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More Time Spent on Television and Video Games, Less Time Spent Studying?

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More Time Spent on Television and Video Games, Less Time Spent Studying?[1]

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Abstract

This study attempts to characterize the trade-off between time spent on educational activities and that spent on alternative activities such as watching television or playing video games. Utilizing a nationally representative longitudinal dataset, robust evidence was found for a negative causal relationship between time spent on television/video games and that spent studying. However, because the effect size is nearly negligible, the time spent studying appears to be insensitive to these alternative activities. More importantly, this is greatly affected by the parental commitment to a child's study, even after controlling for their employment status and family structure. This suggests that, as compared to intervention to alter a child's learning environment, the direct interplay between parents and children may be a more important determinant of time spent studying.

JEL classification codes: I10, I20

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Introduction

The more the studying, the higher the academic achievements—this is the norm for parents. However, this causal effect relationship is very difficult to prove, because highly educated parents may encourage their children to study, which might make them more likely to enjoy studying. Such unobserved parental and child characteristics may confound the effect of children's efforts, which may be the most fundamental determinant of academic achievements. However, recent economic research has attempted to isolate the pure effect of students' efforts on their achievements to answer the causal question of whether effort measured by children's time spent studying truly matters (e.g., Stinebrickner & Stinebrickner, 2008; Shinogaya & Akabayashi, 2011). For example, to explore the potential endogeneity described above, Stinebrickner & Stinebrickner (2008) investigated whether a random selection of roommates in a student dorm bought video games, an activity that may reduce the students' time spent studying. The important finding of their study was that students' efforts, measured by time spent studying, significantly affected their achievements.

Given this finding, there has been growing interest in investigating the determinants of time spent studying, although there are few existing studies (e.g., Ward, 2012). Therefore, this study identifies the factors that increase students' time spent studying. Stinebrickner & Stinebrickner (2008) implied that time spent playing video games may be predetermined before the time spent studying. However, because their results were drawn from a small sample in Berea College in the United States, it may not be possible to generalize their finding. On the other hand, without a random selection of students with access to video games, it is difficult to rigorously measure the effect of playing them. This is because the observed differences in the number of hours playing video games may merely reflect, for example, differences in the extent to which students are allowed to play video games or students' motivation to study. Selection bias arises when part of a student's efforts can be explained by unobserved parental or individual characteristics.

Ward (2012) bears the closest resemblance to this study. He used the exogenous variations in video game sales to identify the effect of time spent playing them on time spent studying. The results showed that each additional hour of playing video games led to 8.4 minutes less time spent studying. This study expands on previous research by focusing on early elementary school children and attempts to characterize the trade-off between time spent studying and time spent on video games or television (TV)[3]. Much of the debate on this topic depends on finding more concrete scientific evidence: if the

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[3] The reason for focusing on video games as well as TV is that previous research indicates that the allocation of children's time to watching TV is an important determinant of children's cognitive and non-cognitive development (e.g., Fiorini & Keane, 2012).

trade-off is explicit, parents should restrict the number of hours children spend watching TV or playing video games and make them spend more time studying. Therefore, this study employed a nationally representative longitudinal data set collected between 2008 (Wave 7) and 2011 (Wave 10), which makes three primary contributions to the existing literature. First, early elementary school children are examined because numerous studies have found that skills observed at an early age are strong predictors of outcomes in later life, such as educational attainment, labor market success, and adolescent social behaviors (e.g., Cameron & Heckman, 1998, 2001; Heckman, Stixrud & Urzua, 2006). Second, the data provide a large amount of information on what, for how long, and where a child performs an activity. In addition, they contain a wealth of information on parents' commitment to their children's study or homework in a typical week. Thus, it is clarified how parenting is an effective determinant of children's time spent studying as compared with the child's time allocation. Third, several econometric models are employed to estimate the causal relationship between time spent on educational activities and time spent on alternatives: first, the conventional Ordinary Least Squares (OLS) with various control variables that may affect time spent studying; then, the child fixed-effects model to deal with time-varying unobservables; and finally, instrumental variable estimation to control for time-invariant unobservables. Considering the non-linear nature of the output, time spent studying, and the incidental parameters problem (Wooldridge, 2011), the correlated random-effects Tobit model was employed.

The most significant finding of this study is that after addressing the potential bias, there was clear, robust evidence of the negative causal relationship between time spent watching TV or playing video games and time spent studying. However, because the effect size is nearly negligible, watching TV or playing video games barely reduces the time spent studying. In other words, time spent studying appears to be unaffected by these alternative activities. More surprising, however, is that the time spent studying is greatly affected by parental commitment to a child's study, even after controlling for their employment status. This suggests that as compared to intervention to alter a child's learning environment, the direct interplay between parents and children may be a more important determinant of time spent studying.

The remainder of this paper is organized as follows. The next section introduces the methodology and empirical specifications for estimation, identifies the potential bias emerging in the econometric analysis, and determines the analytical techniques for obtaining unbiased estimates of the impact of TV or video games on children's time spent studying. The third section describes the data used in the empirical analyses as well as the coded variables. The fourth section presents the empirical results.

Then, the final section presents the conclusions.

