Time Trade Doesn't Happen:[1]
The Determinants of Children's Hours Spent Studying

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Abstract

This research attempts to characterize the tradeoff between time spent in educational activities and time spent in alternatives, such as watching television or playing video games. By taking an advantage of a nationally representative longitudinal dataset, we find the robust evidence of the negative causal relationship between time spent using television/video games and time spent studying. However, because the effect size is quite small to be negligible, watching TV or playing video games do not reduce significant learning hours of a child. In other words, time spent studying appears insensitive to those alternative activities. More surprisingly, time spent studying is greatly affected by mother's commitment to child's study, even after mother's employment status is controlled. This suggests that the direct interplay between parents and children may be a more important determinant of child's time spent studying than an intervention to change the learning environments.
JEL classification codes: I10, I20

[1] This study was conducted as part of a project titled "Analysis on Service Industries: Productivity, Economic Welfare, and Policy Evaluation" of the Research Institute of Economy, Trade, and Industry (RIETI). We gratefully acknowledge that this research was financially supported by Grant-in-Aid for Scientific Research (A) titled "The Assessments of the Quality and the Productivity of Non-marketable Services" (Research Representative: Takeshi Hiromatsu, No. 3243044). The authors would like to thank the Ministry of Health, Labour and Welfare for permission to use the Longitudinal Survey of Babies in the 21st Century as well as well as Jimmy Nobuteru Shirota for their insightful comments, suggestions, and assistance in relation to the draft of this study. All the remaining errors are ours.
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子どもはテレビやゲームの時間を勉強時間とトレードするのか
－小学校低学年の子どもの学習時間の決定要因－[3]

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要約

最近の教育経済学研究では，学習時間が学力に与える因果的効果が明らかになるにつれ，教育生産関数におけるもっとも重要な投入物は，学習への努力をしめす学習時間であるという考え方が主流となってきている．その一方で，学習時間の決定要因は明らかになっていない．本研究では，21 世紀出生児縦断調査（厚生労働省）の個票データを用い，小学校低学年の子どもらの学習時間に影響を与える要因は何かについて，実証分析を行う．先行研究では，ゲームが 10 代の若者の学習時間を奪うことについて指摘されており（Stinebricker & Stinebricker, 2008），子どもの一日のうちテレビやゲームの時間が，勉強時間に先行して決定されている可能性は否定できない．小学校低学年はテレビやゲームをして過ごす時間がもっとも長い年齢コーホートであることを考えても，テレビやゲームの時間と勉強時間の間にトレードオフの関係があるかどうかを明らかにすることは政策的な意義が大きいと考えられる．本研究の分析結果から得られた結論は，テレビやゲームは勉強時間を減らす効果を持つが，それは殆ど無視できるほどに小さいものであり，テレビやゲームの時間を制限したからといって，勉強時間を増やす効果を持たないというものである．むしろ，子どもの学習に対する母親のコミットメントの効果は大きく，子どもの時間の配分を変えるような学習環境への介入は意味を持たず，親が子どもとどのように直接的な関係を築いているかということが重要である．

JEL classification codes: I10, I20

[3] 本稿は独立行政法人経済産業研究所の「サービス産業に対する経済分析：生産性・経済厚生・政策評価」のプロジェクトの一環として行われた．また本稿で用いたデータの分析にあたっては，科研費基盤 A「非市場型サービスの質の評価と生産性の計測」（研究課題番号：23243044，研究代表者：廣松毅）からの支援を受けた．ここに記して感謝したい．

Introduction

The more studying, the higher academic achievements – this is the norm for parents but, on the other hand, very difficult question to answer in the causal way. Because highly educated parents may be more likely to encourage their children to study, and children who were raised by those parents may be more likely to enjoy studying. Technically speaking, such unobserved parental and child characteristics may confound the effect of children's "efforts", which may be the most fundamental input in education production function, on academic achievements. However, recent economic research attempted to isolate the pure effect of efforts on student achievements and then answer the causal questions about whether efforts really matters: For example, Stinebricker & Stinebricker (2008) used an instrument, a random assignment of whether or not roommates at student dorm brought video games, which may steal student's time from studying, to deal with potential endogeneity described the above. The important implication from this research was efforts measured by time spent studying have significant effect to raise student achievements.

