Hell to touch the SKY? Private tutoring and academic achievement in Korea

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Although not exclusive to the Republic of Korea's educational system, the pervasiveness of private tutoring, and its consequences, serve to distinguish it from systems operated in other countries. However, the identification of inefficiencies linked to this phenomenon have seen the educational authorities struggling against private tutoring since the 1980s. Yet, public policies have systematically failed because of the widely held belief that private tutoring services increase students' academic performance. This paper quantifies the impact of time spent in private tutoring on the performance of students in the three competence fields assessed in the PISA-2006 (Programme for International Student Assessment). Instrumental variables are applied in a multilevel model framework in an attempt at addressing the endogeneity of the effects of private tutoring on academic performance. Our results indicate that the impact of time dedicated to private tutoring on academic performance depends on the particular competence: positive for mathematics, positive but decreasing for reading, and non-significant for science.

Keywords: Private tutoring; Demand for schooling; Academic performance; PISA.

1. Introduction

Private tutoring consists of a series of activities, supplementary to mainstream schooling, whose aim is to enhance a student's academic performance in exchange for monetary payment (Bray, 2005). Although not exclusive to the Republic of Korea's (Korea, hereafter) educational system[1], the pervasiveness of private tutoring, and its consequences, do serve to distinguish it from systems operated in other countries. According to the Korean National Statistics Office, Koreans devoted 20.9 trillion won to private tutoring activities in 2008 (approximately 2% of its GDP), with 75% of primary and secondary school students receiving tutoring.

The primary objective behind the hiring of private tutoring services by Korean families is to enhance their children's academic performance at school and on the College Scholastic Achievement Test (CSAT; *Suneung* in Korean), so as to boost their chances of being admitted to one of Korea's elite universities, the so-called "SKY[2] universities". Admittance into one of these universities provides better employment prospects and social rewards. Thus, Chae et al. (2005) report that, in 2004, 88.9% of senior officials, 83.3% of congressmen and 82.3% of senior executives had graduated from one of Korea's top 20 universities (from a total of 190), while the respective proportions corresponding to SKY graduates were 63.7%, 58.1% and 39.5%. In 2007, 38% of CEOs working in Korea's top 100 companies and 88% of high court and supreme court judges were alumni of Seoul National University (SNU) as were nearly 60% of government ministers and almost half the members of the National Assembly. In addition, SKY university graduates enjoy non-economic benefits. As Lee and Brinton (1996:182) point out, "school background is a basis of informal social groupings that serve as an important source of social capital among South Koreans".

These rewards, plus the recent evolution in aggregate demand for higher education, have given rise to a situation of overheated competition or "education fever" in Korea. In 1989, 14,340 higher education students from a total of 400,000 were enrolled in SKY universities; in 2004, the respective figures were 14,810 and 733,000 (Chae et al. 2005). Credentialism has, therefore, split the skilled workers' labor market and the higher educational system in two unequal parts.

[1] Bray (2003 and 2005) reviews the countries in which the practice of private tutoring is widespread.
[2] Korea's top three universities are Seoul National University (public), and Korea and Yonsei Universities (private). They are commonly referred to as the SKY universities, alluding to the universities' initials.

While the evidence available on the impact of private tutoring on academic performance is contradictory and inconclusive, the educational authorities have adopted a number of measures[3] to tackle the proliferation of private tutoring owing to their having detected a number of negative side effects. The most serious of these are: 1) unreasonable pressure on students through endless timetables which prevent them from developing skills other than those included on the official academic curriculum; 2) low levels of motivation in schools among both pupils - the lowest in the OECD countries included in the PISA-2006 (Programme for International Student Assessment) - and teachers, as the pupils are often already familiar with the lesson being taught; and 3) the impact of the institutionalization of private tutoring on equality of opportunities in student access to higher education[4], as children from higher socio-economic groups tend to consume more private tutoring services than children in lower socio-economic groups, as is shown below in Section 5.

However, public policies aimed at cooling down the overheated private tutoring market have systematically failed due to the widely held belief that the hiring of private tutoring services increases students' academic performance. In this context, Sohn et al. (2010) claim that the economic literature to date has failed to quantify consistently the impact of private tutoring in the Korean case. Hence, the principal question here remains unanswered: Does private tutoring enhance the academic performance of Korean students? And if it does, does it have the same impact on all fields of competence? This article seeks to shed light on these issues, quantifying the impact of private tutoring on the academic performance of high school students using the PISA-2006 data.

One of the main methodological concerns in analyzing the impact of private tutoring on academic achievement is its potential endogeneity. A child's innate ability and the parents' preferences for their children's education might affect both academic achievement and the demand for private tutoring services. It is thus possible that the best students consume more private tutoring services than the average, with private tutoring services making good students even "better". Endogeneity must therefore be controlled for by obtaining consistent coefficients. This paper addresses the problem of endogeneity through the use of instrumental variables in a multilevel framework, which simultaneously takes into account the nested nature of the PISA data. Our approach is thus innovative as it quantifies consistently the impact of private tutoring in Korea through a combination of both techniques. The analysis is applied to the three fields of

[3] Seth (2002) describes the Korean educational authorities struggle against private tutoring services.
[4] Kim (2004) shows that expenditure in private tutoring in Korea is positively correlated with the level of education of the mother, living in a big city and the family's socioeconomic status.

competence measured by the PISA, in order to identify potentially different effects of private tutoring on academic achievement. Other determinants of academic achievement are also assessed collaterally.