Econometric Methodology

To determine whether there is a trade-off between time spent on educational activities and time spent on alternative activities such as watching TV or playing video games, a child's cognitive development is estimated, regarding time spent watching TV or playing video games as inputs. The model can be formally expressed by the following mathematical equation:

$$y_{it} = X_{it}\beta + +\gamma T_{it} + \delta V_{it} + \varepsilon_{it} \quad (1),$$

where y_{it} is time spent studying by child *i* at time *t*, T_{it} is the number of hours of TV watched, V_{it} is the number of hours of video games played, and $\boldsymbol{X}_{it}$ is a vector of individual-level socioeconomic and demographic control variables. Both the TV and video game variables are included in the same regression model because the number of hours spent on each are positively, though weakly, correlated (i.e., the more the children watched TV, the more they played video games, and vice versa).

First, the conventional Ordinary Least Squares (OLS) was employed, in which the coefficient for T_{it} or V_{it} is interpreted as the effect of child *i*'s exposure to TV or video games at time *t*, holding all other observed factors constant. However, the observed differences in the number of hours watching TV or playing video games may simply reflect differences in the amounts of time that parents allowed children to spend on them or in the level of children's motivation to study. These unobserved parental and child characteristics may be associated with children's time spent studying. If such unobserved characteristics are present, equation (1) may be subject to omitted variable bias and yield inconsistent estimates of the effect of watching TV or playing video games.

The fixed-effects model enables us to control for time-invariant unobservables that affect both dependent and key independent variables. The model also enables us to answer the question of whether differences in childhood exposure to TV and video games *cause* differences in children's development. In particular, the fixed-effects model incorporates an individual-specific, time-invariant factor, A_i, as specified in equation (2):

$$y_{it} = X_{it}\beta + \gamma T_{it} + \delta V_{it} + A_i + v_{it} \quad (2),$$

where $\varepsilon_{it} = A_i + v_{it}$, and v_{it} is an idiosyncratic error term that is assumed to be independent of other terms in the equation. The time-invariant unobservables can be eliminated by taking time-demeaned transformations induced by repeated observations of the same individual, yielding

$$(y_{it} - \overline{y_i}) = (\boldsymbol{X}_{it} - \overline{\boldsymbol{X}_i})\beta + \gamma(T_{it} - \overline{T_i}) + \delta(V_{it} - \overline{V_t}) + v_{it} \quad (3).$$

However, even after fully controlling for time-invariant unobservables, T_{it} or V_{it} may be endogenous owing to measurement errors within each and time-varying, unobserved parental and child characteristics correlated with them. To address this potential complication, an instrumental variable originally proposed by Lewbel (1997) was used along with the fixed-effects model: the third order centered around the mean moment of T_{it} and V_{it} to instrument T_{it} and V_{it}, which are strongly correlated with T_{it} and V_{it} but unlikely to be correlated with y_{it}.

Finally, the non-linear unobserved effects Tobit model for a corner at zero, the correlated random effects (CRE) approach was employed (see Wooldridge, 2011 for a more detailed explanation). The dependent variable is continuous over strictly positive values, but it takes on zero with positive probability. Considering the non-linear nature of this variable and the incidental parameters problem (Wooldridge, 2011) the non-linear unobserved effects model may be more effective than a linear one. The CRE framework is attractive because the model can incorporate both the time-invariant and time-varying unobservables and is consistently estimated, providing simple implementations in the context of the Tobit model. In other words, this approach enables us to obtain bias-corrected versions of fixed-effects estimators to be obtained for non-linear models. Furthermore, it allows for some degree of dependence between unobserved heterogeneity and a set of observed time-varying covariates. More specifically, the approach assumes a relationship between the unobserved heterogeneity component, A_i in previous equations, and the means of time-varying independent variables as follows, where v_i is normally distributed with mean zero and constant variance and assumed not to be correlated with any independent variables:

$$A_i = \overline{X}_i \beta + \gamma \overline{T}_i + \delta \overline{V}_i + v_i \quad (4).$$

Moreover, this approach became extremely popular among empirical researchers as it was able to identify, very generally, the partial effects with the heterogeneity averaged out, known as average partial effects (APEs) of T_{it} and V_{it}.

Data

The data used in the empirical analysis were drawn from the Longitudinal Survey of Babies in 21st Century, which was organized in 10 waves as of today and collected by the Japanese Ministry of Health, Labour and Welfare between 2001 (Wave 1) and 2011 (Wave 10). Despite random sampling, the survey is complete and targeted all 53,575 babies born in Japan during January 10–17 and July 10–17, 2001. As the monthly Vital Statistics collected by the Ministry of Health, Labour and Welfare indicates no systematic or seasonal pattern in the births, this data set can be considered representative. From Waves 1 through 6, the surveys were conducted six months postpartum, i.e., on August 1, 2001 and February 1, 2002. One and a half years after Wave 6, surveys for Waves 7 through 10 were conducted on January 18 and July 18, indicating that the subjects in these waves had reached school age (G1 through G4) at the time of the survey. The respondents included primary caregivers: 92.3% were mothers, while the remainder comprised fathers, grandparents, and other guardians[4]. In this study, four consecutive waves were used, from Waves 7 through 10, which provided a detailed series of questions on what, for how long, and where a child performs an activity. Our sample was restricted to children whose parents were both Japanese, because children of immigrants, although few, may have different educational backgrounds, such as having attended international or ethnic schools.