Given the findings that time spent studying affect student achievements, there has been growing interest in investigating the determinants of time spent studying, while, to our best of knowledge, there exists only a few research at this moment though (e.g., Ward, 2012, etc). The objective of this paper is thus to reveal what factors makes

students spend more time for studying. The evidence provided by Stinebricker & Stinebricker (2008) suggested that the video games may be predetermined and to reduce the hours of studying. However, because their results were drawn from the small sample collected in a particular college, Berea College in the United States, it may be concern to generalize to a larger age group and population. On the other hand, without a random assignment of the access to video games explored in Stinebricker & Stinebricker (2008), it is difficult to measure the rigorous effect of video games. This is because the observed differences in hours playing video games may merely reflect, for example, differences in the extent to which students are allowed to play more video games, or in the extent to which students have weak motivation to study: selection bias arises when part of student's efforts can be explained by unobserved parental or individual characteristics.

As we will see, Ward (2012) was the closest to our research. He used the exogenous variations in video game sales to identify the causal effect of time spent playing video games on time spent studying. The results presented each additional hour of playing video games leads to 8.4 minutes reduction in time spent studying. Our work is to extend earlier work by focusing on early elementary school children and attempt to characterize the trade-off between time spent studying and time spent using video

games along with television (TV)[4]. Much policy debate on this topic hinges on more concrete and scientific evidence. Because if the trade-off is explicit, parents strictly restrict the hours of TV watched or video games played, and make their children spend more time for studying. To answer this research question, this study took advantage of a nationally representative longitudinal dataset, collected from 2008 through 2011, making three primary contributions to existing literature. First, we target early elementary school children because a number of studies have found the skills measured at early ages are strong predictors of later life outcomes, such as educational attainment, labor market outcomes as well as adolescent social behaviors (Cameron & Heckman, 1998; 2001; and Heckman, Stixrud & Urzua, 2006, etc). Second, the data provides a large amount of information on what a child does, how long and where. In addition, it also contains rich information on how parents have committed child's study or homework in a typical week. Thus, we are able to see how "parenting" is a productive input to raise child's time spent studying as compared with "child's time allocation." Third, we employ several econometric models to estimate the causal relationship between time spent in educational activities and time spent in alternatives. We begin

[4] The reason why we focus not only on video games but also TV is that previous literature showed the evidence that the allocation of children's time to using media through TV is an important determinant of children's cognitive and non-cognitive development (e.g., Fiorini & Keane, 2012).

with the conventional Ordinary Least Squares (OLS), then use the child fixed-effects models to control for time-variant unobservables, and implement instrumental variable estimation to control for time-invariant unobservables. Considering the non-linear nature of our output, time spent studying, and the incidental parameters problem (Wooldridge, 2002), we employ correlated random-effects Tobit model.

The most significant findings of this paper is that after addressing the potential bias, we clearly find the 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 quite small to be negligible, watching TV or playing video games do not reduce time spent studying almost at all. In other words, time spent studying appears insensitive to those alternative activities. More surprisingly, time spent studying is greatly affected by mother's commitment to child's study, even after mother's employment status is controlled. This suggests that the direct interplay between parents and children may be a more important determinant of child's time spent studying than an intervention to change the learning environments.

The remainder of this paper is organized as follows. The next section introduces the methodology and empirical specifications for estimation, identify the potential bias emerging in the econometric analysis, and determine 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 our empirical analyses and the coded variables. The fourth section presents the empirical results. In the final section, we present our conclusions.

Econometric Methodology

To address our research question of whether there a trade-off between time spent in educational activities and time spent in other alternative activities, such as watching television (TV) or playing video games, we estimate a child skill production function where time spent watching TV and time spent playing video games are regarded as inputs. The model can be formally expressed by the following mathematical equation:

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

where y_{it} is time spent studying of 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. We include both the TV and video game variables in the same regression model because the number of hours of TV watched and video games played are weakly but positively correlated (the more children watched TV, the more they played video games, and vice versa).