In contrast with most other studies analyzing the impact of private tutoring which use expenditure in private tutoring as their key independent variable, our paper uses the time spent in private tutoring activities. This enables us to examine not only the impact of private tutoring on academic achievement, but also the possible existence of non linear returns in the consumption of these services and to analyze which strategies are the most efficient for students to adopt.

In broad terms, therefore, the originality of this paper lies in the several contributions it makes to the field of study. First, it undertakes a robust comparison of the impact of private tutoring on three different areas of competence while taking endogeneity into account. Second, instead of using proxies such as expenditure in private tutoring, we use time spent in private tutoring as an independent variable for each competence in order to identify non-linear effects. Third, the richness of the information provided by the PISA data allows us to control for a large set of variables in a multilevel framework. Finally, the self-study variables introduced in the regressions were previously treated so as to take into account the fact that some of the time spent in self-study might be induced by participation in private tutoring.

The paper is organized as follows: a brief review of the literature on the impact of private tutoring on academic performance is described in Section 2. Section 3 presents the methodology, while Section 4 describes the data used to feed the hierarchical linear models. The results from the empirical analysis are presented and discussed in Section 5. Finally, Section 6 puts forward the main conclusions.

2. The impact of private tutoring on academic achievement: a brief review

The impact of private tutoring on academic achievement has been the subject of increased attention in the economic literature. The empirical evidence for Korea and other Asian countries, obtained using a wide range of methodologies, is, to date, inconclusive. While some of these analyses show a non-significant (or even negative) effect of private tutoring on achievement, others point to the existence of positive effects, at least for some of the

competences assessed. The latter situation is particularly true of those papers that control for endogeneity. These positive effects, in turn, range from moderate to intense depending on the analysis.

The main methodological distinction found in the literature is the introduction or otherwise of controls for endogeneity. Today, however, the use of endogeneity controls is widespread with most of the articles on the impact of private tutoring published after 2005 including a range of strategies for that very purpose.

Among the contributions not including a specific strategy to control for endogeneity, two articles examining the Korean case (Lee et al., 2004 and Park and Lee, 2005) report contradictory results. Lee et al. (2004), using an OLS model, conclude that private tutoring has no significant effects on the achievement of middle and high school students in mathematics, Korean and English. Conversely, Park and Lee, using the PISA-2003 data and a hierarchical linear model, find a significant positive impact of tutoring on mathematics achievement. Similarly, Sohn et al. (2010) report that the studies published in Korean are biased by endogeneity. Furthermore, they point out that these studies present problems as regards their definitions of 'private tutoring', and find that private expenditure or participation in private tutoring is usually adopted as a proxy. They cite the case of a study published in Korean by Jo and Lee (2005) as being, to date, the only one to use time spent in private tutoring to measure the impact of private tutoring on academic performance for Korea, finding a non-significant effect.

Other studies conducted in Asian countries do not include a specific strategy to control for endogeneity. Cheo and Quah (2005), after applying a simultaneous equation model to middle school Singapore students, find a negative impact of tutoring on achievement. By contrast, Stevenson and Baker (1992), employing a logistic regression model, show a positive incidence of tutoring on the chances of Japanese high school students reaching university. The evidence provided by Ha and Harpham (2005), in a study of Vietnamese primary pupils, is mixed: the results of different logistic regressions indicate a positive incidence of tutoring on reading, but a neutral incidence on writing and numeracy.

Contributions that do include a specific strategy to control for endogeneity typically adopt an instrumental variables approach. However, two key studies of the Korean case implement alternative techniques. Kang (2007) uses a combination of OLS and Propensity Score Matching

to measure the impact of private tutoring on the CSAT results, concluding that tutoring has a slight positive effect on achievement. Sohn et al. (2010) apply an autoregressive cross-lagged model to panel data, aimed at establishing the impact of tutoring on a student's position in the school's overall academic ranking. Their empirical evidence indicates a positive incidence of tutoring; however, their results should be treated with some reservations, since the methodology used is limited by a number of factors: first, the selection of the achievement variable (position in the school's achievement ranking) does not take into consideration differences between schools; second, the analysis does not control for family background, personal characteristics or school variables; and third, the authors include 'after-school classes', provided by the school itself, to their variable of 'private tutoring'.

Several recent analyses for other Asian countries also use instrumental variables in order to control for endogeneity and report mixed findings regarding the impact of private tutoring. Suryadarma et al. (2006), in a study of Indonesian fourth graders, do not find any significant effect of tutoring on mathematics or dictation results. By contrast, Dang (2007) concludes that private tutoring has a significant positive effect on the achievement of Vietnamese primary and secondary students. Achievement, in this study, is construed as the student's position in the school academic ranking. An analysis by Ono (2007), applied to the *ronin* phenomenon (by which Japanese students receive an additional year of private education in order to prepare for college entrance examinations), shows how the probability of accessing an elite university is positively affected by this additional education. Ono's study, however, is limited by the fact that only a small set of variables referring to family background, personal and school characteristics is controlled for in the analysis. Finally, mention should be made of Banerjee et al's. (2007) empirical analysis of private tutoring in India, in which, through a randomized experiment, the authors conclude that tutoring has a significant positive effect on achievement.

3. Data

Data come from the "Programme for International Student Assessment" (PISA) of 2006. The PISA is an internationally standardized assessment administered to 15-year-olds in schools. The 2006 assessment was the third edition (after 2000 and 2003) and comprised 57 countries (30 OECD members and 27 partner economies). PISA collects information on the performance of students in three fields of competence (reading, mathematics and science). Results were initially set using a scale with an average score of 500 and a standard deviation of 100 for each competence. In addition, students complete a questionnaire about their approaches to learning

and their family characteristics. School principals also report on their school's characteristics and their management procedures. In some countries, including Korea, students also fill in a questionnaire on their familiarity with ICT and the students' parents provide more detailed information about the household through the parent questionnaire.