The main outcome is defined as the average daily hours spent studying[5]. The key independent variables of interest were the average daily hours spent watching TV and playing video games[6,7]. The descriptive statistics summarized in Table 1 show that

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4 One may question whether the observations regarding children differ significantly between mothers and other caregivers. However, the empirical results of the latter section were indistinguishable from the results restricted to the sample of mothers. Both results can be provided on request.

5 In the original questionnaire, the minimum and maximum times were set between 1 (=zero) and 8 (=over 5 h). Then, the median value was taken for categories between 2 (0.25 = less than 30 minutes) and 7 (4.5 = 4–5 h).

6 These variables are coded in the same manner as the dependent variable: the response category in the original questionnaire ranged from the minimum set, 1 (=no television or video games), through to the maximum set, 6 (=over 6 h). Then, the median value was taken for categories between 2 (0.5 = less than 1 h) and 5 (5.5 = 5–6 h).

7 Nakamuro et al. (in press) used the same data set as this study and examined the relationship between the hours spent watching TV or video games and children’s development, such as

on average, children in this age cohort spend less than an hour a day studying, whereas they watch TV for approximately two hours and play video games for an hour a day. Time spent studying increases in the higher grades (see Figure 1). The analysis controlled for various child or parental socioeconomic and demographic variables: (i) parental socioeconomic status, such as their employment status and access to shadow education; (ii) family structure, such as the number of siblings and the number of grandparents living together; and (iii) parental commitment to children's study.

More specifically, a mother's and father's employment statuses were coded as a set of dummy variables for the category based on their employment contracts (reference = not working; 1 = full-time; 2 = part-time; 3 = self-employed). Access to shadow education, which is very popular in Asian countries, including Japan, was also a dummy variable, coded to 1 when a child participated in either a cram school, distance learning, or tutoring, and otherwise coded to 0. According to the descriptive statistics, while a majority of fathers are employed full-time, approximately 50% of mothers do not work. Furthermore, 35% of children receive shadow education to some extent. Access to shadow education appears to be an important determinant of time spent studying; the data across the four waves reveals that the average time spent studying for children who

problem behavior, orientation to school, and obesity. The empirical analysis suggested that TV or video games negatively affect children's development, although the effect is negligible.

receive shadow education is 1.10 hours per day, while that for children who receive no shadow education is 0.83 hours per day. If parents force a child into shadow education, their time spent studying may increase; however, this may differ from a proxy of efforts. Therefore, the sample that accessed shadow education was excluded and the same analysis was repeated. It is worth noting that the results are very similar and the results will be provided upon request.

With regard to the numbers of siblings and grandparents, it is not always possible to determine *a priori* the impact of family structure on outcomes. The number of siblings might have both positive and negative effects, as could whether children live with their grandparents. The mechanisms for fewer siblings positively influencing a child's outcome are as follows: parents can allocate more household resources or attention toward each child and children are less often forced to assist with household errands. However, previous research has found that the larger the family, the faster the children's academic progress, because older siblings often help the younger children with their homework (Bianchi & Robinson, 1997). The effect of children living with their grandparents on outcomes is also ambiguous. Children may sometimes receive extra support and attention from their grandparents, which increases their well-being at home. However, they may become confused and unstable owing to the death or illness of their grandparents if they have a strong emotional attachment to them. Thus, the overall effect is unclear *a priori* and must be resolved empirically.

Parental commitment to a child's study is defined as a composite index to measure a mother's or father's active involvement in a child's studies, including homework. In this study, four questions common to all waves were identified: (i) tells the child to study, (ii) makes the child adhere to set study times, (iii) watches the child study and (iv) confirms that the child studied. Each item was coded to 2 if the respondent answered "often," 1 if they answered "sometimes," and 0 if they answered "never/almost never." These commitment indicators were then calculated as the sum of all coded items, ranging from 0 to 8[8]. The larger this index, the more directly parents tell a child to study as well as observe and check his/her study. The descriptive statistics summarized in Table 1 illustrate that a mother's average commitment is 5.89, significantly stronger than a father's, 2.63, across the four waves. Examining the subcomponent of the parental commitment indicator, in 2008 (when the children were six years old), "watches the child study" was the most frequent commitment for both parents, while in 2011 (when the children were nine years old), "tells the child to study"

[8] A factor analysis of each item was undertaken to derive a concise set of indicators for parental commitment to children's study. However, the empirical results of this were indistinguishable from those of the analysis using these indicators and the principal component factors. The results can be provided on request.

was the most frequent commitment (see Figure 2). This indicates that parental commitment to a child's study may change according to a child's age and maturity. Moreover, psychological literature has investigated the link between parenting and children's skills (e.g., Hart, Newell, & Olsen, 2003).

However, there are several drawbacks to using this data, the first of which is attrition. The average response rate for each wave was 90%. Overall, 72.6% of the sample from the first wave completed the questionnaire for the latest wave, indicating that the response rates remained very high. In addition to the low data attrition, as pointed out by Kitamura (2013), attrition bias is not a serious concern in this study. Since the respondents in this survey were primary caregivers, mainly mothers, they may have stopped responding to the survey because of reasons unrelated to their children's outcomes.

