad$	0.0012	-0.00053	0.0177*	0.0052	0.0048	-0.0284
	(0.0235)	(0.0063)	(0.0129)	(0.006)	(0.0062)	(0.023)
$momcollege$	-0.0036	-0.0017	0.024*	0.0064	0.0002	-0.0253
	(0.0232)	(0.0069)	(0.0149)	(0.0070)	(0.0053)	(0.0202)
$momemployed$	0.0217**	-0.0038	-0.008*	-0.0029	0.0016	-0.0086
	(0.0097)	(0.0039)	(0.0059)	(0.0032)	(0.0032)	(0.0092)
$momage$	-0.0995	0.0128	0.0583	-0.0083	0.0241	0.0126
	(0.7943)	(0.1798)	(0.9138)	(0.2028)	(0.4543)	(0.3275)
$dadHSgrad$	-0.0138	0.0082	-0.0039	0.00084	0.0095	-0.00089
	(0.0138)	(0.0066)	(0.0074)	(0.0043)	(0.0087)	(0.0102)
$dadcollege$	-0.0079	0.01	-0.0022	0.004	0.0042	-0.008
	(0.0146)	(0.008)	(0.0075)	(0.0057)	(0.0063)	(0.0111)
$dademployed$	-0.0024	0.0021	-0.0062	0.0081	0.0062	-0.0078
	(0.016)	(0.0067)	(0.0093)	(0.0071)	(0.008)	(0.0125)
$dadage$	0.0358	-0.0153	0.0121	-0.0026	-0.003	-0.0271
	(0.6675)	(0.2133)	(0.1981)	(0.0661)	(0.0744)	(0.7097)
$logfamilyincome$	0.0904	-0.00031	-0.0308	0.0154	0.0034	-0.0781
	(0.3764)	(0.0454)	(0.1694)	(0.1045)	(0.0329)	(0.5283)
$yr2002$	0.0025*	-0.0085**	0.0142*	-0.0053	0.0066	-0.0096
	(0.0144)	(0.0045)	(0.0095)	(0.0047)	(0.006)	(0.0101)
$yr2007$	0.0145*	-0.0099**	0.0035	-0.0012	-0.0028	-0.0041
	(0.0095)	(0.0051)	(0.0064)	(0.0028)	(0.0035)	(0.0075)
Days			Yes			

[1] Non-discretionary activities include time spent in school, day care, and performing necessities.
[2] Family activities include housework, mealtime with family members, and engaging in household conversations.
[3] Unsupervised developmental activities include studying, outdoor activities, sports, playing, church-sponsored activities, and arts.
[4] Supervised developmental activities include studying, outdoor activities, sports, playing, church-sponsored activities, and arts.
[5] Unsupervised non-developmental activities include playing computer games, surfing the Internet, watching the television, and other passive leisure.
[6] Supervised non-developmental activities include playing computer games, surfing the Internet, watching the television, and other passive leisure.

Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 5% level, ** significant at 10% level, * significant at 20% level.

Table 4.6: Estimated APEs of Weekday Time Use

	NONDISC[1]	**FAMACT**[2]	**DEVA**[3]	**DEVS**[4]	**NDEVA**[5]	**NDEVS**[6]
age	0.0123	-0.0028	0.0087	-0.016	0.0097	-0.0119
	(0.048)	(0.0173)	(0.0293)	(0.0528)	(0.0335)	(0.0503)
$male$	-0.0231**	-0.0206***	0.0215*	0.0341***	-0.0013	-0.0106
	(0.0134)	(0.0089)	(0.0134)	(0.0169)	(0.0043)	(0.0113)
$black$	0.0137	0.0015	-0.0078	-0.0011	0.0119*	-0.0182
	(0.0111)	(0.0072)	(0.0083)	(0.0099)	(0.0082)	(0.0171)
$onlychild$	0.0253	0.0124	0.0258*	-0.0084	0.0089	-0.0641**
	(0.0293)	(0.0149)	(0.02)	(0.0186)	(0.0109)	(0.0381)
$witholdersibling$	0.0007	0.0028	0.0018	-0.0055	0.0014	-0.0012
	(0.0089)	(0.0066)	(0.0062)	(0.0088)	(0.005)	(0.0135)
$momHSgrad$	0.0063	-0.0244***	0.0291*	0.028*	-0.0065	-0.0325*
	(0.0212)	(0.0124)	(0.0216)	(0.0212)	(0.0076)	(0.0224)
$momcollege$	0.0103	-0.0191**	0.0367*	0.0178	-0.0073	-0.0384*
	(0.0233)	(0.0112)	(0.0265)	(0.0193)	(0.0073)	(0.0233)
$momemployed$	-0.0059	0.0016	-0.0045	0.0015	0.0064	0.0009
	(0.0086)	(0.0059)	(0.0061)	(0.0085)	(0.0062)	(0.0123)
$momage$	-0.0621	0.0651	-0.0093	-0.0778	0.0034	0.0808
	(0.9764)	(0.6682)	(0.204)	(0.7874)	(0.1375)	(1.293)
$dadHSgrad$	-0.0101	-0.0023	-0.0053	-0.0089	0.0141	0.0126
	(0.0127)	(0.0088)	(0.0094)	(0.0137)	(0.0113)	(0.0167)
$dadcollege$	-0.0092	0.0014	-0.0015	0.0016	0.0037	0.004
	(0.0126)	(0.0098)	(0.0093)	(0.0146)	(0.0079)	(0.0168)
$dademployed$	0.0113	0.0375**	-0.0087	-0.0204	0.0135	-0.0331
	(0.0208)	(0.0198)	(0.0129)	(0.0169)	(0.011)	(0.0287)
$dadage$	0.0286	-0.0602	0.02	0.0258	0.0281	-0.0423
	(0.5909)	(0.6404)	(0.2511)	(0.3198)	(0.3738)	(0.7198)
$logfaminc$	0.0876	-0.0147	-0.0326	0.1318	0.0502	-0.2224
	(0.5462)	(0.182)	(0.2303)	(0.4084)	(0.1772)	(0.8382)
$yr2002$	0.0122	-0.008	-0.0025	-0.0081	0.0148*	-0.0085
	(0.0099)	(0.0067)	(0.0061)	(0.0093)	(0.0111)	(0.0128)
$yr2007$	0.015	-0.0094*	0.002	-0.0215**	0.0016	0.0122
	(0.0119)	(0.0069)	(0.0064)	(0.0122)	(0.0053)	(0.0158)
Days			Yes			