The Korean sample consists of 5,176 pupils. In our analysis, this number was restricted to 3,147 students (76.3% of the whole sample), since we only considered those in academic upper-secondary education (grade 10 - first year of upper-secondary education or *inmungye godeung hakgyo*). Thus, to obtain a more homogeneous group of pupils, we did not consider students in vocational education (*jeonmungye godeung hakgyo*). This was the case for two reasons. First, the proportion of students in vocational education that decide to enroll in higher education institutions (while over the last two decades rising markedly) remains lower than that for those studying academic upper-secondary education (68.6% vs. 87.5%, in 2006). At the same time, vocational education students are more likely to enroll in junior college programs (two- or three-year post-secondary programs that seek to meet the demand for technicians) than are academic upper-secondary education students, with competition being less intense for these programs. Second, the use of tutoring varies significantly between students from the academic and vocational track (since tutoring is mainly used to gain a university pace, an option chosen primarily by those in academic education). Thus, 87.1% of students on the academic track receive tutoring, whereas this figure falls to 39.4% for those on the vocational track. This different profile of academic and vocational students is reflected in the results on the PISA test: pupils on the academic track scored an average of 569.6 points in mathematics, 542.6 in science and 575.5 in reading, while the results for vocational education students were 475.1, 455.6 and 492.9 respectively.

Korea ranks first on the PISA-2006 for reading (556 points), and second (among the OECD countries) for mathematics with an average of 547 points (just behind Finland). Korea's ranking is lower for science (although still among the best performing countries), occupying seventh position among the OECD countries, with an average of 522 points (Finland ranks first with 563 points). This higher achievement in mathematics and reading might be due to the fact that these subjects are particularly important on the CSAT and, therefore, students and their families dedicate greater efforts to them.

The level of competence in each subject is indicated in the PISA by five plausible values (PV). These are not the test results but rather a representation of the range of abilities that a

student might reasonably have, taking into consideration students' answers, the difficulty of the questions and certain conditioning variables (see OECD, 2009). To avoid any biases when estimating any given parameter, the latter has to be calculated for each PV. Subsequently an average value is computed.

We considered several individual, household and school characteristics as our independent variables. Individual traits relate to student gender, age (between fifteen and just over sixteen years old), course level, and hours of private tutoring in mathematics, reading and science as well as weekly hours dedicated to self-study in each competence. However, part of the time devoted to self-study might be the result of receiving private tutoring. Therefore, an auxiliary regression was used for each competence in order to deduct the time spent in self-study attributable to private tutoring. For each competence, the dependent variable used in these auxiliary regressions was time dedicated to self-study, while time spent in private tutoring and a set of individual and household characteristics are to be found on the right side of the expression.

Family traits refer to household socio-economic and cultural characteristics and educational resources and their use. In the case of the former, we considered mother's and father's years of schooling, whether they are active in the labor market as well as household occupation, defined as the highest occupation of the father or the mother. Occupations were classified as follows: highly-skilled white-collar, low-skilled white-collar, highly-skilled blue-collar and low-skilled blue-collar. As for educational resources, information refers to whether there is a computer at home, the intensity of its use by the pupils, and the type of use to which it is put (as a text processor, for email or videogames). In addition, the number of books in the household was also taken into consideration.

Information about the school includes its characteristics and those of its students, the school's resources and educational practices. School traits indicate the type of school (public or private), location (population size of the municipality), size (number of students) and whether there are other centers near the school. We also considered the composition of students at each school, including the proportion of girls, average years of schooling of parents, main occupation of students' parents and their perception of discipline in the school. School resources are described through class size, student-teacher ratio and ICT variables. Streaming of students, admission criteria and managerial autonomy were also considered in taking educational practices into account.

INSERT TABLE 1 AROUND HERE

Table 1 shows the dependent and independent variables considered together with a descriptive summary. If we focus on the variables related to private tutoring, only 16.0% of students do not attend private tutoring in mathematics. This figure increases to 28.3% in reading and 39.4% in science. Those that attend 3-4 weekly hours of private tutoring form the largest group of students in mathematics (38.3% of the whole) and reading (32.3%). As for science, of those receiving tutoring, the largest group is made up of those receiving 1-2 weekly hours (33.6%). The same pattern is found when analyzing the self-study variables: only 9.0% of students report that they do not study mathematics in an autonomous fashion. The figures for reading and science are 16.0% and 20.3%, respectively. Interestingly, while 45.8% of students devote at least 3 hours a week to self-study in mathematics, this figure falls to 26.9% and 22.0% for reading and science.

4. Econometric strategy

The PISA sample is designed using a two-stage method. In the first stage, a school sample is randomly selected from all schools in each country providing education for 15-year-old students. In the second stage, a random sample of students is chosen from each school selected in the first stage. Thus, the sample of students has a hierarchical structure (students are 'nested' in schools) but the principle of independence of variables between the students at each center is not maintained: students enrolled in the same school typically share socio-economic characteristics, which makes the average correlation among the variables for students within the center higher than that between students from different schools (Hox, 1995). The nested structure of the data suggests that the use of a hierarchical linear model would be an optimal strategy for estimating simultaneously the effects of variables belonging to different levels (Willms, 2006).