The second drawback is the within-variation in children's outcomes. For reasonable confidence in employing the child fixed-effects model as an identification strategy, there must be a reasonable amount of within-child variation. Unfortunately, the time spent studying does not vary between early elementary school children and teenagers, implying that the coefficients may be small and/or insignificant. However, it is vital to determine how a child accumulated his/her study skills while still very young, because such skills are likely to continue into the teens and sometimes even into adulthood (Cameron & Heckman, 1998, 2001; Heckman, Stixrud, & Urzua, 2006).

Empirical Results

Main Results (Tables 2-1 and 2-2)

First, the conventional OLS, shown in equation (1), was estimated to measure the effect of time spent watching TV or playing video games on time spent studying, holding numerous child and parental characteristics constant. As illustrated in the first columns in Tables 2-1 (for boys) and 2-2 (for girls), the results, coupled with the negative coefficients for watching TV and playing video games, suggest that time spent playing video games was correlated with time spent studying for both male and female children, although the coefficient for watching TV was statistically significant only for males. The coefficient for playing video games indicated that each additional hour of playing video games was associated with a reduction of 0.021 in study hours (1.26 minutes) for boys and 0.031 (1.86 minutes) for girls. Furthermore, each additional hour of watching TV was associated with a reduction of 0.007 (0.42 minutes) in study hours for boys. Therefore, watching TV and playing video games, on average, do displace children’s time spent studying. However, the magnitude of the effect is that one additional hour of watching TV or playing video games reduces the time spent studying by 1–4%, which is statistically but not economically significant.

With regard to the impact of the other control variables, having siblings was negatively correlated with time spent studying, while living with grandparents in the same household had no significant effect. In addition to family structure, parents may play a crucial role in determining a child's time spent studying. Furthermore, parental employment status is important: if a child's parents are employed either full- or part-time, his/her time spent studying is significantly shorter than it is for a child whose parents are not working or are self-employed. Parental employment status merely reflects the amount of time that parents can dedicate to their own affairs and spend with their child. Moreover, parental commitment to a child's study was strongly associated with an increase in his/her time spent studying. In particular, the standardized coefficients for parental commitment were the largest among the control variables. Access to shadow education, which may partly reflect parents' socioeconomic status, such as their income and education, is also statistically significant at the 1% level. These findings did not vary by gender.

The second columns in Tables 2-1 and 2-2 provide estimates from the fixed-effects model. The results demonstrate that the coefficients for time spent watching TV are statistically significant for both boys and girls and are larger than the

OLS estimates. On the other hand, the coefficients for time spent playing video games are also statistically significant for both boys and girls but are smaller than the OLS estimates. Thus, the argument can be maintained that watching TV and playing video games have negative effects; however, the magnitudes of these effects are nearly negligible, even after controlling for time-invariant, child and parental, unobserved characteristics. More specifically, the magnitude of the effect is that each additional hour of watching TV is associated with a reduction of 0.009 (0.54 minutes) in study hours for boys and 0.014 (0.84 minutes) for girls, less than approximately 2% of the standard deviation. In addition, each additional hour of playing video games is associated with a reduction of 0.016 (0.96 minutes) for boys and 0.018 (1.08 minutes) for girls, approximately 2% of the standard deviation.

The coefficients for the other control variables are strikingly different from the OLS estimates. The most significant difference is that the coefficients of family structure and parental employment status became statistically insignificant. In other words, after controlling for unobserved heterogeneity among the children, the effects of family structure and parental employment status are indistinguishable from zero. However, the coefficients of parental commitment to children’s study are still statistically significant regardless of gender. Although the effect size of these variables drops to almost half that of the OLS estimates, the standardized coefficients suggest that it is relatively larger than the effect size for other factors. To summarize, the fixed-effects estimates suggest that the number of hours spent watching TV and playing video games are both negatively significant; however, the effect size is small.

The crucial underlying assumption in the fixed-effects model is that unobserved factors remain constant over time. If there are time-varying unobservables, then the result may be difficult to interpret in a causal way. In other words, if a correlation exists between T_{it} and v_{it} or V_{it} and v_{it} in equation (2), even after controlling for time-invariant, child, and parental unobservables (A_{it}), then the coefficients of interest may be endogenous. To address this issue, an instrument proposed by Lewbel (1997) can be used; it is defined as the third order centered (around the mean) moment of the TV and video game variables to instrument the TV and video game variables. Obviously, these instruments are strongly correlated with the time spent watching TV or playing video games, but they are unlikely to be correlated with the time spent studying.

The third columns in Tables 2-1 and 2-2 illustrate the results of the fixed-effects model along with the instrumental variable described above. The results are similar to those of the fixed-effects model, but the coefficient of time spent watching TV for boys becomes statistically insignificant. Moreover, the coefficient of time spent playing video games for girls becomes significantly larger in absolute terms: almost equivalent to the OLS estimate.