We begin with the conventional Ordinary Least Squares (OLS). In the OLS estimate, 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 hours watching TV or playing video games may simply reflect differences in the kind of parents who allow children to spend more time on TV or video games or in the kind of children who have weaker motivation to study. These unobserved parental and child characteristics may be associated with children's time spent studying. If a selection on unobserved characteristics is 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 models also enable 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).

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

where $\varepsilon_{it} = A_i + v_{it}$, 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 transformation induced by repeated observations on 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 still be endogenous due to measurement errors in T_{it} and V_{it} and time-varying unobserved parents' and child's characteristics that are correlated with T_{it} and V_{it}. To address this potential complication, we use an instrumental variable originally proposed by Lewbel (1997) along with the fixed-effects model, the third order concerted around mean moment of T_{it} and V_{it} to instrument T_{it} and V_{it}, which, as a matter of course, are strongly correlated with T_{it} and V_{it} but unlikely to be correlated with y_{it}.

Finally, we employ the non-linear unobserved effects Tobit model for a corner at zero, the correlated random effects (CRE) approach (see Wooldridge, 2011 for more detailed explanation on this approach). Our dependent variable is continuous over strictly positive values but takes on zero with positive probability. Considering the non-linear nature of this variable and the incidental parameters problem (Wooldridge, 2002), non-linear unobserved effects model may make more sense than a linear one. The correlated random effects (CRE) framework is attractive because the model is able

to incorporate both the time-invariant and time-varying variables and is consistently estimated providing simple implementations in the context of Tobit models. In other words, this approach enables us to obtain bias-corrected versions of fixed effects estimators for nonlinear models. Furthermore, it allows some degree of dependence between unobserved heterogeneity and a set of observed time-varying covariates in the model. More specifically, the approach assumes the relationship between 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 uncorrelated with all independent variables.

$$\mathrm{A}_i = \bar{\boldsymbol{X}}_i\beta + \gamma\bar{T}_i + \delta\bar{\mathrm{V}}_i + v_i \quad (4)$$

Moreover, the reason why this approach became very popular with empirical researchers was to be able to identify very generally the partial effects with the heterogeneity averaged out, what is called average partial effects (APEs) of T_{it} and V_{it}.

Data

The data used in our empirical analysis were drawn from the Longitudinal Survey of Babies in the 21st Century, a longitudinal dataset organized in 10 waves, collected by the Japanese Ministry of Health, Labour and Welfare between 2001 and 2011. Despite random sampling, the survey is complete, which targeted all 53,575

newborn babies in Japan born during January 10–17 and July 10–17, 2001. Because there is no systematic or seasonal pattern in the population of births, shown in the monthly Vital Statistics collected by the Ministry of Health, Labour and Welfare, this dataset can be considered representative. The respondents were primary caregivers, mostly parents. From Waves 1 through 6, the surveys were conducted six months postpartum on August 1, 2001, and February 1, 2002. One and a half years after Wave 6, Waves 7 through 10 were conducted on January 18 and July 18, indicating that the subjects in these waves reached school age in the same grade (G1 through G4) at the time of the survey. The respondents to this survey were primary caregivers of a child: 92.3% of the respondents were mothers; the rest were fathers, grandparents, and other guardians[5]. In this paper, we use four consecutive waves, from Waves 7 through 10, which provide a detailed series of questions on what a child does, how long and where. Our sample was restricted to children whose parents were both Japanese, because children of immigrants, though small in number, may more likely have different educational backgrounds, such as international or ethnic schools.

The main outcome is defined as the average daily hours of studying[6]. The key

[5] One may question whether the observations regarding children differ significantly between mothers and other caregivers. The empirical results in the latter section were indistinguishable from the results restricted sample of mothers. Both results will be provided upon request.