The econometric model is shown in equations (1) to (4), where Y_{ij} is the expected score in each competence of a student 'i' in school 'j', X_{kij} is a vector of 'k' characteristics of student 'i' at school 'j' (or independent variables at level 1), and Z_{lj} is a vector of 'l' characteristics of school 'j' (independent variables at level 2). Random effects are μ_j (at school level) and ε_{ij}, (at student level). β are the estimated parameters. Equation (4) is obtained by introducing equations

(2) and (3) into equation (1). Thus, in equation (4) a set of fixed effects (γ_{00}, γ_{10} X_{kij}, γ_{0l} Z_{lj}) can be distinguished from a group of random effects (μ_{1j} X_{kij}, μ_{0j}, ε_{ij}).

$$Y_{ij} = \beta_{0j} + \sum_{k=1}^{n} \beta_{1j} X_{kij} + \varepsilon_{ij} \qquad \varepsilon_{ij} \sim N(0,\sigma^2) \tag{1}$$

$$\beta_{0j} = \gamma_{00} + \sum_{l} \gamma_{0l} Z_{lj} + \mu_{0j} \qquad \mu_{0j} \sim N(0,\tau_0) \tag{2}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j} \qquad \mu_{1j} \sim N(0,\tau_1) \tag{3}$$

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{kij} + \gamma_{0l} Z_{lj} + \mu_{1j} X_{kij} + \mu_{0j} + \varepsilon_{ij} \tag{4}$$

Before running the econometric estimations, the endogeneity between the dependent variable and the independent ones needs to be considered. Thus, there might be endogeneity between the students' scores on the PISA and private tutoring, since it might be assumed that families whose children are more capable of achieving higher results are more willing to invest more in tutoring (i.e., these students are more capable of getting a higher return on their families' investment).

The Durbin-Wu-Hausman test confirms the existence of endogeneity between the dependent variable and private tutoring in mathematics and reading but not in science (residuals for private tutoring in science are non-significant). This result is in accordance with the fact that science is given less importance than mathematics and reading on the CSAT and, moreover, the students in the PISA sample report that science is less important than the other two competences. These factors are consequent with the fact that in the PISA test Koreans obtain worse results in science than in the other two competences (see Section 3).

Thus, in the hierarchical estimation (equation 4) private tutoring in mathematics and reading are considered through instrumental variables. The instrument used is the weekly number of hours spent receiving private tutoring in science. This variable is highly correlated with private tutoring in mathematics and reading but not with the dependent variable. Therefore, we estimated the effect of the instrument on the weekly number of hours spent receiving private tutoring in mathematics and reading (which are not included in the final model) together with a set of variables referring to a pupil's personal and family variables as well as to those of his or her school (results are available upon request). These new estimations of the hours of tutoring in

mathematics and reading were then introduced in equation (4) as explanatory variables together with the rest of the independent variables shown in Table 1.

The introduction of time dedicated to self-study as an independent variable could also be a matter of concern when seeking to measure the impact of private tutoring, since part of the time spent in self-study might be the result of receiving private tutoring. Consequently, we used three auxiliary regressions, one for each competence, to deduct the effect of private tutoring on the amount of time devoted to self-study. In these regressions, time spent in self-study was the dependent variable, while time spent in private tutoring and other personal and socioeconomic characteristics were the independent variables. Finally, our estimations provided robust standard errors and multicollinearity was not observed (all VIF values being below 4).

5. Results and discussion

The results of the complete models for the three fields of competence assessed in the PISA are presented in Table 2. Table 3 shows the random effects of the multilevel regression, indicating that total variance in academic performance is mainly explained by differences between individuals. The independent variables are grouped according to the type of characteristics described, with private tutoring variables (weekly number of hours of private tutoring in each competence) being included in the first group (individual characteristics).

Private tutoring does not always have a significant effect on a student's academic performance in all the models: while private tutoring in mathematics and, more modestly, in reading, seems to enhance the student's academic performance, tutoring in science appears to be ineffective. Results in Table 2 show that spending one or two hours per week in private tutoring in mathematics increases the expected performance on the PISA scale of the mathematics competence by approximately 16 points, while the impact of spending the same amount of time in private reading tutorials raises the student's achievement in this competence by about 12.5 PISA points. By contrast, the effect of spending one or two hours a week in private science tutoring on the academic performance in this competence is statistically non-significant.

Note also that the positive impact of private tutoring in mathematics and reading follows different trends: while the effect of private tutoring grows linearly for the former, it seems to describe a diminishing returns pattern for the latter. Its relatively large impact on academic

performance and its non-decreasing effect, therefore, provide a large incentive for investing heavily in private tutoring in mathematics.

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There are two possible reasons for the differences in the impact of private tutoring depending on the particular competence: on the one hand, repetition might play a greater role in acquiring competences such as mathematics; on the other hand, tutoring in science may be less effective reflecting student attitudes[5] towards tutoring in that competence, given that science has a lower weight on the final score of the CSAT compared to language and mathematics[6]. It might also be the case that the competence in science evaluated in the PISA differs from that which Korean students have to demonstrate on the CSAT.

It should also be stressed that the impact of private tutoring on academic performance does not always offset that of the number of hours of self-study time not induced by having received private tutoring. Table 2 shows that self-study time in mathematics and science has positive effects on academic performance. It increases the PISA scores by about 9.0 and 6.2 points per hour, respectively. By contrast, self-study in reading does not have a significant effect.