[1] Non-discretionary activities include time spent in school, day care, and performing necessities.

[2] Family activities include housework, mealtime with family members, and engaging in household conversations.

[3] Unsupervised developmental activities include studying, outdoor activities, sports, playing, church-sponsored activities, and arts.

[4] Supervised developmental activities include studying, outdoor activities, sports, playing, church-sponsored activities, and arts.

[5] Unsupervised non-developmental activities include playing computer games, surfing the Internet, watching the television, and other passive leisure.

[6] Supervised non-developmental activities include playing computer games, surfing the Internet, watching the television, and other passive leisure.

Standard errors are shown in parentheses. Indicators of significance levels have the following signs: *** significant at 5% level, ** significant at 10% level, * significant at 20% level.

for the research question. The analytical approach and empirical results allow for the interpretation of the magnitudes estimated.

The results from the fractional multinomial logit regression estimation indicate that maternal education has the strongest impact on time spent on developmental activities, both supervised and unsupervised. This suggests the presence of intergenerational transmission, as children of higher educated mothers may understand the importance of such activities more than those of lower educated mothers do.

The methodology used not only identifies the relationship between children's time use for developmental activities and maternal education, but also shows from which the time trade-offs for these activities may have come from. Children of higher educated mothers spend more time on developmental activities and less time on non-developmental and family activities.

Male children are also found to spend more time on developmental activities, particularly on weekends, and less time on family and non-developmental activities. This is true for both supervised and unsupervised time. Blacks, in turn, spend more time on non-developmental activities, and less on developmental activities. If the year dummies are interpreted as indicators for time trend, we see a general increasing time spent on active alone time during weekdays through the years, and decreasing time on family activities, both on weekdays and weekends. These results are in general present when a week is constructed from the representative weekday and weekend. The results, however, do not suggest the substitution of activities between weekdays and weekends.

Bibliography

[1] Aguiar M, Hurst E (2007) Measuring Trends in Leisure: The Allocation of Time Over Five Decades. Quarterly Journal of Economics 122:969-1006

[2] Aizer A (2004) Home Alone: Supervision After School and Child Behavior. Journal of Public Economics 88(9-10):1835-1848

[3] Altonji J, Cattan S, Ware I (2010) Identifying Sibling Influence on Teenage Substance Use. NBER Working Paper No. 16508

[4] Altonji J, Dunn T (1996) The Effects of Family Characteristics on the Return to Education. Review of Economics and Statistics 4:692-704

[5] Amato P, Fowler F (2002) Parenting Practices, Child Adjustment, and Family Diversity. Journal of Marriage and the Family 64:704-716

[6] Amato R, Rivera F (1999) Parental Involvement and Children's Behavior Problems. Journal of Marriage and Family Issues 61(2):375-384

[7] Anderson D et al. (1985) Estimates of Young Children's Time with Television: A Methodological Comparison of Parent Reports with Time-Lapse Video Home Observation. Child Development 56:1345-1357

[8] Anger S, Heineck G (2009) Do Smart Parents Raise Smart Children? The Intergenerational Transmission of Cognitive Abilities. SOEP Papers on Multidisciplinary Panel Data Research at DIW Berlin

[9] Argys L, Rees D, Averett S, Witoonchart B (2006) Birth Order and Risky Adolescent Behavior. Economic Inquiry 44(2):215-233

[10] Asmussen L, Larson R (1991) The Quality of Family Time among Young Adolescents in Single-Parent and Married-Parent Families. Journal of Marriage and the Family 53(4):1021-1030

[11] Auld M (2005) Causal Effect of Early Initiation on Adolescent Smoking Patterns. Canadian JOurnal of Economics 38:709-734

[12] Averett S, Argys L, Rees D (2011) Older Siblings and Adolescent Risky Behavior: Does Parenting Play A Role? Journal of Population Economics 24: 957-978

[13] Baker F, Dye J, Denniston M, Ainsworth S (2001) Risk Perception and Cigar Smoking Behavior. American Journal of Health Behavior 25(2):106-114

[14] Balsa A, Giuliano L, French M (2011) The Effects of Alcohol Use on Academic Achievement in High School. Economics of Education Review 30:1-15

[15] Bantle C, Haisken-DeNew J (2002) Smoke Signals: The Intergenerational Transmission of Smoking Behavior. DIW Berlin Discussion Paper 277