[6] In the original questionnaire ranged from 1 (=zero) through 8 (over 5 h). We set the minimum at zero and maximum at 5 h. Then, we took the median value for categories between 2 (0.25 =

independent variables of interest were the average daily hours of TV watched and of video games played[7][8]. The descriptive statistics summarized in Table 1 show that the average children at this age cohort have spent only less than an hour a day, while they have watched TV about 2 hours and played video games for an hour a day. Time spent studying has been increasing by grade (see Figure 1). We also controlled for various child or parental socioeconomic and demographic variables corresponding to (i) parental socioeconomic status, such as their employment status and the access to shadow education, (ii) family structure, such as the number of siblings and the number of grandparents lived together; and (iii) parental commitment to children's study.

More specifically, mother's and father's employment status are 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). The access to shadow education, which is very popular in Asian countries including Japan, is also the dummy variable coded as 1 if a child participates in either cramming school, distance learning,

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less than 30 minutes) and 7 (4.5 = 4–5 h).

[7] These variables are coded in the same matter with the dependent variable: The response category in the original questionnaire ranged from 1 (=no television or video games) through 6 (over 6 h). We set the minimum at zero and maximum at 6 h. Then, we took the median value for categories between 2 (0.5 = less than 1 h) and 5 (5.5 = 5–6 h).

[8] Nakamuro et al (in press) used the same dataset with this study and examined the relationship between the hours spent for TV or video games and children's development, such as children's problem behavior, orientation to school and obesity. The empirical analysis suggested that TV or video games negatively affect children's development, although the magnitude is small enough negligible.

or tutoring, 0 otherwise. According to descriptive statistics, while a majority of fathers are employed as full-time workers, approximately 50 percent of mothers are not working. 35 percent of subject children are involved in shadow education to some extent. Apparently, the access to shadow education is an important determinant of time spent studying. Our data shows the average time spent studying for children who receive shadow education was 1.10 hours a day while average time spent studying for children who do not receive it was 0.83 hours a day across four waves.

The numbers of siblings and grandparents deserve further comments. One cannot always determine *a priori* the direction of the impact of family structure on outcomes: the numbers of siblings could have both positive and negative effects, as does whether children live with their grandparents. The mechanism for fewer siblings having a positive effect on child's outcome is that parents can allocate more household resources or attention toward each child, and children are less often forced to assist in running household errands. However, previous research has found that the larger the family size, the faster children's scholastic progress, because older siblings are often available to help the younger children with their homework (Bianchi & Robinson, 1997). The effect of children living with their grandparents on outcomes is also ambiguous. Sometimes children may receive extra support and attention from grandparents,

increasing children's well-being at home. However, they may become confused and unstable owing to the death or illness of grandparents, if they have a strong emotional attachment toward them. Thus, the total effect is unclear *a priori* and is a question to be resolved empirically.

Parental commitment to child's study is defined as the composite index to measure how the mother or farther is actively involved in the child's study, including homework. In this study, we identify four questions that are common across waves: (i) tells the child to study, (ii) makes the child adhere to set study times, (iii) watch the child's study, and (iv) confirms that the child studied. Each item was coded as 2 if the respondent answered "often", 1 if s/he answered "sometimes", and 0 if s/he answered "never/almost never". The commitment indicators were then calculated as the sum of all items coded, ranging from 0 to 8[9]. The larger this index, the more directly parent(s) tell, observe and check the child's study. The descriptive statistics summarized in Table 1 illustrated that mother's commitment on average is 5.89 that is much stronger than father's one, 2.63 across four waves. Looking at the sub-component of the parental commitment indicator, in 2008 (when the child was 6 years old), "watch the child's

[9] We factor analyze the item to derive a concise set of indicators of parental commitment to child's study. However, the empirical results in the latter section were indistinguishable from the analysis using these indicators and the principal-component factors. The results will be provided upon requests.

study" was the most frequent commitment for both mothers and fathers, while in 2011 (when the child was 9 years old), "tells the child to study" was the most frequent commitment for parents (See Figure 2). It indicates that parental commitment to child's study may be changed, depending on child's age and maturity. The psychology literature has investigated the link between parenting and child's skills (e.g., Hart, Newell & Olsen, 2003).