These findings open the door to the possibility of choosing, with certain temporal and budgetary restrictions, the optimal strategies for each individual. In other words, the simple accumulation of more hours dedicated to private tutoring might not always be the optimal strategy for maximizing academic performance. This is clearly the case, for example, for students wishing to enhance their competence in science. These students would be better served by dedicating more time to self-study rather than receiving private tutoring. Nevertheless, Korean families tend to hire the standard private tutoring "packages" offered by *hagwon* (academies specialized in the provision of private tutoring).

[5] This low level of interest in science is reflected not only in the lower mean scores that Korean students obtain in this competence in the PISA-2006 compared to their reading and mathematics scores, but also in the lower percentage of students that hire private tutoring services in science and in the lower interest index provided by PISA. By way of example, only 26.99% of high school students reported that doing well in science subjects was very important for them. These figures were 63.64% and 58.20% for the mathematics and reading competences, respectively. At the same time, only 11.72% of high school students strongly agreed with the statement "science is very relevant to me".

[6] The CSAT consists of five parts: Korean language, English, a second foreign language, mathematics and social studies/sciences/vocational education. While the first four parts are compulsory, students can choose between sitting the social studies, sciences or vocational education exam. Once they have chosen, they must then select four subordinate subjects.

Although certain combinations of tutoring might be more efficient than others in enhancing academic performance (students seeking to increase their overall performance through the use of the system should concentrate on hiring mathematics and language tutoring services, families that consume private tutoring are not acting irrationally, from an individual point of view. Potential marginal increases in academic performance mean Korean families will consume large amounts of private tutoring services in order to maximize their children's chances of being admitted to a SKY university. In a hypercompetitive and credentialist society such as Korea's, even the false belief that a certain strategy can boost academic performance (such as investing in private tutoring in science) will induce families to adopt it. This situation call into question the social efficiency of private tutoring.

Measuring the social efficiency of expenditure on private tutoring would require the conversion of all the costs and benefits linked to private tutoring to monetary units. This would involve translating increases in academic performance (in terms of the PISA and CSAT scores, for example) into GDP points, a task that falls beyond the scope of this paper. However, even if the positive effects of private tutoring measured in terms of GDP exceeded the effective costs (approximately 2% of GDP in 2008), it would not be easy to determine whether these benefits offset the negative externalities and the opportunity costs described in Section 1. If the individual benefits associated with the consumption of private tutoring did not offset their social costs, Korea would be trapped in a prisoner's dilemma. Further research would be needed to test this hypothesis.

Our results also have implications for social equality. If private tutoring in mathematics and reading have a positive effect on academic performance and it is the wealthier families that hire a larger number of private tutors (or better quality tutors), then the consumption of private tutoring will reduce the equality of opportunity for students seeking admission to higher education. Our analysis of the relationship between the time spent in private tutoring in the three fields of competence with total household income (the PISA-2006 dataset does not permit the calculation of income per individual household member) and the wealth and socioeconomic status indices provided by the PISA (Table 4) shows that the amount of time spent in private tutoring increases as the socioeconomic status and wealth of the household rise. This finding is consistent with results reported in recent studies (Jung and Lee, 2010 and Kim and Lee, 2010).

INSERT TABLE 4 AROUND HERE

Although a lower consumption of private tutoring could be offset in the case of mathematics and science by devoting more time to self-study, it should be borne in mind that students from low-income families are also those that are more likely to have fewer educational resources at home. Table 2 shows that the impact on academic performance of a household's educational resources is, in the Korean case, more important than that of household characteristics. This result indicates that the socioeconomic characteristics of a family find an indirect channel of influencing academic performance through the consumption of private tutoring. This should raise the concerns of the educational authorities as it could mean, in the long run, an increase in intergenerational educational inequalities.

With a wide range of policies aimed at reducing the consumption of private tutoring having failed, the Korean educational authorities find themselves at a crossroads. A blanket ban on private tutoring (implemented in 1980) failed and was declared unconstitutional in 2000. The public provision of services, in theory aimed at substituting private tutoring, including a TV educational scaffolding service (introduced in 1990) and, more recently, internet websites, has been unable to dampen the private tutoring market either. Modifying the admissions system to higher education has also proved to be ineffective (since the introduction of test essays by each university as a complementary criterion to the CSAT has led, as Lee (2010) reports, to the appearance of *hagwon* specialized in the preparation of such essays[7]). Therefore, there appear to be two main options left to the Korean educational authorities: on the one hand, they could seek to minimize the negative social consequences of the excessive consumption of private tutoring by regulating this private market[8]; on the other hand, the Korean public sector could go a step further in its sequential education expansion policy (Choi, 2009), enhancing the quality of the universities that Korean society currently perceives as non-elite centers and increasing the number of places offered by public universities. Yet, turning this situation around is not easy, as private tutoring is deeply rooted in the country's credentialism and social values.

To conclude, we end this section by sounding a note of warning. We studied the impact of private tutoring on the academic performance of 15-year-old students in the PISA. However, the extent to which these effects can be considered to persist to the age of 17, when Korean students sit their CSAT exam, is uncertain. Second, this paper does not include variables related

[7] Nevertheless, in recent times, the number of faculties using the CSAT scores as their sole criteria for admission rose from 11 in 2008 to 81 in 2010 (JoongAng Daily, 2009).
[8] For example, since 2008 *hagwon* have had to close at 10pm, as before it was common practice to remain open until the early hours.

to the quality of private tutoring, as the PISA data does not provide information about the different types of private tutoring received by the students.