[16] Bard D, Rodgers J (2003) Sibling Influence on Smoking Behavior: A Within-Family Look at Explanations for a Birth-Order Effect. Journal of Applied Social Psychology 33(9):1773-1795

[17] Barnes G, Farrell M (1992) Parental Support and Control as Predictors of Adolescent Drinking, Delinquency, and Related Problem Behaviors. Journal of Marriage and Family 54:763-776

[18] Barnes G, Hoffman J, Welte J, Farrell M, Dintcheff B (2007) Adolescents' Time Use: Effects on Substance Use, Delinquency and Sexual Activity. Journal of Youth Adolescence 36:697-710

[19] Becker G (1965) A Theory of the Allocation of Time. Economic Journal 75(299):483-517

[20] Becker G (1974) A Theory of Social Interactions. Journal of Political Economy 82(6):1063-1093

[21] Becker G, Lewis H (1973) On the Interaction Between the Quantity and Quality of Children. Journal of Political Economy 81(2):S279-S288

[22] Becker G, Murphy K (1988) A Theory of Rational Addiction. Journal of Political Economy 96(4):675-700

[23] Becker G, Grossman M, Murphy K (1994) An Empirical Analysis of Cigarette Addiction. American Economic Review 84(3):396-418

[24] Becker G, Tomes N (1976) Child Endowments and the Quantity and Quality of Children. Journal of Political Economy 84(4):143-162

[25] Begue L, Roche S (2005) Birth Order and Youth Delinquent Behaviour: Testing the Differential Parntal Control Hypothesis in a French Representative Sample. Psychology, Crime, and Law 11(1):78-85(13)

[26] Behrman J, Taubman P (1986) Birth Order, Schooling, and Earnings. Journal of Labor Economics 4(3):S121-S14

[27] Berger L, Brooks-Gunn J, Paxson C, Waldfogel J (2008) First-year Maternal Employment and Child Outcomes: Differences Across Racial and Ethnic Groups. Children and Youth Services Review 30:365-387

[28] Bernal R (2008) The Effect of Maternal Employment and Child Care on Children's Cognitive Development. International Economic Review 49:1173-1209

[29] Bernal R, Keane M (2007) Maternal Time, Child Care, and Child Cognitive Development: The Case of Single Mothers. Mimeo, Universidad de los Andes, University of Technology in Sydney, and Arizona State University

[30] Bernal R, Keane M (2009) Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers. Universidad de los Andes Working Paper WP-July 31

[31] Bernal R, Keane M (2010) Quasi-Structural Estimation of a Model of Child Care Choices and Child Cognitive Production. Journal of Econometrics 156(1):164-189

[32] Bernal R, Keane M (2011) Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers. Journal of Labor Economics 29(3):459-512

[33] Bianchi S (2000) Maternal Employment and Time with Children: Dramatic Change or Surprising Discontinuity. Demography 37(4):401-414

[34] Bianchi S, Robinson J (1997) What Did You Do Today? Children's Use of Time, Family Composition, and the Acquisition of Social Capital. Journal of Marriage and the Family 59:332-344

[35] Black S, Devereux P (2010) Recent Developments in Intergenerational Mobility. IZA WP No. 4866

[36] Black S, Devereux P, Salvanes S (2005) The More the Merrier? The Effect of Family Size and Birth Order on Children's Education. Quarterly Journal of Economics 120(2):669-700.

[37] Black S, Devereux P, Salvanes K (2007) Older and Wiser? Birth Order and IQ of Young Men. NBER Working Papers 13237, National Bureau of Economic Research, Inc.

[38] Blake J (1981) Family Size and the Quality of Children. Demography 18(4):421-442

[39] Blau D (1999) The Effects of Child Care Characteristics on Child Development. Journal of Human Resources 34:786-822

[40] Blau F, Grossberg A (1992) Maternal Labor Supply and Children's Cognitive Development. Review of Economic Statistics 74(3):474-481

[41] Bonke J (2010) Children's Housework - Are Girls More Active Than Boys. electronic International Journal of Time Use Research 7(1):1-16

[42] Booth A, Kee HJ (2009) Birth Order Matters: The Effect of Family Size and Birth Order on Educational Attainment. Journal of Population Economics 22:367-397

[43] Booth A, Nolen P (2012) Gender Differences in Risk Behavior. Does Nurture Matter? The Economic Journal 122(558):F56-F78

[44] Borghans L, Duckworth A, Heckman J, ter Weel, B (2008) The Economics and Psychology of Personality Traits. Journal of Human Resources 43(4):972-1059

[45] Bronte-Tinkew J, Moore K, Carrano J (2006) The Father-Child Relationship, Parenting Styles, and Adolescent Risk Behaviors in Intact Families. Journal of Family Issues 27:850-881

[46] Brook J, Newcomb M (1995) Childhood Aggression and Unconventionality: Impact on Later Academic Achievement, Drug Use, and Workforce Involvement. Journal of General Psychology 4:393-410

[47] Brooks-Gunn J, Duncan G (1997) The Effects of Poverty on Children. The Future of Children 7(2):55-71

[48] Brown J, Nicholson J, Broom D, Bittman M (2011) Television Viewing by School-Age Children: Associations with Physical Activity, Snack Food Consumption and Unhealthy Weight. Social Indicators Research 101:221-225

[49] Browning C, Leventhal T, Brooks-Gunn J (2005) Sexual Initiation in Early Adolescence: The Nexus of Parental and Community Control. American Sociological Review 70(5):758-778

[50] Bryant W, Zick C (1996a) An Examination of Parent-Child Shared Time. Journal of Marriage and the Family 58(1):227-237

[51] Bryant W, Zick C (1996b) Are We Investing Less in the Next Generation? Historical Trends in Time Spent Caring for Children. Journal of Family and Economic Issues 17:365-92

[52] Cameron S, Heckman J (1998) Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males. Journal of Political Economics 106:262-333

[53] Capizzano J, Main R, Nelson S (2004) Adolescents Assuming Adult Roles: Factors Associated with Teens Providing Child Care for Younger Siblings. Urban Institute Working Paper 353.