There are several drawbacks to use this data. First, we discuss problem with attrition. The response rate for each wave was, on average, 90%. Of the total, 72.6% of the sample in the first wave completed the questionnaire for the latest wave, indicating that the response rates remained very high. In addition to the overall low level of data attrition, as pointed out by Kitamura (2013), attrition bias is not a serious concern in our study. Since the respondents in this survey were primary caregivers, mostly mothers, the reason why they stopped responding to the survey may be unrelated to their children's outcomes. Second, we concern the within-variation in children's outcomes.

Second, for reasonable confidence to employ child fixed-effects model as an identification strategy, there has to be some reasonable amount of within child variation. Unfortunately, time spent studying does not vary across early elementary children in comparison with teenage children, which may lead that the coefficients are likely to

small and/or insignificant. However, we must emphasize the importance of finding out how a child accumulated skills for studying while children are still very young because such skills are more likely to continue into the teens and sometimes even into adulthood (Cameron & Heckman, 1998; 2001; and Heckman, Stixrud & Urzua, 2006).

Empirical Results

Main Results (Table 2-1–Table 2-2)

We first estimated the conventional OLS shown in equation (1) to measure the effect of time spent using TV or video games on time spent studying, holding numerous child and parental characteristics constant. As illustrated in the first columns of Table 2-1 (for boys) and 2-2 (for girls), the results, coupled with the negative coefficients for TV and 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 TV was statistically significant only for males. The coefficient for video games means that each additional hour of video games played was associated with decreases in 0.021 study hours (1.26 minutes) for boys and 0.031 study hours (1.86 minutes) for girls. Each additional hour of TV watching was associated with decreases in 0.007 (0.42 minutes) study hours for boys. Therefore, TV and video games, on average, displace children's time spent studying. However, the magnitude of the effect is that one additional hour of

TV or video game decreased the hours spent studying by approximately 1–4%, which is significant statistically, but not economically.

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

The second columns of Table 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 became larger than OLS estimates. Meanwhile, the coefficients for time spent playing video game are also statistically significant for both boys and girls but became smaller than OLS estimates. We can still maintain our argument that TV and video games have negative effects, but the magnitudes are small enough to be negligible even after controlling for time-invariant child and parental unobserved characteristics. More specifically, the magnitude of the effect is that one additional hour of TV watched was associated with decreases in 0.009 (0.54 minutes) study hours for boys and 0.014 (0.84 minutes) for girls, which are approximately less than 2% of its standard deviation. Each additional hours of video game played was associated with decrease in 0.016 (0.96 minutes) for boys and (1.08 minutes) for girls, which are approximately 2% of its standard deviation.

The coefficients for other control variables are strikingly different from the OLS estimates. The most significant difference is the coefficients of family structure and parental employment status became statistically insignificant. In other words, after controlling for unobserved heterogeneity across children, the effect of family structure and parental employment status are indistinguishable from zero. However, on the other hand, the coefficients on parental commitment to child's study are still statistically significant regardless of gender. Although the magnitude of these variables is dropped to

almost half as compared with OLS estimates, the standardized coefficients suggest that the effect size of these factors is relatively larger than other factors. To summarize, the fixed-effects estimates suggest that the magnitude of hours of TV watched and video game played are both negatively significant, but the effect size is quite small.

The crucial underlying assumption in fixed-effects model is that unobserved factors are constant over time. If there are time-variant unobservables, our result may be difficult to interpret in a causal way. Technically speaking, if there is a correlation 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}, the coefficients of interests may still be endogenous. To address this issue, we use an instrument proposed by Lewbel (1997), which are defined as the third order centered (around mean) moment of the TV and video game variables to instrument TV and video game variables. These instruments, obviously, are strongly correlated with time spent using TV or video games, but unlikely to be correlated with time spent studying.

The third columns of Table 2-1 and 2-2 illustrate the results of the fixed-effects model along with the instrumental variables described the above. The result is quite similar with the one drawn from fixed effects model, but the coefficient on time spent watching TV for boys became statistically insignificant. Moreover, the coefficient on

time spent playing video games for girls became much larger in absolute values, which is almost the equivalent with the OLS estimate.

The fourth columns of Table 2-1 and 2-2 provide the estimates from the correlated random-effects Tobit model. We calculate the APEs and make them bold in Tables. When controlling for unobserved heterogeneity in the correlated random effects Tobit model, the results already discussed so far still are maintained, although the coefficients on video games for both boys and girls decrease in absolute values, which are almost equivalent with individual fixed effects estimates.

In sum, the empirical results suggest that getting rid of TV or video games doesn't exert to increase their child's time spent studying. More specifically, each additional hour of TV and video games leads to 1.86 minutes reduction at most in time spent studying for boys and 2.70 minutes for girls. The video games have the greater effect in the absolute value than TV, but the effect size is still smaller than the estimates drawn from the teenager's data in the Unites States, 8.4 minutes (Ward, 2012). After accounting for unobserved heterogeneity, family structure and parental employment status are not associated with child's time spent studying, implying that the presence of the responsible caregivers to observe what a child's does and the length of parents' time spent at home do not really change child's behavior, attitude or enthusiasm for study.

However, once parents clearly show their principle for child's study and commit it through direct communication with him or her, the child will substantially increase the amount of time spent studying. According to the standardized coefficients, the effect size of these measurements is the largest among covariates including TV and video game variables.

Non-linearity (Figure 3)

We then examine the non-linearity of time spent watching TV and playing video games because many studies suggested the relationship between cognitive ability of an individuals and hours of using media is not linear (e.g., Zavodny, 2006; Munasib & Bhattacharya, 2010). Furthermore, because getting rid of TV or video games is very difficult for parents today, they may be more interested in the extent to which TV or video games are significantly harmful to child's study, rather than whether they are harmful. Does the negative effect increase with the time spent watching TV or playing video games? To answer this question, we conducted separate regressions, with the same covariates used in Tables 2-1 and 2-2, to check for the cumulative effect of TV and video games.

The results for fixed-effects estimates show that the dummy variables for the categories of 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 becomes larger with additional hours of TV watching. The dummy variables for the categories of video game watching show the similar results but are statistically significant for 1 (= less than 1 h) though through 5 (= 5–6 h) and the magnitude becomes larger with additional hours of video games playing. These findings did not vary by gender. Figure 3 clearly illustrates the nonlinear relationship.

Type of Parental Commitment (Figure 4)

Because each sub-component of parental commitment variables measured different aspects of parenting principle and had different degrees of dedication to child's study, we ran separate regressions to see which sub-component is more significantly important to determine the child's time spent studying. Intuitively, watching the child study may be more sacrificial and time-consuming commitment for parents than just telling him or her to study. As shown in Figure 4, the findings are quite intriguing: first, the effect size is largest when mothers make the child adhere to set study times and fathers watch the child's study. Mothers who tell their daughter to study are not successful to make her more time to study and rather, make her unmotivated. Second, fathers' commitment is more effective for boys and mothers' one for girls, implying that

the parental commitment is more likely to benefit in the same sex parent-child relationship.

Conclusion

This paper asks a straightforward question: Does children trade their time spent studying for time spent watching TV or playing video games? If so, is getting rid of TV or video games a good parenting strategy to exert to boost their child's studying hours? This research thus attempts to characterize the tradeoff between time spent in educational activities and time spent in alternatives, such as watching television or playing video games. By taking an advantage of a nationally representative longitudinal dataset, we find the robust evidence of the negative causal relationship between time spent using television/video games and time spent studying for early elementary school children. However, the effect size is quite small to be 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. Taken as a whole, watching TV or playing video games do not reduce significant learning hours of a child and time spent studying appears insensitive to those alternative activities. More surprisingly, time spent studying is greatly affected by parental commitment, especially mother's one, to child's study, even after their employment status and family structure are controlled. In

particular, mother’s attitude to make a child adhere to set the child’s study time and father’s dedication to watch his or her study are strongly associated with the amount of time spent studying, while mother’s claim to force the child more time to study and rather, make unmotivated. This suggests that the direct interplay between parents and children may be a more important determinant of child’s time spent studying than an intervention to change the learning environments.

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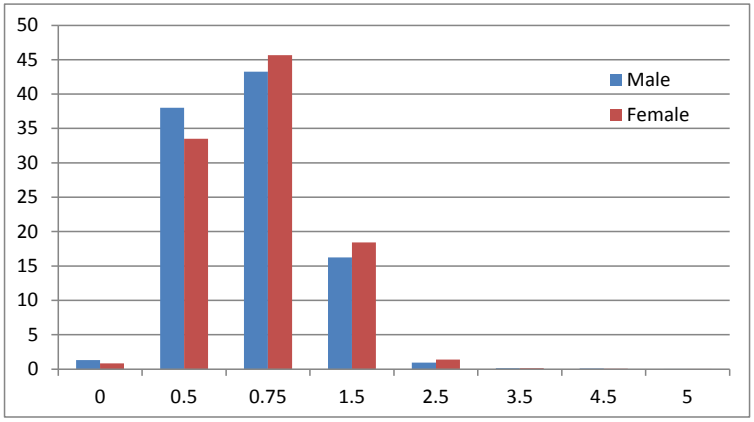
Figure 1: Time Spent Studying

[G1 (mean=0.81 h)]



[G4 (mean=1.05 h)]

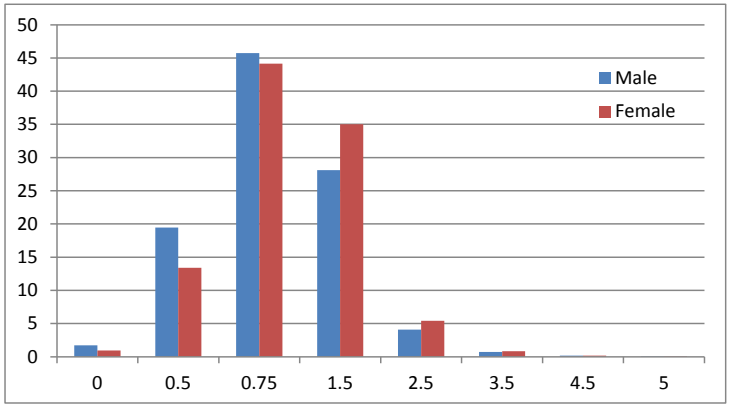
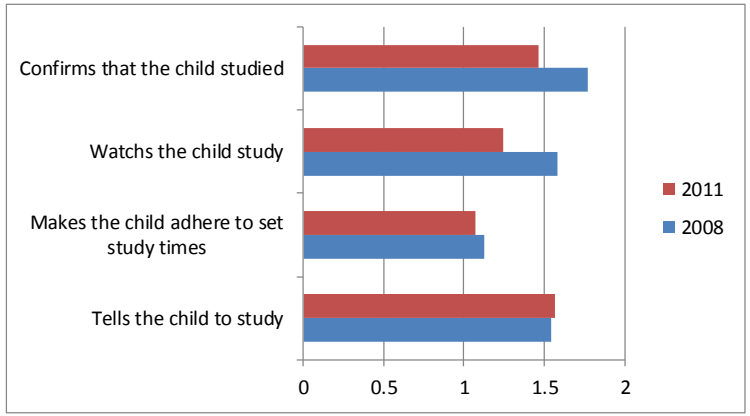
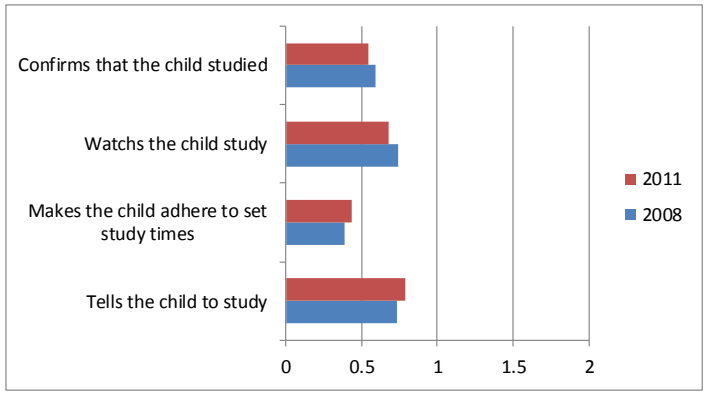


Figure 2: Parental Commitment to Child's Study

[Mothers]



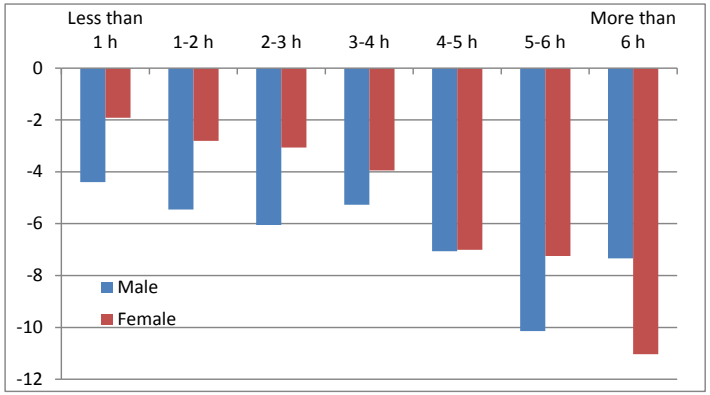
[Fathers]



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

Figure 3: Nonlinearity

[TV (minutes)]



[Video Games (minutes)]

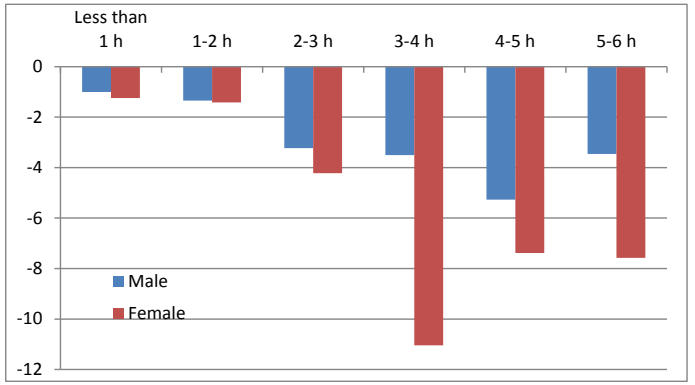
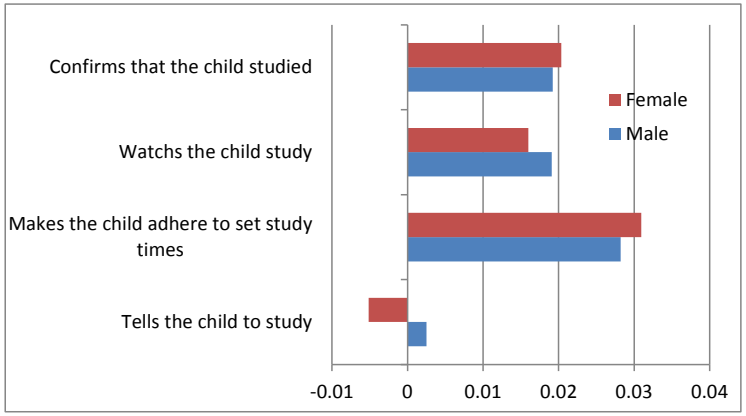
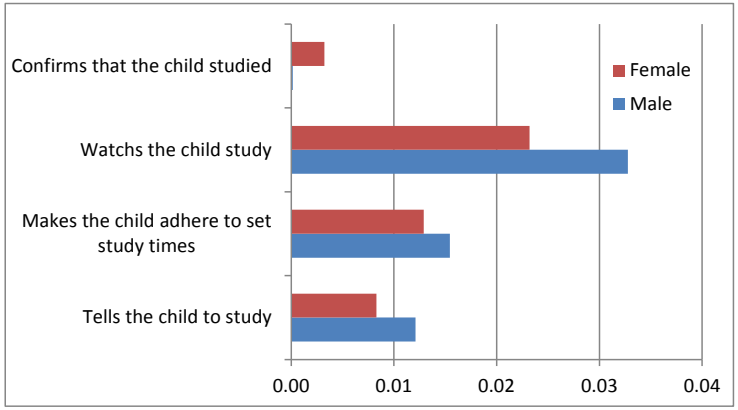


Figure 4: Type of Parental Commitment

[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