6. Conclusions

Korean students grow up in a credentialist society where overheated competition leads families to adopt strategies that might enhance their children's chances of graduating from an elite university. The most frequently adopted of these strategies is the consumption of private tutoring services, based on the widely held belief that such services can improve students' academic performance. However, any specific evidence of the actual impact of private tutoring on academic performance in Korea is scarce. This paper has sought to fill this gap by undertaking a robust estimation of the effects of private tutoring on the three fields of competence assessed in PISA-2006.

The effects of private tutoring on academic performance have proved complex. Thus, the impact on academic achievement in mathematics is positive and increases linearly. In the reading competence, private tutoring has a positive but decreasing effect on the PISA-2006 reading scores, but investing in science tutoring appears not to be an efficient strategy for raising performance. These different effects seem to be related to both the nature of the competence assessed and the structure of the CSAT examination. For instance, an analysis of the PISA-2006 data shows that Korean students tend to take the mathematics competence more seriously than they do that of the sciences, reflecting in all likelihood the weight of both competences on the CSAT. At the same time, the effects of time dedicated to self-study also vary among the competences assessed, the greatest impact being recorded for time dedicated to mathematics.

These findings have several implications. First, the educational investment decisions of Korean families seem to be conditioned by the CSAT structure. Second, from an individual point of view, Korean families overinvest in certain kinds of private tutoring because of a lack of information about the actual benefits of such investment. Korean students, especially those attending private tutoring in the sciences, might well be assuming a high opportunity cost in the form of time not devoted to self-study. Third, our results also have equity implications. Consuming private tutoring might not always be the best strategy for increasing academic performance but, in a hypercompetitive environment, marginal gains may make a difference on the CSAT and few families are willing to take the risk of reducing their children's chances of

being admitted to a SKY university. Considering that families with high income levels invest more heavily in private tutoring, it may represent a source of inequality in student access to higher education.

Finally, two issues concerning the impact of private tutoring on academic performance in Korea remain unexplained. First, it is plausible that quality might be as important as quantity in determining the impact of private tutoring on academic performance. Second, although this paper shows that some types of private tutoring are beneficial for individuals, the situation might well be socially inefficient. However, this question can only be addressed by translating increases in the PISA or CSAT scores and the externalities of private tutoring into GDP points.

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Table 1. Data description.

	N	Min.	Max.	Mean	Std. dev.
Individual characteristics 1: Age and gender					
WOMEN (gender dummy: 1 if female)	3,947	0	1	0.500	0.500
AGE (student's age, in years)	3,947	15.33	16.25	15.77	0.29
YEAR9 (3rd year of middle school)	3,947	0	1	0.01	0.12
YEAR10 (1st year of high school)	3,947	0	1	0.98	0.15
YEAR 11 (2nd year of high school)	3,947	0	1	0.01	0.09
Individual characteristics 2: Self-study and private tutoring					
TUTMA0 (0 weekly hours in private tutoring - maths)	3,902	0	7	0.16	0.37
TUTMA1 (1-2 weekly hours in private tutoring - maths)	3,902	0	1	0.21	0.41
TUTMA2 (3-4 weekly hours in private tutoring - maths)	3,902	0	1	0.38	0.49
TUTMA3 (5+ weekly hours in private tutoring - maths)	3,902	0	1	0.25	0.43
TUTRE0 (0 weekly hours in private tutoring - reading)	3,905	0	1	0.28	0.45
TUTRE1 (1-2 weekly hours in private tutoring - reading)	3,905	0	1	0.31	0.46
TUTRE2 (3-4 weekly hours in private tutoring - reading)	3,905	0	1	0.32	0.47
TUTRE3 (5+ weekly hours in private tutoring - reading)	3,905	0	1	0.09	0.28
TUTSC0 (0 weekly hours in private tutoring - science)	3,905	0	1	0.39	0.49
TUTSC1 (1-2 weekly hours in private tutoring - science)	3,905	0	1	0.33	0.47
TUTSC2 (3-4 weekly hours in private tutoring - science)	3,905	0	1	0.24	0.43
TUTSC3 (5+ weekly hours in private tutoring - science)	3,905	0	1	0.04	0.20
SSTUDMA(weekly hours in self study - maths)	3,899	0	7	2.71	2.09
SSTUDRE (weekly hours in self study - reading)	3,907	0	7	1.61	1.50
SSTUDSC (weekly hours in self study - science)	3,902	0	7	1.40	1.39
Household 1. Socio-economic and cultural characteristics					
MOTSCY (years of schooling: mother)	3,910	3	16	12.53	2.53
FATSCY (years of schooling: father)	3,895	3	16	13.34	2.64
MOTNACT (dummy: 1 if mother economically non-active)	3,801	0	1	0.26	0.44
FATNACT (dummy: 1 if father economically non-active)	3,876	0	1	0.01	0.08
QWHITEC (white collar, highly-skilled household)	3,913	0	1	0.71	0.45
NQWHITEC (white collar low-skilled household)	3,913	0	1	0.16	0.36
QBLUEC (blue collar highly-skilled household)	3,913	0	1	0.08	0.28
NQBLUEQ (blue collar low-skilled household)	3,913	0	1	0.04	0.21
Household 2. Educational resources and their use					
NCOMPU (dummy: 1 if no computer at home)	3,943	0	1	0.02	0.14
25BOOKS (0-25 books at home)	3,942	0	1	0.10	0.30
100BOOKS (26-100 books at home)	3,942	0	1	0.31	0.46
200BOOKS (101-200 books at home)	3,942	0	1	0.27	0.44
500BOOKS (over 200 books at home)	3,942	0	1	0.33	0.47
REGUSECO (student uses computers frequently)	3,934	0	1	0.93	0.25
OCUSECO (student uses computers occasionally)	3,934	0	1	0.05	0.23
NUSECO (student never uses computers)	3,934	0	1	0.11	0.10
REGWRITE (student uses text processors frequently)	3,917	0	1	0.30	0.46
OCWRITE (student uses text processors occasionally)	3,917	0	1	0.63	0.48
NWRITE (student never uses text processors)	3,197	0	1	0.07	0.26
REGEMAIL (student uses email frequently)	3,921	0	1	0.63	0.48
OCEMAIL (student uses email occasionally)	3,921	0	1	0.25	0.43
NEMAIL (student never uses email)	3,921	0	1	0.11	0.32
REGVIDEO (student plays videogames frequently)	3,916	0	1	0.49	0.50
OCVIDEO (student plays videogames occasionally)	3,916	0	1	0.29	0.46
NVIDEO (student never plays videogames)	3,916	0	1	0.21	0.41
School1. School characteristics					
PUBLIC (public school)	3,947	0	1	0.54	0.50
PRIVPUBF (private school; publicly funded)	3,947	0	1	0.27	0.44
PRIVATE (private independent school)	3,947	0	1	0.19	0.39
CITYSIZ1 (population > 1,000,000)	3,947	0	1	0.48	0.50
CITYSIZ1 (population 100,000-1,000,000)	3,947	0	1	0.37	0.48
CITYSIZ3 (population < 100,000)	3,947	0	1	0.14	0.35
OTHERSCH (maximum 2 centers near the school)	3,913	0	1	0.26	0.44
SCHSIZE (school size)	3,947	68	2,053	1,154.43	402.06
School 2. Student characteristics					
PCGIRLS (proportion of girls at school)	3,947	0	1	0.50	0.37
SCHEDU (average years of schooling of parents)	3,947	10.88	15.83	13.65	0.92
SCHQWHI (white collar, high-skilled, mode)	3,947	0	1	0.98	0.12
SCHQBLU (blue collar, high-skilled, mode)	3,947	0	1	0.02	0.12
DISCPROB (dummy: 1 if parents think there are discipline problems at school)	3,861	0	1	0.20	0.40
School 3. School resources					
CLSSIZ (class size)	3,947	23	43	33.62	3.59
STRATIO (student-teacher ratio)	3,947	6.11	27.78	16.73	2.25
FTEACH (proportion of full-time teachers)	3,947	0.73	1	0.97	0.05