[54] Card D, Giuliano (2011) Peer Effects and Multiple Equilibria in the Risky Behavior of Friends. NBER Working Paper No. 17088

[55] Cardoso A, Fontainha E, Monfardini C (2010) Children's and Parents' Time Use: Empirical Evidence on Investment in Human Capital in France, Germany, and Italy. Review of Economics of the Household 8:479-504

[56] Carneiro P, Cunha F, Heckman J (2003) Interpreting the Evidence of Family Influence on Child Development. Paper presented at the Economics of Early Childhood Development: Lessons for Economic Policy Conference, Minneapolis. Available at http://athens.src.uchicago.edu/jenni/klmcarn/FILES/minnesota/paper.pdf

[57] Carneiro P (2008) Equality of Opportunity and Educational Achievement in Portugal. Portuguese Economic Journal 7(1):17-41

[58] Carneiro P, Rodrigues M (2009) Evaluating the Effect of Maternal Time on Child Development Using the Generalized Propensity Score. Institute for the Study of Labor, 12th IZA European Summer School in Labor Economics

[59] Cawley J, Ruhm C (2011) The Economics of Risky Health Behaviors. NBER Working Paper No. 17081

[60] Chatterji P (2006a) Does Alcohol Use During High School Affect Educational Attainment? Evidence from the National Education Longitudinal Study. Economics of Education Review 25(5):482-497

[61] Chatterji P (2006b) Illicit Drug Use and Educational Attainment. Health Economics 15(5):489-511

[62] Clark A, Lohéac Y (2005) "It Wasn't Me, It Was Them!" Social Influence in Risky Behavior by Adolescents. IZA DP No. 1573

[63] Cobb-Clark D, Tekin E (2011) Fathers and Youth's Delinquent Behavior. IZA DP No. 6042

[64] Coley R, Medeiros B, Schindler H (2008). Using Sibling Differences to Estimate Effects of Parenting on Adolescent Sexual Risk Behaviors. Journal of Adolescent Health 43:133-140

[65] Coneus K, Laucht M. (2008) The Effect of Early Noncognitive Skills on Social Outcomes in Adolescence. Zentrum für Europäische Wirtschaftsforschung (ZEW)/Center for European Economic Research Discussion Papers 08-115

[66] Coneus K, Goeggel K, Muehler G (2009) Maternal Employment and Child Care Decision. Oxford Economic Papers 61:1172-1182

[67] Conley D, Pfeiffer K, Velez M (2007) Explaining Sibling Differences in Achievement and Behavioral Outcomes: The Importance of Within- and Between-Family Factors. Social Sciences Research 36:1087-1104

[68] Connolly S, Micklewright J, Nickell S (1992) The Occupational Success of Young Men Who Left School at Sixteen. Oxford Economic Papers New Series 44(3):460-479

[69] Cook P, Moore M (1993) Drinking and Schooling. Journal of Health Economics 12:411-429

[70] Cook P, Moore M (2001) Environment and Persistence in Youthful Drinking Patterns. In Gruber J (ed.) Risky Behavior Among Youths: An Economic Analysis. University of Chicago Press

[71] Cooksey E, Fondell M (1996) Spending Time with His Kids: Effects of Family Structure on Fathers' and Children's Lives. Journal of Marriage and the Family 58:693-707

[72] Copperman R, Bhat C (2007) An Exploratory Analysis of Children's Daily Time-Use and Activity Patterns Using the Child Development Supplement (CDS) to the Panel Study of Income Dynamics (PSID). Transportation Research Record 2021: 36-44

[73] Cosconati M (2011) Parenting Style and the Development of Human Capital in Children. Paper presented at ICREA-MOVE Conference on Family Economics, Universitat Autònoma de Barcelona, Spain

[74] Cummings H, Vandewater E (2007) Relation of Adolescent Video Game Play to Time Spent in Other Activities. Archives of Pediatrics and Adolescent Medicine 161(7):684-689

[75] Cunha F, Heckman J (2003) The Technology of Skill Formation. Unpublished manuscript, University of Chicago, presented at AEA meetings, January, 2003, San Diego, CA and Federal Reserve Bank of Minneapolis, October, 2004. Revised May, 2005 for presentation at the Society for Economic Dynamics and Control.