The fourth columns in Tables 2-1 and 2-2 provide the estimates from the CRE Tobit model: the APEs are in bold. When controlling for unobserved heterogeneity in the CRE Tobit model, the results discussed thus far remain unaltered, although the coefficients for video games for both boys and girls decrease in absolute terms: almost equivalent to the individual fixed-effects estimates.

In summary, the empirical results suggest that eliminating TV or video games does not lead to an increase in a child's time spent studying. More specifically, each additional hour spent watching TV and playing video games leads to a reduction of 1.86 and 2.70 minutes at most in time spent studying for boys and girls, respectively[9]. In absolute terms, video games have a greater effect than TV, although the effect size is still smaller than the estimates drawn from teenagers' data in the United States, 8.4 minutes (Ward, 2012). After accounting for unobserved heterogeneity, family structure and parental employment status are not associated with a child's time spent studying,

[9] Considered as a whole, the results show that time spent watching TV and playing video games does not affect the time spent studying. If so, children trade the time spent in leisure activities, such as watching TV and playing video games, with the time spent in other activities, such as sleeping. As the data set provides a series of sleeping hours across all waves, whether children trade their time spent on TV or video games with time spent sleeping was checked. The result suggests that there is a negative trade-off in a causal way but that the effect size is very small, suggesting that children may reduce the hours spent playing with friends after school or on other daily activities, such as eating or bathing.

implying that the presence of the responsible caregivers observing a child's activities and the amount of time parents spend at home do not significantly alter a child's behavior of, attitude toward, or enthusiasm for studying. However, once parents clearly demonstrate and communicate their commitment to a child's study, he/she will substantially increase the time spent studying. According to the standardized coefficients, the effect size of these measurements is the largest among the covariates, including those of the TV and video game variables.

Non-linearity (Figure 3)

The non-linearity of time spent watching TV and playing video games was examined, because many studies suggest that the relationship between cognitive ability and time spent using media is not linear (e.g., Zavodny, 2006; Munasib & Bhattacharya, 2010). Furthermore, because eliminating TV or video games is very difficult for parents, they may be interested in the extent to which these factors significantly hinder their child's study, rather than in determining whether they are harmful. Does the negative effect increase with the time spent watching TV or playing video games? To determine this, separate regressions were conducted, using the same covariates as those in Tables 2-1 and 2-2, to check for the cumulative effect of time spent on watching TV and playing video games.

The results from the fixed-effects estimates show that the dummy variables for the categories of watching TV watching (reference = 0 h; 1 = less than 1 h; 2 = 1–2 h; 3 = 2–3 h; 4 = 3–4 h; 5 = 4–5 h; 6 = 5–6 h; and 7 = more than 6 h) are statistically significant for 1 (=less than 1 h) through 7 (=more than 6 h), and the magnitude of the effect becomes larger with additional hours of watching TV. The dummy variables for the categories of playing video games exhibit similar results but are statistically significant for 1 (=less than 1 h) through 5 (=5–6 h), and the magnitude of the effect becomes larger with additional hours of playing video games. These findings did not vary by gender. Figure 3 clearly illustrates this non-linear relationship.

Type of Parental Commitment (Figure 4)

As each subcomponent of the parental commitment variables measures different aspects of parenting principles and indicates varying degrees of dedication to a child’s study, separate regressions were conducted to identify which subcomponent is more significant in determining a child’s time spent studying. Watching a child study may be a more sacrificial and time-consuming commitment for parents than simply telling their child to study. As shown in Figure 4, the findings are intriguing: first, the effect size is largest when mothers make their child adhere to set study times and fathers watch their child study. Mothers who tell their daughters to study are unsuccessful in making them spend more time studying; rather, it demotivates the daughters. Second, fathers' commitment is more effective for boys and mothers' for girls, implying that parental commitment is more likely to reap benefits in same-sex parent–child relationships.

Conclusion

This study addressed a straightforward question: Do children trade their time spent studying with time spent watching TV or playing video games? If so, is eliminating TV and video games a good parenting strategy to boost a child's study hours? Thus, this study characterizes the trade-off between time spent on educational activities and time spent on alternatives such as watching television or playing video games. By utilizing a nationally representative longitudinal data set, robust evidence was found of the negative causal relationship between time spent on television/video games and time spent studying among early elementary school children. However, the effect size is nearly negligible, regardless of the linear and non-linear unobserved heterogeneity models, although it becomes larger with an excessive amount of exposure to TV or video games. Considered as a whole, watching TV or playing video games do not significantly reduce a child's study time, which appears to be insensitive to these alternative activities. More surprisingly, the time spent studying is greatly affected by parental commitment, especially a mother's, to a child's study, even after controlling for employment status and family structure. In particular, a mother's attitude toward making her child adhere to a set study time and a father's dedication to watching his child study are strongly associated with the amount of time spent studying. On the other hand, a mother's attempts to forcefully increase a child's time spent studying results in demotivating her child. This suggests as compared to intervention to change the learning environment, the direct interplay between parents and children may be a more important determinant of a child's time spent studying.