IRATCO (computers for instruction/ school size)	3,774	0.11	0.07	0.03	0.64
School 4. Educational practices					
STREB (streaming between classes)	3,574	0	1	0.17	0.37
STREW (streaming within classes)	3,325	0	1	0.35	0.48
RESID (residence is used as admission criterion)	3,844	0	1	0.40	0.49
SELEC (academic records or recommendations are used as admission criterion)	3,831	0	1	0.66	0.47
RELIG (religious or philosophical issues are used as admission criterion)	3,831	0	1	0.10	0.30
AUTCONT (autonomy for selecting teachers for hire)	3,947	0	1	0.37	0.48
AUTBUDG (budgetary autonomy)	3,947	0	1	0.71	0.46
AUTEXT (autonomy for selecting textbooks)	3,947	0	1	0.96	0.19
AUTCONTE (autonomy for selecting contents)	3,947	0	1	0.92	0.28
AUTOCU (autonomy for modifying the curriculum)	3,947	0	1	0.81	0.39

Table 2. Determinants of academic performance in Korea: fixed effects with robust standard errors of multilevel models in PISA-2006.

	Mathematics	Reading	Science
Constant	397.06*** (2.93)	482.82*** (3.49)	319.05** (2.31)
Individual characteristics 1: Age and gender			
Female	-17.53** (-2.39)	31.51*** (5.65)	-8.58 (-1.18)
Age	-8.38 (-1.18)	-6.38 (-0.89)	4.32 (0.70)
Enrolled in year 9	-57.84*** (-3.20)	-75.84*** (-4.20)	-64.75*** (-4.03)
Enrolled in year 11	41.72** (2.33)	38.94** (2.10)	30.22*** (1.86)
Individual characteristics 2: Self-study and private tutoring			
Weekly hours in self study in competence	8.99*** (5.06)	3.15 (1.30)	6.23** (2.45)
1-2 weekly hours in private tutoring in competence	16.40* (1.93)	12.48** (1.99)	6.54 (0.88)
3-4 weekly hours in private tutoring in competence	23.54** (1.98)	15.42** (1.96)	11.16 (1.41)
5+ weekly hours in private tutoring in competence	36.28*** (2.89)	25.26 (1.18)	11.68 (1.11)
Household 1. Socio-economic and cultural characteristics			
Mother's years of schooling	-0.36 (-0.26)	-0.49 (-0.33)	-0.14 (-0.09)
Father's years of schooling	-0.93 (-1.01)	-2.50** (-2.34)	-0.95 (-0.98)
Mother economically non-active	-10.61 (-1.56)	-7.26 (-1.28)	-10.45* (-1.87)
Father economically non-active	-13.19 (-0.72)	-15.67 (-0.90)	-0.21 (-0.01)
White collar low-skilled household	-6.64 (-0.90)	-14.85** (-2.53)	-13.88** (-2.25)
Blue collar highly-skilled household	-4.30 (-0.45)	-13.03 (-1.32)	-5.33 (-0.51)
Blue collar low-skilled household	9.58 (1.38)	-5.56 (-0.49)	-6.87 (-0.53)
Household 2. Educational resources and their use			
Household without computer	-44.43** (-2.18)	-42.79** (-2.19)	-40.25*** (-3.40)
26 to 100 books at home	18.66** (2.51)	20.71*** (3.15)	14.29* (1.82)
101 to 200 books at home	28.54*** (3.14)	27.78*** (3.45)	29.51*** (2.92)
Over 200 books at home	45.36*** (4.96)	44.93*** (4.23)	39.03*** (3.64)
Student uses computers occasionally	-2.72 (-0.24)	0.86 (0.06)	5.77 (0.47)
Student never uses computers	16.16 (0.59)	28.56 (1.11)	33.89 (1.47)
Student uses text processors occasionally	17.39** (1.99)	11.22 (1.47)	12.00 (1.55)
Student never uses text processors	-12.22 (-1.03)	-26.53** (-2.57)	-32.65*** (-2.81)
Student uses email occasionally	8.39* (1.71)	10.13** (2.26)	9.70 (2.37)
Student never uses email	-10.20 (0.27)	-10.17 (-1.40)	-6.37 (-0.82)
Student plays videogames occasionally	11.45 (1.32)	7.09 (0.97)	13.89* (1.84)