[76] Cunha F, Heckman J (2006) Formulating, Identifying and Estimating the Technology of Cognitive and Non-cognitive Skill Formation. Unpublished manuscript, University of Chicago, Department of Economics

[77] Cunha F, Heckman J, Lochner L, Masterov D (2006) Interpreting the Evidence on Life Cycle Skill Formation. In Hanushek E, Welch F (Eds.) Handbook of the Economics of Education, Chap. 12. Amsterdam: North-Holland:697-812

[78] Cunha F, Heckman J (2007) The Technology of Skill Formation. American Economic Review 97(2):31-47

[79] Cunha F, Heckman J (2008) Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation. Journal of Human Resources 43(4):738-782

[CunhaHeckman2010] Cunha F, Heckman J (2010) Investing in Our Young People. NBER Working Paper No. 16201

[81] Cunha F, Heckman J, Schennach S (2010) Estimating the Technology of Cognitive and Noncognitive Skill Formation. Econometrica 78(3):883-931

[82] Currie J, Thomas D (1999) Early Test Scores, Socioeconomic Status and Future Outcomes. NBER Working Papers 6943, National Bureau of Economic Research, Inc.

[83] Datcher-Loury L (1988) Effects of Mother's Home Time on Children's Schooling. Review of Economics and Statistics 70(3):367-373

[84] Dauphin A, El Lahga A, Fortin B, Lacroix G (2011) Are Children Decision-Makers within the Household? Economic Journal 121:871-903

[Deal2008] Deal D (2008) Time for Play - An Exploratory Analysis of the Changing Consumption Contexts of Digital Games. electronic International Journal of Time Use Research 5(1):65-89

[86] Del Boca D, Flinn C, Wiswall M (2010) Household Choices and Child Development. Carlo Alberto Notebooks No. 149

[87] Del Boca D, Monfardini C, Nicoletti C (2012) Children's and Parents' Time-Use Choices and Cognitive Development During Adolescence. Paper presented at RECent-CHILD Workshop on The Economics of the Family, Education, and Social Capital, Modena, Italy

[88] DeSimone J (2008) Drinking and Academic Performance in High School. Applied Economics 42:1481-1497

[89] DeSimone J (2010) Binge Drinking and Risky Sex Among College Student. NBER Working Paper No. 15953

[90] Dodson L, Dickert J (2004) Girls' Family Labor in Low-Income Households: A Decade of Qualitative Research. Journal of Marriage and Family 66:318-332

[91] Dohmen T, Falk A, Huffman D, Sunde U (2010) Are Risk Aversion and Impatience Related to Cognitive Ability? American Economic Review 10:1238-1260

[92] Duarte R, Escario J, Molina J (2007) Peer Effects, Unobserved Factors and Risk Behaviours: An Analysis of Alcohol Abuse and Truancy Among Adolescents. IZA Discussion Paper No. 2589

[93] Duckworth A, Seligman M (2005). Self-discipline outdoes IQ in predicting academic Performance of Adolescents. Psychological Science 16(12): 939-944

[94] Duncan G, Boisjoly J, Kremer M, Levy D, Eccles J (2005) Peer Effects in Drug Use and Sex Among College Students. Journal of Abnormal Psychology 33:373-385

[95] Durmer J, Dinges D (2005) Neurocognitive Consequences of Sleep Deprivation. Seminars in Neurology 25:117-129

[96] Eccles J, Barber B (1999) Student Council, Volunteering, Basketball, Or Marching Band: What Kind of Extracurricular Activities Matter? Journal of Adolescent Research 14:10-43

[97] Eisenberg M, Olson R, Neumark-Sztainer D, Story M, Bearinger L (2004) Correlations Between Family Meals and Psychosocial Well-being Among Adolescents. Pediatric Medicine 158:792-796

[98] Ellickson P, Tucker J, Klein D (2001) High-Risk Behaviors Associated With Early Smoking: Results From a 5-Year Follow-up. Journal of Adolescent Health 28:465-473

[99] Ellickson P, Tucker J, Klein D (2008)Reducing Early Smokers' Risk for Future Smoking and Other Problem Behavior: Insights from a Five-Year Longitudinal Study. Journal of Adolescent Health 43:394-400

[100] Ellickson P, Tucker J, Klein D (2010) Reducing Early Smokers' Risk for Future Smoking and Other Problem Behavior: Insights from a Five-Year Longitudinal Study. Journal of Adolescent Health 43(4):394-400

[101] Fagan A, Najman J (2003) Sibling Influences on Adolescent Delinquent Behavior: An Australian Longitudinal Study. Journal of Adolescent 26:546-558

[102] Fernandez R, Fogli A, Olivetti C (2004) Mothers and Sons: Preference Formation and Female Labor Force Dynamics. Quarterly Journal of Economics 119(4):1249-1299

[103] Fields J, Smith K, Bass L, Lugaila T (1994) A Child's Day: Home, School, and Play (Selected Indicators of Child Well-being) No. P70-68. US Census Beurau, Washington DC

[104] Fletcher A, Darling N, Steinberg L (1995) Parental Monitoring and Peer Influences on Adolescent Substance Use. In McCord J (Ed.) Coercion and Punishment in Long-term Perspectives. Cambridge, MA: Cambridge University Press

[105] Fiorini M, Keane M (2011) How the Allocation of Children's Time Affects Cognitive and Non-cognitive Development. Manuscript Available at http://www.canberra.edu.au/centres/natsem/attachments/pdf_folder/How-the-Allocation-of-Childrens-Time-Affects-Cognitive-and-Non-Cognitive-Development.pdf

[106] Fletcher J, Ross S (2010) Estimating the Effects of Friendship Networks on Health Behaviors of Adolescents. University of York Working Paper No. WP11/13

[107] Flouri E, Buchanan A (2002) Childhood Predictors of Labor Force Participation in Adult Life. Journal of Family and Economic Issues 33(2):101-120

[108] Fuligni A (1997) The Academic Achievement of Adolescents from Immigrant Families - The Roles of Family Background, Attitudes, and Behavior. Child Development 68(2):351-363

[109] Fuligni A, Stevenson H (1995) Time Use and Mathematics Achievement among American, Chinese, and Japanese High School Students. Child Development 66:830-842

[110] Gager C, Cooney T, Call K (1999) The Effects of Family Characteristics and Time Use on Teenagers' Household Labor. Journal of Marriage and Family 61:982-994

[111] Gardner M, Steinberg L (2005) Peer Influence on Risk Taking, Risk Preference, and Risky Decision Making in Adolescence and Adulthood: An Experimental Study. Developmental Psychology 41:625-635

[112] Gary-Bobo R, Prieto A, Picard N (2006) Birth Order and Sibship Sex Composition as Instruments in the Study of Education and Earnings. Centre for Economic Policy Research, CEPR Discussion Paper Series No. 5514

[113] Ginsburg K, Durbin D, Garcia-Espana J, Kalicka E, Winston F (2009) Associations Between Parenting Styles and Teen Driving, Safety-Related Behaviors and Attitudes. Pediatrics 124 (4): 1040-1051

[114] Golden J, Stafford F (2011) Children's Internet and Video Gaming Activities: Emerging Forms of Cognitive and Social Skills. Paper presented at the 33rd Conference of the International Association for Time Use Research, University of Oxford, UK

[115] Gruber, J (2001) Introduction. In Risky Behavior Among Youths: An Economic Analysis. University of Chicago Press

[116] Gupta N, Simonsen M (2011) Where to Put the Kids? Effects of Type of Non-parental Child Care on Pre-teen Skills and Risky Behavior. IZA DP No. 5848

[117] Guryan J, Hurst E, Kearney M (2008) Parental Education and Parental Time with Children. NBER Working Paper 13993

[118] Hanushek E (1992) The Trade-off Between Child Quantity and Quality. Journal of Political Economy 100:84-117

[119] Hauser R, Sewell W (1985) Birth Order and Educational Attainment in Full Sibships. American Educational Research Journal 22(1):1-23

[120] Heckman J, Rubinstein Y (2001) The Importance of Noncognitive Skills: Lessons from the GED Testing Program. American Economic Review 91(2):145-149

[121] Heckman J, Hsse J, Rubinstein Y (2000) The GED is A 'Mixed Signal': The Effect of Cognitive and Non-Cognitive Skills on Human Capital and Labor Market Outcomes. Mimeo, University of Chicago

[122] Heckman J, Stixrud J, Urzua S (2006) The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. NBER Working Paper No. 12006

[123] Heiland F (2009) Does the Birth Order Affect the Cognitive Development of a Child? Applied Economics 41(14):1799-1818

[124] Hertwig R, Davis J, Sulloway F (2002) Parental Investment: How an Equity Motive Can Produce Inequality. Psychological Bulletin 128(5):728-745

[125] Hoeft F, Watson C, Kesler S, Bettinger K, and Reiss A (2008) Gender Differences in the Mesocorticolimbic System During Computer Game-play. Journal of Psychiatric Research 42(4): 253-258

[126] Hofferth S (2006) Residential Father Family Type and Child Well-Being: Investment Versus Selection. Demography 43(1):53-77

[127] Hofferth S, Sandberg J (2000) Changes in American Children's Time, 1981-1997. Research Report: Population Studies Center at ISR, University of Michigan

[128] Hofferth S, Sandberg J (2001) How American Children Spend Their Time. Journal of Marriage and Family 63:295-308

[129] Hopkins K, Bracht G (1975). Ten-year Stability of Verbal and Non-verbal IQ Scores. American Educational Research Journal 72: 469-477

[Hsin2007] Hsin A (2007) Mothers' Time with Children and the Social Reproduction of Cognitive Skills. California Center for Population Research Working Paper Series

[Hsin2009] Hsin A (2009) Parent's Time with Children: Does Time Matter for Children's Cognitive Achievement? Social Indicators Research 93(1):123-126

[132] Huston A, Aronson S (2005) Mother's Time with Infant and Time in Employment as Predictors of Mother-Child Relationships and Children's Early Development. Child Development 76(2):467-482

[133] James-Burdumy S (2005) The Effect of Maternal Labor Force Participation on Child Development. Journal of Labor Economics 23(1):177-211

[134] Jenkins J (1996) The Influence of Peer Affiliation and Student Activities on Adolescent Drug Involvement. Adolescence 122:297-306

[135] Juster F, Stafford F (1991) The Allocation of Time: Empirical Findings, Behavioral Models, and Problems of Measurement. Journal of Economic Literature 29:471-522

[136] Kalenkoski C, Ribar D, Stratton L (2009) How Do Adolescents Spell Time Use? IZA DP No. 4374 (published as Chapter 1 in Research in Labor Economics, ed. S. Polachek and K. Tatsiramos)

[137] Kantarevic J, Mechoulan S (2005) Birth Order, Educational Attainment, and Earnings: An Investigation Using the PSID. Journal of Human Resources 41(4):755-776

[138] Keane M, Wolpin K (1997) The Career Decisions of Young Men. Journal of Political Economy 105(3):473-522

[139] Keane M, Wolpin K (2001) The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment. International Economic Review 42(4):1051-1103

[140] Keith T, Fermann T, Pottebaum P, Aubey S (1986) Parental Involvement, Homework, and TV Time: Direct and Indirect Effects on High School Achievement. Journal of Educational Psychology 78:373-380

[141] Kidwell J (1982) The Neglected Birth Order: Middleborns. Journal of Marriage and Family Issues 44:225-235

[142] Koolstra C, Van Der Voort T (1996) Longitudinal Effects of Television on Children's Leisure-Time Reading: A Test of Three Explanatory Models. Human Communication Research 23:4-35

[143] Lehrer S, Audrain-McGovern J, Ding W, Rosenquist J (2009) Reinvestigating Adolescent Smoking Decisions: The Importance of Genetic Markers, Impulsitivity and Their Interactions. Paper presented at the 2nd Annual Meeting on the Economics of Risky Behaviors. March 19-20, 2010, Stone Mountain, Georgia, USA

[144] Leibowitz A (1974) Home Investments in Children. Journal of Political Economy 82:111-131

[145] Leibowitz A (1977) Parental Inputs and Child's Achievement. Journal of Human Resources 12(2):242-251

[146] Lizzeri A, Siniscalchi M (2008) Parental Guidance and Supervised Learning. Quarterly Journal of Economics 123(3):1161-1195

[147] Lundberg S, Romich J, Tsang K (2009) Decision-Making by Children. Review of Economic Household 7:1-30

[154] Mullahy R (2005) Squandering Time? Economic Aspects of Children's Time Use. Available in https://mywebspace.wisc.edu/jmullahy/web/time%20ucd%20alt%202.pdf

[149] Mancini A, Monfardini C, Pasqua S (2011) On Intergenerational Transmission of Reading Habits in Italy: Is a Good Example the Best Sermon? Carlo Alberto Notebooks No. 218

[150] Marini M, Shelton B (1993) Measuring Household Work: Recent Experience in the United States. Social Science Research 22:361-382

[151] Martin R, Wisenbaker J, Huttunen M (1994) Review of Factor Analytic Studies of Temperament Measured Based on the Thomas-Chess Structural Model: Implications for the Big Five. In Halverston C, Kohnstamm G, Martin R (eds.) The Developing Structure of Temperament and Personality from Infancy to Adulthood. Hillsdale, New Jersey:157-172

[152] Morin A, Rodriguez D, Fallu J, Maiano C (2011) Academic Achievement and Smoking Initiation in Adolescence: A General Growth Mixture Analysis. Addiction 107:819-828

[153] Mullahy J (1997) Instrumental-Variable Estimation of Count Data Models: Applications to Models of Cigarette Smoking Behavior. Review of Economics and Statistics 79(4):586-593

[154] Mullahy R (2005) Squandering Time? Economic Aspects of Children's Time Use. Available at https://mywebspace.wisc.edu/jmullahy/web/time%20ucd%20alt%202.pdf

[155] Mullahy J, Robert S (2010) No Time to Lose: Time Constraints and Physical Activity in the Production of Health. Review of Economic Household 8:409-432

[156] Mullahy J, Sindelar J (1994) Alcoholism and Income: The Role of Indirect Effects. The Milbank Quarterly 72(2):359-375

[157] Neidell M (2000) Early Parental Investments in Children's Human Capital Development: Effects of Time in the First Year on Cognitive and Non-cognitive Outomces. UCLA Working Paper No. 806

[158] Ono H, Tsai H (2008) Race, Parental Socioeconomic Status, and Computer Use Time Outside of School Among Young American Children, 1997 to 2003. Journal of Family Issues 29(12):1650-1672

[159] Ouyang L (2004) Sibling Effects on Teen Risky Behaviors. Unpublished paper. Department of Economics, Duke University

[160] Paakkonen H (2008) Alone at Home. electronic International Journal of Time Use Research 5(1):54-64

[PSID] Panel Study of Income Dynamics, public use dataset. Produced and distributed by the Institute for Social Research, Survey Research Center, University of Michigan, Ann Arbor, MI (2008-2011)

[162] Papke L, Wooldridge J (1996) Econometric Methods for Fractional Response Variables With an Application to 401 (K) Plan Participation Rates. Journal of Applied Econometrics 11:619-632

[163] Pellegrini A, Smith P (1998) Physical Activity Play: The Nature and Function of a Neglected Aspect of Play. Child Development 69:577-874

[164] Powell L, Tauras J, Ross H (2005) The Importance of Peer Effects, Cigarette Prices and Tobacco Control Policies for Youth Smoking Behavior. Journal of Health Economics 24(5):950-968

[165] Presti D, Ary D, Litchenstein E (1992) The Context of Smoking Initiation and Maintenance: Findings from Interviews With Youths. Journal of Substance Abuse 4:35-45

[166] Price J (2008) Parent-Child Quality Time: Does Birth Order Matter? Journal of Human Resources 43(1):240-265

[167] Ramey V (2011) Is There a 'Tiger Mother' Effect? Time Use Across Ethnic Groups. Economics in Action, UCSD

[168] Renna F (2008) Alcohol Abuse, Alcoholism, and Labor Market Outcomes: Looking for the Missing Link. Industrial and Labor Relations Review 62(1). Available at: http://digitalcommons.ilr.cornell.edu/ilrreview/vol62/iss1/5

[169] Richardson J, Radziszewska B, Dent C, Flay B (1993) Relationship Between After-School Care of Adolescents and Substance Use, Risk Taking, Depressed Mood, and Academic Achievement. Pediatrics 92(1): 146-148

[170] Robinson J, Bianchi S (1997) The Children's Hours. American Demographics 20:22-24

[171] Rodgers J, Rowe D, Harris D (1992) Sibling Differences in Adolescent Sexual Behavior: Inferring Process Models from Fmaily Composition Patterns. Journal of Marriage and Family 54(1):142-152

[172] Ronka A, Pulkkinen L (1995) Accumulation of Problems in Social Functioning in Young Adulthood: A Developmental Approach. Journal of Personality and Social Psychology 69: 381-391

[173] Rosenzweig M, Wolpin K (1994) Are There Increasing Returns to the Intergenerational Production of Human Capital? Maternal Schooling and Child Intellectual Achievement. Journal of Human Resources 29(2):670-693

[174] Rosenzweig M, Zhang J (2009) Do Population Control Policies Induce More Human Capital Investment? Twins, Birth Weight and China's "One Child" Policy. Review of Economic Studies 76:1149-1174

[175] Ruhm C (2004) Parental Employment and Child Cognitive Development. Journal of Human Resources 39(1):155-192

[176] Sandberg J (2011) Maternal Child Socialization Values and Children's Time in Unstructured Play and Studying. electronic International Journal of Time Use Research 8(1):62-84

[177] Sandberg J, Hofferth S (2001) Changes in Children's Time with Parents: United States, 1981-1997. Demography 38(3):423-436

[178] Sandberg J, Rafail P (2007) Family Size, Children's Cognitive Skills and Familial Interactions: U.S., 1997-2002. PAA Annual Meeting. New York, NY

[179] SanfordM, Offord D, McLeod K, Boyle M, Byrne C, Hall B (1994) Pathways into the Work Force: Antecedents of School and Work Force Status. Journal of the American Academy of Child and Adolescent Psychiatry 33:1036-46

[180] Sayer L, Bianchi S, Robinson J (2004) Are Parents Investing Less Time with Children? Trends in Mothers' and Fathers' Time with Children. American Journal of Sociology 110(1):1-43

[181] Shann M (2001) Students' Use of Time Outside of School: A Case for After School Program for Urban Middle School Youth. The Urban Review 33(4):339-355

[182] Shiner R, Masten A, Roberts J (2003) Childhood Personality Foreshadows Adult Personality and Life Outcomes Two Decades Later. Journal of Personality 71:1145-1170

[183] Shirley Y, Shen S, Lowers L, Locke J (2000) Factors Predicting the Onset of Adolescent Drinking in Families at High Risk for Developing Alcoholism. Biological Psychiatry 48:265-275

[184] Silles M (2010) The Implications of Family Size and Birth Order for Test Scores and Behavioral Development. Economics of Education Review 29:795-803

[185] Smolensky E, Gootman J (2003) Working Families and Growing Kids: Caring for Children and Adolescents. The National Academic Press, Washington DC. Available at http://www.nap.edu/openbook.php?isbn=0309087031

[186] Snell E, Adam E, Duncan G (2007) Sleep and the Body Mass Index and Overweight Status of Children and Adolescents. Child Development 78:309-323

[187] Stafford F (1987) Women's Work, Sibling Competition, and Children's School Performance. American Economic Review 77(5): 972-980

[188] Stewart J (2011) Do Children Sleep Less when Both Parents Work? Paper presented at the 33rd Conference of the International Association for Time Use Research, University of Oxford, UK

[189] Sulloway F (2007a) Birth Order and Intelligence. Science 1711-1712

[190] Sulloway F (2007b) Chapter 21: Birth Order and Sibling Competition. In: Dunbar R, Barrett L (ed) The Oxford Handbook of Evolutionary Psychology, Oxford University Press 297-311

[191] Todd P, Wolpin K (2003) On the Specification and Estimation of the Production Function for Cognitive Achievement. Economic Journal 113(485):F3-F33

[192] Todd P, Wolpin K (2007) The Production of Cognitive Achievement in Children: Home, School, and Racal Test Score Gaps. Journal of Human Capital 1(1):91-136

[193] Trogdon J, Nonnemaker J, Pais J (2008) Peer Effects in Adolescent Overweight. Journal of Health Economics 27(5):1400-1405

[194] Vandell D, Ramanan J (1991) Children of National Longitudinal Survey of Youth: Choices in After-School Care and Child Development. Developmental Pscyhology 27(4):637-643

[195] Vandewater E, Bickman D, Lee J (2006) Time Well Spent? Relating Television Use to Children's Free-Time Activities. Pediatrics 117(2):e181-e191

[196] Videon T, Manning C (2003) Influences on Adolescent Eating Patterns: The Importance of Family Meals. Journal of Adolescent Health 32:365-373

[197] Waddell G (2012) Gender and the Influence of Peer Alcohol Consumption on Adolescent Sexual Activity. Economic Inquiry 50(1):248-263

[198] Wight V, Price J, Bianchi S, Hunt B (2009) The Time Use of Teenagers. Social Science Research 38:792-809

[199] Yeung W, Sandberg J, Davis-Kean P, Hofferth S (2001) Children's Time with Fathers in Intact Families. Journal of Marriage and the Family 63(1):136-154

[200] Zajonc R (1976) Family Configuration and Intelligence. Science 192:227-236

[201] Zick C, Bryant W, Osterbacka E (2001) Mothers' Employment, Parental Involvement, and the Implications for Intermediate Child Outcomes. Social Science Research 30(1):25-49