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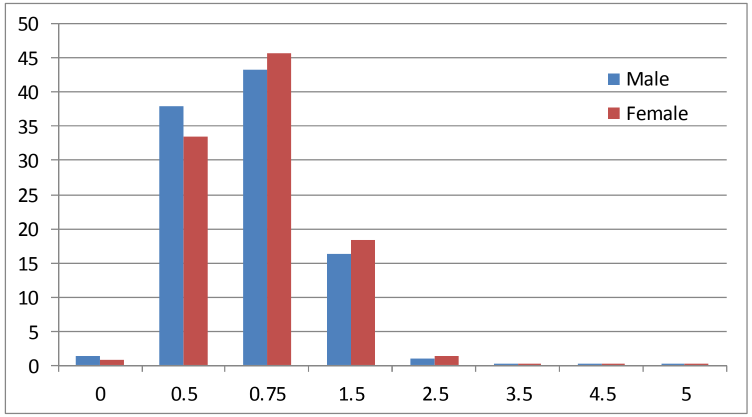
Figure 1: Time Spent Studying

[G1 (mean=0.81 h)]



[G4 (mean=1.05 h)]

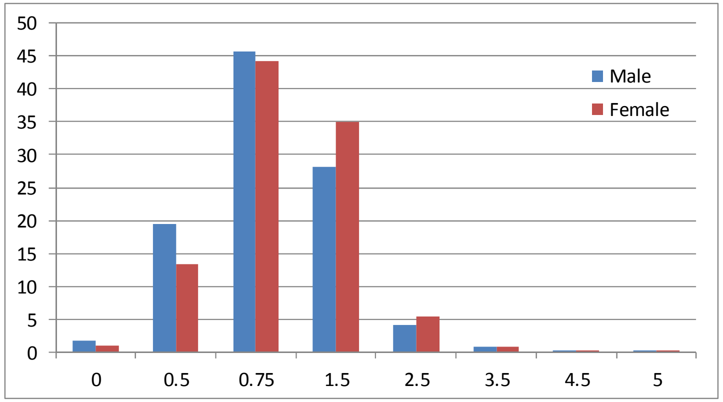
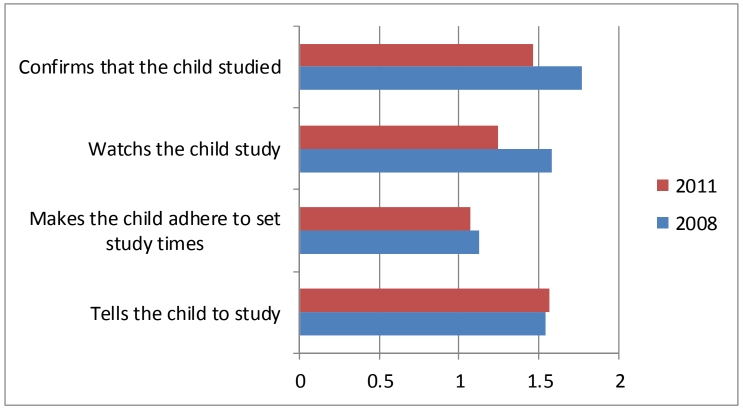
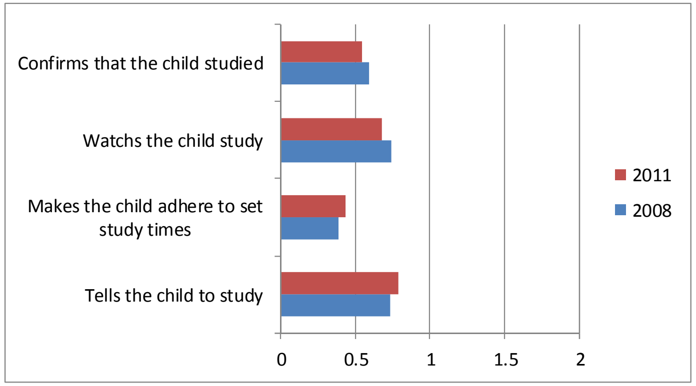


Figure 2: Parental Commitment to Child's Study

[Mothers]



[Fathers]



(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Figure 3: Nonlinearity

[TV (minutes)] [Video Games (minutes)]