Student never plays videogames	-2.57 (-0.26)	-1.77 (-0.23)	0.53 (0.07)
School 1. School characteristics			
Private publicly funded school	-30.83*** (-3.13)	-26.12** (-2.51)	-34.92*** (-2.81)
Private independent school	-3.84 (-0.36)	-3.73 (-0.35)	-11.21 (-0.93)
Medium size city: population from 100,000 to 1,000,000	4.89 (0.69)	7.07 (0.94)	2.03 (0.29)
Small size city: population < 100,000	-6.33 (-0.59)	-2.24 (-0.21)	-3.29 (-0.31)
School size	0.00 (0.28)	-0.01 (-0.48)	-0.00 (-0.23)
Maximum two other centers near the school	11.47 (1.54)	10.75 (1.25)	6.04 (0.77)
School 2. Student characteristics			
Proportion of girls at school	26.24*** (2.91)	17.29* (1.94)	26.07** (2.47)
Average years of schooling of parents	20.97*** (3.84)	20.80*** (4.12)	19.29*** (3.79)
Blue collar highly-skilled school	2.63 (0.15)	6.37 (0.30)	6.67 (0.28)
Discipline problems	-16.04** (-2.60)	-8.40 (-1.40)	-9.30 (-1.60)
School 3. School resources			
Class size	-2.58* (-1.84)	-2.59* (-1.79)	-2.90* (-1.87)
Student-teacher ratio	-1.34 (-0.70)	0.79 (0.42)	0.53 (0.28)
Proportion of part-time teachers	83.14 (0.20)	-6.01 (-0.09)	-32.57 (-0.44)
Computers for instruction per student	-5.17 (-0.12)	-78.08 (0.17)	-28.49 (-0.54)
School 4. Educational practices			
Streaming within classes	-9.99 (-1.20)	-14.29 (-1.59)	-8.28 (-1.09)
Streaming between classes	5.69 (0.76)	-11.32 (0.13)	1.63 (0.22)
Admission criterion: residence	-10.69* (-1.92)	-5.47 (-0.90)	-4.09 (-0.67)
Admission criteria: Acad. records and recommendations	19.08*** (3.03)	9.23 (1.27)	15.65** (2.47)
Admission criteria: Religious or philosophical issues	2.42 (0.29)	3.40 (0.37)	11.79 (1.17)
Autonomy for selecting teachers for hire	7.23 (0.77)	16.31* (1.73)	12.35 (1.12)
Budgetary autonomy	-21.64*** (-2.85)	-23.09*** (-2.94)	-26.00*** (-3.51)
Autonomy for selecting textbooks	-10.65 (14.83)	-15.95 (-1.08)	-7.29 (-0.56)
Autonomy for selecting contents	8.59 (6.59)	7.25 (0.80)	-7.22 (0.71)
Autonomy for modifying the curriculum	-1.88 (-0.27)	5.17 (0.72)	7.77 (1.10)
Observations	3.947	3.947	3.947

Note: 1. *t* statistics in parentheses; *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 3. Multilevel regression: Random effects.

	Mathematics		Reading		Science	
Variances	Null model	Complete model	Null model	Complete model	Null model	Complete model
Schools (uj)	2,851.37	485.88	2,254.30	556.53	2,137.68	539.73
Individuals (εij)	4,472.83	3,832.16	4,018.13	3,547.23	4,454.48	4,055.12
Total (uj + εij)	7,324.20	4,318.04	6,272.43	4,103.76	6,592.16	4,594.85
% of the total variance explained by the variables		41.0%		34.6%		30.3%
% of the level 1 (students) variance explained by the variables		14.3%		11.7%		9.0%
% of the level 2 (schools) variance explained by the variables		83.0%		75.3%		74.6%

Table 4. Relationship between consumption of private tutoring in mathematics and the household's socioeconomic status and wealth indices as provided by PISA-2006.

	Household's socioeconomic status index	Household's wealth index
0 weekly hours	-0.35	-0.52
0-2 weekly hours	-0.10	-0.36
2-4 weekly hours	0.12	-0.20
More than 4 weekly hours	0.32	-0.04
Mean	-0.15	-0.29

Note: More positive (or less negative) values indicate higher socioeconomic status and wealthier households, respectively.