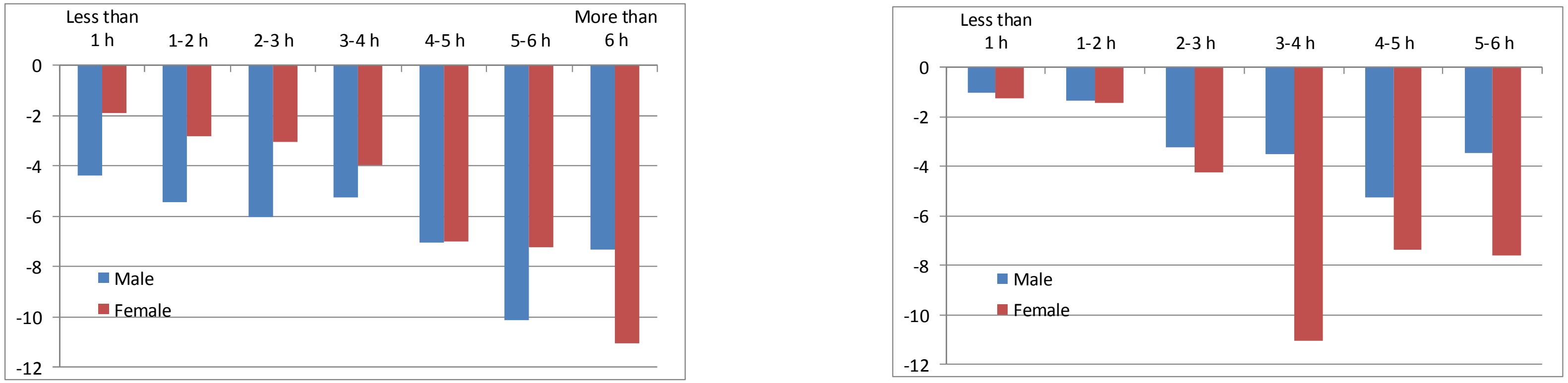
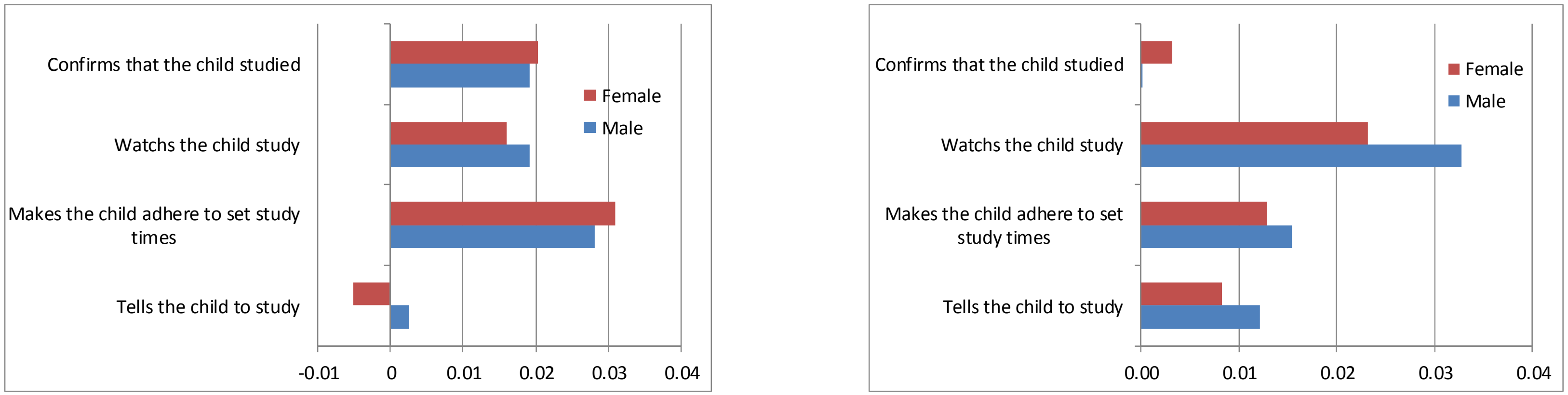


Figure 4: Type of Parental Commitment

[Mothers] [Fathers]



(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 1: Descriptive Statistics

	Boys					Girls				
	Mean	STDV	Min	Max	Obs.	Mean	STDV	Min	Max	Obs.
Dependent Variable:										
Hours of studying a day	0.89	0.49	0	5	72,554	0.96	0.52	0	5	67,140
Independent Variables:										
Hours of television watched a day	2.06	0.91	0	6	71,940	2.07	0.94	0	6	66,686
Hours of video games played a day	1.10	0.73	0	6	71,886	0.73	0.62	0	6	66,531
Control Variables:										
(i) Family structure:										
Number of siblings	1.25	0.77	0	10	72,771	1.22	0.76	0	8	67,336
Numbers of grand parents lived together	0.38	0.73	0	4	66,849	0.37	0.72	0	4	61,638
(ii) Parental socioeconomic status:										
Mother’s employment status (ref=not working)										
1=full-time	0.19	0.39	0	1	70,669	0.19	0.39	0	1	65,385
2=part-time	0.37	0.48	0	1	70,669	0.37	0.48	0	1	65,385
3=self-employed	0.06	0.24	0	1	70,669	0.06	0.24	0	1	65,385
Father’s employment status (ref=not working)										
1=full-time	0.84	0.37	0	1	66,740	0.84	0.36	0	1	61,372
2=part-time	0.01	0.09	0	1	66,740	0.01	0.10	0	1	61,372
3=self-employed	0.14	0.35	0	1	66,740	0.13	0.34	0	1	61,372
Mother’s commitment to child’s study	5.89	1.77	0	8	71,471	5.59	1.86	0	8	66,155
Father’s commitment to child’s study	2.63	2.04	0	8	66,634	2.35	1.97	0	8	61,422
Access to shadow education	0.34	0.47	0	1	72,711	0.35	0.48	0	1	67,336

(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 2-1: Empirical Results (Boys)

	Linear			Non-linear
	OLS	FE	FEIV	CRE Tobit
Key Independent Variables:				
Hours of television watched	-0.007***	-0.009**	-0.006	-0.010***
	(0.002)	(0.004)	(0.005)	(0.003)
Average partial effect				**-0.006**
Hours of video games played	-0.021***	-0.016***	-0.016***	-0.017***
	(0.003)	(0.004)	(0.006)	(0.004)
Average partial effect				**-0.010**
Control Variables:				
(i) Family structure:				
# of siblings	-0.024***	-0.007	-0.007	-0.008
	(0.003)	(0.012)	(0.012)	(0.012)
# of grand parents lived together	-0.002	0.010	0.010	0.006
	(0.003)	(0.009)	(0.009)	(0.009)
(ii) Parental socioeconomic status:				
Mother's employment status				
1=full-time	-0.049***	-0.016	-0.016	-0.017
	(0.006)	(0.014)	(0.014)	(0.014)
2=part-time	-0.032***	-0.003	-0.003	-0.002
	(0.005)	(0.007)	(0.007)	(0.007)
3=self-employed	0.010	0.009	0.009	0.008
	(0.010)	(0.017)	(0.016)	(0.016)
Father's employment status				
1=full-time	-0.022	0.014	0.014	0.018
	(0.021)	(0.022)	(0.022)	(0.022)
2=part-time	-0.053*	-0.024	-0.024	-0.024
	(0.027)	(0.030)	(0.031)	(0.031)
3=self-employed	-0.016	0.007	0.007	0.008
	(0.022)	(0.025)	(0.025)	(0.025)
Mother's commitment	0.025***	0.014***	0.015***	0.014***
	(0.001)	(0.002)	(0.001)	(0.001)
Father's commitment	0.038***	0.019***	0.019***	0.020***
	(0.001)	(0.002)	(0.002)	(0.002)
Access to shadow education	0.245***	0.108***	0.108***	0.107***
	(0.005)	(0.006)	(0.006)	(0.006)
(iii) Year fixed effects:				
2009		0.093***	0.093***	0.093***
		(0.004)	(0.005)	(0.005)
2010		0.107***	0.107***	0.105***
		(0.005)	(0.005)	(0.005)
2011		0.213***	0.212***	0.212***
		(0.006)	(0.005)	(0.005)
Constant	0.632***	0.638***	0.634***	0.359***
	(0.023)	(0.030)	(0.031)	(0.035)
# of Observations	57,714	57,714	57,714	57,714

(Note) 1. *** indicates statistical significance at a 1% level, ** at a 5% level, and * at a 10% level. Parentheses in the table indicate heteroskedasticity-robust standard errors.
2. In the results of the CRE Tobit model, the coefficients on time average variables are not listed in the Table.
(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 2-2: Empirical Results (Girls)

	Linear			Non-linear
	OLS	FE	FEIV	CRE Tobit
Key Independent Variables:				
Hours of television watched	0.003	-0.014***	-0.013**	-0.014***
	(0.002)	(0.004)	(0.005)	(0.004)
Average partial effect				**-0.008**
Hours of video games played	-0.031***	-0.018***	-0.031***	-0.019***
	(0.004)	(0.005)	(0.009)	(0.005)
Average partial effect				**-0.011**
Control Variables:				
(i) Family structure:				
# of siblings	-0.024***	-0.013	-0.012	-0.013
	(0.003)	(0.015)	(0.014)	(0.013)
# of grand parents lived together	0.005	0.008	0.008	0.002
	(0.003)	(0.010)	(0.010)	(0.009)
(ii) Parental socioeconomic status:				
Mother's employment status				
1=full-time	-0.034***	-0.005	-0.006	-0.010
	(0.006)	(0.016)	(0.015)	(0.015)
2=part-time	-0.028***	-0.001	-0.001	-0.000
	(0.005)	(0.008)	(0.008)	(0.008)
3=self-employed	0.018	-0.012	-0.013	-0.009
	(0.011)	(0.018)	(0.018)	(0.018)
Father's employment status				
1=full-time	-0.048**	-0.027	-0.027	-0.028
	(0.021)	(0.024)	(0.023)	(0.023)
2=part-time	-0.050*	-0.008	-0.007	-0.012
	(0.030)	(0.032)	(0.034)	(0.033)
3=self-employed	-0.030	-0.003	-0.003	-0.006
	(0.022)	(0.028)	(0.027)	(0.027)
Mother's commitment	0.025***	0.012***	0.012***	0.011***
	(0.001)	(0.002)	(0.002)	(0.002)
Father's commitment	0.033***	0.017***	0.017***	0.017***
	(0.001)	(0.002)	(0.002)	(0.002)
Access to shadow education	0.236***	0.099***	0.099***	0.097***
	(0.005)	(0.006)	(0.006)	(0.006)
(iii) Year fixed effects:				
2009		0.114***	0.115***	0.115
		(0.005)	(0.005)	(0.005)
2010		0.147***	0.149***	0.147
		(0.005)	(0.006)	(0.005)
2011		0.272***	0.274***	0.271
		(0.006)	(0.006)	(0.006)
Constant	0.743***	0.749***	0.753***	0.492***
	(0.023)	(0.034)	(0.033)	(0.037)
# of Observations	52,900	52,900	52,900	52,900

(Note) 1. *** indicates statistical significance at a 1% level, ** at a 5% level, and * at a 10% level. Parentheses in the table indicate heteroskedasticity-robust standard errors.
2. In the results of the CRE Tobit model, the coefficients on time average variables are not listed in the Table.
(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare