THE DETERMINANTS OF NATIONAL COLLEGE ENTRANCE EXAM PERFORMANCE IN CHINA –WITH AN ANALYSIS OF PRIVATE TUTORING

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ABSTRACT

The Determinants of National College Entrance Exam Performance in China – With an Analysis of Private Tutoring

Yu Zhang

This study ascertains the effects of private tutoring and other factors on student performance in the National College Entrance Examination (NCEE) in China, using first hand data collected in a typical Chinese city in 2010. Three identification strategies including the instrumental variable model, the 3-level hierarchical linear model, and the Heckman two-stage method are applied in order to account respectively for the endogeneity of private tutoring participation, hierarchical data structure, and non-random high school selection bias. The quantile regression and the analysis of the urban and rural subsamples identify heterogeneous effects of various education factors on student performance. The study finds that the High School Entrance Exam (HSEE) score, good study habits and ability, parents caring about study and respecting the child, key class, the HSEE admission line, rich school activities, and the administrative style of high authority and accountability are significant and positive determinants of the NCEE score across subjects and models. Socioeconomic status has a significant and positive effects on the NCEE English score and total score, but the effect size is relatively small. Female students perform better than male students in Chinese and English, and there is no gender gap in math or in the

total score. Private tutoring generally has no effect on the NCEE score for the whole sample, but may have a positive effect on low performing urban students and a negative effect on rural students who are not at the top. Rural students may face limited access to high quality private tutoring compared with their urban counterparts. Lower HSEE score, a higher SES, and more school level educational inputs are positive predictors of private tutoring participation.

By using primary data, this study is the first to provide a comprehensive investigation of the effects of three levels (individual, class, and school) of factors on the NCEE performance in China. It includes factors such as the parental styles of educating their child and the school administrative styles that were seldom considered in previous studies in China. This also is the first to investigate the effect of private tutoring on student performance in China. Detailed information on the private tutoring industry is documented for the first time. The findings of this study have significant implications for education decision making by public policymakers and parents.

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Chapter 1 Introduction

1.1 The Context and Motivation

China has one of the largest student bodies in the world, with 209 million students enrolled in basic education[1] and 20.2 million students in higher education in 2009[2]. The National College Entrance Examinations (NCEE) are conducted every year to select students from high schools into colleges, with the transition rate as high as 61.67% in 2009[3]. The NCEE has become one of the most important events and hot topics each year in China, involving wide focus from various social classes and energetic debates over it.

The NCEE is extremely influential in at least three ways. First, the NCEE is the primary way to compete for higher education resources for young people. It is the key decision point with tremendous implications for a student's future prospects in adult life. The gross enrollment rate of higher education in China was only 23.3% in 2008[4] and the quality of different institutions varied seriously (Bao, 2009). Thus, the NCEE becomes a playing field for both opportunity and quality of higher education. Second, a huge amount of public and private resources have been devoted to the competition of NCEE achievement (Xue & Ding, 2009), the effects of educational inputs should be evaluated in order to make better use of them and to improve education quality.

[1] From preschool to Grade 12, excluding vocational secondary education. Students enrolled in all kinds of vocational secondary education is 7.6 million.
[2] Data source: China Statistical Yearbook 2010.
[3] Data source: the National Education Examination Authority
[4] Data source: the National Education Examination Authority

Third, since education is an important determinant for both future earnings (Brauw & Rozelle, 2007; Guo & Ding, 2005; Min et al. 2006; Solomon & Fagnano, 1995; Zhao & Zhou, 2007) and social and occupational mobility (Hannum & Park, 2007; Levin, 1995; Zheng, 2009), NCEE as the main pass towards higher education provides a somewhat objective opportunity for all and is crucial to social mobility in China (Zheng, 2009).

In addition, private supplementary tutoring has been expanding rapidly in China (Lei, 2005; Tsang, Ding, & Shen, 2010; Xue & Ding, 2009) and elsewhere (Dang & Rogers, 2008). According to Xue and Ding (2009), for example, 73.8% of students in elementary schools, 65.6% of junior middle school students, and 53.5% of senior high school students participated in private tutoring in urban China in 2004. It has become more and more prevalent for high school students to employ private tutors to improve their competitiveness in the college entrance process in China (Xue & Ding, 2009). It is argued by some scholars that the main reasons for the expansion of private tutoring in China include the large disparities in educational quality, test-oriented education, high cultural value of education, as well as school teachers' need to increase income because of the increasing living expense and relatively low teacher salary (Xu, 2009). Given the large proportion of students employing private tutoring, the shadow education in urban China has become a significant part of the whole educational` system that cannot be neglected by educational researchers and policymakers.

Therefore, the research on the determinants of the NCEE performance and private tutoring participation is crucial to not only education policy makers but also the thousands of parents. The evaluation of education equity and efficiency could be done through the empirical analysis.

1.2 Statement of the Problem

Given the significance of NCEE and the great deal of resources it involves, there are surprisingly few empirical studies investigating the relationship between the various educational inputs and the NCEE achievement in China. How different kinds of inputs work is still unclear from the academic perspective, which may undermine policymaking as well as household education decisions. In addition, the debate on the relative impacts of school versus family influence, which is closely related to education equity issues, has not received adequate attention in China, although it has persisted for decades in the U.S. (Borman & Dowling, 2010; Coleman, 1966; Green, Dugoni, Ingels, & Cambrun, 1995; Hanushek, 1989 & 1996). Therefore, this proposed study attempts to identify and estimate the determinants of student achievement in China with appropriate estimation techniques that correct for common data problems.

Closely correlated with both formal schooling and private investment in education, a rapidly growing share of high school students participate in private tutoring in order to be better prepared for the NCEE. But existing studies on student achievement have not paid much attention to this change and have neglected this private input for education until now. Scholars have raised serious concerns on the social stratification effects and inequity of private tutoring

(Baker & LeTendre, 2005; Xue & Ding, 2009). Household spending on private tutoring and students' time devoted to private tutoring are part of the household's private cost of education. And private cost of education has been found to be an important part of the total cost of education in China and elsewhere (Li & Tsang, 2003; Tsang 2002). However, very few studies have been carried out to investigate the determinants of private tutoring in China. There is also no study on the impact of private tutoring on student academic achievement. This study may identify the determinants of private tutoring participation and the potential effects of private tutoring on the NCEE achievement. This would shed light on policy decisions towards more equitable and efficient education resource allocation in education in China.

1.3 Key Research Questions

There are two key research questions in this study:

(1) What are the determinants of student performance on the NCEE in China?

(2) What are the determinants and effects of private tutoring?

i. What factors influence the students' private tutoring participation?

ii. Does private tutoring improve student achievement?

The first research question aims at identifying the main determinants of the NCEE score at student level, class level, and school level. The potential influence of socioeconomic status, pre-test score, gender, and rural residence will be evaluated. Parents' styles of educating their child

and class and school level inputs including school administrative styles will also be incorporated into the analysis. Three different identification strategies will be conducted in order to control respectively for endogeneity of private tutoring, nested data structure at different levels, and the high school selection bias.

The second research question highlights the analysis of private tutoring for several reasons. First, private tutoring is a rapidly emerging phenomenon and deserves more up to date research to uncover its determinants and consequences. Second, since private tutoring is taken as an endogenous variable, more efforts are needed to address its causal determinants and consequences.

Those two research questions will be answered by academic subject, registered residence, and identification strategy. The three core subjects – Chinese, math, and English – will be analyzed, as well as the NCEE total score. The relevant terms will be defined at the end of this chapter.

1.4 Brief Picture of the Education System in China

In this section, a brief picture of the educational system in China will be interpreted through the introduction of the current educational system, the major problems and concerns in education in China, and the *Mid and Long Term Education Reform Plan (2010-2020)*. More detailed education indicators and the history of the National College Entrance Exam will be discussed in Chapter 2.

1.4.1 Current Education System[5]

The educational system in China is composed of preschool education, 9-year compulsory education, the 3-year upper-secondary education, postsecondary education, the continuing education, and special education. Most of the preschool education is in the cities and is not run by the government. The 9-year compulsory education includes primary education and lower-secondary education, with the gross enrollment rates as 99.54% and 98.50% respectively in 2008. Upper-secondary education is not compulsory, and includes both regular high school education and vocational high school education. The gross enrollment rate of the upper-secondary education was 74% in 2008, with a large disparity between the urban and rural areas. The 9th graders must write the High School Entrance Exam (HSEE) in order to apply for high schools. Most of the high quality schools are public schools, among which the top schools are called the key schools that receive significantly more public resources. Thus, there is large disparity in school quality.

The various types of institutions in postsecondary education include the 2-3 year short-cycle college, the 4-year college, and the graduate school. The gross enrollment rate of higher education was 23.3% in 2008. All the college applicants must write the National College Entrance Exam before the application. Most of the universities are public institutions and are financed by the central government, the provincial government, and the local government

[5] Data source of this section: Quanguo Jiaoyu Shiye Fazhan Tongji Gongbao (National Statistic Bulletin of Education Development, China) 2008

respectively. The quality of higher education varies tremendously from the top universities to the local colleges. Most of the private universities are for profit and are relatively new, compared with the public universities.

The Chinese culture values education highly and every parent wants their child to have as much education as possible, regardless of family income, socioeconomic status, and urban/rural areas. Academically oriented education is highly preferred to vocational education.

1.4.2 Major Problems and Concerns

There are several major problems in the current Chinese education system. First, high quality educational resources are scarce in China and there is serious educational inequity at different educational levels. This leads to fierce competition in the standard exams, which not only promotes test-oriented teaching but also puts a heavy burden on the students. The test-oriented education is criticized for killing students' imagination, creativity, and critical thinking skills. Although the curriculum reform was initiated many years ago, the test-oriented teaching cannot be avoided as long as fierce competition still exists and the standard test is the major way to get access to high quality education. More and more parents have begun to send their children to study abroad starting from the high school, in order to avoid the competition and potential harm to their offspring's creativity. This kind of education migration may cause a serious loss of human resource within China. However, standard tests may serve as the fairest way in educational resource allocation because they set up clear rules and limit the chance for corruption

to a large extent. Thus, more high quality education resources are needed in order to reduce the competition through the tests.

Second, the educational quality disparity raises a serious issue of school choice at each educational level. Students must compete to get into the top kindergarten in order to have more chance to be admitted into the key primary school, and then the lower-secondary school, the high school, and the top university in the end. Rich students with lower academic performance can buy their way into the key schools, which exacerbates educational inequity. The school choice fee is usually several times higher than the tuition. A large amount of household education expenditure is spent on it (Tsang, 2003).

Third, the higher education expansion during the last decade increased the number of college graduates dramatically, while the quality of education received by these graduates decreased. In addition, the Chinese economic structure relies more on the labor-intensive industries and does not provide enough innovation-oriented positions or opportunities for technology based small business. Thus, more and more university graduates cannot find suitable jobs when they enter the labor market. On the one hand, the employers claim to have difficulty in finding qualified employees. On the other hand, the new graduates with Bachelor's degrees, Master's degrees, or Doctoral degrees have difficulty in finding jobs that match what they have learned in school. Rural students who have little social capital have more difficulty finding a job

than urban students. The high economic burden to go to college makes more and more rural students give up higher education and even do not write the NCEE[6].

1.4.3 The Mid and Long Term Education Reform Plan (2010-2020)[7]

Educators and policymakers in China recognize the problems in education. The Chinese government issued *The Mid and Long Term Education Reform Plan (2010-2020)* in 2010, which addresses most of the issues and problems in education. According to the plan, the government will invest more money in the preschool education, and raise the gross enrollment rate from 74% in 2009 to 95% in 2020, especially in rural areas. The high school gross enrollment rate will increase from 79% in 2009 to 90% in 2020. And the higher education gross enrollment rate will be raised from 24.2% in 2009 to 40% in 2020. Raising quality at all educational levels is also an important objective of *The Mid and Long Term Education Reform Plan (2010-2020).*

The plan explicitly proposes the improvement of education equity in basic education (primary and secondary education), especially in rural areas. Comprehensive skills of high school students are emphasized. It also points out that the government will expand vocational education in order to solve the job placement problem. The importation of high quality educational resources will be increased through the internationalization of the educational system and international cooperation. Teacher's training and salary will also be increased.

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[6] For example, about 10,000 rural high school graduates in Chongqing gave up NCEE in 2009 and go to the later market (http://pinglun.eastday.com/p/20090419/u1a4318902.html). About 840,000 high school graduates out of the 8340,000 graduates nationwide gave up the NCEE (http://news.163.com/09/0603/02/5AROBFUU0001124J.html).

[7] http://www.gov.cn/jrzg/2010-07/29/content_1667143.htm

The educational system reform is proposed for student admission system at high school and college levels, the autonomy of universities, the encouragement of private school establishment, and the increase of public financial resources for education.

In summary, the educational system in China has reached a period when reform is needed and eagerly advocated. Both the government and the parents are expecting positive transformation of this educational system. However, it is easier said than done, especially for the reform of one of the world's largest educational systems. Extensive research should be devoted to this area in order to provide effective and feasible policy suggestions. This study concentrates on the analysis of determinants of student performance in the NCEE. It is conducted in this key period of educational development and innovation in China, and is expected to provide concrete policy suggestions based on empirical evidence.

1.5 Structure of Dissertation

Following this introductory chapter, Chapter 2 reviews the literature in (1) the empirical analysis on the determinants of student academic achievement, (2) the NCEE in China, and (3) the determinants and effects of private tutoring. For the first section, the empirical findings of the determinants of student achievement in the U.S. as well as in the developing countries are reviewed separately. For the second section, the general education indicators in China, the history of the NCEE, and the empirical studies on the determinants of student academic achievement in China are reported and discussed. In the last section of Chapter 2, the definition

and development of private tutoring in the world are discussed first, followed by the survey of the empirical findings on the determinants and effects of private tutoring in various countries including China.

Chapter 3 presents and discusses the methodological design and the data collection of this study. The former includes three identification strategies including the instrumental variable (IV) design, the hierarchical linear model (HLM), and the control function (CF) method. The latter discusses and documents the data collection and data process from the aspects of sampling strategy, questionnaire design, field work of data collection, data entry, computation of sampling weights, missing data, and index construction. Reliability measures of selected variables are reported at the end of this chapter.

In Chapter 4, the descriptive statistics and the correlation matrix of selected variables that pass the collinearity test are reported first. The NCEE score is then reported by urban-rural residence, gender, academic track, parental education and profession, and private tutoring participation status. The private tutoring industry is explored through the percentage of private tutoring participants in the sample, the major professions of private tutors, the class size and agency type of private tutoring, the hourly fee of private tutoring, the self-reported reasons for and evaluation on private tutoring participation by students.

Chapter 5 is devoted into the presentation and discussion of the results regarding the instrumental variable model (the Basic Model). The first section reports the findings on the determinants of NCEE score by subjects and by three measures of private tutoring participation.

The results are compared with those of the ordinary least square (OLS) model. The validity tests of the instrumental variables are discussed, followed by the quantile regression analysis that aims at identifying the heterogeneous effect of private tutoring. The second section discusses the determinants of private tutoring participation using the logit model, the tobit model, and the OLS model respectively. Following Chapter 5, Chapter 6 presents the empirical results of the HLM model and the CF model. Comparisons between these two models with the IV model are conducted respectively.

Chapter 7 concludes by summarizing the key findings, discussing the significance and limitations of this study, proposing policy implications, and pointing out the directions of further research.

In the annexes, Appendix 1 reports the detailed information of the High School Entrance Exam. Appendices 2 and 3 show the location of Shandong Province and Jinan City respectively. Appendix 4 presents the four questionnaires for students, parents, teachers, and principals respectively. Appendix 5 lists the descriptive statistics without the sampling weight. Appendix 6 reports the descriptive statistics of the predicted probability of private tutoring participation from the logit model. In Appendix 7, the second stage estimates of the Control Function model are reported by urban and rural subsamples for each subject and each measure of private tutoring.

1.6 Definition of Key Terms

The following part of this section gives the brief definition of some key concepts involved in this study.

(1) Student Performance in the NCEE

The forms and contents of the NCEE vary across provinces and overtime (as will be discussed in Chapter 2). Students with talents in some subjects, fine art, music, dancing, athletics, and student leadership may get some extra rewards. The term "student performance in the NCEE" only refers to original test scores of Chinese, mathematics, English, and total score in the NCEE. Test scores of other subjects (such as science and humanity) and extra rewards (in student leadership skills, art, or sports) are not considered in this study.

(2) Regular High School

In China, primary education is usually from Grade 1 to Grade 6, lower secondary education is usually from Grade 7 to Grade 9, and upper secondary education is from Grade 10 to Grade 12. G10-12 is also called high school, which is neither compulsory nor free (basic education consists of grades 1-12). There are two types of high school – regular high school and vocational/technical high school. The former could be considered as the academic tracking, and the latter could be considered as the vocational tracking. Regular high schools have to admit students through the High School Entrance Exam (HSEE), while vocational and technical high schools can recruit students through both the HSEE and their own admission exams. There are both public and private regular high schools, and the former constitute the major part of the regular high school system. This study only looks at students in public regular high schools, which may be called high schools for convenience.

(3) High School Entrance Exam (HSEE)

The HSEE exam in 2007 included three parts: paper-based exam, physical training exam, and the information technology exam. The paper-based exam is the most important one. It includes Chinese, math, English, the Comprehensive Exam of Science (Physics, Chemistry, and Biography), and the Comprehensive Exam of Humanity (Political Science, History, and Geography). The first four subjects are closed-book exam while the last subject is open-book. The full marks of the HSEE are 690, including the score of physical training exam. Detailed information of each test is reported in appendix.

(4) High school selection rule

The high school selection is non-random and is related to a number of factors including the HSEE score, home residence, government policy to promote equity, and so on. The key schools are allowed to admit students from the entire city in order to get the best students. Other schools are only allowed to recruit students in their own districts. Each school has an admission line that is determined by the school's prestige and historical academic performance in history. Basically speaking, only students with a HSEE score above the admission line can apply and be enrolled into a certain high school. Students with a HSEE score with a few points lower than this threshold can pay for school choice fee in order to get in. To improve educational equity, the government requires high performing high schools to admit a small amount of students from lower performing middle schools with

lower admission line without charging extra choice fee. Students with talent in art and athletics can be admitted with much lower HSEE scores than the admission line.

(5) School choice student

High school applicants with a HSEE score a few points lower (ranges from 10 to 80 points across schools, usually around 30 points) than the admission line of a certain school can pay for "school choice fee" in order to get into that school. This kind of student is called school choice student. They are considered as regular students after being admitted. By doing this, school choice students can go to schools with relatively higher quality. The school choice admission line and the school choice fee are usually determined by the local education authority and have to comply with the law. The school choice fee is between two to four times the three-year tuition in total, and must be paid before admission. School choice students do not need to pay for tuition every year after paying for the school choice fee.

(6) Key class

In basic education in China, the top performing students are usually assigned into one or two classes in that cohort, and the top performing teachers are also assigned to these classes. This kind of class is called the "key class," and the other classes are called the "panel class." The key classes have the best students and are expected to produce the best educational outcome. The purpose of the key class is to provide advanced education to the talented students. It also generates high performance in the standard tests and school promotion. In the past few years, to improve education equity, the Chinese Ministry of Education and the

provincial departments of education began to forbid the establishment of key classes in compulsory education, but not in upper-secondary education.

(7) Science and humanity tracks in regular high school

There are no academic tracks in compulsory education, but high school students are divided into a science track or a humanity track according to their own academic interest. Chinese, math, and English are the three common core courses for all students. Besides that, science track students have three additional required course including physics, chemistry, and biology; and humanity track students will have history, political science, and geography as their required courses. The NCEE is also designed for these two tracks respectively.

(8) Private supplementary tutoring

This study only discusses private tutoring for academic subjects, and does not investigates private tutoring in arts, music, etc. Corresponding to the NCEE subjects that are investigated in this study, the tutored subjects of interests include Chinese, mathematics, and English. Different forms of private tutoring include (a) one-to-one private tutoring, (b) small groups of students with one tutor, and (c) private tutoring in a large class setting. Both school teachers and other tutors are considered as private tutors as long as they charge fees for providing tutoring. Some public schools require students to participate in some kind of remedial classes or classes for enrichment on weekends and charge extra fees for these classes. It would be considered as private tutoring as well.

(9) Registered permanent residence

In China, the "*Hukou*" policy, which is the "registered permanent residence" in English, segregates the rural residents from the urban residents. People with urban registered residence can enjoy welfare including free health care, high quality education, and retirement pension in the cities, while people with rural residence can only have low quality welfare (and it is not free) and no retirement pension in the rural areas. At high school level, schools are concentrated in the cities and large counties in order to create economics of scale and lower education cost. Rural students can be enrolled into the high schools in the counties and the key urban schools if they have outstanding academic performance.

(10) Socioeconomic status (SES)

Socioeconomic status in this study is defined by the parents' educational level and parents' professions. The parents' educational level is measured by the parents' highest education degrees. The parents' professions are classified and ranked according to Lu (2002, 2010)'s study on the social stratification in contemporary China. SES is an indicator constructed from the principal analysis, which is discussed in Chapter 3.

Chapter 2 Literature Review

2.1 Introduction

The review of literature includes three parts. The first part reviews the empirical findings on the determinants of student academic achievement in both the U.S. and developing countries. The second part reviews the history of the National College Entrance Exam (NCEE) and college admission in China, as well as empirical studies on determinants of student achievement in China. The third part surveys empirical studies in the scale and determinants of the demand for private tutoring (PT), and its effects on student achievement in both China and other countries.

2.2 Empirical Findings on the Determinants of Student Academic Achievement

Empirical analysis on the determinants of student academic achievement could be divided into two categories: the effects of school related inputs, i.e., school effects, and the effects of nonschool related inputs, such as student's own characteristics, family background, and community.

Before the discussion of school effects, one should first distinguish between "school effects" and "effects of schooling." The latter is the influence on achievement of being schooled versus not being schooled, while the research of the former examines the variation of the level of resources, or policies, or school climate and so forth among schools explains achievement differences among students" (Baker & LeTendre, 2005).

2.2.1 Empirical Findings in the U.S.

Numerous empirical studies in the United States have been conducted to evaluate the effects of various education inputs and processes on student academic achievement. The purpose of this section is to present a concise summary of the key findings. Overall, evidence from these studies about school related inputs is mixed, depending on the data, models, and methodologies. But most studies support the finding that student family background (e.g., SES and parental education level) plays an important role in determining student academic achievement (Alwin & Thorton, 1984; Coleman, 1966 & 1988; Dossey, Mullis, Lindquist, & Chambers, 1988; Green, Dugoni, Ingels, & Cambrun, 1995; Keith & Cool, 1992; McConeghy, 1987).

The mixed research findings on school effects started from the well-known Coleman Report (1966), which used a national sample and concluded that school resources had a surprisingly small and uncertain impact on student achievement, while family background such as socioeconomic status mattered significantly. The Coleman report was criticized to be deficient because of methodological problems including omitted variable bias, measurement error, multicollinearity, stepwise multiple regressions and aggregation bias (Edmonds & Frederiksen, 1979). Jencks, Smith, Acland, et al. (1972) re-analyzed the Coleman Report data using methodology that could assess the impact of home and school in terms of effect sizes, rather than percent of variance accounted for in student achievement. They conclude that effect sizes for schools would be no larger than 0.17 for white students and 0.20 for black students, after controlling for student intake and prior achievement.

The importance of family influence was further studied by Coleman (1988) using the concept of social capital. Coleman (1988) used High School and Beyond (HSB) data to show that greater amounts of social capital, presence of two parents in the home, lower number of siblings, higher parental educational expectations, and intergeneration closure lead to lower incidence of dropping out of school. Most of the current research linking social capital and educational outcomes is based on large U.S. data sets, namely the National Educational Longitudinal Study of 1988 (NELS: 88). Educational researchers have generally not strayed far from the social capital indicators proposed by Coleman in his original work, that is, mainly family structure and parent child interaction variables. Dika and Singh (2002) reviewed educational literatures involving the concept of social capital and concluded that overall, social capital indicators and indicators of educational attainment are positively linked.

Inspired by empirical studies on school effects, a new literature emerged shifting from the question of "whether school matters" to "how does school matter." Education process variables were included by Brookover, Beady, Flood, Schweitzer, and Wisenbaker (1979) to measure school climate. They conclude that teachers do make a difference and some school characteristics matter. Through case studies, they find that "whether or not higher achievement was considered a real and attainable goal" (p.133) was a common factor of successful schools. Purkey and Smith (1983) review various forms of school effectiveness research exploring the effects of educational process and resources, such as outlier studies, case studies, surveys, and evaluations, as well as studies of program implementation and theories of organization of schools

and other institutions. They concluded that some studies showing no-school-effect are due to the flaw of the research, and that school effects do exist. A student's chance for success in learning cognitive skills is heavily influenced by such school related variables as 1) school-site management, 2) instructional leadership, 3) staff stability, 4) curriculum articulation and organization, 5) school wide staff development, 6) parental involvement and support, 7) school wide recognition of academic success, 8) maximized learning time, 9) district support, 10) collaborative planning and collegial relationships, 11) sense of community, 12) clear goals and high expectations commonly shared, and 13) order and discipline. In fact these variables measure the organization structure (the former nine) and school climate (the latter four). However, one may argue that this review can only look at what has been done in schools, but cannot provide evidence of actions that have not been undertaken by schools. In addition, the way the author creates those school characteristics is limited to the existing knowledge and assumptions.

Hanushek (1989, 1997) initiated "Does money matter debate." He synthesized studies on the relationship between school inputs and student achievement in the past two decades, using a vote-counting method. He concluded that "there is no strong or systematic relationship between school expenditures and student performance." Hanushek's vote counting method was challenged by Hedges, Laine, and Greenwald (1994) who re-analyzed the same studies as Hanushek's by using a meta-analysis that employs a more sophisticated procedure for aggregating the information from different studies. Their study rejected the null hypothesis that there is no positive relation between school resources and student achievement. They concluded

that there is a systematic relationship between school inputs and student performance and that this relationship is large enough to be educationally important. Krueger (2003) argued that results of quantitative summaries of the literature, such as Hanushek (1997), depend critically on whether studies are accorded equal weight. When studies are given equal weight, resources are systematically related to student achievement. When weights are in proportion to their number of estimates, resources and achievements are not systematically related.

Teddlie, Reynolds, and Sammons (2000) conducted a more comprehensive review of the school effectiveness studies and points out that different methodological decisions can influence the estimation of school effects. Bryk and Raudenbush (1988) used a multilevel longitudinal model to analyze the student achievement from the Sustaining Effects Study and found that over 80 percent of the variance in mathematics learning is between schools. In addition, Geoffrey Borman and Maritza Dowling (2010) re-analyzed the data used in the Coleman Report with HLM, and found that school effects are as large as family effects.

The size of a school has been shown to be negatively associated with achievement (e.g., Edington & Martellaro, 1990). It is argued that the small school may facilitate social interactions but inhibit differentiated curriculum and teachers' specialization. Compelling evidence on peer effects remains scarce because of endogeneity issues such as selection bias and the reflection problem (Hanushek, Kain, Markman, & Rivkin, 2003; Sacerdote, 2001; Zimmerman, 2003). Students choose their roommates or select schools according to their own characteristics which may also affect education outputs. Slavin (1990) concluded from his best-evidence review of

some 25 studies that ability grouping has no significant overall effects on secondary-school achievement.

At present, there is no clear conclusion on the does-money-matter debate. The results from existing studies vary depending on the method they used and the dataset they employed. With better quality data and more sophisticated methodology, school effects are shown to be significant in more studies. Although previous analyses did not reach the same conclusion, there is one point that everybody agrees regarding school effectiveness research: money can make a difference if it is spent wisely and effectively.

2.2.2 Empirical Findings in Developing Countries

Due to the variation of economic development level and national effort on education, it is possible that school effects in developing countries differ from those in developed countries. Many school effectiveness studies in developing countries have shown a large effect of school resources even after controlling for family background (Buchmann, 2002a; Casassus et al., 2001; Fuller, 1987; Fuller & Clarke, 1994; Heyneman, 1976; Heyneman & Loxley, 1983; Willms & Somers, 2001).

The well known Heyneman-Loxley (HL) effect states that 1) the economic development level of a country conditions the relative strength of two relationships – one between family SES and achievement and the other between school inputs and achievement; and 2) about one-third of the cross-national variation in mathematics and science achievement is accounted for by variation in national economic development; comparatively wealthier nations produce more

mathematics and science achievement among their youth (Heyneman & Loxley, 1983). Using 1970s data, they showed that the established pattern of larger family SES effects with smaller school effects occur mostly in economically developed countries, while the reverse-smaller SES effects with larger school effects-occurs in developing countries.

Baker et al. (2002) used 1994-95 data from Trends in International Mathematics and Science Study (TIMSS) to reanalyze the HL effect and found that the first part of the HL effect had vanished by 1994. Economic development is unrelated to both the relationship between family background and student achievement and the relationship between school resources and student achievement. The second part of the HL effect still exists, but these positive relationships between the natural logarithm of GDP per capita and mean national student achievement in mathematics and science in 1990s are smaller than those in 1970s. In addition, the authors found little effect of school resources for either richer or poorer countries after controlling for students' family backgrounds. They argued that part of the reason for not finding an effect of school resources in poorer countries is that, due to economic growth, such countries have moved beyond the threshold at which schools are so underfunded that school resources matter. Hanushek and Luque (2003) used the same dataset and also found that the school effects are not large or significant after controlling for family background.

However, one problem with using TIMSS to update Heyneman and Loxley's research is that the countries in the TIMSS sample may be too wealthy to be comparable with those in the sample used by Heyneman and Loxley (1983). The average per capita income of TIMSS sample

is $14,988, compared to the 1995 global average of $5,252. Tests of the HL effect by Baker, Goesling, and Letendre (2002) and Hanushek & Luque (2003) used a sample of countries with an average per capita income 200% larger than the global average. In contrast, Heyneman and Loxley's sample of countries had an average per capita income only 50% larger than the global average ($1,613 as compared with $1,043) (Gamoran & Long, 2007).

Fuller and Clarke (1994) reviewed a large amount of school effectiveness studies across developing countries from a local culture perspective, because "it is the culturally constructed meanings attached to instructional tools and pedagogy that sustain this socialization process, not the material character of school inputs per se" (Fuller & Clarke, 1994; p.119). Based on their review, local attributes that may condition the effects from school inputs and classroom practices include the intensity of families' demand for schooling; and how basic teaching tools are assigned culturally variable meanings. Other types of local conditions that are not cultural in nature but also must be taken into account include whether input levels have reached necessary thresholds before effects can be observed and whether inputs and teaching practices are distributed with reasonable proximity to normality.

Baker and LeTendre (2005) did cross-national studies using data from TIMSS. They concluded that in all the TIMSS nations the educational background of parents has a large impact on school achievement even though school quality has been on the increase over the past three decades. In addition, gender differences in eighth grade mathematics almost vanished across so many national school systems. It is believed by the authors that the differences in family

resources are generating larger and larger achievement disparities from the early 1970s to the mid-1990s; and this trend is largely due to the institutionalized mass schooling. The rationale is like this: school quality becomes more similar due to institutionalization of mass schooling, while family inputs still vary a lot, the latter will therefore be a larger force in achievement. This can also explain why schooling can greatly reduce gender differences in math achievement but cannot easily wipe out family background influence.

2.3 National College Entrance Exam in China

The National College Entrance Exam has become one of the most important events and hot topics each year in China, stimulating a wide focus from various social classes and energetic debates over it. Fang (2004) reported that according to a survey the NCEE has become a "nationwide primary examination." Special events such as traffic control, police vehicle escort, bus station change and airline diversion could all happen during the NCEE period. This section will review the context of education in China, the brief history of the NCEE, and the debates and reforms of the NCEE.

2.3.1 General Education Indicators in China

In China, primary education is usually from Grade 1 to Grade 6, the lower secondary education is usually from Grade 7 to Grade 9, and the upper secondary education is from Grade 10 to Grade 12. Primary education and lower secondary education are compulsory education in China. The gross enrollment rates (GER) in 2008 were 99.54% and 98.5% for primary and lower secondary education respectively (See Table 2-1). There are two types of upper secondary

school[8]: regular high schools and vocational/technical secondary schools. The share of the enrollment of these two types of upper secondary schools was 51.7% and 48.3% respectively (See Table 2-2). Although upper secondary education is not compulsory, the gross enrollment rate has been increasing rapidly from 42.8% in 2002 to 74.0% in 2008 (See Table 2-1). Thus, most of the students will go to upper secondary school after compulsory education.

Table 2-1 Basic Education Indicators in China

(Unit: Million students)

	# of Students at school					Gross Enrollment Rate			
			Upper Secondary						
	Primary	Lower Secondary	Sum	Regular High School	College	Primary	Lower Secondary	Upper Secondary (Sum)	College
2002	121.57	66.87	29.08	16.83	16	98.90%	90.00%	42.80%	15%
2003	116.90	66.91	32.43	19.65	19	98.70%	92.70%	43.80%	17%
2004	112.46	65.28	36.49	22.21	21	98.90%	94.10%	48.10%	19%
2005	108.64	62.15	40.31	24.09	23	99.20%	95.10%	52.70%	21%
2006	107.12	59.58	43.42	25.14	25	99.30%	97.00%	59.80%	22%
2007	105.64	57.36	44.81	25.22	27	99.50%	98.00%	66.00%	23%
2008	103.31	55.85	45.76	24.76	29	99.54%	98.50%	74.00%	23.3%

Data source: Quanguo Jiaoyu Shiye Fazhan Tongji Gongbao (National Statistic Bulletin of Education Development, China) 2003-08

Table 2-2 Share of Regular High School V.S. Vocational High School Enrollment

	Regular High School	Vocational High School
2002	58.9%	41.1%
2003	59.3%	40.7%
2004	59.2%	40.8%
2005	57.2%	42.8%
2006	53.8%	46.2%
2007	51.7%	48.3%

Data source: Quanguo Jiaoyu Shiye Fazhan Jianming Tongji Fenxi (Brief Statistic Analysis of China Education Development) in 2007

[8] The Ministry of Education also considers adult education as kind of secondary education. But the size of adult education is very tiny, with 127 thousands students in 2008, which account for less than 0.3% of the total student body in secondary education. Data source: National Statistic Bulletin of Education Development in 2008.

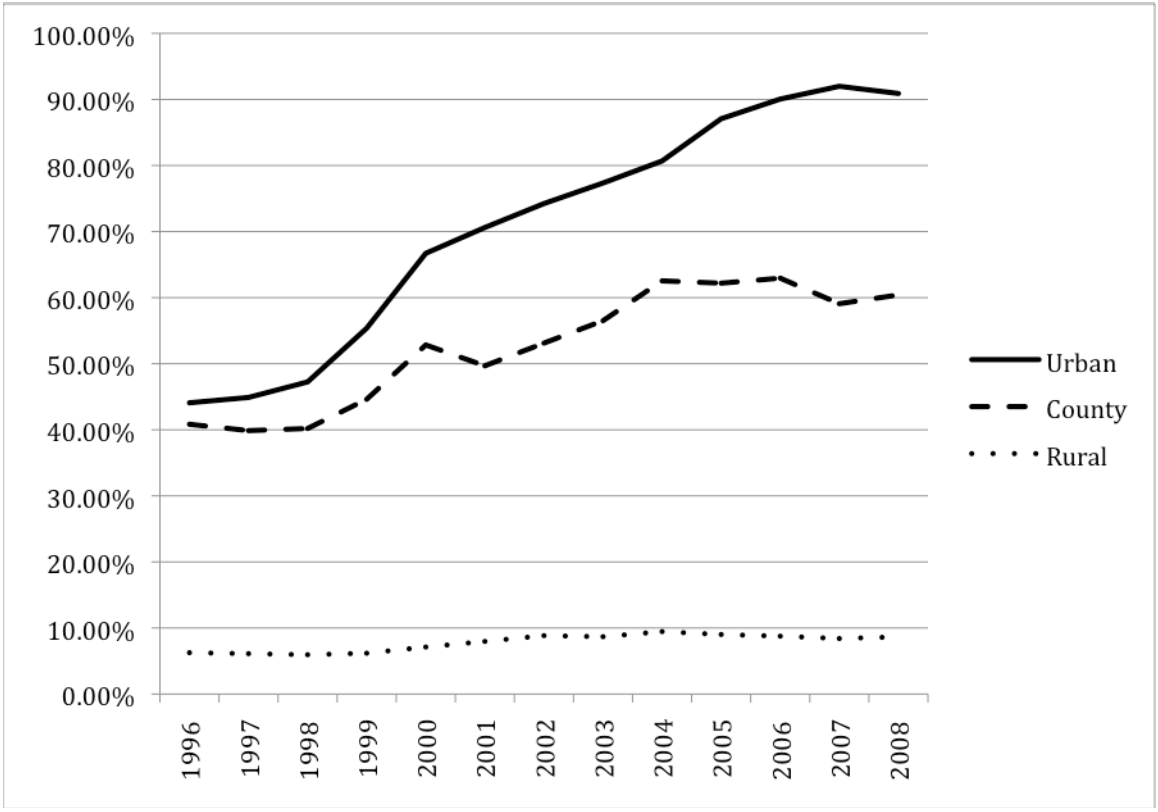
However, there is an increasing disparity in the high school promotion rate among urban, county and rural areas (See Figure 2-1). In 1996, for example, the high school promotion rate in China was 44.09% in urban schools, 40.83% in county high schools, and 6.27% in rural schools; while in 2008, the high school promotion rate in China had reached 90.90% in urban schools, but it was only 8.65% in rural schools (See Figure 2-1), with a large urban-rural disparity of 82% percent. During the last 12 years, the rural high school promotion rate only increased by 2%. The gap between urban and county high school promotion rates also increased from about 3% in 1996 to 30% in 2008. Thus, the increase in promotion rate was mainly urban. Taking into account the large population of rural residence, it is plausible to suggest that only those rural students ranked at the top in academic performance can be enrolled in high school. According to Table 2-3, the high school promotion rate in Jinan in 2007 was 57.08% on average, 89.97% for urban schools, and was only 37.26% for county and rural schools.

In regards to higher education, the GER of college has increased from 15% in 2002 to 23.3% in 2008 (See Table 2-1), and the acceptance rate has increased from 4% in 1970s to 61.67% in 2009 (See Figure 2-2). At least three observations could by implied from this trend. First, rapid higher education enrollment expansion significantly increased the education opportunity for students, and is changing higher education in China from elite education into mass education. Second, although it increased quite fast recently, GER is still quite low compared to that in the advanced industrialized countries[9]. Thus, the competition for the

[9] For example, the tertiary entry rates in 2006 are 76.30%, 64.08%, and 58.91% in Finland, the U.S., and Korea respectively. Data source: Organization for Economic Co-operation and Developmemnt.

opportunity of higher education is still very keen. Third, because of the relatively low increase rate of higher education expenditure (Chen, 2009), one would worry about the quality of higher education (especially for those non-elite colleges). Although more students could go to college, the higher education system stratifies students through variation in quality among colleges and universities (Bao, 2009). Thus, competition for better education quality through NCEE preparation becomes a new target for high school students.

Figure 2-1 Urban-Rural Disparities in High School Promotion Rate



Data source: Yearbooks of China Education Statistics (2000-2008)

Table 2-3 Student Number of Target Cohort and Senior High School Promotion Rate

(Unit: student)

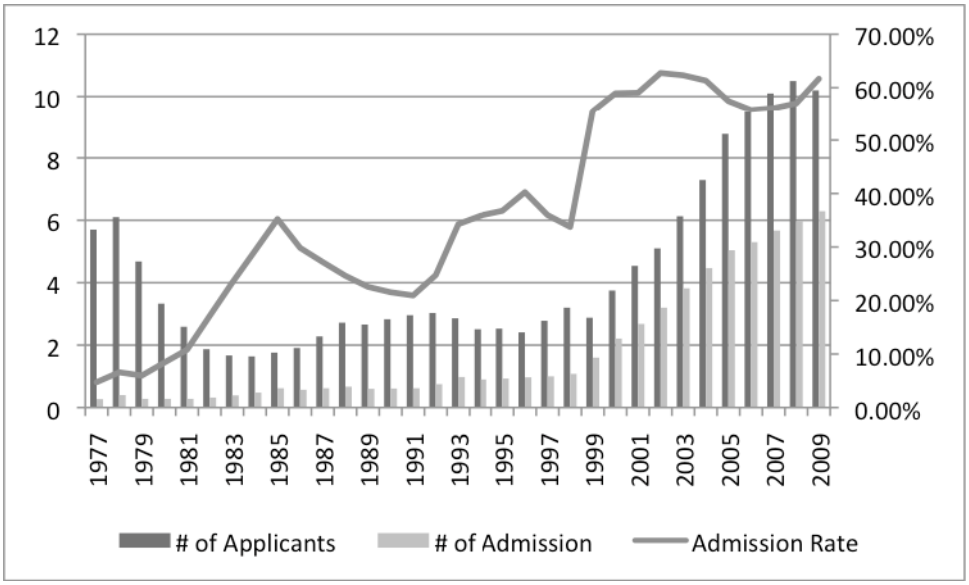
	Urban school	County school	Rural school	Total
Lower secondary graduates in AY 2006-07	22593	17812	19676	60081
Upper secondary freshman in AY 2007-08	20328	13968	0	34296
Senior high school promotion rate	89.97%	37.26%		57.08%

Data source: Jinan Shi Jiaoyu Tongji Shouce (Jinan Education Statistic Yearbook) 2007-2008

AY: academic year

Figure 2-2 Numbers of NCEE Applicants and Admission, and Admission Rate

(Unit: million people)



Data source: the National Education Examination Authority, China

2.3.2 The History of the National College Entrance Exam in China

The National College Entrance Exam was first established in 1952, less than three years after the establishment of the People's Republic of China in 1949. Before 1952, universities recruited students by themselves. The NCEE in its early stage was highly centralized and served as the test for selecting highly qualified candidates for college and cultivating reserve cadres for

the nation (Zheng, 2008). During the Cultural Revolution (1966-1976), the NCEE was abandoned for political reasons, and the only way to go to college was through the recommendations of local officials, whose standards were the applicant's political status and relationship with the official, but not academic achievement. After the Cultural Revolution, Deng Xiaoping, the paramount leader of China, resumed the NCEE in 1977 in order to select high quality people to contribute to the nation's economic development. The 5.7 million high school graduates who had completed during the ten-year Cultural Revolution were allowed to apply for college in the 1977 and 0.27 million of them were admitted (See Figure 2-2). The admission rate in that year was as low as 4.74%. The situation was the same in 1978 and 1979. Thereafter, this relatively fair competition for higher education has been maintained for more than 30 years. From 1983 to 1998, the admission rate was below 40%. In 1999, the higher education enrollment expansion began, and the admission rate jumped sharply from 33.75% in 1998 to 55.56% in 1999. From 1999, the admission rate kept on increasing to 61.67% in 2009, despite the rapid increase of the NCEE applicants (See Figure 2-2).

The NCEE is not only a test for college enrollment. It is also crucial to social mobility, social equity, and the stability of the nation (Zheng, 2008). China has a long history (about 1,300 years) of selecting officials through national examination (Zheng, 2009). Even in the modern era of China, the initial mission of the NCEE included this function. Before the 1990s, college graduates enjoyed a high social status and were guaranteed tenured jobs. From the 1990s, with the development of the market economy, the NCEE was no longer responsible for selecting civil

officials nor did it guarantee job placement. However, the diploma of colleges and universities are still very important for finding a good job. Thus, it is argued by some scholars that the NCEE provides an equal opportunity for lower social classes or students from disadvantaged areas to change their status and improve their life. In the contemporary time of polarization between the wealthy and the poor, the NCEE is also an important factor of social stability, since it relieves the discontent of the lower social classes (Zheng, 2008).

Because of the side effects of the uniform NCEE, such as test oriented teaching and the investment of time and resources on NCEE preparation, a debate over the abolishment of the NCEE was carried out in early 1990s. However, there seemed to be no better alternative selection method to replace NCEE. Some one proposed the multi-standards approach used in the U.S.A., i.e., universities have the autonomy to recruit students according to not only test scores, but also high school performance, recommendation letters, interviews and so on (Xu, 2006). This process may be feasible in the U.S., but may not fit the situation in China, where without a solid test score standard, parents and high schools may endeavor to attempt under-the-table deals to promote their students through the soft standards such as interviews or so called comprehensive capabilities, which will seriously undermine the principle of equity and cause social problems such as corruption and dissatisfaction from the lower social classes (Zheng, 2009). In addition, the relaxation of the requirement on academic performance may cause the decline of student academic achievement.

During the past 30 years, although many problems emerged, the NCEE has been maintained and has been well developed because of the continuous efforts on the NCEE reforms (See Table 2-4). First, the highly uniform test failed to take into account differences across provinces. In 2003, Beijing and Shanghai autonomously assigned their own examination questions. By 2006 there were 16 different sets of the NCEE examination papers across the provinces[10]. Students are limited to their own provinces for college acceptance.

Second, NCEE has been criticized to have led to incomplete knowledge learning because of the dual humanity and science tracks and test-oriented teaching. Students choose one track and won't learn subjects in the other. In the early 2000s, comprehensive tests on humanity and science were carried out to solve this problem (Zang, 2007). And on July 15th, 2009, the Education Department of Hunan province first announced the cancellation of humanity and science tracks in the NCEE in Hunan[11]. During the past 30 years, the subjects test in the NCEE has been changed from "6 for humanity track and 7 for science track" to "3+2"[12] in early 1990s, and from "3+2" to "3+X"[13] in early 2000 (Zang, 2007). In 2007, Shandong Province designed a new test scheme of "3+X+1," where the "1" refers to a basic capability test. This new scheme of the NCEE is a follow up to the new curriculum reform initiated in 2004 (Wang & Song, 2008).

[10] Data source: China Education Online: http://www.eol.cn/kuai_xun_3075/20060930/t20060930_198980.shtml
[11] http://edu.people.com.cn/GB/116076/9674040.html
[12] "3" refers to the 3 required subjects including Chinese, Math and English, and "2" means history and political science for humanity track or physics and chemistry for science track.
[13] "3" still refers to the 3 required subjects including Chinese, Math and English. "X" here usually refers to a comprehensive test for humanity track or a comprehensive test for science track.

Table 2-4 The Timeline of NCEE Reform in China

Year	Event about NCEE Reform	Enrollment Policy Change
1952	NCEE first established. Mission: (1) select highly qualified candidates for college; (2) cultivate reserve cadres for the nation. Highly centralized mechanism, no space for provincial governments, universities, or individual candidates	The college graduate thereby enjoyed the superior social status of pre-officials and a guaranteed tenure.
1966	NCEE was stopped during the cultural revolution	The only way to go to college was through local official's recommendation according to the political status.
1977	Deng Xiaoping resumed the NCEE after the cultural revolution	
1984		(1) The MOE tried to carry out "recommendation to college admission." (2) Part of the NCEE candidates with relevant low test scores could pay tuition to be enrolled. Before that, higher education was free.
1985	NCEE standardization reform first initiated in some provinces including Guangdong	43 universities began to enroll students recommended by some high schools.
1988		The MOE issued an official regulation for this "recommendation to college admission" policy.
1989	All the provinces in China adapted the standardized NCEE.	
1991	Hunan, Hainan and Yunnan provinces reduced the number of subjects test in the NCEE from "6 for humanity track and 7 for science track" to "3+2," where 3 refers to the 3 required subjects including Chinese, math and English, and two means history and political science for humanity track or physics and chemistry for science track.	CEE no longer took the responsibility for preparing reserve cadres.
		37 elite universities began to charge tuition. College graduates would not get tenure job, but had to find a job in the labor market, which was consistent with the market economy reform.
1995	All the provinces in China adapted the "3+2" scheme.	
1997		All the universities began to charge tuition, and no longer be responsible for graduate's job placement.

1999	Guangdong province first test the new scheme of "3+X," where 3 still refers to the 3 required subjects including Chinese, math and English, and X refers to one or two optional subjects chosen from history, political science, geography, physics, chemistry and biology.	(1) MOE began to use online system to process the college admission. (2) MOE required all the recommended students must pass the qualification exam in order to be enrolled to colleges without taking the NCEE. (3) Higher education expansion began.
2000	Other provinces followed Guangdong to adapt the "3+X" scheme, but X here usually refers to a comprehensive test for humanity track or a comprehensive test for science track.	Some provinces including Beijing and Anhui added another NCEE in spring and correspondingly added another enrollment, in addition to the regular summer enrollment.
2001		(1) The MOE tried out "Autonomous Recruitment Reform" with three universities, which challenged the long existing practice of taking score of CEE as the sole recruitment criteria. (2) The MOE cancelled the restriction on age and marriage of the eligibility of NCEE examinees.
2003	(1) Beijing and Shanghai autonomously assign their own examination questions. (2) The date of NCEE changed from every July 7th-9th to every June 7th-9th.	Twenty-two elite universities including Tsinghua University and Beijing University are granted a 5% quota for antonymous recruitment.
2005	There were 15 different sets of the NCEE papers across the provinces.	Forty-two universities enjoy the autonomy of 5% recruitment.
2006		Fudan University and Shanghai Jiaotong University in Shanghai enrolled 300 students respectively who are not limited by the NCEE test score.
2007	Shandong Province designed new test scheme of "3+X+1," where the 1 refers to a basic capability test. This new scheme of NCEE is a follow up to coordinate the new curriculum reform initiated in 2004.	

Data source: The Great River Newspaper: http://gaokao.haedu.cn/2009/08/17/1250478734300.html

Zang (2007). Key events in NCEE reform from 1977 to 2007, Education in Yunnan.

Zheng (2008). Chinese college entrance examination: Review of discussions and the value orientation of reforms. Front. Educ. China 2008, 3(1): 137–148

In fact, tests in all different subjects have been focusing more on examining student's ability of solving real problems, inquiry, doing research, imagination, and innovation. All these reforms in the contents of the test are changing the NCEE from a knowledge-based test into a learning capability-based test. It is quite the case that the NCEE plays a positive role in orienting curriculum reform and education reform in China (Wang & Song, 2008).

Third, it was argued that NCEE as the sole criterion to decide student enrollment was unfair, because a test score could not reflect the whole student achievement. From 1984, a small number of excellent students could be recommended to enroll in universities without taking the NCEE, and the Ministry of Education (MOE) specified later in 1988 that students admitted through this approach must pass a qualification exam. In 2001, the MOE tried to carry out "Autonomous Recruitment Reform" with three universities. By 2005, 42 universities enjoyed the autonomy of 5% autonomous recruitment quota (Zang, 2007). In addition to the recommendation mechanism and autonomous recruitment mechanism, awarded marks are added to the NCEE score for students showing exceptional ability in certain subject area, fine arts, music or athletics in many provinces. In Shandong province, for example, students whose major is not arts, music, or athletics but show a strong talent in one of those fields can be award marks of up to 20 points in addition to the total point (maximum of around 700 points) of the paper test. Province level awards for outstanding student leaders can also get 20-point awarded marks. Students of minorities, overseas Chinese, and Taiwanese could get 10-point awarded marks[14].

[14] Preferential Policy of College Enrollment in Shandong Province in 2008.

To summarize, currently most people in China agree that the NCEE is the best approach to promote students among existing alternatives. In addition to its initial function of selecting college candidates, the NCEE is also crucial in providing social mobility and maintaining social equity. The NCEE reforms in regards to the contents and forms have made it more innovative and more supportive of the education reforms in China. Given the significant role that the NCEE plays in education and the whole society in China, the determinants of student achievement in the NCEE would reveal the mechanism of higher education resource allocation, the potentials for social mobility, and the prospects for and barriers to education reform in China.

However, there are several weaknesses using the NCEE as the measure of student learning. First, the NCEE is taken once each year, and the measure of student learning may not be reliable. Second, the NCEE serves as a test for promoting students into higher education, but not a test for student learning. Third, the research on how good the NCEE is in distinguishing student academic performance is not open to public.

2.3.3 Empirical Evidence on Determinants of Student Academic Achievement in China

Until recently, there were very few published empirical studies on student achievement in China, mainly because of the difficulty in getting access to data. By now, a few empirical studies emerged in this field in both China and the U.S (See Table 2-5). An (2005) did an OLS analysis using data of rural primary school students in Gansu Province collected by Northwestern Normal University and Harvard University in 2000. She found that teacher's salary and education level were positively correlated with student test scores; teacher gender and teaching experience were

not significant. This study did not control for student background variables, nor did it explicitly distinguish between effects from different hierarchies (e.g. school level, class level, and student level).

Ma, Peng, and Thomas (2006) established a two-level HLM model with data from high schools in Baoding City in Hebei Province in 2005. They controlled for student background information such as the High School Entrance Exam (HSEE) score, family background, and so on. The dependent variables at level-1 were the NCEE scores for six tests respectively (i.e., math for science tracking, math for humanity tracking, Chinese, English, Integrated test for science tracking, and integrated test for humanity tracking). They concluded that student's own pre-high school study ability measured by the HSEE score accounted for 60% of the NCEE score variation between schools. Family background and school inputs accounted for another 20% of the variation. However, this study did not involve class level analysis. The identification strategy was not considered, too.

Table 2-5 Empirical Studies on Student Achievement in China

Article	Model	Data	NCEE score as dependent variable	Identification strategy	Conclusion
An (2005)	OLS	Rural primary school students in Gansu Province	No	No	Teacher salary and education level are positively correlated with student test scores; teacher gender and teaching experience are not significant.
Ding and Lehrer (2005)	OLS	High school students in a county in Jiangsu	Yes	Yes	Strong evidence that peer effects exist and operate in a positive and nonlinear manner
Ma, Peng, and Thomas (2006)	2-level HLM	High school students in Baoding City	Yes	No	Student's own pre-high school study ability accounts for 60% of the NCEE score variation between schools. Family background and school inputs account for another 20% of the variation.
An, Hannum & Sargent (2007)	OLS	9-12 age olds in rural areas of Gansu Province	No	No	Teachers from the same village and treat students fairly are positively correlated to test scores. But parental education and family income are not significantly correlated with test scores.
Hannum and Park (2007)	OLS	9-12 age olds in rural areas of Gansu Province	No	No	Mother's aspiration and higher paid teachers are significantly correlated to higher test scores.
Xue and Min (2008)	3-level HLM	Rural junior middle school students in Gansu Province	No	No	All the common school inputs and family background are also positively related to test scores, except per student expenditure.
Lai et al. (2008)	Quantile	Middle school students in Beijing	No	Yes	Positive causal effects of teacher quality on students' HSEE performance
Park et al. (2008)	RD	High school students in rural counties of Gansu Province	Yes	Yes	Attending the best high school in one's county of residence increases college entrance scores by 0.256 standard deviations and increases the probability of entering college by 22.5 percentage points.
Ding and Xue (2009)	3-level HLM	High school students in Kunming City	Yes	No	School inputs, classmates, and family background do not have significant effects on NCEE scores. Data quality problem.

Xue and Min (2008) conducted a 3-level HLM model using data of rural junior middle school students in Gansu Province[15] in 2004. They found that teacher quality (measured by teacher's education level, experience, and on the job training), smaller class size, smaller school size, and school autonomy were positively correlated with student achievement in math and Chinese. Student SES, study ability and willingness to study were also positively related with test scores. But per student expenditure was negatively correlated with student academic achievement in math and Chinese. However, this study suffers from a questionable classification of variables at different levels. And again, they did not apply any identification strategy to establish a causal relationship.

Ding and Xue (2009) examined the determinants of the NCEE score in 2006 with data collected from Kunming City using a 3-level HLM model. They concluded that the most important factors are students' own cognitive skills and pre-high school study ability. Contrasting with the previous studies, they found that school effects, classmates, and family background did not have significant effects on the NCEE scores. The data quality as mentioned by the authors was a major concern of this paper. There was also no causality analysis.

In addition to the four Chinese studies discussed above, there are five studies written in English. Ding and Lehrer (2005) found strong evidence that peer effects existed and operated in a positive and nonlinear manner using a unique administration dataset of the cohort of students who attended the NCEE in 1998 at a county in Jiangsu Province. In addition, they found that

[15] The data used in this study is collected by Professor Emily Hannum from University of Pennsylvania, with the assistance of Gansu Statistic Bureau.

students benefited most from higher ranked teachers (accounts for 35%-50% of the variation in school effects), while teacher quality measured by extrinsic measures such as highest degree attained and teaching experience could only explained a very little part of the variation.

An, Hannum, and Sargent (2007) employed data from the first wave of the Gansu Survey of Children and Families (GSCF-1) carried out in the summer of 2000. The children sampled were 9-12 year old and in rural areas. The educational outcomes in this study are the scores of two tests: mathematics and Chinese language, both of which were designed by the Gansu Institute for Educational Research and based on the standard curriculum. They found that teachers who treat students fairly were significantly related to student achievement. In addition, teachers from the same village were also positively related to test score. However, surprisingly, family backgrounds including parental education and family income were not significantly related to test score. This study only uses the OLS regressions, in which the control variables such as educational aspirations, academic confidence and alienation might be endogenous variables. But the authors did not control for endogeneity, thus leading to limitations in their findings.

Hannum and Park (2007) ran an OLS regression on the Gansu data collected by the authors in 2000 [16] and found that mother's aspirations and higher paid teachers were significantly correlated with higher test scores. However, logged wealth was not a significant predictor of math scores and only a marginally significant predictor of language scores. This study did not

[16] The same dataset used by An, Hannum & Sargent (2007).

control for potential endogeneity and selection bias and did not provide explanation of the unexpected estimation of family income effect on student achievement.

Lai, Sadoulet, and Janvry (2008) identified the positive causal effects of teacher quality on students' HSEE performance by constructing a rigorous identification strategy based on a unique educational reform involving preference-based random assignment of students to different middle schools in Beijing in 1998. The data was from a census of the 3rd year lower secondary students conducted in early 2002 by the Education Bureau of Beijing's Eastern City District. The authors showed that an upgrading of 10% of the teachers to higher rank would increase by 5% to 14% the students' probability of successfully reaching the minimum required for admission in high school. By contrast, informal degree training was not effective and teachers' number of years on the job lowers the overall test score, expectedly due to job burnout under considerable parent pressures to perform. Using a quantile regression, they also found that students with weaker academic achievements or socioeconomic backgrounds benefit more from the quality of their teachers. They found no significant difference in teacher effects across gender. However, due to data limitation, this paper cannot examine the effects of classroom level resources, which vary a lot and may be endogenous. In addition, the matching method used in studies of HSEE cannot be used in studies of NCEE, because high school enrollment is usually merit based.

Park, Shi, Hsieh, and An (2008) investigated the impact of school quality on students' educational attainment using a regression discontinuity research design that compares students just above and below entrance examination score thresholds that strictly determine admission to

the best high schools in China's rural counties. The data was from Gansu Province in China in 2004, the same dataset used by An (2005). They found that attending the best high school in one's county of residence decreased the probability of taking the college entrance examination by 14.9 percentage points (which is somewhat unexpected), increased college entrance scores by 0.256 standard deviations and increased the probability of entering college by 22.5 percentage points.

To summarize, recently emerging empirical studies on student achievement in China provide a fuzzy picture of school effects and family effects on test scores. This is due to at least three reasons. First, there is no well-designed, high quality national survey in China to provide solid datasets for scholars to analyze. The researchers reviewed above either use administrative data, which have a limitation on variables, or use data from inadequate surveys conducted by individual institutions. No one else except the circle of those authors could get access to these survey data. Thus it is impossible to have an external evaluation of data quality. Second, only three studies (Ding & Lehrer, 2005, Lai et al., 2008; Park et al., 2008) use sophisticated empirical strategies and have identified positive effects of the variable of interest on student achievement. Other studies fail to control for problems such as endogeneity and selection bias. Third, China as a developing country with unique cultural context and education reforms has unique education processes and education inputs that are omitted by the conventional education production function. Fourth, there are so far only two published empirical studies (by Ding & Xue, 2009 and Ma, Peng, & Thomas, 2006, both in Chinese) on NCEE. More and better studies

on NCEE are sorely needed. Therefore, high quality datasets exploited by solid empirical analyses based on more elaborate education production function theories andapplications are needed to further explore the determinants of student achievement in China.

2.4 Private Supplementary Tutoring

2.4.1 Definition

Private supplementary tutoring refers to the outside school tutoring service offered by the private sector and paid for by families. "*Private"* means that the tutoring is private for-profit service. It is not financed by public expense, nor is it free. The definition of *supplementation* here refers to the tutoring that covers subjects that have already been or supposed to have been covered in school.

The demand for private tutoring could be motivated by enrichment or remediation. These activities are set up to specifically shadow the requirements of the school that the child attends. Thus, private tutoring is also called shadow education (Stevenson & Baker, 1992). Shadow education is endowed with four characteristics. First, private tutoring only exists because the formal school education exists. Second, the size and shape of private tutoring change with those of the formal school education. Third, usually much more public attention focuses on the formal school education than on its shadow. Fourth, the features of the shadow education system are less distinct than those of the formal school education (Bray, 2007).

There are several different forms of private tutoring. Some private tutoring is provided one-to-one in the home of either the tutor or the client. Other tutoring is provided in small groups or in large classes. Some tutoring is entirely through mail, telephone, or internet. In some nations the scale of private tutoring is so extensive that it would be more accurate to describe it as a system of tutoring that runs parallel to formal schooling, such as in Japan, Hong Kong, Singapore, Taiwan, South Korea, Greece, and Turkey (Baker & LeTendre, 2005).

The terminology used to identify private tutoring varies across countries. In some English-speaking societies, private tuition is more frequently used than private tutoring. Entrepreneurs who establish formal private tutoring often call themselves learning centers, academies or institutes. In Japan, tutoring centers which supplement the school system are known as *juku*, which is distinguished from *yobiko*, which refers to enrichment tutoring after school that prepare students for better examination performance (Bray, 2007).

2.4.2 Private Tutoring in the World

Private tutoring has arisen as a substantial parallel educational sector of the formal education system in quite a few countries, and it is still expanding. Substantial private tutoring industries can be found in countries as diverse economically and geographically as Romania, Egypt, Kenya, Morocco, Mainland China, Taiwan (China), Singapore, Japan, South Korea, Cambodia, United States, and the United Kingdom (Baker & LeTendre, 2005; Dang & Roger, 2008; Xue & Ding, 2009).

In Japan, for example, where private tutoring has been a huge commercial industry for a long time, the annual revenues had reached an estimated US$14 billion by the mid-1990s. Nine private tutoring schools were already listed on the Japanese stock exchange at that time, and the tutoring sector had become a “crucial component of Japanese education” (Russell, 1997). In South Korea, nearly all primary and secondary school students used some form of shadow education during their schooling, spending U.S. $ 16.4 billion in 1998, which was 80% of the total government expenditure on public primary and secondary education (Ki-Bong Lee; 2003). South Korean education is currently the largest system of shadow education known in the world.

Table 2-6 presents the scale of private tutoring in selected countries. While the incidence appears to be highest in East Asian countries, private tutoring is now an important phenomenon in many countries of different size, level of economic development, political institutions, or geographical locations. In addition, private tutoring is an important phenomenon not only for upper-secondary students preparing for university exams, but also for students at the primary and lower secondary levels, and sometimes (as in Japan) even among upper-secondary graduates. Moreover, the private tutoring industry appears to be growing in many countries, both in absolute terms and relative to the formal education sector.

Table 2-6 The Scale of Private Supplementary Tutoring in Selected Countries

Country	Year	Level/Grade/Age	Percent of student tutored	Comment	Sources
Azerbaijan	2004	Secondary school	57%		Silova & Kazimzade (2006)
		University	92%	These first-year university students received private tutoring in their last year in secondary school.	
Bangladesh	2004	Primary school	43%	This study finds more boys receiving tutoring than girls.	Ahmed et al. (2005)
Cambodia	1997-98	Primary school	31%	The proportion of students taking private tutoring was 60% among urban schools, and 9% among rural schools.	Bray (1999b)
Canada	1999	Students age 13and 16	The proportion of students age 13 and age16 taking private Tutoring respectively ranges from 5% to 17% and 8% to 20% across districts		CME (2000)
	1997	School age children	N/A	Over the past 30 years, the number of formal tutoring business in major Canadian cities has grown between 200%-500%.	Aurini & Davies (2004)
China	2004	Preschool	49. 5%	- The students sampled all live in urban areas. - Residents in provincial capitals and large cities are more likely to receive private tutoring than those in counties. - The more education the parents received, the larger proportion of the students who receive private tutoring. - Students in high quality schools are more likely to receive private tutoring than their counterparts in lower quality schools.	Xue & Ding (2009)
		Primary school	73. 8 %		
		Regular lower secondary school	65. 6 %		
		Vocational lower secondary school	59. 3 %		
		Regular upper secondary school	53. 5 %		
		Vocational upper secondary school	33. 0 %		
		Technical secondary school	28. 7 %		
		Vocational tertiary & associate bachelor	18. 9 %		
		Bachelor	22. 7 %		
		Graduate student	13. 8 %		
	2008	Lower secondary school		82.8% for students in provincial capital, 66.1% for students in poor counties.	Tsang, et al. (2010)
Cyprus	2003	College	86%	These students received private tutoring in lyceum.	Stylianou et al. (2003)
Egypt	2000	Children age 6-15	71%	This study uses the Egypt Demographic and Health Survey	Suliman & ElKogali (2002)

Greece	2000	University	80% attended group (cram) preparatory schools, 50% received individual private tutoring and 33% received both group and individual tutoring		Psacharopoulous & Papakonstantinou (2005)
Hong Kong	2004-05	Primary	36.0%	A 2004-2005 survey of 13,600 households	Bray & Kwok (2003)
		Lower secondary	28.0%		
		Middle secondary	33.6%		
		Upper secondary	48.1%		
	2006	Primary and secondary	34%	Government statistics	
Japan	2007	Primary 1	15.9%		Ministry of Education, Science, Culture and Sport (2008, p. 13)
		Junior Secondary 3	65.2%	6.8% of Junior Secondary 3 pupils received tutoring at home, and 15.0% followed correspondence courses.	
Kenya	2000	Grade 6	88%	- 58% of the students attending private tutoring paid for it. The proportion of pupils who received private tutoring had gone up from 69% in 1998 to 88% in 2000. - This study uses data from the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) II.	Onsomu et al. (2005)
Republic of Korea	2003	Primary school	83%	In aggregate, 73% of all Korean students had private tutoring. This study cites estimates from the Korean Educational Development Institute	Kwak (2004)
		Middle school	75%		
		High school	56%		
Lithuania	2004-05	University	62%		Budiene & Zabulionis (2006)
Mauritius	2001	Grade 6	87%	- 91% of these students paid for private tutoring. The proportion of pupils who received private tutoring had gone up from 78% in 1995 to 87% in 2001. - This study uses data from the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) II	Kulpoo & Soonarane (2005)
Romania	1994	Grade 12	32% in rural areas and 58% in urban areas received private supplementary tutoring	This study cites estimates from a study undertaken by the Romanian Institute for Sciences of education, in 1994, on a national sample of 12th graders.	UNESCO (2000)
Singapore	1992	Primary school	49%		George (1992)
		Secondary school	30%		
Sri Lanka	2003	Grade 5	78%		Glewwe & Jayachandran

					(2006)
Turkey	2001	High school	35%	The number of private tutoring centers in 2002 was 2,100 (up from only 174 in 1984), which is close to the number of 2,500 high schools in the whole country in the same year. This study uses estimates from the Private Tutoring Centers Association in Turkey in 2003.	Tansel & Bircan (2006)
Ukraine	2004	University	68%	These students received private tutoring in their last year in secondary school.	Hrynevych et al (2006)
United Kingdom	2003	Years 6 & 11	26%	In aggregate, 27% received private tutoring	Ireson & Rushforth (2005)
		Year 13	30%		
United States	1990-92	High-school students		To prepare for the SAT or ACT, 14%-21% take special courses at high school, 8%-14% take group private tutoring (commercial coaching classes), and 6%-8% take one-to-one private tutoring.	Briggs (2001)
	2000			It is estimated that almost 7 million elementary school students are likely to take tutoring, and that tutoring has grown to be a professional-service industry of over $5-$8 billion.	Gordon & Gordon (2003)
Vietnam	1997-98	Primary students	31%		Dang (2007)
		Lower secondary	56%		
		Upper secondary	77%		
	2001	Grade 5	38%	In a 2001 sample survey of 72,660 Grade 5 pupils in 3,639 primary schools	World Bank (2004, p. 81)
Zanzibar	2000	Grade 6	56%	- 38% of these students paid for private tutoring. The proportion of pupils who received private tutoring had gone up from 46% in 1995 to 56% in 2000. - This study uses data from the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) II.	Nassor et al. (2005)
Zimbabwe	1995	Grade 6	61%	The percentage varies from 36% to 74% across the regions.	Machingaidze, Pfukani & Shumba (1998)

Data source: Dang & Rogers (2008); Xue & Ding (2009); Bray (2010), Tsang et al. (2010)

2.4.3 Determinants of Private Supplementary Tutoring

The determinants of demand for private tutoring can be divided into three categories according to the education production process. In the formal school system, students as raw material with certain characteristics are sent to schools, which can be seen as factories, and are expected to become certain products evaluated by future earnings and social class. Characteristics in one segment are correlated with those in the other two segments. For example, peer effects at school may be seen as one kind of cultural influence that is correlated with future earnings and social class. During this production process, characteristics in each segment can affect the demand for shadow education. The summary of determinants of private tutoring will follow this framework.

2.4.3.1 Student characteristics

Analyzing data from the Third International Mathematics and Science Study (TIMSS) in 1995 for 41 countries, Baker, Akiba, LeTendre, and Wiseman (2001) showed that private tutoring was used significantly more often by low math achievers than by high achievers, in three-fourths of these countries, controlling for family income, student, and community characteristics. However, according to Kim (2007b), students from the second quintile from the top have a significantly higher probability of participating in private tutoring, and those in the fifth quintile have a lower probability of private tutoring participation.

According to recent empirical studies, the family background variables that most influence the use of private tutoring include household income (household wealth for Egypt, household expenditure in the case of Turkey and Vietnam), parental education, and whether the household lives in an urban area (Assaad & El-Badawy, 2004; Dang, 2007; Kim, 2007b; Kim & Lee, 2004;

Stevenson & Baker, 1992; Tansel & Bircan, 2006). All these variables predict higher student attendance at private tutoring, meaning that students from wealthier and more educated households living in urban areas will be more likely to attend and spend more on private tutoring, which also reflects the heterogeneity of demand across household types. These results are very consistent across the countries and fairly robust to the different models being used.

Some studies also report that the number of children in households is negatively correlated with private tutoring expenditures in Korea, Turkey, and Vietnam (Dang, 2007; Kim & Lee, 2004; Tansel & Bircan, 2006). This household-size effect may hint at the quantity-quality tradeoff between number of children and average child educational achievement. However, these variables are not used in all the studies, and the household size variable is likely to be endogenous which may bias estimated results. For example, households with higher parental education level, higher income, and urban residence might have fewer children and thus smaller household-size.

2.4.4.2 School context

In countries with a deficient public education system or no full access to mass schooling, parents may resort to using private tutoring to compensate for poor quality or lack of education opportunity (Kim & Lee, 2004). Using data for 41 countries participating in the 3rd TIMSS international student assessment, Baker et al. (2001) found that higher public education expenditures as a share of GNP and gross enrollment rates predicted lower use of private tutoring. The former result is consistent with the hypothesis that private tutoring is more popular in countries with deficient public education systems. However, the analysis did not control for per-capita income levels, which were highly correlated with both public education expenditures and gross enrollment rates. Thus, their estimation may be biased. In South Korea, students in schools

with higher student-teacher ratios are more likely to participate in private tutoring (Kim 2007b). Low pay levels and weak monitoring of teachers in the public system can also cause teachers to force tutoring on students (Buchmann, 1999; Silova & Bray, 2006), as formalized in a theoretical model by Biswal (1999).

In addition to school quality, the student's grade level may also affect the purchasing of private tutoring. For example, in both Egypt and Vietnam, students in the last year of their current school spend more on private tutoring (Assaad & El-Badawy, 2004; Dang, 2007). This pattern reflects the use of private tutoring to prepare for the school-leaving examinations. Kim (2007b) shows that the proportion of classmates receiving private tutoring services is significantly and positively related to expenditure on private tutoring. In addition to school context, Dang (2007) also finds that the share of people with upper secondary education or higher in the commune significantly predict higher private tutoring expenditure.

2.4.4.3 Incentive from future earning and social class

Tight linkages between education and work are argued to lead to intense competition for more education, and thus a high demand for private tutoring (Stevenson & Baker, 1992). Competition is based on the signaling effects of diploma – employers use diploma as a signal of the interviewee's potential capability because of incomplete information. Kim (2007a) constructs game theoretical model to explain the consumption of private tutoring based on this job market signaling model. This article shows a Nash Equilibrium where parents with competitive advantages in income, child's ability, and preference for education spend all the income on private tutoring while relatively disadvantaged parents do not invest in private tutoring.

Cultural values are argued to be the reason for more prevalent private tutoring in some countries, especially in East Asia (Bray, 1999). Students in countries with extensive shadow

education system often remark that “one reason they attend is because their friends do” (Baker & LeTendre; 2005). In other words, it is what you do after school to be social, which is consistent with peer effects discussed in school context section. But Baker et al. (2001) shows that a high-stakes testing system had no significant impact on private tutoring.

2.4.4 Impacts on Students, Formal Schooling, and Society

Quantitatively identification of the impacts of private supplementary tutoring on student achievement is difficult because of all the technical problems such as endogeneity and measurement error. Various causal inference designs have emerged to address this issue. Briggs (2001) uses a Heckman correction and finds positive effects on both SAT (Math and Verbal) and ACT (Math and English) test scores and negative effects on the ACT Reading score in the US. Jacob and Lefgren (2004) find positive evidence on low achieving third graders for both Math and Reading but no effect on the sixth graders, using the regression discontinuity method. Lavy and Schlosser (2005) find that private tutoring increases average matriculation rates in Israel using the difference-in-difference method. Suryadarma, Suryahadi, Sumarto, and Rogers (2006) find that tutoring was not associated with higher performance by 4^{th}-graders in Indonesia by using school reported extracurricular courses as an instrumental variable. Dang (2007) finds a positive effect of private tutoring on student academic ranking in Vietnam using per hour tutoring fee as an instrumental variable. Burde and Linden (2010) use randomized control trail and find that private tutoring increases test scores and enrollment in Afghanistan. Ono (2007) uses *Ronin* (examination hell) as an instrumental variable and concludes that *Ronin* indirectly improves rate of return measured by future earning, through increasing the chance to be admitted by high quality colleges. However, this study of Japan does not control for the endogeneity of tutoring itself.

It is argued by many scholars (e.g. Bray, 2004 & 2009) that private tutoring may affect the dynamics of teaching and learning in formal schools. On the one hand, tutoring may help students to understand the materials which have been, or will be, presented in school, and thus may reduce the workload of formal school teachers. De Silva (1994, p.5) has observed that supplementary tutoring can satisfy individual needs on remediation. Private tutoring may also serve higher ability students to enrich their learning by offering broader scope of knowledge and deeper training (Yiu, 1996, p.78). On the other hand, private tutoring may upset the teaching plan in formal school and exacerbate inequality in classrooms. If teachers take the students who receive tutoring as the norm in their teaching and do not cover the repeated materials in class, all parents are placed under pressure to invest in private tutoring for their children. According to Sawada and Kobayashi (1986, p.9), Japanese pupils attending *juku* do not take the formal school mathematics classes seriously.

Private tutoring can have both positive and negative effects on the society. Private tutoring can facilitate students to gain additional human capital (if it is not only for test preparation but also for enrichment) through extended learning outside school, which would benefit not only individual students, but also the whole society. It might also increase teacher income especially in situations in which teachers are paid really low. However, private tutoring can create and maintain social inequality through only serving students from relatively wealthy families. In addition, for those tutorial services mainly for enrichment and exam preparation, a large amount of human and financial resources is devoted to them which actually could be used more effectively and appropriately in other activities (Baker & LeTendre, 2005; Bray, 2007).

2.4.5 Private Supplementary Tutoring in China

Private supplementary tutoring in China has become more and more prevalent, especially in urban areas (Lei, 2005; Xue & Ding, 2009). It is argued by some scholars that the main reasons for the expansion of private tutoring in China include the large disparities in education quality, test-oriented education, high cultural value of education, and school teacher's need to increase income because of the increasing living expense and relatively low teacher salaries (Xu, 2009). Given the large proportion of students employing private tutoring, the shadow education in urban China has become a significant part of the whole education system that cannot be neglected by education researchers and policymakers.

The government does not regulate private tutoring offered by outside school agencies, but does rule against private tutoring carried out by public schools and school teachers[17]. In addition, different local governments have various regulations. For example, the Bureau of Education (BOE) in Jinan, Wenzhou, and Wuhan clearly forbid school teachers providing for-profit tutoring; the BOE in Jinhua and Nanjing allow the existence of school teachers providing for-profit tutoring, but the BOE in Guangzhou and Zhoushan just ignore this phenomenon (Xu, 2009).

A few empirical studies in this field recently emerged due to some available datasets. Over half of the urban students sampled have engaged in some kinds of private tutoring (Peng and Zhou, 2008; Xue and Ding, 2009), even for students at the preschool level (Xue and Ding, 2009). A larger proportion of students in provincial capitals than those in less developed counties receive private tutoring. Urban students are more likely to employ private tutoring than their rural counterparts (Lei, 2005).

[17] This was just announced by MOE on October 26th, 2009. http://www.infzm.com/content/36429

The purpose of private tutoring includes both enrichment and remediation (Xue and Ding, 2009; Lei, 2005). Since the enrollment rates of compulsory education and high school education have already been very high in cities and counties, the shadow education in urban China is mainly to compete for a high quality of education, not for the education opportunity.

According to Xue and Ding (2009)[18], the percentage of students employing private tutoring is highest in compulsory education (73.8% in elementary school and 65.6% in junior middle school), compared to those in high school education (53.5%), higher education (22.7%), and vocational secondary education (33.0%). The main reason for this phenomenon is that the whole education system is highly segregated by school quality. Education resources are highly concentrated in the key schools. Students have to compete at the very beginning of the school system, i.e. kindergarten and primary school, in order to have a larger chance to win in the competition for high school, and then higher education.

According to the regressions done so far, factors such as SES and school background have a significant positive relationship with the choice of and expenditure on employing private tutoring (Lei, 2005; Xue and Ding, 2009). In addition, Xue and Ding (2009) find that student academic achievement is not significantly related to the employment of private tutoring. However, Lei (2005) finds that students with lower achievement are more likely to employ private tutoring. It is argued by the authors that the private tutoring in urban China has maintained and increased social stratification, and expanded the inequality for the urban students to obtain basic educational resources, which has challenged the objective of basic educational equity.

These studies provide consistent information about the size of shadow education in China. However, in regard to the determinants of private tutoring, the Logistic regression and OLS

[18] The data used by Xue & Ding (2009) is from "Chinese Urban Household Education and Employment Survey (CHU HEES) - 2004", which was designed by the Economic Education Research Institute of Beijing University to study the activities of additional instruction for students in Chinese cities and towns.

regression used by those authors can only reveal some correlations but not causal relationships in the absence of an identification approach. For example, student test score is taken as a control variable in Lei (2005) and Xue and Ding (2009), which is obviously an endogenous variable. In addition, gender, academic track, teacher influence and peer effects omitted in these studies might also affect the decision on private tutoring as well as the test score. All these problems will make the estimation biased and the conclusion implausible.

In addition, no research has yet been done to investigate the effect of private tutoring on student achievement. It is partially due to a data access problem. The relatively slow response to this emerging shadow education system may be another reason. Given the large magnitude and potential influential impacts of private tutoring in China now, it is very necessary and urgent to fill this research gap.

2.5 Summary and Discussion

The National College Entrance Exam is crucial to Chinese society not only because it is the primary way to compete for better higher education resources, but also because it plays an important role in social mobility, social equity, and stability of the nation. Presently, there is no better alternative to replace this national exam. In addition, with the continuous the NCEE reform, this test becomes more capability oriented, compared to the former knowledge based test. It is more flexible according to province differences and student's heterogeneous characteristics. Thus, the NCEE is actually directing the curriculum reform in basic education, too. However, only two published studies so far have examined the determinants of student achievement on the NCEE, because of the difficulty in getting access to student level data. Considering the large population taking the NCEE each year and the huge amount of resources devoted to it, the

uncovering of these determinants will not only contribute to a better understanding of this huge education system, but also provide a more solid basis to inform government education policy.

The analysis could be based on existing education production function theory. However, the one-equation education production function is too simple to capture all the relationships in the complex and selective education process in reality. That is why identification strategies addressing endogeneity and selection bias come in. Thus, instead of a single equation, an appropriate methodology to enhance the causal inference of education production process may be needed. New instrument design to better measure education inputs is also desirable in future surveys.

Shadow education has become a significant parallel of the formal school system both in China and elsewhere. Private supplementary tutoring has become a new focus of education researchers. Although studies observed some factors influencing the demand for private tutoring, only a few empirical studies examine the effect of tutoring on student achievement, due to the complex interactions among student, school, and tutoring, as well as the data access issues. Most of the studies on student achievement actually omit the private tutoring effect. In China, only three articles are found regarding empirical analysis on the determinants of private tutoring. But these studies suffer from a simple regression without any control for problems such as endogeneity and omitted variable bias. In addition, there has been no research about the effects of private tutoring on student academic achievement in China by now. Thus, there is a large knowledge gap in this field.

In summary, there is a need for more research on determinants of student achievement in the NCEE, including the potential impact of private tutoring. Such research should incorporate theoretical innovation, a well-designed dataset, and carefully developed identification strategies.

Chapter 3 Methodology

3.1 Introduction

In this chapter, two key research questions of this dissertation are identified based on the knowledge gap identified from Chapter 2. The education production function is presented as the conceptual framework of this study. A number of alternative models involving different identification strategies are presented to address the endogeneity problem, selection bias, and the nature of hierarchical data structure. Based on the empirical models, the data collection procedure is discussed and reported in order to describe the data used in this study. Sampling strategy and questionnaire design are presented in detail in this part. Sampling weight is calculated based on sampling strategy and respond rate. The treatment of missing data is then discussed and explained. Index construction of selected variables is presented based on empirical strategies and questionnaire design.

3.2 Key Research Questions

The review of existing literature concludes that little research has been done in investigating the determinants of student academic performance of NCEE in China. In addition, there is a lack of research on private tutoring, given its rapidly expanding magnitude and increasing influence on family, formal schooling, and the society. Among existing studies, no research has been done in China to evaluate the effect of private tutoring on academic achievement.

Based on the understanding of the knowledge gap from the literature review, two key research questions for the dissertation study are proposed as follows.

1) What are the determinants of student academic performance on the NCEE in China?

2) What are the determinants and effects of private tutoring?

i. What factors influence the students' participation in private tutoring?

ii. Does private tutoring improve student academic achievement?

To carry out this study, special attention is given to both data sources and estimation methods. First, a well-designed and carefully implemented data collection is undertaken. The dataset from this data collection enables the use of statistical estimation involving instrumental variables, which is often difficult to do when using existing second hand data. The new dataset also removes the data constraint of this kind of study in China. Second, a number of identification strategies are employed to address various issues due to the complex education production process, which may enhance the robustness of the results and the causality of relationships identified.

3.3 Conceptual Framework

An education production function is a mathematical relation showing the maximum education outputs that can be produced with the given educational resources under a given education technology (Cohn & Geske, 1990). The generalized education production function is given by

$f(Q,X/S)=0$

where Q is the vector of educational outputs: $Q:q_1,q_2,\ldots q_n$

X is the vector of non-school inputs: X: $x_1,x_2,\ldots,x_k$

S is the vector of school related inputs: S: $s_1, s_2, \ldots,s_m$.

Thus, we have n outputs and k+m inputs. f is the functional operator.

As Cohn and Geske (1990) pointed out, within a certain range of data, a linear relationship between the X inputs and the Q outputs would be empirically valid to the extent that the curvature of this certain part of output function is only mildly violated by employing a linear approximation. However, if the range of the data is quite wide, linear assumption might be invalid. In addition, any conclusion derived from linear analysis should not be applied to input levels beyond the range of the data sample.

For a linear model, the general form of the ith production function is given by:

$$q_i = a_i + \sum_{g=1}^{n} b_{ig} q_g + \sum_{h=1}^{k} c_{ih} x_h + \sum_{j=1}^{m} d_{ij} s_j + e_i$$

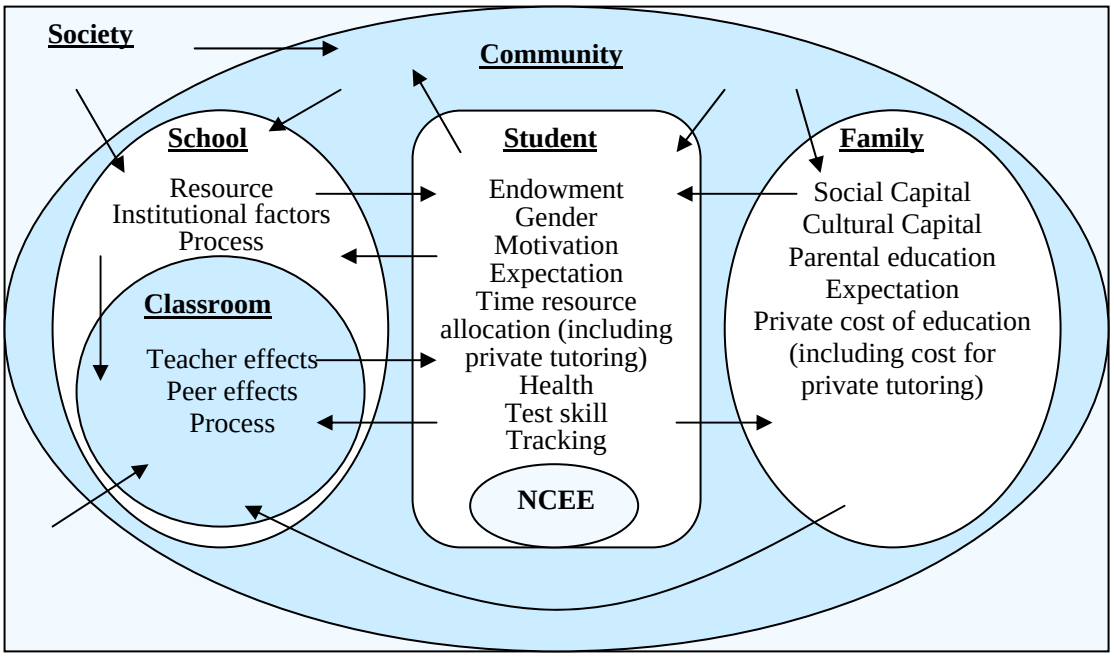
Where a_i is the intercept, and the b_{ig} s, c_{ih} s, and d_{ij} s are the coefficients to be estimated. The coefficient in a linear function means a constant marginal productivity of the corresponding input. e_i is a stochastic error term.

Education inputs possess a hierarchical structure (Raudenbush & Bryk, 2002). Figure 3-1 illustrates the relationships of the inputs at different levels. Generally speaking, there are five hierarchical levels: the society level, community level, school level, classroom level, and student level. The society provides countrywide environment including culture, institutional feature of education system, and education policies. The community provides neighborhood inputs including safety, neighborhood peer effects, economic conditions, social capital (Bourdieu, 1986; Coleman, 1988), and so on. The society and community levels constitute the external contexts of the school. The school level inputs could be classified as institutional and physical inputs.

Institutional inputs include principal leadership, school culture, school level student composition with regard to socioeconomic status (SES), study ability, and so on. Physical inputs refer to school level resources such as per student expenditure, equipment, libraries, facilities, and building characteristics. Classroom level inputs include teacher effects such as teacher experience, teacher expectation, and peer effects from the perspectives of gender, study ability and SES. Student level inputs could be divided into student input and family input. Student inputs include gender, race, study ability, motivation and expectation, time resource allocation (how to manage time), test skills, and health. Family inputs include family socioeconomic status (SES), social capital, cultural capital, parental education, parental expectation, private cost of education (including expenditure on private tutoring), parental involvement in school activities, and so on.

As shown in Figure 3-1, different factors (i.e. the society, community, school, classroom, family, and student) affect one another in a very complex process. The arrows indicate the influences from one factor to another. On the one hand, school resource and institutional factors may affect student directly and indirectly via teacher effects. Parents could influence students directly and again indirectly through teachers (Hallinger, Bickman, & Davis, 1996). On the other hand, school principals, teachers, and parents may be influenced by students. For example, the reflection problem describes one potential mechanism of peer effects, arguing that the peer effects is actually peer students' influence on teachers which is then reflected by teachers onto the specific student (Manski, 1993; Sacerdote, 2001). Parents' expectation and private investment on education might also be affected by student characteristics such as study ability.

Figure 3-1 Education Production



A key objective of the econometric estimation of educational production function is to identify causal relationships of interest. The empirical models used by all the quantitative studies in economics of education should be informed by the causal theory, i.e. the general form of education production function. However, because of the complexity and selectivity of the education production process (as discussed in part 2.1), and the difficulty in identifying and quantifying inputs (Cohn & Geske, 1990), difficulties may arise in the estimation of education production, such that researchers may only capture a small part of the real causal relationships or even wrong causal relationships. Various research methodologies have been devised to identify the causal effects of certain inputs or intervention on the outputs in empirical research.

A main difficulty or issue is the missing data problem. An individual student can only be in one state of being treated or not, but cannot be in both simultaneously. If the researcher can observe the outcomes of being treated and not being treated for each individual student, there

would be no identification problem. Constructing this counterfactual in a convincing way is the main purpose of any identification strategy. In addition, several other issues are also widely discussed in economics of education, such as omitted variables, measurement error, nonlinearity, heterogeneity, collinearity, and hierarchical data.

According to Angrist and Pischke (2009) and Blundell and Costa-Dias (2008), there are several approaches to identify causal effects: (1) social experiment methods, (2) natural experiment methods (i.e. differences-in-differences methods, DID), (3) discontinuity regression (RD) methods, (4) matching methods, (5) instrumental variable (IV) methods, (6) control function (CF) methods, and (7) quantile regression (QR). All these approaches except the first and the last two attempt to mimic the randomized assignment of the experimental setting with non-experimental data. The adaption of these identification strategies heavily depends on whether the model hypotheses are valid on specific data structure. Hierarchical linear model (HLM) and the fixed/random effect model are designed to address the hierarchical data problem, and index computation could solve the collinearity problem to some extent.

This study will design some appropriate empirical models to the Chinese setting based on this theoretical framework.

3.4 Research Methodology

Basically, this study attempts to address three issues from the methodological perspective: 1) endogeneity of private tutoring when evaluating its effects; 2) selection bias derived from non-random high school assignment; and 3) hierarchical data structure and the corresponding fixed/random effects at the class level and school level. This section will establish three models to address these issues.

3.4.1 Basic Model and Control Function Model

The basic model attempts to control for endogeneity of private tutoring and selection bias generated by non-random high school assignment by a two-stage regression. The latent education production function without selection problem and endogeneity would be like this:

$$NCEE^{*}_{ijk} = \alpha_0 + \alpha X_{ijk} + \rho T_{ijk} + \beta C_{jk} + \gamma S_k + u_{ijk} \quad (1)$$

where $NCEE^{*}_{ijk}$ is the NCEE score of student i is in class j in school k[19]; X_{ijk} is vector of student characteristics including gender, age, student motivation, student ability, socioeconomic status, family wealth, cultural capital, and parent's involvement in child's education; T is vector of private tutoring inputs including time and money spent on private tutoring and private tutoring quality; C_{jk} is vector of class level inputs including peer effects and teacher quality; S_k is vector of school level inputs including average teacher quality, physical school inputs, school culture, and school climate; and u_{ijk} is the error term. All the detailed instruments are listed in Table 3-1. Most of the variables follow previous studies and some of the variables are designed according to the pilot studies. Based on this list, correlation check of the data will be conducted. For a set of variables with significant and high correlation, only one variable will be kept in order to minimize collinearity. The final list of variables after the correlation check will be reported in Chapter 4.

[19] This study only considers the selection problem at school level, not at the class level.

Table 3-1 Instruments Used in the Models

Category	Instruments	Measurement or Comments
Student level characteristics	Gender	Dummy variable: female =1, male=0
	Academic track	Dummy variable: science track=1, humanity track=0
	Registered residence	Dummy variable: rural=1, urban=0
	Student ability	(1) Index calculated based on self-reported evaluation regarding study ability and study habit
		(2) HSEE score as pre-existing difference in academic ability
	Socioeconomic status	Socioeconomic status Index calculated from individual variables including parental education level, parents' professions. The ranking of professions follows the studies Lu (2002 & 2010).
	Family wealth	Family wealth indices calculated from wealth related variables: urban wealthy family and rural wealthy family
	Cultural capital	Two indices calculated from measures such as paintings on the wall at home, number of books, frequency of going to museums and performance, etc. One is facility related index, the other is related with interaction with parents.
	Parents' education style	Four indices calculated from a series of instruments measuring parents' style of involvement in child's education. See Table 3-14 for details.
	Optimistic	Index calculated from self-evaluation instruments
	Not nervous to test and like playing	Index calculated from self-evaluation instruments
	Misconduct	Index calculated from measures regarding to misconduct at school
	Leadership	Index constructed to measure leadership and prestige at school
Private tutoring inputs	Participation status	Dummy variable indicating whether or not participated in private tutoring
	Time spent on private tutoring	Index calculated from hours during spent on private tutoring for Chinese, math, and English respectively during weekdays, weekends, and summer
	Private tutoring quality	1) Fees per hour 2) Private tutor's background
Class level inputs	Peer effects	Average SES Index of the class
	Class Type	Dummy variable: key class=1, non-key class=0
	Class environment of personal relationship	Aggregated evaluation scores from students on the relationship with teachers and classmates, and on whether the head teacher is responsible and treats

		students well
School level inputs	School selectivity	The HSEE admission line
	School size	Number of students
	Average teacher quality	1) Percentage of teachers with certain professional ranks 2) Percentage of teachers at certain education levels
	Principal quality	Years of principal experience
	Physical school inputs	1) Student teacher ratio index 2) Index calculated from the scale and condition of laboratories 3) Computer index calculated from per student computers, and per student computer used in instruction.
	School culture and administration	1) Principal leadership type measured by aggregated categorical evaluation scores from teachers in terms of collegial, High authority and accountability, and lax leadership 2) School wide staff development measured by aggregated categorical evaluation scores from teachers 3) School's effort on extra curriculum and cultural activities measured by aggregated evaluation from students

It is highly possible that student's participation in private tutoring is correlated with student characteristics such as study ability, academic track, and family background. In addition, classes and schools may also influence student's decision in the sense that if schools cannot provide education of adequate quality, students may want to seek private tutoring outside schools; and that if most of the classmates participate in supplementary tutoring outside school, students have to do the same thing in order to compete for higher rankings in the exam. If there are some factors that influence both the NCEE score and private tutoring participation that are not controlled for, such as the teaching quality in the classroom and some education policy, the vector T would be correlated with the error term u_{ijk}, which violate the basic assumption. To

solve this problem, several instrumental variables (IV) are proposed as follows. There are variables that are correlated with private tutoring participation but not with NCEE score.

First, according to the literature review (Baker & LeTendre, 2005; Bray, 2010), students may be influenced by their peers in making decisions of private tutoring participation. The more friends participate in private tutoring, the more likely that this student participates in private tutoring. Thus, the number of private tutoring participants among one's five closest friends could be a valid IV.

Second, if the supply of private tutoring in certain districts or neighborhoods is higher, the probability of students' participation in private tutoring would be higher. The measurement of private tutoring supply could be measured by the distance between the nearest private tutoring agency and home.

Third, if students are exposed to a lot of advertisements of private tutoring, they are more likely to participate. The number of advertisements exposed to particular student every week would be exogenous and might be an appropriate IV.

Sargan test of overidentifying restrictions would be conducted to test the exogeneity of these instrumental variables. For now, vector *Z* is used to represent the set of instrumental variables.

The reduced form of two-stage least square (2SLS) regression is

$$NCEE^{*}_{ijk} = \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + u_{ijk} \quad (2)$$

where $E\left(u_{ijk} \middle| X_{ijk}, Z_{ijk}, C_{jk}, S_k\right) = 0$, and $V\left(u_{ijk} \middle| X_{ijk}, Z_{ijk}, C_{jk}, S_k\right) = \sigma^2$.

In China, lower secondary graduates are not randomly assigned to high schools. The High School Entrance Exam (HSEE) score is used as the primary selection criterion, although a few counties and rural schools are allowed to enroll students only in their own districts. Detailed information of HSEE is in Appendix 1. Thus, two methods are considered. First, since HSEE is

the main determinant of high school assignment and is also included in the outcome equation (2), HSEE score alone should be able to control for both student quality and potential bias from high school selection. Thus, equation (2) is considered as the appropriate empirical model for estimation. Second, control function is employed to construct and control for high school selection process. Two sets of estimates will be derived from this point.

For the first method, 2SLS models will be estimated based on equation (2). A hierarchical linear model (HLM) will then be designed involving predicted measures of private tutoring participation from the first stage of 2SLS models. The HLM approach will be discussed in section 3.4.2.

In regard to the second method, the control function is employed based on equation (2) to address the selection problem. Three prevailing approaches based on Heckman (1979) are those suggested by Lee (1983), Dubin and McFadden (1984), and Dahl (2002). Schmertmann (1994) carefully compared the former two methods and concluded that the Dubin-McFadden approach is theoretically preferred to the Lee approach, but does not always perform better. Bourguignon, Fournier , and Gurgand (2007) did theoretical analysis of underlying assumptions made by the different methods and conducted Monte Carlo analysis to compare the three methods. They concluded that in most cases, the approaches proposed by Dubin and McFadden (1984) and Dahl (2002) should be preferred to the Lee method, and that the Dubin-McFadden (1984) correction method waving the restriction (imposed in Dubin-McFadden (1984)) that all correlation coefficients sum-up to zero clearly outperforms the traditional Dubin and McFadden's correction method. This study will therefore follow this approach.

Suppose that individual student i's utility function in selecting school k is:

$$I_{ki}^{*} = W_i \delta_k + \eta_{ik} \qquad (3)$$

where W_i is the exogenous and pre-treatment variable that determines school selection - $HSEE_{ijk}$, δ_k is the vector of coefficients, and η_{ik} is the error term and is independent and identically Gumbel distributed (i.e., the IIA hypothesis: independence of irrelevant alternatives).

Individual student i will select school k if and only if school k maximizes utility function (3). Define I_i as individual i' school selection indicator.

$$I_i = k \quad \text{iff } I_{ki}^* > \text{Max} I_{ni}^* \quad (k \neq n)$$
$$= 0 \quad \text{otherwise}$$

For this truncated data, one only observes the NCEE score for student i who selects school k:

$$NCEE_{ijk} = NCEE_{ijk}^* \quad \text{iff } I_i = k$$
$$= ? \qquad \text{otherwise}$$

Let $\varepsilon_{ki} = \text{Max} I_{nk}^* - \eta_{ik}$, thus $I_i = k$ iff $\varepsilon_{ijk} < W_i \delta_k$

Assume that ε_{ki} has an extreme value distribution, and are independent and identically distributed (iid).

$$F(\varepsilon_{ki}) = \exp(-\exp(-\varepsilon_{ki}))$$

$$f(\varepsilon_{ki}) = \exp(-\varepsilon_{ki})\exp(-\exp(-\varepsilon_{ki}))$$ [20]

The conditional multinomial logit model is

$$\Pr(\varepsilon_{ki} < W_i \delta_k) \equiv \Pr(I_i = k) = \frac{\exp(W_i \delta_k)}{\sum_{k=1}^{K} \exp(W_i \delta_k)}, \text{ k=1, 2, …, K} \qquad (4)$$

[20] Suppose the marginal distribution function of u is $G(u_{ijk})$, and let $g(u_{ijk})$ be the density function of $G(u_{ijk})$. Let the marginal distribution function of ε_{ki} is $F(\varepsilon_{ki})$, and let $f(\varepsilon_{ki})$ be the density function of $F(\varepsilon_{ki})$.

$$
\begin{aligned}
&E\left[NCEE^{*}_{ijk} \mid X_{ijk}, Z_{ijk}, C_{jk}, S_k, I_i = k\right] \\
&= E\left[\alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + u_{ijk} \mid X_{ijk}, Z, C_{jk}, S_k, I_i = k\right] \\
&= \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + E\left[u_{ijk} \mid X_{ijk}, Z, C_{jk}, S_k, I_i = k\right] \\
&= \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + E\left[u_{ijk} \mid I_i = k\right] \\
&= \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + E\left[u_{ijk} \mid \varepsilon_{ki} < W_i \delta_k\right] \\
&= \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + \sigma \frac{\sqrt{6}}{\pi}\left[\sum_{s \neq k} r_{ks}\left(\frac{P_s \ln(P_s)}{1 - P_j}\right) - r_{kk}\ln(P_k)\right] + \upsilon_{ijk}
\end{aligned}
\tag{5}
$$

where r_{ks} is a correlation coefficient between u_{ijk} and η_s.

By now, equation (5) could be used to estimate determinants of NCEE scores with fix/random effects at the class level and school level. According to Bourguignon et al. (2007), selection bias correction based on this model can provide fairly good correction for the outcome equation, even when the IIA hypothesis is violated.

Let $\lambda = \sum_{s \neq k} r_{ks}\left(\frac{P_s \ln(P_s)}{1 - P_j}\right) - r_{kk}\ln(P_k)$, the first stage regression of 2SLS model is

$$
T^{*}_{ijk} = a_0 + aX_{ijk} + bC_{jk} + rS_k + \pi_1 Z_{ijk} + t\lambda_{ki} + \varepsilon_{ijk} \tag{6}
$$

Equation (6) answers the research question of the determinants of private tutoring participation. Different specifications of the econometric model are used to estimate equation (6) according to different measures of the dependent variable. If the dependent variable is the time spent on private tutoring, the OLS model is used to estimate equation (6). If the dependent variable is the expenditure on private tutoring which is highly censored data, it is considered as a forbidden regression (Angrist & Pischke 2009, p.190), and two steps are taken. First, use the tobit model to estimate equation (6) and get the nonlinear fitted values. Second, use the nonlinear fitted values as the new instrument for the expenditure on private tutoring in the linear 2SLS regression. If the dependent variable is the binary dummy variable, the same two-step strategy is

employed. First, get nonlinear fitted values from the logit model based on equation (6), and then use these fitted values as the new instrument for linear 2SLS regression.

$$T^{*}_{ijk} = a_0 + aX_{ijk} + bC_{jk} + rS_k + \pi_1 Z_{ijk} + t\lambda_{ki} + \varepsilon_{ijk}$$

The effect of private tutoring on student achievement is measured by coefficient $\rho^{*} = \frac{\pi_2}{\pi_1}$.

Substituting Z_{ijk} by $\hat{T}_{ijk}$ in equation (4), one get

$$E\left[NCEE^{*}_{ijk} \mid X_{ijk}, Z_{ijk}, C_{jk}, S_k, I_i = k\right] = \hat{\alpha}_0 + \hat{\alpha} X_{ijk} + \rho \hat{T}_{ijk} + \hat{\beta} C_{jk} + \hat{\gamma} S_k + \hat{\tau}\lambda_{ki} + \upsilon_{ijk} \qquad (7)$$

where $\hat{\alpha}_0 = \alpha_0 - \frac{a_0}{\pi_1}$, $\hat{\alpha} = \alpha - \frac{a}{\pi_1}$, $\hat{\beta} = \beta - \frac{b}{\pi_1}$, $\hat{\gamma} = \gamma - \frac{r}{\pi_1}$, and $\hat{\tau} = \tau - \frac{t}{\pi_1}$.

It is important to notice that the selection bias correction based on a multinomial logit model will derive k regressions on the outcome equation due to the nature of multinomial logit model. If the schools are collapsed into four categories, four sets of estimates will be presented for each category. To obtain the average treatment effect for the whole sample, a simple 2SLS model involving IV method will be employed without CF. It is reasonable to argue that IV method can provide sufficient estimation without CF, because the information used in the CF method has already been controlled in IV approach. No more information is added by involving CF approach.

3.4.2 Hierarchical Linear Model

This unique hierarchical linear model will incorporate the combination of IV and regular HLM in order to control for endogeneity of private tutoring participation. The endogenous level-1 variable will be replaced by the predicted fitted values in the private tutoring participation models.

$$T^{*}_{ijk} = a_0 + aX_{ijk} + bC_{jk} + rS_k + \pi_1 Z_{ijk} + t\lambda_{ki} + \varepsilon_{ijk} \qquad (8)$$

In this new HLM model, vectors *X*, *C* and *S* will be expanded into specific variables. The level-1 conditional model would be within each classroom and is a function of student-level predictors plus a random student-level error:

$$\begin{aligned} NCEE_{ijk} &= \pi_{0jk} + \pi_{1jk}Gender_{ijk} + \pi_{2jk}HSEE_{ijk} + \pi_{3jk}rural_{ijk} + \pi_{4jk}SES_{ijk} + \pi_{5jk}SchoolChoice \\ &+ \pi_{6jk}wealth_{ijk} + \pi_{7jk}AcademicTrack_{ijk} + \pi_{8jk}StudyHabits_{ijk} + \pi_{9jk}CulturalCapital_{ijk} \\ &+ \pi_{10jk}ParentEduStyles_{ijk} + \pi_{11jk}\text{F}_{ijk} + e_{ijk} \end{aligned} \quad (9)$$

Each of the regression coefficients in the student-level can be predicted by some class-level variables. The general level-2 model would be at the class level:

$$\pi_{pjk} = \beta_{p0k} + \beta_{p1k}ClassEnviornment_{jk} + \beta_{p2k}ClassType_{jk} + \beta_{p3k}ClassSESMean_{jk} + r_{pjk} \quad (10)$$

where *p* indexes the p^{th} coefficient in level-1 model. Note that different π_{pjk} may have a unique set of these level-2 predictors.

Each of the regression coefficients in the class level model can be predicted by some school-level characteristic. The general level-3 model would be:

$$\begin{aligned} \beta_{pqk} &= \gamma_{pq0} + \gamma_{pq1}SchoolSize_k + \gamma_{pq2}StudentTeacherRatio_k + \gamma_{pq3}PhysicalInput_k \\ &+ \gamma_{pq4}TeacherQuality_k + \gamma_{pq5}SchoolSizeAdmissionLine_k + \gamma_{pq6}SchoolCulture_k \\ &+ u_{pqk} \end{aligned} \quad (11)$$

where *p* and *q* index the p^{th} coefficient in level-1 model and the q^{th} coefficient in level-2 model respectively. Again, different β_{pqk} may have a unique set of these level-3 predictors.

Variables such as *SES, Cultural Capital, Wealth, Parents' styles of educating their child, Teacher Quality, Physical Inputs, and School Culture* are index variables calculated from questionnaire measures.

The multilevel models are conducted in several stages. The first stage estimates the proportion of variances of the NCEE score that are presented among schools and among classes within schools in order to better understand the data structure. Second, student level fixed effect

model is estimated, with level-1 measures grand-mean centered and their effects fixed. Third, the three-level model is conducted with two distinct parameters separately: (1) intercepts-as-outcome model which allows the estimation of class/school's influence on the average NCEE score; and (2) slopes-as-outcome model which helps to understand how class/school characteristics affect the effect of private tutoring on the NCEE score.

Table 3-2 summarizes the research design discussed so far.

Table 3-2 Summary of Research Design

<table>
<tr><td colspan="2">Basic model (Model 1)</td></tr>
<tr><td colspan="2">2SLS using IV for endogenous measures of private tutoring participation</td></tr>
<tr><td colspan="2">Four sets of regressions for NCEE total score, Chinese score, Math score, and English score respectively.</td></tr>
<tr><td>3 measures of private tutoring participation</td><td>Instruments in the first stage</td></tr>
<tr><td>(1) Dummy variable: 1=participated, 0=did not participate</td><td>Fitted values from the logit model</td></tr>
<tr><td>(2) Money spent on private tutoring (censored data)*</td><td>Fitted values from the tobit model</td></tr>
<tr><td>(3) Index: time spent on private tutoring (continuous normally distributed)*</td><td>Original IV</td></tr>
<tr><td>Model 2</td><td>Model 3</td></tr>
<tr><td>HLM model involving predicted measures of private tutoring participation in level-1 equation.</td><td>Control function (involving predicted measures of private tutoring participation) to control for high school selection bias</td></tr>
</table>

* These two measures of private tutoring participation are only for all subjects.

3.5 Data Collection and Data Processing

Based on the empirical models discussed above, the data needed to conduct this study is hierarchical data nested at student level, class level, and school level. Individual level data includes student background information, test scores, parents' pecuniary and non-pecuniary input in education, and detailed information in private tutoring participation. The class level data includes class level student characteristics, teacher quality, and class atmosphere. School level

data includes school level education inputs such as teacher quality, labs and libraries, organization administration style, and school level peer effects.

The needed database is not available to the author for China. Several potential reasons lead to this data constraint. First, there might be some appropriate databases that can facilitate this study, but are restricted to the government and not open to public. Second, there are also a few databases used by existing studies in China, but most of them are characterized by low quality and limited information, and they are not available to other researchers, either. Third, a high quality second hand dataset with all the information needed is scarce, because of the expertise and large amount of resources needed to establish this kind of database. Thus, data collection is the only way to conduct this study.

The data collection was conducted in Jinan City, the capital of Shandong province in eastern China (See Appendix 2 & 3). The reasons to choose Jinan were as follows. First, Shandong province has one of the largest student bodies in China, and is a good representative when studying education policies in China. In 2010, about 660,000 students[21] took the NCEE in Shandong, and this number ranked second across the provinces. Second, Jinan is a typical city in Shandong, with significant amount of socioeconomic variation across the ten districts and has 41 regular senior high schools with varying quality in 2009[22]. Third, Jinan is above the average province level in terms of both population and economic development. The Gross Domestic Product (GDP) of Jinan in 2007 was 256.281 billion RMB and accounted for 9.9% of that in Shandong Province[23]. The per capita GDP of Jinan was 43,952 RMB in 2007 and ranked 5th in

[21] Data source: iqilu.com
[22] Data source: Jinan Education Statistic Yearbook 2009.
[23] Data source: Jinan Statistic Yearbook 2008.

Shandong[24]. Thus, we could expect a considerable amount of private tutoring in Jinan City, while not losing the representativeness.

Shandong had a population of 93,669,700 in 2007[25]. The GDP of Shandong province was 2588.770 billion RMB (about 370 billion US dollars) in 2007, and ranked second across all 31 provinces in China, just behind Guangdong Province[26]. However, the per capita GDP in Shandong was 28,000 RMB and the ranking falls to the 7th among all the provinces in China[27]. Jinan lies in the middle west of Shandong, with a population of 6,048,500 in 2007, in which urban[28] population accounted for 58.3%. The urban registered unemployment in Jinan was 5.43% in 2007. There are 10 county-level districts in Jinan: Lixia District, Central City District, Huaiyin District, Tianqiao District, Licheng District, Changqing District, Zhangqiu City, Pingyin County, Jiyang County, and Shanghe County. The latter four are counties outside the urban area of Jinan. The basic socioeconomic indicators are reported in Table 3-3.

Table 3-3 Socioeconomic Indicators in Jinan, 2007

District	Population (Unit: thousand)	Per Capita GDP unit: RMB	Regular Budgetary Expenditure (unit: million RMB)	
			All Sectors	Education Sector
Whole City	6048.5	42371.00	9880.38	2170.78
Lixia District	575.3	75722.23	966.41	194.35
Shizhong District	568.5	57120.49	903.75	222.17
Huaiyin District	373.5	35295.85	696.78	142.37
Tianqiao District	504	43351.19	793.78	169.48
Licheng District	935	55182.89	1697.12	395.17
Changqing District	570.8	28740.36	758.66	197.52
Pingyin County	368.7	29582.32	586.19	126.74
Jiyang County	609.7	19696.57	695	140.82
Shanghe County	539.2	10736.28	547.88	143.69
Zhangqiu City	1003.8	32060.17	2234.81	438.47

Data source: Jinan Statistical Yearbook 2008

The data is collected through two methods: questionnaire survey and administrative data collection. The latter collects data including the HSEE scores, the NCEE scores, school revenue

[24] Data source: http://zhidao.baidu.com/question/61711995.html
[25] Data source: Jinan Statistic Yearbook 2008.
[26] Data source: Shijie 2007 Nianjian (World Yearbook 2007). China Finance and Economic Publishing House
[27] Data source: Shijie 2007 Nianjian (World Yearbook 2007). China Finance and Economic Publishing House
[28] Urban means the registered residence is urban.

and expenditure, student tuition and school choice fees charged by each school, county-level socioeconomic indicators, and so on. Administrative data are usually more precise and could avoid self-report bias. Questionnaire survey will be discussed in section 3.5.2.

3.5.1 Sampling Strategy

In 2007, 60,302 Grade 9 students wrote the HSEE in Jinan, and among them, 40,500 students were enrolled in 48 regular high schools (including 35 public high schools, 5 complete high schools, and 8 private high schools).[29]

Taking into account the feasibility of data collection and the significant difference between public and private schools[30], this study only focuses on public regular high school students. A stratified non-proportional sampling strategy was employed from the perspective of school system. The sample was derived from 25 schools among the 34 public regular high schools across all the nine districts and counties[31] in Jinan. Among the 25 selected schools, 15 schools are urban schools, 8 schools are county schools, and 2 schools are rural schools. Table 3-4 reports school sampling in term of location. Total schools sampled account for 71% of all public regular high schools in Jinan. The proportions of sampled schools in urban, county, and rural areas account for 71%, 73%, and 67% of all public regular high schools in the three areas respectively. Overall, the 25 sampled schools are representative of all the public regular high schools in Jinan.

Table 3-4 School Sampling in Term of Location

	Urban	County	Rural	Total
All public regular high schools in Jinan	21	11	3	35
Selected public regular high schools	15	8	2	25
Percentage	71%	73%	67%	71%

[29] Data source: http://www.kaoshi365.com/zk/show_5185_1621.html
[30] High quality schools are all public schools. Private schools basically attract students from wealthy families and with lower achievement.
[31] One district (Huaiyin) out of ten does not have senior high school.

Within each high school, 3 to 5 classes were randomly chosen, with a guarantee of covering all kinds of class types, such as science track and humanity track in academic track dimension, and key class, non-key class, and panel class in study ability grouping dimension. All the students in the selected classes (about 50 to 60 students per class) were sampled. For a population of 40,000 students (has not excluded students enrolled in private schools), the margin of error for a sample with 6,000 students is 1.17%.

Figure 3-2 Frequency of the HSEE Total Score in 2007: All Junior Middle School Graduates in Jinan V.S. Students Sampled

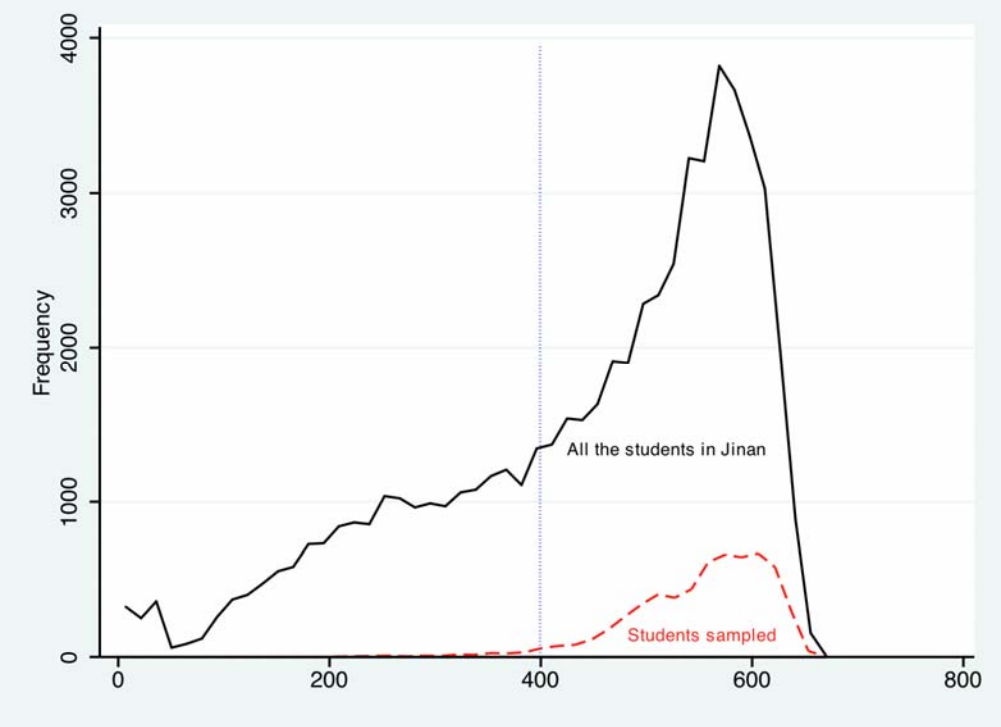


Figure 3-2 compares the frequency of the HSEE total score of all junior middle school graduates in Jinan in 2007 with that of students sampled. The lowest official admission line was 400. But there were still some high school students with admission line below 400. The

distributions of the population and the sample are quite similar. T-test for students with the HSEE total score higher than 400 shows that the mean of student sampled is 15 points higher than the mean of all students in Jinan. 15 points only account for about for 2% of the full mark (690 points). Thus, the sample selection bias is very modest.

3.5.2 Questionnaire Design

To obtain background information of students, parents, teachers, and principals, four sets of questionnaires are designed for students, parents, teachers, and school administrators respectively. The questions will focus on three subjects: Chinese, math, and English.

It is important to make sure that the measures of instruments derived from the questionnaires are reliable and valid to the highest extent. Reliability of measures refers to the consistency of the measurement. If the variation among repeated measurements using the same measurement method and on the same subject is low, then the degree of reliability is high, and visa versa. Internal consistency estimates reliability by grouping questions in a questionnaire that measure the same concept. One common way of computing correlation values among the questions on the instruments is by using Cronbach's Alpha, which was originally derived by Kuder and Richardson (1937) for dichotomously scored data (0 or 1) and later generalized by Cronbach (1951) to account for any scoring method. In short, Cronbach's alpha splits all the questions measuring the same instrument every possible way and computes correlation values for all of them. Cronbach’s alpha for each component measure is given in the section 3.5.6 on index construction.

Validity of measures refers to the extent to which an empirical measure adequately indicates the real meaning of the concept under consideration. In another word, it is the match between the conceptual definition and the operational definition. Complete validation is never fully attained,

and therefore should be viewed as a never-ending process. Validity evidence is empirical evidence and theoretical rationales that support the inferences made from measures (Johnson & Christensen, 2007). Validity evidence can be obtained through different methods. Evidence based on internal structure of the test, is often obtained from factor analysis and a test of homogeneity. Evidence based on relation to other variables is obtained by relating the questionnaire measurement to a relevant criterion, or by collecting convergent evidence and discriminate evidence (Johnson & Christensen, 2007).

To improve the validity and reliability of measures used in this model, most of the variables used in the questionnaires are already tested instruments from previous studies and datasets. The questionnaire design has referred to the questionnaires used by National Education Longitudinal Study, Program of International Student Assessment, Trends in International Mathematics and Science Study, National Survey of Student Engagement, and those used by relevant surveys in China. The questionnaire design also carefully referred to the instruction in Johnson and Christensen (2007, Chapter 7). In addition, two pilot studies have been taken to make sure that the participants clearly understand the questions and the options for the multiple-choice questions are appropriate.

The first pilot study carried out in the summer of 2009 was used to draft the preliminary version of questionnaires reported in dissertation proposal. Around 100 high school students and 10 teachers filled out the preliminary questionnaires. About 15 teachers and 20 students were asked to voluntarily provide their feedbacks on question design and instrument design (e.g. best instruments to measure teacher quality, the most important factors influencing achievement, etc.). Wording and writing style were revised in the questionnaires of Chinese version after this pilot

study, in order to make sure that all the questions were explicitly stated and in a reader-friendly way.

The second pilot study conducted in January 2010 aimed at testing the validity of questions and options. The second pilot study was conducted at an average-level high school, by asking about 60 students, 10 teachers, and 1 principal to fill up the questionnaires and provide feedbacks on the question design and other issues. By examining the distribution of answers of multiple-choice questions, the scales of some categorical answers were reset. In addition, a few questions are not appropriate to ask in the questionnaire survey, and are considered to introduce large measurement error. For example, no teacher reported income earned outside school (such as from private tutoring), which is very sensitive and seen as illegal. These questions were deleted. Table 3-5 documents the revision according to the second pilot study. The four questionnaires are given in Appendix.

Table 3-5 Questionnaire Change Document

Questionnaire question	In dissertation proposal	In final version
Student – A23: How large is your house/apartment?	(1) Under 50m2 (2) 50-90 m2 (3) 91-120 m2 (4) 121-160 m2 (5) more than 160 m2	(1) under 50m2 (2) 50-70 m2 (3) 71-90 m2 (4) 91-120 m2 (5) more than 120 m2
Student – A24: How far is your school from your home?	(1) Within 5 km (2) 6-120 km (3) 11-20 km (4) Beyond 20 km	(1) Within 5 km (2) 6-10 km (3) 11-20 km (4) Beyond 20 km
Student – A25&26: What is the highest education level of your father/ mother?	(1) No schooling	(1) Did not finish primary education
Student – A39: How many books do you have in your family (exclude magazines, newspapers, and textbooks)?	(1) 0-10 (2) 11-25 (3) 26-100 (4) 101-200 (5) 201-500 (6) 501	(1) 0-10 (2) 11-25 (3) 26-50 (4) 51-100 (5) 101-200 (6) 201
Student – E4	School choice fee or donation	Delete this question
Student – E5	Class choice fee	Delete this question
Student – E6	Tuition for G12 (two semester)	Delete this question
Student – E7	Board fee for G12 (two semester)	Delete this question
Parent – B1: What's your monthly income in your family? (including salaries, welfare incomes, subsides, returns on investment, etc.)	(1) Below 200 RMB (2) 201-500 RMB (3) 501-800 RMB (4) 801-1000 RMB (5) 1001-1500 RMB (6) 1501-2000 RMB (7) 2001-2500 RMB (8) 2501-3000 RMB (9) 3001-4000 RMB (10) 4001-6000 RMB (11) 6001-8000 RMB (12) Above 8001 RMB	(1) Below 500 RMB (2) 501-1000 RMB (3) 1001-2000 RMB (4) 2001-3000 RMB (5) 3001-4000 RMB (6) 4001-5000 RMB (7) 5001-6000 RMB (8) 6001-7000 RMB (9) 7001-9000 RMB (10) 9001-11000 RMB (11) 11001-15000 RMB (12) Above 15000 RMB
Teacher – A19	What is your average income from tutoring per month?	Delete this question

3.5.3 Data Collection

The data collection was conducted with the help of Jinan Education Bureau (JEB), who issued the approval letter for the survey and informed all the principals in the public schools in Jinan about this survey, asking them to provide assistance. An information reception was held by JEB for the principals of participant schools. In this reception, the vice director of JEB who was in charge of basic education in Jinan, introduced this research project, explained the significance to Jinan education, and asked the principals to assist this survey. A survey schedule (the format is in Table 3-6) was framed with the agreement from all the principals. Principals' cell phone numbers were collected for the researcher to contact.

Table 3-6 Survey Schedule Format

Item	Format of the content for each school
School	Name
Contact person	Name
Phone	Number
Address	Address
Research assistant	Name
Phone	Number
Questionnaire distribution date	mm/dd/ a.m. or p.m.
Parent questionnaire collection date 1	The next day of distribution date, a.m./p.m.
Parent questionnaire collection date 2	The next Monday from the distribution date, a.m./p.m.

In addition, twenty graduate students were recruited as research assistants from Shandong Normal University (SNU). With the help of a visiting scholar of the Center on Chinese Education, Teachers College Columbia University, who is an associate professor at SNU, the author delivered a presentation at SNU and introduced this research project. Twenty graduate students volunteered to register as research assistants for this project. They were all majors in education and had a strong interest in data collection and school visit. They would not only learn about field study from this project, but also build up good relationships with local high schools,

which may be helpful for their job hunting. A team leader was picked among these research assistants. Her responsibility was to organize this research team, communicate with me and deliver my messages to the team during the survey. These research assistants got a reasonable payment for this work.

One week before the formal survey, a two-hour training was carried out for this research team. There were several parts in this training. First, the research goal and data collection requirement were carefully explained. Second, the responsibility of the team was detailed. The detailed process on how to contact school principals, how to read *"Participant's right"* and *"Informed Consent form"* before the survey, how to deliver and collect back the questionnaires, and how to collect back participants' signatures were discussed with the team. Third, logistics issues such as grouping volunteers into small teams and signing them to different schools, transportation arrangement, and emergency contact were set up. Fourth, all the questionnaires were reviewed with the research assistants, so that they could answer potential questions raised by the survey participants. Fifth, professional behavior was emphasized, such as arriving at school on time, respecting school arrangements to avoid any potential conflict, and patiently explaining the requirement of this data collection when misunderstandings occurred. Volunteers were strongly encouraged to call the author when they were not sure how to deal with certain situations. In the end, volunteers were asked to raise questions and practice on how to speak in front of the high school students.

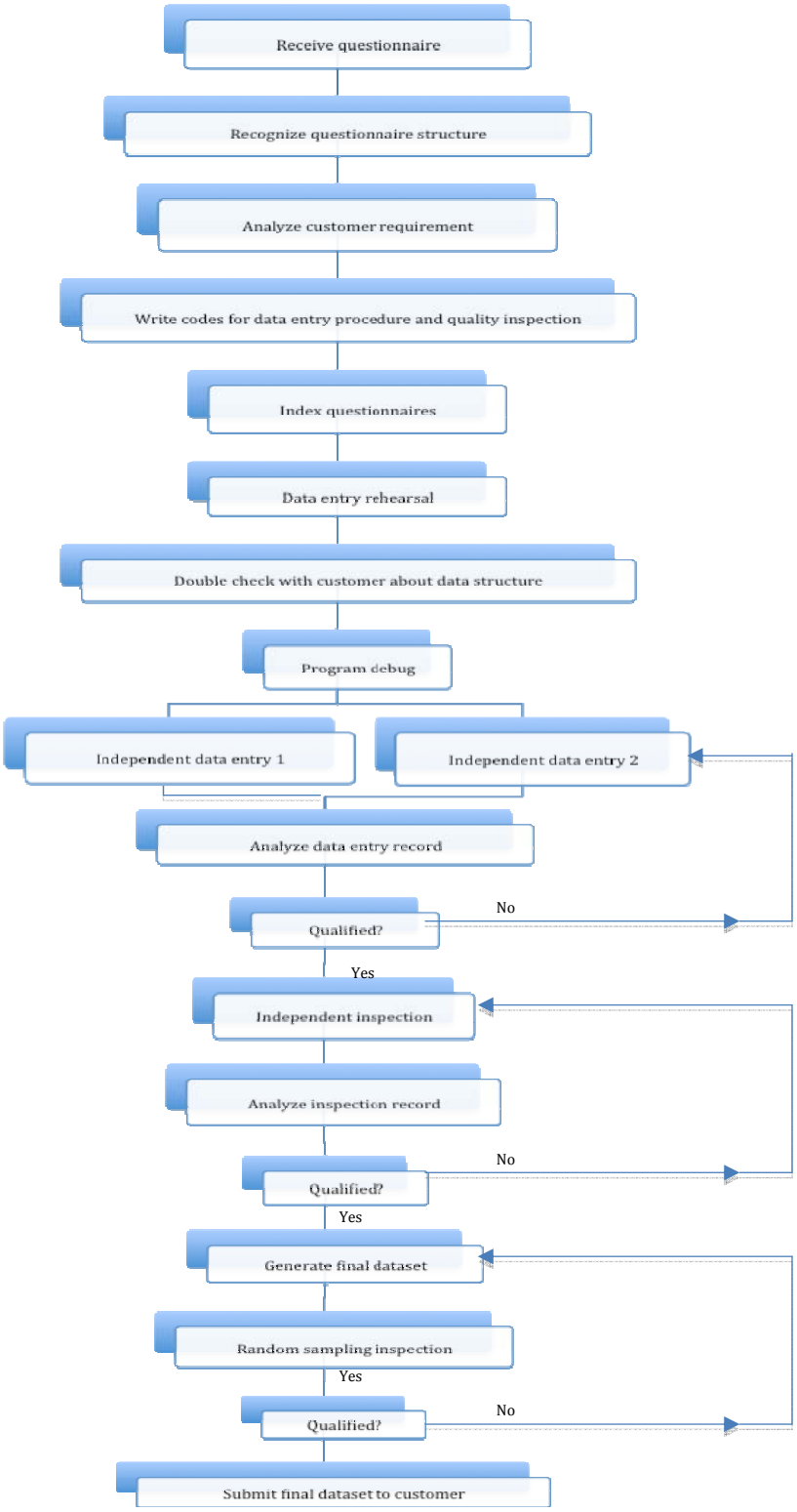
In late February 2010, when the spring semester just began, the research team went to different high schools with the approval letter from JEB following the survey schedule, distributed the questionnaires, and collected them back. All the student questionnaires, teacher questionnaires, and principal questionnaires were collected back by the research team on the day

of the school visit. Parent questionnaires were collected one week later, because most schools were boarding schools and students had to bring the parent questionnaires back home on weekends. All the collected questionnaires were sealed in the envelopes. The whole on-site survey took ten days.

After that, all the questionnaires were delivered to a Questionnaire Company (QC) for data entry. The advantages of employing a QC instead of doing the work by volunteer students are as follows. First, the selected QC is a professional academic questionnaire company with a business license issued by the government and with a high reputation in privacy protection among the major education research institutes in Beijing. Data confidentiality can be effectively protected by signing a confidential agreement with QC. Second, the total number of questionnaires is around 12,000. Only professional companies can handle such a large amount of data entry.

The data entry quality is guaranteed by both the dual-independent data entry procedure and the random inspection from me. Figure 3-3 presents the dual-independent data entry procedure. The error rate is 0.45% for independent data entry 1, and 0.24% for independent data entry 2. Thus, the possibility of data entry mistake is 0.001% (which equals 0.45%*0.24%).

Figure 3-3 Dual-independent Data Entry Procedure



3.5.4 Sampling Weight

The sampling weight is calculated according to the stratified sampling strategy and can be decomposed into three parts. For each stage, the weight is adjusted by the response rate.

The first-stage (school) weight represents the inverse of the first stage selection probability assigned to a sampled school. Schools were selected from each district/county independently. Thus, the first-stage weight is the total number of high schools in this district/county divided by number of schools chosen from it.

$$W_s = \frac{N_j}{n_j}$$

where W_s is the school weight, N_j is the total number of high schools in district/county *j*, and n_j is number of schools chosen from it.

The school level response rate is 100%. Therefore, there is no need to calculate it.

The second-stage (class) weight is the inverse of the second stage selection probability assigned to a sampled class. Several classes were selected from each sampled school. Thus, the second-stage weight is the total number of classes in this school dived by number of classes chosen from it.

$$W_{jk} = \frac{M_{jk}}{m_{jk}}$$

where W_{jk} is the school weight, M_{jk} is the total number of high schools in district/county *j* and school *k*, and m_{jk} is number of classes chosen from it.

The class level response rate is 100%. Therefore, there is no need to calculate it.

The third-stage (student) weight is the inverse of the third stage selection probability assigned to a sampled student. Since all the students in selected classes were sampled, the third stage weights are 1 for all students.

The student level participation rate is the number of students who submitted questionnaire with complete or identifiable student ID number divided by the total number of students in the corresponding class.

$$R_{jki} = \frac{s_{jki}}{S_{jki}}$$

where R_{jki} is the student respond rate, s_{jki} is the number of students in district/county *j*, school *k*, and class *i*, who submitted questionnaire with complete or identifiable student ID number, and S_{jki} is total number of students in this class.

Thus, the sampling weight should be $W = \frac{Ws \cdot W_{jk}}{R_{ijk}}$.

However, because of data limitation, M_{jk} and S_{jki} is unknown. Assuming that in each school, the class size is equal, then

$$W = \frac{Ws \cdot W_{jk}}{R_{ijk}} = Ws \cdot \frac{M_{jk} S_{jki}}{m_{jk} S_{jki}} \cdot \frac{S_{jki}}{s_{jki}} = Ws \cdot \frac{M_{jk} S}{m_{jk} S} \cdot \frac{S}{s} = Ws \cdot \frac{M_{jk} S}{m_{jk} S} \cdot \frac{S \cdot m_{jk}}{s \cdot m_{jk}}$$
$$= Ws \cdot \frac{M_{jk} S}{s \cdot m_{jk}} = Ws \cdot \frac{G_s}{g_s}$$

where G_s is the total number of G12 students in school s, and g_s is the students responded. Table 3-7 reports the sampling weight for students in each school.

Table 3-7 Sampling Weights for Students in Each School

District index	School Index	N_j	n_j	G_s	g_s	Sampling weight
1	101	2	2	1690	216	7.824
5	102	11	6	1279	209	11.219
4	103	2	2	686	161	4.261
1	104	2	2	701	286	2.451
5	105	11	6	1115	261	7.832
2	106	3	3	1817	239	7.603
2	107	3	3	1137	252	4.512
2	108	3	3	1043	184	5.668
5	109	11	6	827	244	6.214
8	110	3	3	700	278	2.518
4	111	2	2	585	275	2.127
5	112	11	6	1760	271	11.907
5	113	11	6	1246	278	8.217
5	114	11	6	472	283	3.058
10	115	5	4	744	233	3.991
10	116	5	4	1763	247	8.922
10	117	5	4	1290	259	6.226
10	118	5	4	981	208	5.895
6	119	4	2	1475	228	12.939
6	120	4	2	795	250	6.360
7	121	3	1	1900	230	24.783
8	122	3	3	1666	234	7.120
8	123	3	3	1789	263	6.802
9	124	2	2	872	237	3.679
9	125	2	2	679	217	3.129

3.5.5 Missing Data

The original sample size for student questionnaire data is 6,474. Since student ID number and student names are required to link the survey data with the NCEE score, which is the dependent variable measuring student achievement, cases without complete ID and name are considered as data missing their dependent variables. According to Table 3-8 below, the valid sample size accounts for 92.1% of original sample size. Therefore the missing data problem is quite minor. When merging questionnaire data with administrative NCEE data, another 187 cases are lost because they have no record in NCEE dataset. Thus, the final data size is 5841.

Table 3-8 Missing Values of Outcome Variables in Student Questionnaire

	Action	Frequency	Percent	Cumulative Percent
With correct ID number and name	Keep	6,038	93.3	93.3
With incomplete ID or name, but can be recognized	Keep	115	1.8	95.0
Among above: no NCEE score	Delete	187	2.9	95.0
With duplicated ID and name	Delete	2	0.0	95.1
With unrecognizable ID and name	Delete	263	4.1	99.1
With ID but without name	Delete	56	0.9	100.0
Total		6,474	100.0	

Although there are various models of missing data imputation (Puma et al. 2009), they require more assumptions of the data, which may be difficult to verify. In addition, the proportion of missing data in this dataset is only 7.9%. Thus, the cases with missing student IDs or names are just deleted.

In terms of data missing explanatory variables, two steps are taken. First, keep variables with missing values less than 15%, and drop variables with missing data more than 15%. Second, replace missing values of kept data, in which two different ways are tried. The first one is just deleting anyone of the missing data, and the valid sample sized shrinks sharply from around 6,000 to around 4,000. The limitation of this method includes the loss of power and the difficulty

in comparing results of different models caused by the inconsistency of the sample used by these models. Another way is dummy variable adjustment. A new set of explanatory variables Z are created by recoding missing values of original explanatory variables X to 0[32] and include additional dummy D for "missing x" in regression. Then X is replaced by Z and D. The coefficients of Z are the effects of the non-missing X, and the intercept and coefficients of D are the average impact of missing data. Jones (1996) showed that if the assignment to the treatment is not correlated with the covariate that has some missing data, the estimates will not be biased. In fact, with regard to this dataset, the results are robust no matter which method is used. Table 3-9 reports the percentage of missing values of all measures in student and parent questionnaires that have non-missing dependent variables.

Table 3-9 reports the proportion of missing values of all the items in the four questionnaires. The percentage of missing values in student questionnaire is very low (most of which are below 5%), while the proportions of missing values in the parent questionnaire are higher than 20%. The response rates of all questions in teacher questionnaire are higher than 95%. But when matching teacher questionnaires with student questionnaires, the percentages of missing values become very high, due to the miss of teacher participants for certain classes[33]. Thus, some of the teachers' response relating to teacher quality measures will not be used in the class level index construction, but will be used in school level index construction. Income and expenditure related data in principal questionnaire also have high percentage of missing values.

[32] In fact, the missing values could be replaced to any value such as zero, mean, or mode, and it does not affect the results.
[33] This is mainly due to the random arrangement mistakes or difficulties during the on-site survey.

Table 3-9 Proportions of Missing Values of Covariates

Questionnaire measures	Percent of missing values
Student questionnaire	
High School and Class index	1.10%
Check if you participated in Chinese private tutoring outside school in G12	0.00%
Check if you participated in math private tutoring outside school in G12	0.00%
Check if you participated in English private tutoring outside school in G12	0.00%
CN Private tutor is my school teacher	0.00%
Math PT is my school teacher	0.00%
EN PT is my school teacher	0.00%
Fee per hour for Chinese tutoring	0.00%
Fee per hour for math tutoring	0.00%
Fee per hour for English tutoring	0.00%
HSEE score: Chinese	1.30%
HSEE score: Math	1.30%
HSEE score: English	1.30%
HSEE score: Total score	1.50%
School Choice	2.10%
Academic track as science	2.00%
Female	0.20%
Rural Residence	0.40%
Migrant children	0.40%
Minority	0.20%
Siblings Number	0.60%
Single Parent	1.40%
How many private tutoring advertisements are you exposed to every week from all kinds of forms (including poster, TV, newspaper, internet, walk by, etc.?	4.90%
As far as you know, what is the distance between your home and the nearest private tutoring center?	4.20%
Among the five closest classmates, how many of them participate in private tutoring?	6.60%
Father's highest education level	0.70%
Mother's highest education level	0.60%
Father (or other male guardian)'s profession	1.70%
Mother (or other male guardian)'s profession	1.30%
How large is your house/apartment?	2.40%
TV	0.70%
Cell phone	0.90%
Air conditioner	3.80%
Personal Computer including laptop	3.10%
Motorcycle	3.30%
Car	5.60%
Paintings on the wall	3.10%
Internet at home	0.30%
Own room for study	0.80%
No. of magazines and newspapers	0.20%
No. of books do you have in your family (exclude magazines, newspapers, and textbooks)	0.20%
My Chinese teacher has strong academic background and the instruction is very clear	1.00%
My math teacher has strong academic background and the instruction is very clear	1.00%
My English teacher has strong academic background and the instruction is very clear	1.40%
My Chinese teacher knows how to stimulate my enthusiasm on study.	1.70%
My math teacher knows how to stimulate my enthusiasm on study.	1.70%
My English teacher knows how to stimulate my enthusiasm on study.	1.90%
My Chinese teacher has very charming personality	1.90%

My math teacher has very charming personality	1.80%
My English teacher has very charming personality	1.90%
Weekday hours: Have classes at school	0.00%
Weekday hours: Do homework	0.00%
Weekday hours: Participate in private tutoring	0.00%
Weekday hours: Watch TV or use PC	0.00%
Weekday hours: Play with friends	0.00%
Weekday hours: Part time job or work for my family	0.00%
Weekday hours: Read news reports	0.00%
Weekday hours: Sport	0.00%
Weekday hours: Read books or participate in clubs	0.00%
Weekday hours: Sleep	0.00%
Weekend hours: Have classes at school	0.00%
Weekend hours: Do homework	0.00%
Weekend hours: Participate in private tutoring	0.00%
Weekend hours: Watch TV or use PC	0.00%
Weekend hours: Play with friends	0.00%
Weekend hours: Part time job or work for my family	0.00%
Weekend hours: Read news reports	0.00%
Weekend hours: Sport	0.00%
Weekend hours: Read books or participate in clubs	0.00%
Weekend hours: Sleep	0.00%
I spent a lot of time relax and on hobbies last summer	0.00%
I spent a lot of time study by myself last summer	0.00%
I spent a lot of time on private tutoring last summer	0.00%
I spent a lot of time on part-time job or working for my family last summer	0.00%
I studied very effectively and efficiently last summer	5.80%
I was well prepared for the new semester last summer	4.50%
I like going to school.	0.50%
The study atmosphere of my class is very good.	0.70%
The study atmosphere of my school is very good.	0.50%
I was treated unfairly by my teachers or classmates.	4.00%
My head teacher is very responsible.	4.60%
My head teacher is very open-minded.	0.70%
My head teacher is very kindness.	0.80%
Most of my teachers care about me.	0.70%
I have high prestige among my classmates.	0.90%
I have very few good friends at school.	1.20%
I am good at summing up knowledge and mistakes.	1.10%
I usually do preparation before the lesson.	0.60%
I usually review the material after the lesson.	0.90%
I have a correct attitude to study.	0.90%
I like playing more than studying.	1.10%
My EQ is very high, especially in important tests.	0.90%
I don’t have a clear goal for my life.	1.00%
I am very optimistic.	0.70%
I have a clear life goal.	1.10%
I have a strong ability to concentrate and persevere.	1.10%
I am not interested in participating NCEE and going to college	1.00%
I often receive misconduct penalty.	0.90%
I once fell in love during high school.	1.00%
I can use the city library very conveniently.	1.10%
My school has organized some museum visits or science center visits for us students.	1.20%

My school organizes theatrical performances every year.	1.10%
The school magazine is very popular among students.	1.10%
The psychological consulting provide by school is very effective.	0.80%
My parents go to the Parent Meeting every time.	0.70%
My parents limit the amount of time I can spend on TV, PC, and going out with friends.	0.80%
My parents trust me to do what they expect without checking up on me.	0.90%
It is difficult to communicate with my parents.	1.00%
I often count on my parents to solve many of the problems for me.	1.10%
My parents have high expectation on me.	1.10%
I spent most of my time with my grand parents when I was young.	1.20%
My parents taught me some school knowledge before I went to primary school.	0.80%
My parents were very busy and did not have time to take care of me when I was in primary school.	4.80%
My parents pay special attention to training my self-care ability.	5.60%
My parents respect my opinion.	0.90%
I admire my father.	1.00%
I admire my mother.	1.20%
I care about my parents' work.	1.20%
My parents are my role models in terms of working hard.	1.10%
My parents are my role models to be an upright person.	2.00%
My parents take me to the museums, science centers, and performance every year.	1.40%
The study atmosphere at home is very good.	1.50%
There is a rich collection of books in literature, science, history, geography, English, and arts at my home.	1.20%
How much allowance does your family give you every month?	2.30%
Does your allowance include money spent on meals?	1.70%
If it does, how much is your board expenditure every month?	21.30%
Expenditure on academic oriented private tutoring in G12	10.00%
Expenditure on art/music/sport tutoring	11.60%
Expenditure on Computer purchase	10.80%
Other education related expenditure	25.40%
High school choice fee (3 years)	13.40%
High school tuition per academic year	17.10%
Boarding fee per year	22.60%
Scholarship	22.60%
Financial aid	22.60%
Parent questionnaire	
Monthly income in your family	23.40%
How much money did you expense on your children's education last year?	23.30%
How much dose your household property worth?	23.90%
What is the total value of your car(s), tractor(s)(or other large agricultural machine(s) approximately?	24.40%
You invested a lot of energy or time on your child's pre-school education, interest inspirations and intellectual development before your child went to primary school.	24.90%
You were too busy to educate your child when he or she was in primary school.	25.00%
You had a high standard on your child's academic performance when he or she was in primary school.	25.30%
You were too busy to educate your child when he or she was in middle school.	25.60%
You had a high standard on your child's academic performance when he or she was in middle school.	25.10%
You had a high standard on your child's academic performance when he or she was in high school.	25.10%
You highly expect that your child can go to college	25.10%
Your child is usually very cooperative with you when he or she was in senior high school.	25.30%
You don't really know what your child is thinking.	25.20%
You can communicate with your child very well.	25.20%
You child is usually counts on you to solve his or her studying problems or pressures.	25.40%
Your child usually discuses with you about what's happening at school.	25.20%
You are very clear about your child's rank in his or her class.	25.10%

You are very clear about your child's rank in the whole city.	25.20%
You value a lot on your child's moral and virtue development.	25.10%
You educate your child by yourself / send your child to private tutoring class to cultivate broad interest.	25.00%
Teacher questionnaire	
Chinese teacher is the head teacher	0.59%
Chinese teacher is female	29.41%
Chinese teacher's political status	30.00%
Chinese teacher's age	29.41%
Chinese teacher's highest education degree	29.41%
Chinese teacher's years of teaching experience	30.00%
Chinese teacher's positional rank	29.41%
Chinese teacher is school level academic leader / teaching expert	84.12%
Chinese teacher is county level academic leader / teaching expert	84.12%
Chinese teacher is provincial level academic leader / teaching expert	84.12%
Chinese teacher is provincial level special class teacher	84.12%
Chinese: Which quartile is the average NCEE score of your class in among all the classes?	57.65%
Chinese teacher is has an administrative position in school	30.00%
Chinese teacher's basic salary per month	31.76%
Chinese teacher's average bonus per month and subsidy per month	36.47%
Chinese teacher's other income per month	40.00%
Chinese: I always discuss with my colleagues teaching the same subject on how to teach	29.41%
Chinese: I always prepare lessons with my colleagues.	29.41%
Chinese: I always observe the class of my colleagues of the same subject.	30.00%
Chinese: I sometimes ask my colleagues of same subject to observe my class informally	29.41%
Chinese: I always discuss about the students' performance with colleagues teaching the same subject.	30.00%
Chinese: I always discuss about pedagogy with teachers teaching the same grade.	30.00%
Chinese: Generally speaking, I get along very well with my colleagues.	29.41%
Chinese: I usually don't talk about pedagogy with my colleagues.	31.18%
Chinese: This school emphasis a lot on the cooperation among teachers.	31.76%
Chinese: I'm very strict with my students, which can help establishing my authority.	30.59%
Chinese: I have a very high requirement on my teaching outcomes	30.00%
Chinese: I fell fine if I do my best, I don't really care about my students' scores.	30.59%
Chinese: I'm popular among students.	30.00%
Chinese: I usually organize my class by lecturing most of the time.	30.00%
Chinese: I usually organize my class by letting students doing exercise and tests.	30.59%
Chinese: I like being a teacher.	29.41%
Chinese: I might consider changing career if I can get better offer.	29.41%
Chinese: This school evaluates my teaching mainly by my students' test score.	30.00%
Chinese: This school evaluates my teaching ability mainly by my teaching assessment.	29.41%
Chinese: I don't think this school evaluates teachers teaching ability at all.	29.41%
Chinese: I feel like this school's leaders have a high standard on teaching quality.	30.00%
Chinese: Teachers in this school have a high teaching autonomy.	29.41%
Chinese: I think the school leaders often listen to teachers' advice and opinions.	30.00%
Chinese: I think this school is a typical High authority and accountability institution.	30.59%
Chinese: The school leaders usually make requirement on teachers through the authority.	29.41%
Chinese: The school leaders usually make requirement on teachers through discussion.	29.41%
Chinese: The school leaders usually make requirement on teachers through negotiation.	29.41%
Chinese: The school leaders are very efficient.	29.41%
Chinese: This school provides me with good on-the-job training which improved my expert	30.00%
Chinese: The school leaders value most on the NECC score and the promotion rate to the	29.41%
Chinese: The school leaders value a lot on the extracurricular activities.	29.41%
Chinese: The school leaders care a lot on teacher welfare and career development.	29.41%

Chinese: I like my working environment and atmosphere.	30.59%
Math teacher is the head teacher	0.59%
Math teacher is female	32.94%
Math teacher's highest education degree	32.94%
Math teacher's political status	33.53%
Math teacher's age	32.94%
Math teacher's years of teaching experience	35.29%
Math teacher's positional rank	33.53%
Math teacher is school level academic leader / teaching expert	74.12%
Math teacher is county level academic leader / teaching expert	74.12%
Math teacher is provincial level academic leader / teaching expert	74.12%
Math teacher is provincial level special class teacher	74.12%
Math: Which quartile is the average NCEE score of your class in among all the classes?	49.41%
Math teacher is has an administrative position in school	34.71%
Math teacher's basic salary per month	37.65%
Math teacher's average bonus per month and subsidy per month	40.00%
Math teacher's other income per month	41.18%
Math: I always discuss with my colleagues teaching the same subject on how to teach	32.94%
Math: I always prepare lessons with my colleagues.	32.94%
Math: I always observe the class of my colleagues of the same subject.	34.71%
Math: I sometimes ask my colleagues of same subject to observe my class informally.	33.53%
Math: I always discuss about the students' performance with colleagues teaching the same subject.	33.53%
Math: I always discuss about pedagogy with teachers teaching the same grade.	33.53%
Math: Generally speaking, I get along very well with my colleagues.	32.94%
Math: I usually don't talk about pedagogy with my colleagues.	35.88%
Math: This school emphasis a lot on the cooperation among teachers.	32.94%
Math: I'm very strict with my students, which can help establishing my authority.	32.94%
Math: I have a very high requirement on my teaching outcomes	33.53%
Math: I fell fine if I do my best, I don't really care about my students' scores.	35.29%
Math: I'm popular among students.	34.12%
Math: I usually organize my class by lecturing most of the time.	32.94%
Math: I usually organize my class by letting students doing exercise and tests.	34.71%
Math: I like being a teacher.	32.94%
Math: I might consider changing career if I can get better offer.	33.53%
Math: This school evaluates my teaching mainly by my students' test score.	32.94%
Math: This school evaluates my teaching ability mainly by my teaching assessment.	32.94%
Math: I don't think this school evaluates teachers teaching ability at all.	33.53%
Math: I feel like this school's leaders have a high standard on teaching quality.	34.12%
Math: Teachers in this school have a high teaching autonomy.	33.53%
Math: I think the school leaders often listen to teachers' advice and opinions.	33.53%
Math: I think this school is a typical High authority and accountability institution.	33.53%
Math: The school leaders usually make requirement on teachers through the authority.	34.71%
Math: The school leaders usually make requirement on teachers through discussion.	34.12%
Math: The school leaders usually make requirement on teachers through negotiation.	34.12%
Math: The school leaders are very efficient.	34.12%
Math: This school provides me with good on-the-job training which improved my expert	34.12%
Math: The school leaders value most on the NECC score and the promotion rate to the	34.71%
Math: The school leaders value a lot on the extracurricular activities.	33.53%
Math: The school leaders care a lot on teacher welfare and career development.	33.53%
Math: I like my working environment and atmosphere.	33.53%
English teacher is the head teacher	28.82%
English teacher is female	27.06%
English teacher's highest education degree	27.06%

English teacher's political status	27.06%
English teacher's age	27.06%
English teacher's years of teaching experience	27.06%
English teacher's positional rank	27.06%
English teacher is school level academic leader / teaching expert	70.59%
English teacher is county level academic leader / teaching expert	70.59%
English teacher is provincial level academic leader / teaching expert	70.59%
English teacher is provincial level special class teacher	70.59%
English: Which quartile is the average NCEE score of your class in among all the classes?	49.41%
English teacher is has an administrative position in school	27.06%
English teacher's basic salary per month	29.41%
English teacher's average bonus per month and subsidy per month	32.35%
English teacher's other income per month	40.59%
English: I always discuss with my colleagues teaching the same subject on how to teach	27.06%
English: I always prepare lessons with my colleagues.	27.06%
English: I always observe the class of my colleagues of the same subject.	27.06%
English: I sometimes ask my colleagues of same subject to observe my class informally.	27.06%
English: I always discuss about the students' performance with colleagues teaching the same subject.	27.65%
English: I always discuss about pedagogy with teachers teaching the same grade.	28.82%
English: Generally speaking, I get along very well with my colleagues.	28.24%
English: I usually don't talk about pedagogy with my colleagues.	28.24%
English: This school emphasis a lot on the cooperation among teachers.	27.06%
English: I'm very strict with my students, which can help establishing my authority.	28.82%
English: I have a very high requirement on my teaching outcomes	27.06%
English: I fell fine if I do my best, I don't really care about my students' scores.	28.24%
English: I'm popular among students.	27.65%
English: I usually organize my class by lecturing most of the time.	27.65%
English: I usually organize my class by letting students doing exercise and tests.	28.82%
English: I like being a teacher.	27.06%
English: I might consider changing career if I can get better offer.	27.65%
English: This school evaluates my teaching mainly by my students' test score.	28.82%
English: This school evaluates my teaching ability mainly by my teaching assessment.	27.65%
English: I don't think this school evaluates teachers teaching ability at all.	27.65%
English: I feel like this school's leaders have a high standard on teaching quality.	28.82%
English: Teachers in this school have a high teaching autonomy.	27.06%
English: I think the school leaders often listen to teachers' advice and opinions.	27.06%
English: I think this school is a typical High authority and accountability institution.	28.82%
English: The school leaders usually make requirement on teachers through the authority.	27.65%
English: The school leaders usually make requirement on teachers through discussion.	27.06%
English: The school leaders usually make requirement on teachers through negotiation.	27.65%
English: The school leaders are very efficient.	27.06%
English: This school provides me with good on-the-job training which improved my expert	28.82%
English: The school leaders value most on the NECC score and the promotion rate to the	27.65%
English: The school leaders value a lot on the extracurricular activities.	27.65%
English: The school leaders care a lot on teacher welfare and career development.	27.06%
English: I like my working environment and atmosphere.	27.06%
Principal questionnaire	
Admission line for 1st wish students	0.00%
G12 Student No.	4.00%
Principal's highest education degree	0.00%
How many years have you taught?	0.00%
How many years have you been a vise principal?	12.00%
How many years have you been a principal in this school?	0.00%

Principal's education degree when first starting teaching	8.00%
Principal's positional rank	0.00%
Participated in principal training	0.00%
The highest level of principal training you participated	8.00%
How many years have you been a principal?	0.00%
School type	4.00%
Grades	0.00%
Total number of teachers	0.00%
Total number of full-time teachers	0.00%
Total number of substitute teachers	28.00%
Number of provincial level special class teachers	20.00%
Number of provincial level academic leader	32.00%
Number of county level academic leader	8.00%
Number of school level academic leader	20.00%
Number of provincial level teaching expert	20.00%
Number of county level teaching expert	8.00%
Number of school level teaching expert	28.00%
Advanced high school teacher	0.00%
1st level of high school teacher	0.00%
2nd or 3rd level of high school teacher	4.00%
No rank now	12.00%
Associate bachelor	4.00%
Bachelor	0.00%
Master	12.00%
Doctor	40.00%
Transferred to other schools	12.00%
Resigned from the school	16.00%
Transferred from other schools	12.00%
Assigned to you as new graduates	16.00%
Total number of male students	8.00%
Total number of female students	8.00%
Total number of male students in G12	8.00%
Total number of female students in G12	8.00%
# of computers	0.00%
# of computers that could be used for instruction	0.00%
# of computers that could get access to internet	0.00%
Capacity of physics lab	0.00%
Capacity of chemistry lab	0.00%
Capacity of biology lab	0.00%
Capacity of explore lab	28.00%
Library total area	4.00%
# of books	0.00%
Total area of sports field	8.00%
Total area of teaching building	8.00%
The graduate rate last year	16.00%
The promotion rate to elite colleges last year	24.00%
The promotion rate to regular colleges last year	24.00%
# of students could be recommended to college this year	28.00%
Government appropriation	12.00%
Tuition	8.00%
among which handed in to the government	52.00%
School choice fee/ donation	16.00%
among which handed in to the government	32.00%

Other fees (such as board fee)	20.00%
Revenue from school-run enterprise	44.00%
Loan from the bank	36.00%
Other income	44.00%
Teacher salary	16.00%
Administration and staff salary	48.00%
Daily office expenditure	8.00%
Rewards and welfare for teachers	32.00%
Student scholarship and assistantship	8.00%
Student activities	48.00%
Fixed assets	20.00%
Others	64.00%
C59.Please choose one of the statement below which best describe your school's situation	56.00%
Tuition every academic year	8.00%
School choice fee in 2007	12.00%

In terms of outliers, only four cases with the NCEE score of zero are deleted as outliers. Since most questions are multiple-choice questions, there is no outlier for this kind of variable. In terms of test scores, although a few test scores are very low, they are continuously connected with higher scores and cannot be seen as outliers. The highest test scores do not exceed the full marks of tests. In terms of private tutoring expenditure, since the lowest and highest values are also continuously connected with the neighbor values, they are not considered as outliers, either.

3.5.6 Index Construction

To reduce measurement error of self-reported instruments in student questionnaire, multiple questions are asked from different angles in order to precisely evaluate certain variables. To construct more credible measurement and to avoid collinearity in the empirical regression, most variables in questionnaires are reduced to fewer indices with principal components analysis as the extraction method and a varimax rotation. Table 3-8 to Table 3-14 report the rotated factor matrixes for constructed indices.

Table 3-10 presents socioeconomic status (SES) index extracted from four variables: father and mother's highest education levels, and father and mother's professions respectively. In the questionnaire, higher education level is coded with higher numeric value, and more senior

ranks/professions are coded with smaller numbers. So the only one component extracted from the four variables is SES.

Table 3-10 Component Matrix with Loadings for Socioeconomic Status Variable

	Component
	1
Father's highest education level	0.859
Mother's highest education level	0.845
Father (or other male guardian)'s profession	-0.826
Mother (or other male guardian)'s profession	-0.822

Note. Extraction Method: Principal Component Analysis.
Component 1: Socioeconomic status (SES)

Table 3-11 reports wealth related variables. Component 1 has high loadings on numbers of TV, cell phones, air conditioners, personal computers, and cars at home, and is named "*urban wealthy family.*" Component 2 has high loadings on the area of house/apartment and number of motorcycles. It is called "*rural wealthy family,*" because these two are typical characteristics of wealthy family in rural area.

Table 3-11 Rotated Component Matrix with Loadings for Wealth Variables

	Component	
	1	2
How large is your house/apartment?	0.177	0.720
How many TV in your home?	0.486	0.521
How many cell phones in your family?	0.679	0.165
How many air conditioners in your home?	0.846	-0.065
How many personal computers (including laptops) in your home?	0.822	-0.089
How many motorcycles in your home?	-0.355	0.717
How many cars in your family?	0.711	0.113

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Urban wealthy family
Component 2: Rural wealthy family

Table 3-12 lists cultural capital related variables. Component 1 has high loadings on facilities and component 2 has high loadings on cultural related to family activities. The first one is named as "*cultural capital measured by facilities"* and the second one is named "*cultural capital measured by interaction with parents."*

Table 3-12 Rotated Component Matrix with Loadings for Cultural Capital Variables

	Component	
	1	2
No. of paintings on the wall	0.673	0.079
Do you have internet access at home?	0.701	0.054
No. of magazines and newspapers	0.623	0.219
No. of books do you have in your family (exclude magazines, newspapers, and textbooks)	0.708	0.270
Do you have your own room for study?	0.406	0.096
My parents take me to the museums, science centers, and performance every year.	0.202	0.803
The study atmosphere at home is very good.	0.021	0.856
There is a rich collection of books in literature, science, history, geography, English, and arts at my home. (1 as strongly disagree with and 5 as strongly agree with the above 3 statements)	0.378	0.758

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Cultural capital measured by facilities
Component 2: Cultural capital measured by interaction with parents

Two school behavior variables emerged from Table 3-13. In the questionnaire, students were asked to evaluate a series of statement with "1" as strongly disagree and "5" as strongly agree. The first factor has high loadings on misconduct penalty and falling in love in high school (which is commonly considered as problematic behavior and usually causes campus violence and lag behind in study). It is named "*misconduct."* The second factor has high loadings on the first three statements and is named "*prestige."*

Table 3-13 Rotated Component Matrix with Loadings for School Behavior Variables

1 as strongly disagree with and 5 as strongly agree with those statements below.	Component	
	1	2
I like going to school.	-0.164	0.639
I have high prestige among my classmates.	0.264	0.803
I have very few good friends at school.	0.215	-0.516
I often receive misconduct penalty.	0.806	-0.122
I once fell in love during high school.	0.798	-0.032

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Misconduct
Component 2: Prestige and leadership

Table 3-14 reports parental education style variables. Component 1 has high loadings on role model like statements and is named "*parent as role model*." Component 2 has high loadings on the statements that "parents attend parent meeting every time and that parents respect my opinion" and is named "*parents care about the child's study and respect the child*." Compared to Component 2, parents described by Component 3 also attend parent meetings very often, but has strong control in child's leisure time and has high expectation on the child. It is named "*parents regulate*." The fourth one is named as "*parents do too much for their child*."

Table 3-14 Rotated Component Matrix with Loadings for Parental Education Style Variables

1 as strongly disagree with and 5 as strongly agree with those statements below.	Component			
	1	2	3	4
My parents go to the Parent Meeting every time.	-0.051	0.548	0.685	-0.060
My parents limit the amount of time I can spend on TV, PC, and going out with friends.	0.045	-0.229	0.725	0.218
My parents trust me to do what they expect without checking up on me.	0.156	0.701	-0.112	0.095
It is difficult to communicate with my parents.	-0.248	-0.456	0.142	0.482
I often count on my parents to solve many of the problems for me.	0.069	0.114	0.014	0.900
My parents have high expectation on me.	0.343	-0.175	0.466	-0.138
My parents respect my opinion.	0.534	0.558	-0.069	-0.038
I admire my father.	0.780	0.090	0.065	-0.050
I admire my mother.	0.773	0.132	0.077	-0.083
I care about my parents' work.	0.630	0.008	0.025	0.095
My parents are my role models in terms of working hard.	0.787	0.202	0.069	0.004
My parents are my role models to be an upright person.	0.780	0.169	0.059	-0.051

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Parents are good role models
Component 2: Parents care about child's study and respect child
Component 3: Parents care about child's study, have high expectation, and control child's time
Component 4: Parents do too much for their child

Table 3-15 presents self-evaluation variables. Component 1 has high loadings on good study habits and high study ability. Component 2 has high loadings on optimistic and with clear goal. Component 3 has high loadings on liking playing and not being nervous on tests. Table 3-16 reports time allocation variables in G12. Component 4 has high loadings on time spent on private tutoring during school days, weekends, and summer vocation. It is named "*time spent on private tutoring*," and used as one measure of dependent variable in the tutoring demand model.

Table 3-15 Rotated Component Matrix with Loadings for Self-evaluation Variables

1 as strongly disagree with and 5 as strongly agree with those statements below.	Component		
	1	2	3
I studied very effectively and efficiently last summer	0.497	0.018	0.291
I was well prepared for the new semester last summer	0.224	-0.008	0.514
I am good at summing up knowledge and mistakes.	0.676	0.114	0.303
I usually do preparation before the lesson.	0.757	0.033	0.207
I usually review the material after the lesson.	0.793	0.077	0.142
I have a correct attitude to study.	0.755	0.196	-0.038
I like playing more than studying.	-0.586	-0.299	0.436
My EQ is very high, especially in important tests.	0.128	0.060	0.677
I don't have a clear goal for my life.	-0.071	-0.836	0.151
I am very optimistic.	0.050	0.486	0.576
I have a clear life goal.	0.191	0.786	0.266
I have a strong ability to concentrate and persevere.	0.471	0.404	0.351

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1 Strong study ability and good study habit
Component 2: Optimistic and with clear life goal
Component 3: Not nervous to test and likes playing

Table 3-16 Rotated Component Matrix with Loadings for Time Allocation Variables

	Component							
	1	2	3	4	5	6	7	8
Weekday hours: Have classes at school	-0.094	-0.023	0.224	-0.010	-0.480	0.058	0.180	0.124
Weekday hours: Do homework	0.051	0.010	-0.006	0.074	-0.080	-0.016	0.854	0.000
Weekday hours: Participate in private tutoring	0.119	0.282	-0.053	0.756	-0.057	0.080	0.034	-0.074
Weekday hours: Watch TV or use PC	0.027	0.821	0.003	0.110	0.055	0.069	-0.115	-0.048
Weekday hours: Play with friends	0.210	0.603	0.062	0.022	0.010	0.298	0.045	0.118
Weekday hours: Part time job or work for my family	0.208	0.694	-0.080	0.050	-0.120	-0.177	-0.008	0.275
Weekday hours: Read news reports	0.383	0.675	-0.048	0.125	0.146	-0.083	-0.006	-0.034
Weekday hours: Sport	0.636	0.184	-0.032	0.062	-0.254	0.068	0.129	0.194
Weekday hours: Read books or participate in clubs	0.730	0.298	-0.005	0.080	0.070	-0.077	-0.072	-0.138
Weekday hours: Sleep	0.015	0.039	0.885	-0.020	-0.100	-0.014	-0.023	-0.064
Weekend hours: Have classes at school	0.069	0.051	-0.107	-0.094	-0.777	-0.086	-0.109	0.002
Weekend hours: Do homework	-0.037	-0.089	0.017	0.030	0.042	-0.150	0.832	-0.129
Weekend hours: Participate in private tutoring	0.110	0.075	-0.007	0.816	0.179	0.070	0.073	-0.029
Weekend hours: Watch TV or use PC	0.107	0.303	0.190	-0.004	0.539	0.363	-0.065	0.301
Weekend hours: Play with friends	0.335	0.293	0.099	-0.059	0.177	0.399	-0.030	0.343
Weekend hours: Part time job or work for my family	0.338	0.354	0.016	-0.026	0.186	-0.043	0.052	0.605
Weekend hours: Read news reports	0.466	0.366	0.068	0.087	0.428	0.025	0.016	0.158
Weekend hours: Sport	0.718	0.035	-0.011	0.051	-0.089	0.073	0.004	0.322
Weekend hours: Read books or participate in clubs	0.772	0.120	0.014	0.081	0.245	-0.034	-0.029	-0.026
Weekend hours: Sleep	-0.008	-0.060	0.894	-0.029	0.129	0.050	0.030	0.007
I spent a lot of time relax and on hobbies last summer	0.003	0.006	0.015	0.028	0.065	0.707	-0.078	0.084
I spent a lot of time study by myself last summer	0.052	0.020	0.010	0.082	0.005	-0.729	0.059	0.225
I spent a lot of time on private tutoring last summer	0.007	-0.084	0.000	0.601	0.002	-0.320	0.013	0.150
I spent a lot of time on part-time job or working for my family last summer	0.031	-0.005	-0.064	0.032	-0.092	-0.059	-0.131	0.727

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 4: Time spent on private tutoring

Table 3-17 reports students' evaluation on class environment of personal relationship. Only one component is extracted from the six instruments evaluating study atmosphere, treatment received from teachers and classmates, and head teacher's performance. Thus, the only component is named "*a good class environment of personal relationship.*"

Table 3-17 Component Matrix with Loadings for Class Environment of Personal Relationship

	Component
	1
The study atmosphere of my class is very good.	0.609
I was treated unfairly by my teachers or classmates.	-0.403
My head teacher is very responsible.	0.789
My head teacher is very open-minded.	0.844
My head teacher is very kindness.	0.858
Most of my teachers care about me.	0.578

Note. Extraction Method: Principal Component Analysis.
Component 1: Good class environment of personal relationship

Table 3-18 presents students' evaluation on school activities. Only one component is extracted from the five instruments evaluating study atmosphere at the school level, school activities such as visiting museum and science center, theatrical performances, and school magazine publish, and psychological consulting. Thus, the only component is named good school activities.

Table 3-18 Component Matrix with Loadings for School Activity Variable

	Component
	1
The study atmosphere of my school is very good.	0.604
My school has organized some museum visits or science center visits for us students.	0.528
My school organizes theatrical performances every year.	0.614
The school magazine is very popular among students.	0.834
The psychological consulting provide by school is very effective.	0.797

Note. Extraction Method: Principal Component Analysis.
Component 1: Good school activities

Table 3-19 presents teacher-reported variables evaluating school administration style. Component 1 has high loadings on variables indicating high teacher autonomy and collegial administration style. Component 2 has high loadings on variables which indicate that school leaders highly value student academic outcome. It is named "*outcome-oriented*." Component 3 has high loadings on variables indicating political administration style such as negotiation with teachers. Component 4 has high loadings on high authority and accountability administration style.

Table 3-19 Rotated Component Matrix with Loadings for School Administration Style

1 as strongly disagree with and 5 as strongly agree with those statements below.	Component			
	1	2	3	4
This school evaluates my teaching mainly by my students' test score.	-0.157	0.840	-0.055	0.168
This school evaluates my teaching ability mainly by my teaching assessment.	0.063	0.818	0.178	-0.132
I don't think this school evaluates teachers teaching ability at all.	-0.019	-0.010	0.834	-0.137
I feel like this school's leaders have a high standard on teaching quality.	0.337	0.059	-0.430	0.454
Teachers in this school have a high teaching autonomy.	0.672	-0.140	-0.002	-0.120
I think the school leaders often listen to teachers' advice and opinions.	0.820	-0.047	-0.039	0.129
I think this school has high authority and clear hierarchy.	0.135	-0.042	0.037	0.806
The school leaders usually make requirement on teachers through the authority.	-0.503	0.193	0.390	0.440
The school leaders usually make requirement on teachers through discussion.	0.790	-0.050	-0.021	0.005
The school leaders usually make requirement on teachers through negotiation.	0.045	0.188	0.723	0.313
The school leaders are very efficient.	0.805	0.109	-0.065	0.169
This school provides me with good on-the-job training which improves my expertise.	0.699	-0.152	0.084	0.077
The school leaders value most on the NECC score and the promotion rate to the college.	-0.288	0.449	0.067	0.462
The school leaders value a lot on the extracurricular activities.	0.584	-0.207	-0.024	-0.001
The school leaders care a lot on teacher welfare and career development.	0.799	0.028	-0.019	-0.091
I like my working environment and atmosphere.	0.659	0.054	-0.163	0.020

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Collegial
Component 2: Outcome-oriented
Component 3: Political
Component 4: High authority and accountability
These four teacher level indices are aggregated to school level variables.

Table 3-20 reports the loadings for school education input. Component 1 has high loadings on laboratory related variables. Component 2 has high loadings on student teacher ratio variables. Component 3 has high loading on computer related variables. These three components are named *student teacher ratio, lab,* and *computer* respectively.

Table 3-20 Rotated Component Matrix with Loadings for School Education Input

	Component		
	1	2	3
Student teacher ratio	-0.0274	0.7074	0.0382
Student full-time teacher ratio	0.0279	0.7025	-0.0385
Per student computer	0.0512	0.002	0.67
Per student computer that could be used in instruction	-0.045	-0.001	0.7353
Per student physics lab	0.6133	-0.0124	-0.0654
Per student chemistry lab	0.5656	0.0597	0.0206
Per student biology lab	0.5458	-0.0486	0.0537

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Component 1: Lab
Component 2: Student-teacher ratio index
Component 3: Computer

Table 3-21 reports Cronbach's alpha to examine the reliability of items used in index construction discussed above. Most of the alphas are above 0.6 except one alpha. The alpha of items measuring school behavior is 0.3926. Thus, this set of measures is considered unreliable and will not be used in the empirical analysis.

Table 3-21 Cronbach's alpha of Selected Indices

	Number of items	Cronbach's alpha
Wealth	7	0.6948
SES	4	0.7816
Cultural Capital	8	0.7446
School behavior	5	0.3926
Parents' education style	12	0.6826
Self-evaluation	12	0.8002
Class environment of personal relationship	6	0.7652
School activity	5	0.7063
Time allocation	24	0.669
School administration style	16	0.8237
School education input	7	0.8167

Chapter 4 Descriptive Statistics

In this chapter, descriptive statistics and facts on the NCEE scores and private tutoring by subject are presented in detail. In Section 4.1, descriptive statistics of kept variables will be reported first, followed by the correlation coefficients of covariates used in the empirical models. Section 4.2 will discuss the NCEE average score by registered residence, gender, academic track, private tutoring participation, and parent's education level and profession. All the results about the NCEE score are weighted by sampling weights. Results without weighting are presented in appendix. Section 4.3 will describe private tutoring participation and characteristics of private tutor market. The summary of private tutors and private tutor agencies are not weighted, because although the student sample is a non-proportional, stratified sample from the perspective of school, it is random from the perspective of private tutoring.

4.1 Descriptive Statistics and Correlation

4.1.1 Descriptive Statistics

Table 4-1 and Table 4-2 report descriptive statistics of variables that are going to be used in the empirical models. The former is not weighted by sampling weight, and the latter is the weighted result. Both of the results are derived from variables without the replacement of missing values. The two results are similar, and most mean values in Table 4-2 are modestly higher than those in Table 4-1. Indices constructed from z-scored variables will have a standard deviation different from one, because they are the linear combinations of the z-scored variables. The sampling weighted mean of variables with original mean of zero will also change.

Table 4-1 Descriptive Statistics of Variables – Not Weighted

Variable		N	Mean	S.D.	Minimum	Maximum
Student level variables						
NCEE score	Chinese	5841	98.80329	12.96817	31	134
	Math	5841	93.19483	30.55862	1	149
	English	5841	94.1635	29.07724	14	144
	Total score	5841	471.4415	106.2786	144	690
Standardized NCEE score	Chinese	5841	0	1	-5.228439	2.714085
	Math	5841	0	1	-3.016982	1.826168
	English	5841	0	1	-2.756915	1.713935
	Total score	5841	0	1	-3.080973	2.056467
Index: time spent on PT		5841	-0.0028964	1.429325	-2.157357	10.7351
Private tutoring expenditure		5257	902.7839	3698.846	0	120000
Participation in PT in G12	Any subjects	5841	0.5101866	0.499939	0	1
	Chinese	5841	0.066427	0.2490483	0	1
	Math	5841	0.2328368	0.4226753	0	1
	English	5841	0.1818182	0.3857276	0	1
PT distance		5597	2.844917	1.186307	1	4
PT peer No.		5458	2.366618	1.339919	1	5
HSEE score	Chinese	5763	88.02742	8.802508	6	120
	Math	5763	101.3132	15.75983	8	134
	English	5763	103.4722	16.26053	13	125
	Total score	5754	552.7752	63.5187	92	677
Standardized HSEE score	Chinese	5763	0	1	-9.318642	3.632213
	Math	5763	0	1	-5.920951	2.074057
	English	5763	0	1	-5.563918	1.323928
	Total score	5754	0	1	-7.254167	1.95572
School choice student		5716	0.3603919	0.4801561	0	1
Science track		5724	0.572327	0.4947844	0	1
Female		5827	0.5318346	0.4990284	0	1
Rural		5816	0.4874484	0.4998854	0	1
SES		5691	-0.0066523	1.682903	-3.423137	5.405135
Cultural Capital - interaction		5515	-0.0047435	2.079582	-3.78649	5.004331
Parents caring study and respecting child		5601	0.0222646	1.478892	-7.197548	3.28726
Parents regulating		5601	0.0103906	1.258753	-5.779039	2.575459
Parents doing too much for the child		5601	-0.0097617	1.149934	-2.224302	4.332205
Study habits and ability		5288	0.0066531	1.699595	-5.701289	4.181696
Class level variables						
Class environment of personal relationship		5504	-0.0043765	1.71881	-6.89621	2.438625
Class average SES		5841	-0.0065328	1.059478	-1.428705	2.950406
Key Class		5841	0.2232494	0.4164599	0	1
School level variables						
Total number of students in school		5841	3444.369	1224.619	1251	5700
Student-teacher ratio index		5841	.0434706	1.08644	-2.189511	2.058847
Lab		5841	.0016856	.5476137	-.8612591	1.576666
Percent of Level-1 teachers		5841	0.2711853	0.0690885	0.1733871	0.4010152
Percent of teachers with a Master's degree		5841	0.0359035	0.0406945	0	0.1575563
HSEE admission line		5841	551.9685	50.95974	452	635
Percent of school choice students		5841	35.26793	14.86302	1.442308	57.36434
School activity		5710	-0.0095644	1.538161	-3.353802	3.578284
Collegial		5841	0.018925	1.048285	-2.003543	1.823218
Outcome-oriented		5841	0.0071095	0.4325571	-1.256014	0.6007412
Lax principal leadership		5841	-0.0997604	0.5484167	-1.204744	0.9413713
High authority and accountability		5841	0.0604547	0.7535669	-1.277359	1.683352

Table 4-2 Descriptive Statistics of Variables – Weighted

Variable		N	Mean	S.D.	Minimum	Maximum
Student level variables						
NCEE score	Chinese	5841	101.3655	12.26818	31	134
	Math	5841	99.88633	28.11856	1	149
	English	5841	99.80058	27.05834	14	144
	Total score	5841	496.3208	97.79958	144	690
Standardized NCEE score	Chinese	5841	0.1975781	0.9460222	-5.228439	2.714085
	Math	5841	0.2189725	0.9201515	-3.016982	1.826168
	English	5841	0.1938656	0.9305676	-2.756915	1.713935
	Total score	5841	0.2340945	0.9202189	-3.080973	2.056467
Index: time spent on PT		5841	-0.1011334	1.361832	-2.157357	10.7351
Private tutoring expenditure		5257	815.4868	3341.432	0	120000
Participation in PT in G12	Any subjects	5841	0.486069	0.4998487	0	1
	Chinese	5841	0.0641162	0.2449809	0	1
	Math	5841	0.2168222	0.4121158	0	1
	English	5841	0.1711828	0.3767008	0	1
PT distance		5597	2.852621	1.201932	1	4
PT peer No.		5458	2.34747	1.339288	1	5
HSEE score	Chinese	5763	89.50799	8.50704	6	120
	Math	5763	104.4685	14.0743	8	134
	English	5763	106.3912	14.10224	13	125
	Total score	5754	566.4829	58.65818	92	677
Standardized HSEE score	Chinese	5763	0.1681992	0.9664337	-9.318642	3.632213
	Math	5763	0.2002085	0.8930489	-5.920951	2.074057
	English	5763	0.1795114	0.8672683	-5.563918	1.323928
	Total score	5754	0.2158057	0.9234789	-7.254167	1.95572
School choice student		5716	0.3604778	0.4801811	0	1
Science track		5724	0.593443	0.4912337	0	1
Female		5827	0.5086143	0.4999687	0	1
Rural		5816	0.5061823	0.5000048	0	1
SES		5691	0.0758414	1.696614	-3.423137	5.405135
Cultural Capital - interaction		5515	0.0093792	2.092069	-3.78649	5.004331
Parents caring study and respecting the child		5601	0.1261181	1.453029	-7.197548	3.28726
Parents regulating		5601	0.0718183	1.229398	-5.779039	2.575459
Parents doing too much for the child		5601	-0.0723135	1.14516	-2.224302	4.332205
Study habits and ability		5288	0.1323564	1.696127	-5.701289	4.181696
Class level variables						
Class environment of personal relationship		5504	0.0399482	1.715818	-6.89621	2.438625
Class average SES		5841	0.074206	1.031572	-1.428705	2.950406
Key Class		5841	0.2288726	0.420143	0	1
School level variables						
Total number of students in school		5841	4017.478	1216.343	1251	5700
Student-teacher ratio index		5841	-.0485285	1.096378	-2.189511	2.058847
Lab		5841	-.0868359	.5980794	-.8612591	1.576666
Percent of Level-1 teachers		5841	0.2670044	0.0627556	0.1733871	0.4010152
Percent of teachers with a Master's degree		5841	0.0373286	0.0427325	0	0.1575563
HSEE admission line		5841	561.9299	43.34841	452	635
Percent of school choice students		5841	35.34421	16.74913	1.442308	57.36434
School activity		5710	0.1343287	1.510892	-3.353802	3.578284
Collegial		5841	-0.0878702	1.098627	-2.003543	1.823218
Outcome-oriented		5841	0.0230883	0.4291238	-1.256014	0.6007412
Lax principal leadership		5841	-0.2277966	0.5640224	-1.204744	0.9413713
High authority and accountability		5841	0.2260922	0.7609403	-1.277359	1.683352

According to Table 4-2, the sampling weighted average NCEE scores of Chinese, math, English, and all subjects are 101.4, 99.9, 99.8, and 496.3 respectively. The HSEE scores of Chinese, math, English, and all subjects are 89.5, 104.5, 106.4, and 566.5 respectively. The average private tutoring expenditure for all subjects is 815.5 RMB in Grade 12. The percentage of students who have participated in private tutoring in G12 in any subjects is 48.6%, and is 6.4%, 21.7%, and 17.1% for Chinese, Math, and English respectively. The average number of private tutoring participants among the 5 closest peers is 2.37, which is consistent with the proportion of students participating in private tutoring (48.6%). 36% of all the students sampled claimed to be school choice students, meaning that they have paid certain amount of school choice fees in order to be enrolled in the current school with HSEE score a few points lower than the admission line. The percentage of students in the science track is 59.3%. Female students account for 50.8% of all the students. Among students in the science track, 58.88% of them are male students, and 41.12% of them are female students. Among humanity track students, male students only account for 30.61%, and female students account for 69.39%. Students with rural registered-residence account for 50.6% of all the students.

At the class level, 22.9% of students sampled are in the key classes. At the school level, the HSEE high school admission line for students with first choice[34] varies from 452 to 635. There are several admission lines for each school, including an admission line for first choice[35] students, second choice students, school choice students, etc. Only the first choice admission line is reported, which often is the highest line. The average percentage of school choice students at the school level is 35.3%. The total number of students in the school varies from 1251 to 5700. The

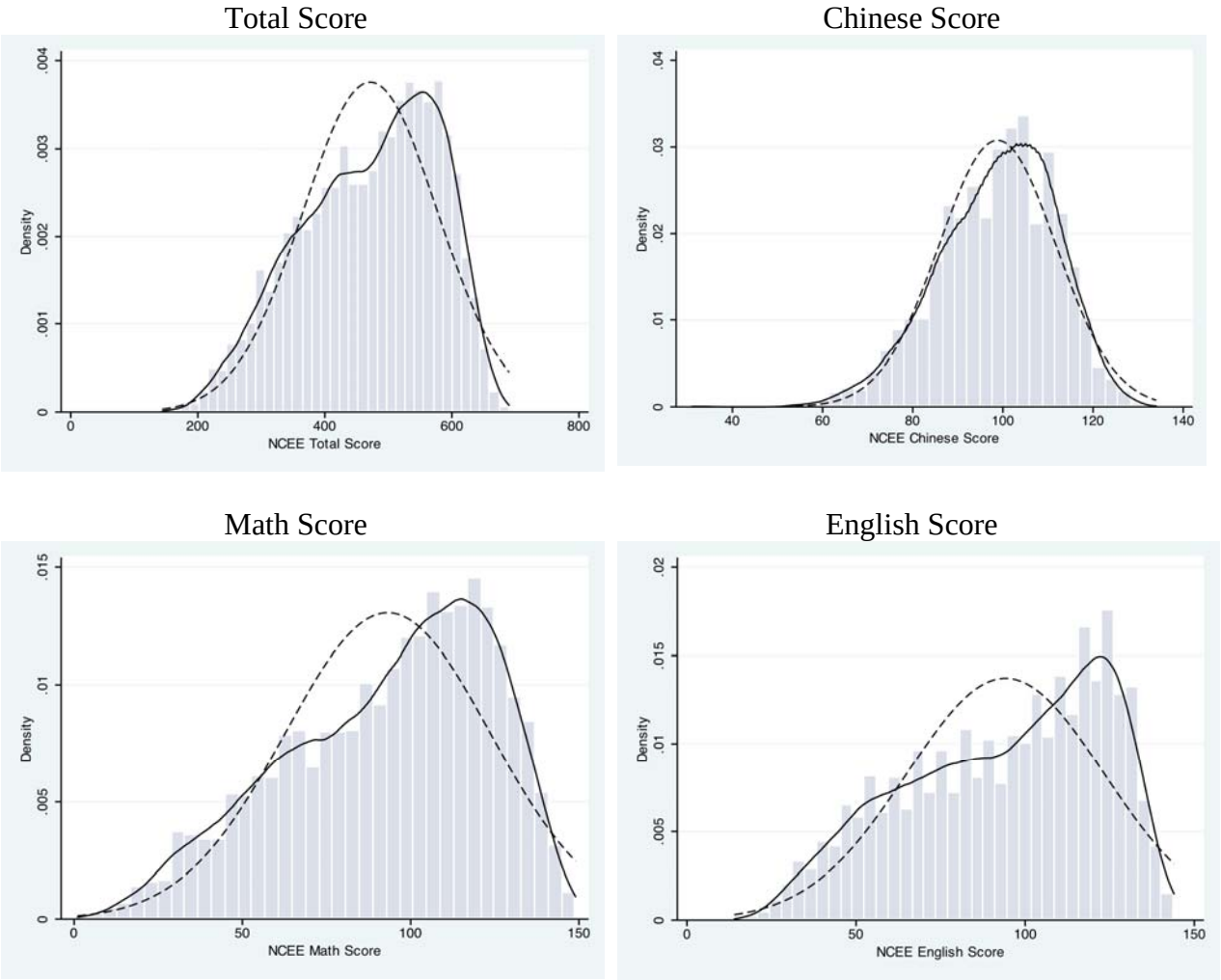
[34] Junior middle school graduates can apply for two high schools with an order of willingness. The High school will consider applicants who put it as the first choice school as first choice students and will admit them first, before considering second choice students.

[35] G9 graduates usually have two choices when applying for the high school. A high school considers applicants who take it as the first choice school as the first choice students, and consider those who take it as the second choice as the second choice students.

percentage of Level-1 teachers (the highest professional rank) is 26.7%. The proportion of teachers with a Master's degree is 3.7%.

Figure 4-1 presents the distribution density of the NCEE score by subject, with the solid lines as the kernel density estimates and the dash lines as the normal density. The test scores are usually considered as truncated data, because scores exceeding the full marks will be coded as the full marks. But according to Figure 4-1, the NCEE score is not truncated at the ceiling.

Figure 4-1 Density of the NCEE Scores for the Whole Sample



4.1.2 Correlation

In this section, the process of correlation check is reviewed and the correlation coefficients of the covariates that passed the check are reported in Table 4-3. The variance inflation factor of each explanatory variable in Table 4-3 is below 5, thus there is no problem of multicollinearity.

The correlations between outcome variables and covariates will not be examined here. In terms of covariates, family background variables including *rural, SES, urban wealthy family, cultural capital – facility, and cultural capital – interaction* are highly correlated. Since *SES* is one of the most commonly used measures, and the Cronbach's alpha of SES is the highest among them, SES is kept and the other four variables are deleted. *Key class, non-key class,* and *panel class* are highly correlated, so the latter two are deleted. Parent related variables of *parent as role model* and *parents caring study and respecting the child* are highly correlated, and the former is deleted. Self-evaluation variables including *study habits and ability, optimistic*, and *not nervous to test and likes playing* are highly related, and the latter two are deleted. *Computer* has high correlation with *outcome-oriented style*, and thus is deleted. Principal's years of principal experience is deleted due to its high correlation with the administrative style of lax principal leadership. Among the five variables evaluating school level teacher quality (percent of Level-1 teachers, Level 2&3 teachers, teachers with associate degree, Bachelor's degree, and a Master's degree), two variables are kept: percent of Level-1 teachers and percent of teachers with a Master's degree.

In regards to the instrumental variables for the endogenous measures of private tutoring participation, the IV of PT advertisement seen every week is too weak. First, its correlations with PT participation for all subjects and the three subjects respectively are lower than 0.1. Second, in fact, the coefficients of private tutoring advertisement are not significant for each subject and

total score, if being added to the first stage equation. Therefore, it is deleted to avoid biased estimation (Angrist & Pischke, 2009, p.205).

Table 4-3 Correlation Coefficients of Variables – Weighted

		Participation in PT in G12				Private tutoring expenditure	Index: time spent on PT	PT peer No.
		Chinese	Math	English	Any subjects			
Participation in PT in G12	Chinese	1						
	Math	0.413**	1					
	English	0.466**	0.654**	1				
	Any subjects	0.181**	0.385**	0.319**	1			
Private tutoring expenditure		0.212**	0.303**	0.301**	0.212**	1		
Index: time spent on PT		0.215**	0.426**	0.353**	0.681**	0.340**	1	
PT peer No.		0.134**	0.270**	0.206**	0.251**	0.1620**	0.298**	1
PT distance		-0.075**	-0.169**	-0.135**	-0.186**	-0.147**	-0.223**	-0.218**
Standardized HSEE score	Chinese	0.004	0.050**	0.012	-0.007	0.060**	-0.021	0.038**
	Math	0.001	-0.055**	-0.036**	-0.084**	-0.033	-0.158**	-0.037**
	English	0.013	0.0292*	-0.005	-0.021*	0.004	-0.077**	0.008
	Total score	0.009	-0.006	-0.018	-0.056**	0.001	-0.115**	-0.013
SES		0.095**	0.241**	0.182**	0.265**	0.232**	0.328**	0.215**
Female		-0.038**	0.095**	0.040**	0.076**	0.028*	0.054**	0.085**
Science track		-0.003	-0.067**	-0.058**	-0.054**	-0.012	-0.085**	-0.049**
School choice student		-0.004	-0.030*	-0.028*	-0.039**	-0.028*	-0.050**	-0.042**
Parents caring study and respect the child		0.004	-0.007	-0.013	0.009	-0.024	-0.007	-0.009
Parents regulating		0.076**	0.083**	0.091**	0.098**	0.053**	0.097**	0.056**
Parents doing too much for the child		0.086**	0.081**	0.087**	0.141**	0.053**	0.163**	0.071**
Study habits and ability		0.039**	-0.022	-0.009	0.050**	-0.050**	0.060**	-0.022
Class environment of personal relationship		0.012	-0.042**	-0.006	-0.004	-0.006	-0.029*	-0.068**
Key Class		0.012	-0.048**	-0.038**	-0.039**	-0.032*	-0.068**	-0.087**
Class average SES		0.048**	0.193**	0.114**	0.191**	0.220**	0.301**	0.263**
Standardized student no.		0.000	-0.085**	-0.056**	-0.089**	-0.040**	-0.114**	-0.055**
Student teacher ratio		-0.045**	-0.058**	-0.041**	-0.046**	-0.048**	-0.068**	-0.061**
Lab		0.074**	0.113**	0.074**	0.075**	0.018	0.096**	0.150**
Percent of Level-1 teachers		-0.004	0.050**	0.042**	0.070**	0.081**	0.140**	0.087**
Percent of teachers with a Master's degree		0.027*	0.104**	0.079**	0.110**	0.153**	0.174**	0.169**
HSEE admission line		0.072**	0.146**	0.079**	0.137**	0.131**	0.153**	0.215**
School activity		0.020	-0.027	-0.018	-0.039**	-0.005	-0.024	-0.023
Collegial		-0.012	0.020	-0.002	0.013	-0.001	-0.026*	0.031*
Outcome-oriented		0.012	-0.049**	-0.029*	-0.055**	-0.051**	-0.079**	-0.043**
Lax principal leadership		0.041**	0.096**	0.085**	0.098**	0.047**	0.124**	0.118**
High authority and accountability		-0.041**	-0.112**	-0.080**	-0.113**	-0.127**	-0.228**	-0.142**

** p>0.01, * p>0.05

Table 4-3 Correlation Coefficients of Variables – Weighted (Cont.)

		PT distance	Standardized HSEE score				SES	Female
			Chinese	Math	English	Total		
PT distance		1						
Standardized HSEE score	Chinese	-0.051**	1					
	Math	0.029*	0.459**	1				
	English	-0.003	0.570**	0.617**	1			
	Total score	-0.004	0.680**	0.825**	0.805**	1		
SES		-0.281**	0.195**	0.057**	0.104**	0.133**	1	
Female		-0.039**	0.188**	-0.108**	0.118**	-0.035**	0.005	1
Science track		0.032*	0.044**	0.349**	0.144**	0.286**	0.009	-0.296**
School choice student		0.057**	-0.012	-0.003	-0.030*	-0.015	-0.108**	-0.008
Parents caring study and respect the child		-0.023	0.156**	0.104**	0.149**	0.141**	0.047**	0.130**
Parents regulating		-0.064**	-0.010	0.023	0.030*	-0.002	0.073**	-0.038**
Parents doing too much for the child		-0.061**	-0.130**	-0.089**	-0.119**	-0.130**	0.077**	-0.061**
Study habits and ability		-0.031*	0.134**	0.093**	0.118**	0.124**	-0.019	0.060**
Class environment of personal relationship		0.039**	0.191**	0.131**	0.129**	0.180**	0.015	-0.006
Key Class		0.029*	0.246**	0.225**	0.232**	0.304**	-0.016	0.045**
Class average SES		-0.252**	0.300**	0.124**	0.194**	0.237**	0.615**	0.037**
Standardized student no.		0.041**	0.296**	0.349**	0.310**	0.375**	0.082**	-0.096**
Student teacher ratio		0.081**	-0.080**	-0.096**	-0.126**	-0.133**	-0.100**	-0.016
Lab		0.019	-0.142**	-0.104**	-0.117**	-0.140**	-0.071**	0.044**
Percent of Level-1 teachers		-0.090**	0.053**	-0.000	0.021	0.045**	0.183**	0.021
Percent of teachers with a Master's degree		-0.146**	0.126**	0.072**	0.121**	0.137**	0.357**	0.077**
HSEE admission line		-0.147**	0.368**	0.356**	0.387**	0.441**	0.411**	-0.003
School activity		0.009	0.324**	0.303**	0.286**	0.365**	0.121**	-0.078**
Collegial		0.006	-0.045**	-0.033*	-0.020	-0.059**	0.027*	0.0240
Outcome-oriented		0.073**	-0.113**	0.007	-0.053**	-0.041**	-0.152**	-0.056**
Lax principal leadership		-0.061**	-0.204**	-0.194**	-0.182**	-0.216**	-0.032*	0.070**
High authority and accountability		0.130**	0.044**	0.140**	0.083**	0.101**	-0.167**	-0.098**

** p>0.01, * p>0.05

Table 4-3 Correlation Coefficients of Variables – Weighted (Cont.)

	Science track	School choice student	Parents caring study and respect the child	Parents regulating	Parents doing too much for the child	Study habits and ability	Class environment of personal relationship
Science track	1						
School choice student	-0.046**	1					
Parents caring study and respect the child	0.012	0.014	1				
Parents regulating	-0.019	-0.011	0.049**	1			
Parents doing too much for the child	-0.030*	-0.034**	-0.279**	0.155**	1		
Study habits and ability	-0.019	0.010	0.320**	0.144**	-0.084**	1	
Class environment of personal relationshi	0.028*	0.009	0.113**	0.067**	-0.034**	0.140**	1
Key Class	0.074**	0.014	0.090**	-0.013	-0.063**	0.078**	0.245**
Class average SES	0.014	-0.158**	0.037**	0.030*	0.061**	-0.036**	0.024
Standardized student no.	0.061**	0.020	0.090**	0.061**	-0.093**	0.093**	0.166**
Student teacher ratio	-0.079**	0.064**	-0.058**	-0.007	0.008	-0.003	0.126**
Lab	0.005	0.069**	-0.069**	-0.048**	0.042**	-0.103**	-0.345**
Percent of Level-1 teachers	-0.020	0.027	-0.017	0.030	-0.001	-0.048**	0.067**
Percent of teachers with a Master's degree	0.016	-0.155**	0.042**	0.029*	0.033*	-0.033*	0.003
HSEE admission line	0.117**	-0.087**	0.084**	0.002	-0.002	0.023	0.023
School activity	0.102**	0.104**	0.096**	0.040**	-0.035**	0.128**	0.333**
Collegial	-0.072**	-0.082**	-0.048**	-0.042**	0.029*	-0.042**	-0.222**
Outcome-oriented	0.122**	0.025	0.008	0.022	-0.028*	-0.021	-0.083**
Lax principal leadership	0.056**	-0.128**	-0.051**	-0.030*	0.062**	-0.107**	-0.141**
High authority and accountability	-0.006	0.054**	0.035**	0.051**	-0.089**	0.063**	0.167**

** p>0.01, * p>0.05

Table 4-3 Correlation Coefficients of Variables – Weighted (Cont.)

	Key Class	Class average SES	Standardized student no.	Student teacher ratio	Lab	Percent of Level-1 teachers	Percent of teachers with a Master's degree
Key Class	1						
Class average SES	-0.031*	1					
Standardized student no.	0.007	0.133**	1				
Student teacher ratio	-0.098**	-0.164**	-0.213**	1			
Lab	0.028*	-0.115**	-0.292**	0.235**	1		
Percent of Level-1 teachers	0.070**	0.294**	0.077**	-0.158**	-0.122**	1	
Percent of teachers with a Master's degree	0.143**	0.578**	-0.016	-0.479**	-0.281**	0.319**	1
HSEE admission line	0.189**	0.663**	0.294**	-0.135**	0.044**	-0.039**	0.316**
School activity	0.108**	0.193**	0.545**	0.010	-0.280**	-0.088**	-0.104**
Collegial	-0.262**	0.045**	-0.153**	0.365**	0.120**	-0.457**	-0.202**
Outcome-oriented	0.122**	-0.246**	-0.003	-0.038**	0.314**	-0.068**	-0.130**
Lax principal leadership	0.162**	-0.052**	-0.479**	-0.034**	0.441**	0.039**	0.172**
High authority and accountability	-0.041**	-0.269**	0.321**	0.473**	-0.150**	-0.161**	-0.479**

** p>0.01, * p>0.05

Table 4-3 Correlation Coefficient of Variables – Weighted (Cont.)

	HSEE admission line	School activity	Collegial	Outcome-oriented	Lax principal leadership	High authority and accountability
HSEE admission line	1					
School activity	0.434**	1				
Collegial	0.136**	-0.203**	1			
Outcome-oriented	-0.124**	-0.177**	-0.413**	1		
Lax principal leadership	-0.152**	-0.406**	-0.186**	0.314**	1	
High authority and accountability	-0.077**	0.067**	0.086**	0.319**	-0.274**	1

** p>0.01, * p>0.05

4.2 The NCEE Results

According to Table 4-4, the average NCEE total score for all subjects is 494.47 for urban students and 498.80 for rural students. The Chinese average scores for the two groups are similar. The average NCEE Math score of students with a rural residence is 102, about 4 points higher than that of their counterparts with urban residence, which is 97.86. The relatively higher performance of rural students is consistent with the fact that it is more selective for rural students to be enrolled in high school, compared to the urban students. However, the average NCEE English score of rural students is about 3 points lower than that of urban students. This reveals the fact that rural students have a disadvantage in learning English, which requires more education resource than Chinese and math.

Table 4-4 Average NCEE Score by Registered Residence

	N	Total*	Chinese	Math	English
Urban residence	2981	494.47	101.55	97.86	101.57
Rural residence	2835	498.80	101.24	102.00	98.33

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

As presented by Table 4-5, female students outperform male students by about 2.5 points in the NCEE total score, 3 points in Chinese, and 6 points in English. Male students only perform a little better in math than female students.

Table 4-5 Average NCEE Score by Gender

	N	Total*	Chinese	Math	English
Male	2728	495.07	99.84	100.52	96.46
Female	3099	497.80	102.87	99.36	103.05

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-6 reports the average NCEE score by academic track. The average total score of students in the humanity track is 486.6, which is lower than that of students in science track, which is 503.7. This gap exists across different subjects, even for language subjects.

Table 4-6 Average NCEE Score by Academic Track

	N	Total*	Chinese	Math	English
Humanity	2448	486.64	100.51	96.86	94.05
Science	3276	503.75	102.08	102.14	103.89

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

According to Table 4-7, students' average NCEE score generally increases as father's education level increases. In regards to those whose father's education level lower than senior high school, the average NCEE total score is similar around 490, but is 8 points higher than that of those whose father's education level is senior high school. For those whose father's highest education level is above vocational high school, the average NCEE score is much higher and increases significantly with father's highest education degree. The trends are similar across the three subjects. The increase speed is higher in regard to English, and lower in regard to Chinese, with math in the middle. This might indicate that father's highest education degree has a larger influence on the student's English score.

Table 4-7 Average NCEE Score by Father's Highest Education Level

	N	Total*	Chinese	Math	English
Did not finish primary education	32	488.16	101.33	98.96	95.44
Primary education	452	491.24	100.76	100.71	97.27
Junior high school	2331	490.34	100.17	99.41	96.67
Senior high school	1377	481.60	100.50	95.85	95.97
Associate or vocational high school	728	509.70	102.88	102.21	104.63
Bachelor's degree	753	522.35	104.54	104.59	109.34
Master's degree	98	536.84	105.53	109.09	114.26
Doctoral degree	32	553.71	107.46	109.74	120.69

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-8 presented the average NCEE score by mother's highest education level. Different from the trends discussed above, the trend of the average NCEE total score presents a "U" shape along the axis of mother's highest education level. It first decreases as mother's education level increases from below primary education to senior high school, and then increases as mother's education level increases from senior high school to Master's degree, but decreases again sharply from a Master's degree to a Doctoral degree. The trends are similar for Chinese and English. In regard to math, the average score does not decrease when mother's highest education level increases from a Master's degree to Doctoral degree.

Table 4-8 Average NCEE Score by Mother's Highest Education Level

	N	Total*	Chinese	Math	English
Did not finish primary education	163	500.43	100.87	103.42	98.79
Primary education	1008	497.89	101.01	101.68	98.49
Junior high school	2264	488.75	100.40	98.65	96.57
Senior high school	1176	486.02	100.95	96.45	97.99
Associate or vocational high school	678	508.21	103.14	101.66	104.89
Bachelor's degree	466	530.09	104.85	105.90	112.68
Master's degree	39	562.28	104.86	115.75	119.86
Doctoral degree	13	521.71	103.72	106.32	112.95

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-9 compares the average NCEE scores across father's profession. Government officials and professional and technical personnel's children have higher average NCEE scores than those whose fathers are with other professions. Individual businessmen's children have the lowest average NCEE score. It is interesting to notice that agricultural laborers' children outperform the children of those with professions other than the government officials and professional and technical personnel. This may due to the fact that most rural students are the top rural students selected by the high schools, while the urban students do not face such high selectivity when applying for high school. Table 4-10 presents the average NCEE scores by mother's profession. The trends are similar with those presented in Table 4-9.

Table 4-9 Average NCEE Score by Father's Profession

	N	Total***	Chinese	Math	English
Government officials*	678	515.71	103.48	103.24	107.20
Managers in private company	159	495.45	101.16	96.50	101.39
Private entrepreneurs	187	479.77	100.30	96.41	96.26
Professional and technical personnel **	472	521.95	104.36	105.56	107.60
Clerk and related workers	308	496.06	100.86	99.39	101.66
Individual business	702	476.03	99.85	94.22	94.44
Military personnel and police	97	502.77	103.59	99.59	103.33
Business service personnel	224	493.27	101.85	99.72	99.04
Industrial workers	679	486.62	101.16	97.38	97.56
Agricultural Laborers	1418	508.21	102.03	104.30	100.02
Unemployed	241	480.93	100.00	97.24	94.31
Others	575	469.40	97.32	94.05	93.03

Note: * Including state owned company
** Including faculty in higher education institutions, other researchers, school teachers
*** Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-10 Average NCEE Score by Mother's Profession

	N	Total***	Chinese	Math	English
Government officials*	344	516.24	102.83	103.13	107.25
Managers in private company	82	488.51	101.02	95.25	99.28
Private entrepreneurs	86	462.87	97.32	91.82	92.32
Professional and technical personnel **	398	538.70	105.88	109.08	112.31
Clerk and related workers	470	499.83	102.09	100.03	104.22
Individual business	714	473.77	99.52	93.21	94.21
Military personnel and police	17	508.99	104.97	98.87	106.51
Business service personnel	291	479.11	100.79	94.09	95.45
Industrial workers	424	491.04	101.77	98.58	99.28
Agricultural Laborers	1639	507.11	102.05	103.95	99.58
Unemployed	696	490.41	101.00	99.15	98.35
Others	603	469.34	97.53	93.58	94.22

Note: * Including state owned company
** Including faculty in higher education institutions, other researchers, school teachers
*** Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-11 reports the average NCEE scores by private tutoring participation status. For all subjects, the average NCEE score is 486.44 for students who participated in private tutoring, and is 505.66 for those who did not. The former is 19 points lower than the latter. The comparison is similar for Chinese, math, and English respectively. Thus, the unconditional average NCEE score of private tutoring participants is lower than that of those who did not participate in private tutoring, for all subjects, and the three subjects respectively.

Table 4-11 Average NCEE Score by Private Tutoring Participation

			NCEE score			
		N	Any subject	Chinese	Math	English
PT participation for all subjects	Yes	2980	486.44			
	No	2861	505.66			
Chinese PT participation	Yes	388		100.76		
	No	5453		101.41		
Math PT participation	Yes	1360			97.28	
	No	4481			100.61	
English PT participation	Yes	1062				98.36
	No	4779				100.10

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table 4-12 Average NCEE Score by Private Tutoring Participation and Registered Residence

		NCEE score		Sample size	
		Private tutoring participation		Private tutoring participation	
		Yes	No	Yes	No
All subjects	Urban residence	486.0	507.3	1838	1143
	Rural residence	487.8	505.3	1133	1702
Chinese	Urban residence	101.7	101.5	226	2755
	Rural residence	99.4	101.3	161	2674
Math	Urban residence	96.0	98.6	907	2074
	Rural residence	99.9	102.3	453	2382
English	Urban residence	99.7	102.1	680	2301
	Rural residence	95.9	98.7	381	2454

Considering the significant difference in private tutoring participation between urban and rural students, Table 4-12 reports the average NCEE score by the joint status of private tutoring participation and registered residence. For all subjects, urban private tutoring participants have an average NCEE score that is 20 points lower than those urban students who did not participate in private tutoring. Rural private tutoring participants have an average NCEE score that is 17 points lower than those rural students who did not participate in private tutoring. The situation is similar with regards to math and English. The gap between the participants and non-participants is around 2.5 points. For Chinese, the average NCEE score of urban private tutoring participants is 0.2 points higher than their urban counterparts. Generally speaking, the result that private tutoring participants are outperformed by their counterparts is consistent across subjects and registered residence.

4.3 Private Tutoring

During the past few years, the Shandong Education Department began to forbid public schools providing after-school tutoring and G12-retention for NCEE. This big market thus is shifting from public schools to private sectors. Since many students have been used to

instructions by teachers and have difficulty in effectively utilizing after-class study time by themselves, they have a strong demand for private tutoring.

Table 4-13 reports the number and percentage of students who participated in private tutoring offered outside school by academic subject, grade, and registered residence. For the three subjects (Chinese, math, and English) the demand for private tutoring is higher in junior middle schools than in senior high schools. There are several reasons. First, the time duration is different. The duration of middle school is three years, while the duration for each grade in high school is only one year. Thus, it might not be comparable. Second, even if it is the case, the relatively low percentage of students who participate in private tutoring in high school may due to the demanding school schedule in high schools, compared to that in junior middle schools. Students in high school may not have as much time as when they were in junior middle school to participate in private tutoring. Third, it is also possible that the High School Entrance Exam is fiercer than National College Entrance Exam, because in most cities in China, as long as one can be enrolled in key high schools, one is quite certain to get a college admission three years later. During the high school period, the demand for Chinese and math private tutoring increases as the grade level increases. But as for the demand for English private tutoring, the percentage first increases from 13.3% in G10 to 19.7% G11, and decreases a little to 18.2% in G12. It might be due to the fact that English cannot be improved significantly in a short time, and some students give up a year before graduation. Among the three subjects, the demand for math tutoring is the highest, and the demand for Chinese tutoring is the lowest. It is consistent with the intuition that most students feel it is harder to learn math than to learn Chinese. Larger percentage of urban students sampled participated in private tutoring than that of rural students, across subjects and grades. For example, 30.31% and 22.88% urban students participated in math and English

private tutoring respectively in G12, while only 15.85% and 13.50% of their rural counterparts participated in private tutoring in the same two subjects in the same year. These numbers are consistent with the proportion of private tutoring participation in urban cities reported by Peng and Zhou (2008) and Xue and Ding (2009), and provide more information about the private tutoring participation among rural students.

Table 4-13 Private Tutoring Participation Outside School

		Student	Participants as percentage of all students sampled		
	Grade	Number	Jinan	Among urban students	Among rural students
Chinese	Junior middle school	704	11.60%	14.08%	9.12%
	G10	244	4.00%	4.86%	3.19%
	G11	312	5.20%	5.48%	4.88%
	G12	401	6.60%	7.59%	5.66%
Math	Junior middle school	1,740	28.80%	41.00%	16.15%
	G10	943	15.60%	23.53%	7.39%
	G11	1,341	22.20%	29.11%	15.06%
	G12	1,397	23.10%	30.31%	15.84%
English	Junior middle school	1,773	29.30%	38.66%	19.78%
	G10	806	13.30%	19.82%	6.65%
	G11	1,193	19.70%	25.07%	14.31%
	G12	1,101	18.20%	22.88%	13.50%
Total student number		6,043	100.00%	3,068	2,948

The education authority has forbidden public schools from providing private tutoring. But it is difficult to implement this policy, especially in developing countries. Large licensed tutoring centers claim to have their own full-time teaching body and part-time teachers from universities. But some of them also employ public school teachers. This is also common among underground tutoring agents. Some college students also constitute the part-time tutor body. But to attract students, college students usually hide their identity and pretend as teachers from the public key schools. Table 4-14 presents the information of major professions of private tutors provided by the sampled students. Across three subjects, the majority of private tutors claim to be teachers

from other schools. This should be biased upward because of the prohibition mentioned above. The second largest population of private tutoring provider is students' own teachers. Thus, public school teachers constitute about 80% of all the private tutors[36]. Professional tutors, most of whom should work for registered private tutoring center, are the smallest population among the four professions.

Table 4-14 Major Professions of Private Tutors

		N	Percent of all respondents	Percent of tutors in each subject
Chinese tutor	University student	58	1.0	11.5
	My school teacher	188	3.1	37.3
	Teacher from other school	205	3.4	40.7
	Professional tutor	36	0.6	7.1
	Others	17	0.3	3.4
	Total	504	8.3	100.0
Math tutor	University student	141	2.3	9.8
	My school teacher	416	6.9	29.0
	Teacher from other school	746	12.3	52.1
	Professional tutor	87	1.4	6.1
	Others	43	0.7	3.0
	Total	1,433	23.7	100.0
English tutor	University student	107	1.8	9.2
	My school teacher	301	5.0	25.8
	Teacher from other school	575	9.5	49.4
	Professional tutor	112	1.9	9.6
	Others	70	1.2	6.0
	Total	1,165	19.3	100.0
Total		6,043	100.0	

In addition to the legal identity of private tutors' major professions, market fragmentation can also be revealed from the perspective of class size. The market is divided into large class (more than 26 students and sometimes above 100 students), middle class (5-25 students), small group (below 5 students), and VIP class (1 to 1). VIP classes are more expensive and are expanding quickly in the market. Although there is little evidence that VIP class has a better

[36] It is biased upward because of the bias from the share of teachers from other schools.

effect on student academic achievement, parents tend to believe that it works. The average price for small class tutoring is from 100 to 200 RMB per hour, and the price for VIP class is several hundred RMB per hour, and changes according to the students' situation. As presented in Table 4-15, around 30% of students who attended private tutoring were in 1 to 1 class, around 25% of them were in classes with 6-25 students, and 30-34% were in large classes.

Table 4-15 Class Size of Private Tutoring

Subject	Class size	N	Percent of all respondents	Percent of tutors in each subject
Chinese	1 to 1	142	2.3	29.8
	Below 5 students	48	0.8	10.1
	6-25 students	124	2.1	26.1
	Above 26 students	162	2.7	34.0
	Total	476	7.9	100.0
Math	1 to 1	556	9.2	36.3
	Below 5 students	141	2.3	9.2
	6-25 students	390	6.5	25.5
	Above 26 students	443	7.3	29.0
	Total	1,530	25.3	100.0
English	1 to 1	370	6.1	29.5
	Below 5 students	117	1.9	9.3
	6-25 students	338	5.6	27.0
	Above 26 students	429	7.1	34.2
	Total	1,254	20.8	100.0
Total		6,043	100.0	

As shown in Table 4-16, about half of the students participating in private tutoring choose personal agencies, which have a high possibility of being unregistered, and another half are enrolled in private institutions. Table 4-17 presents the hourly fee for private tutoring. It is interesting to note that the percentage of students who chose the tutoring service with the lowest hourly fee and that of students choosing the highest hourly fee are the highest, above 20% across the three subjects. The population in the middle of the hourly fee distribution is smaller than the population in the two tails. This may reveal the large disparity in household purchase capacity in private tutoring.

Table 4-16 Agency Type of Private Tutoring

		N	Percent of all respondents	Percent of tutors in each subject
Chinese	Personal	191	3.2	50.0
	Private institution	166	2.7	43.5
	Higher education institute	19	0.3	5.0
	Internet	5	0.1	1.3
	Total	382	6.3	100.0
Math	Personal	696	11.5	52.5
	Private institution	561	9.3	42.3
	Higher education institute	61	1.0	4.6
	Internet	6	0.1	0.5
	Total	1,325	21.9	100.0
English	Personal	517	8.6	47.4
	Private institution	509	8.4	46.7
	Higher education institute	52	0.9	4.8
	Internet	11	0.2	1.0
	Total	1,090	18.0	100.0
Total		6,043	100.0	

Table 4-17 Fee per Hour for Private Tutoring

		N	Percent of all respondents	Percent of tutors in each subject
Chinese tutor	Below 20 RMB	122	2.0	25.3
	20-30 RMB	56	0.9	11.6
	30-40 RMB	45	0.7	9.3
	40-60 RMB	94	1.6	19.5
	60-80 RMB	55	0.9	11.4
	Above 80 RMB	111	1.8	23.0
	Total	483	8.0	100.0
Math tutor	Below 20 RMB	284	4.7	20.2
	20-30 RMB	163	2.7	11.6
	30-40 RMB	139	2.3	9.9
	40-60 RMB	283	4.7	20.2
	60-80 RMB	153	2.5	10.9
	Above 80 RMB	381	6.3	27.2
	Total	1,403	23.2	100.0
English tutor	Below 20 RMB	243	4.0	21.2
	20-30 RMB	142	2.3	12.4
	30-40 RMB	120	2.0	10.5
	40-60 RMB	223	3.7	19.5
	60-80 RMB	118	2.0	10.3
	Above 80 RMB	299	4.9	26.1
	Total	1,145	18.9	100.0
Total		6,043	100.0	

Table 4-18 reports the reasons for participating in private tutoring according to the student questionnaires. 27.7% students sampled take tutoring as remediation, and 28.7% students consider it as enrichment. As learned by the author during the survey, a certain proportion of students who participate in private tutoring are not volunteers, but forced by their parents. This kind of student is probably found to have little promotion in test scores. According to Table 4-19, the main reasons for not participating in private tutoring are the suspicion of the effects of tutoring and its high cost.

Table 4-18 Self-reported Reasons for Participating in Private Tutoring

	N	Percent
For remediation	1,674	27.7
For enrichment	1,737	28.7
My teachers/parents want me to participate in private tutoring	301	5.0
A lot of my classmates participate in private tutoring	80	1.3
To cultivate my study interest	294	4.9

Table 4-19 Self-reported Reasons for Not Participating in Private Tutoring

	N	Percent
I can study very well by myself and I don’t need a tutor.	287	4.7
I am too tired and I don’t have time for tutoring.	366	6.1
The tutoring fee is too expensive for me.	800	13.2
I don’t think the effects of tutoring are good enough.	1,282	21.2
My teachers/parents don’t encourage me to do this.	19	0.3

Table 4-20 presents the self-reported evaluation on the effect of private tutoring by the students sampled. In the questionnaire, students are asked to evaluate the statement “Private tutoring is very helpful to my study” for Chinese, math, and English respectively. “1” means strongly disagree with this statement and “5” means strongly agree with this statement. Thus, higher mark indicates a better self-reported effect of private tutoring. According to Table 4-20, for each subject, urban students are more satisfied with the effect of private tutoring, compared with rural students.

Table 4-20 Self-reported Evaluation on the Effect of Private Tutoring

	Mean			Student Number		
	Urban	Rural	Total	Urban	Rural	Total
Chinese	3.94	3.68	3.84	310	202	513
Math	3.91	3.74	3.85	1006	507	1516
English	3.84	3.66	3.78	789	449	1240

Note: This is the mean of the evaluation on the statement “Private tutoring is very helpful to my study” for Chinese, Math, and English respectively. 1 = strongly disagree and 5 = strongly agree.

Chapter 5 Empirical Results of the Basic Model

In this section, empirical findings of the Basic Model will be discussed following the order of key research questions. In section 5.1, the first key research question regarding the determinants of the NCEE score will be examined according to second-stage estimates of the basic model. The first stage estimates will be presented later in the chapter. The results of three subjects – Chinese, math, and English – will be discussed first, followed by the discussion regarding the total NCEE score. It is reasonable to consider the results by academic subject to be more precise, compared to those of all subjects as a whole. In the analysis of each subject, the information of private tutoring participation corresponds to student achievement of the exact subject; while in the analysis of all subjects, the data is coded as participating in private tutoring as long as one participates in private tutoring of at least one subject, which may not have impact on student achievement of all the subjects. To make an in-depth investigation of the effects of private tutoring on student achievement in the NCEE, estimates of the quantile regression are reported in section 5.1.5.

In section 5.2, the determinants of private tutoring participation are explained in order to answer the second key research question. The results are basically from the first-stage estimates of the basic model. Factors that influence the choice of private tutoring for each of the three subjects are reported and discussed in section 5.2.1. In section 5.2.2, the determinants of private tutoring for all subjects as a whole are discussed according to the empirical results of various models: the logit model, the tobit model, and the OLS model.

All the models are estimated for the entire student sample, and by rural and urban subsamples. The dummy variable “rural” is highly correlated with SES, and is thus dropped from

the regression. In addition, the coefficient of "rural" is not significant even when putting it into the regression, because of the collinearity. Thus, regressing on subsamples is one way[37] to examine urban-rural disparity. All the empirical models are weighted by sampling weights. For simplicity, the coefficients of missing value dummy variables are not presented for all the models. Unless stated otherwise, statistical significance is assessed at the 5% level.

5.1 Determinants of NCEE Score

5.1.1 Chinese

Table 5-1 reports the second-stage estimates of 2SLS model using the NCEE Chinese score as the outcome variable. The first equation is the logit model estimated for private tutoring that will be showed later. Column (1) presents the results for the whole sample, column (2) presents the results of the subsample in which students have urban registered residence, and column (3) reports the results of the students with rural registered residence. Each of these three equations employs three levels of explanatory variables: individual-level variables (measure of private tutoring participation, the standardized HSEE Chinese score, SES, gender, academic track, school choice student, parents' three education styles including caring child's study and respect their child, regulating the child, and caring too much, and the student's good study habits and ability), the class-level variables (a good class environment of personal relationship, key class, and class average SES), and school-level variables (standardized total number of students in the school, student-teacher ratio index, lab resources index, percent of Level-1 teachers, percent of teachers with a Master's degree, the standardized HSEE admission line, school cultural and administration features including rich school activity index, collegial, lax principal leadership, and high authority and accountability). The measure of private tutoring is the

[37] Another way is the use of an interaction term.

predicted probability of private tutoring participation derived from the logit model, which is going to be presented in section 5.2. Parents' three education styles might be endogenous in the sense that parents react according to the students' study habits and ability, academic achievement, and other characteristics. However, since the correlation between parents' three education styles and students' characteristics are close to zero and not significant, the potential endogeneity of parents' three education styles is not considered in this study.

For the whole sample (see equation 1 of Table 5-1), there is no significant effect of private tutoring. The HSEE Chinese score has a significant and positive effect on the NCEE Chinese score, meaning that if there is a one standard deviation increase in the z-scored HSEE Chinese score, there would be 0.398[38] unit of standard deviation increase in the standardized NCEE Chinese score. Female students are significantly stronger than male students in the NCEE Chinese test, and the gap is 0.099 standard deviation (which equals 0.094/0.946). SES, academic track, and school choice status are not significant indicators of the NCEE Chinese score. The index of parents caring child's study and respecting their child has a significantly positive effect on the NCEE Chinese score, while the index of parents doing too much for the child has a significantly negative effect. Parents' regulation has no significant effect. Good study habits and ability is a significantly positive predictor.

In terms of class level variables, a good class environment of personal relationship has a significant and positive effect on the NCEE Chinese score, and the estimated coefficient is 0.047. Key class has a strong and significantly positive effect. Being in key class versus non-key and panel classes, one can improve the NCEE Chinese score by 0.344 unit of standard deviation

[38] One standard deviation increase in z-scored HSEE Chinese score is 0.966, and the estimated coefficient of standardized HSEE Chinese score is 0.390. Thus, the increase in NCEE Chinese score is 0.966*0.390=0.377, which accounts for 0.398 of one standard deviation (0.946) z-scored NCEE Chinese score.

(which equals 0.326/0.946). Class level average SES has a negative effect on the NCEE Chinese score.

For school level variables, school size measured by student number has no effect. Student-teacher ratio index has a significantly negative effect, which means that the decrease in per student teacher number will increase the NCEE Chinese score. The percent of teachers with a Master's degree has a significantly positive effect, while the percent of Level-1 teachers has a significantly negative effect on the NCEE Chinese score. The z-scored HSEE admission line has a significantly positive effect, which means that school level study ability grouping has a positive influence on individual students' NCEE Chinese score. School activity index is also a significantly positive predictor of the NCEE Chinese score. Among school organization characteristics, collegial and outcome-oriented indices are not significant predictors. Lax principal leadership characteristic is a significantly negative predictor, and high authority and accountability characteristic has a significant and positive effect on the Chinese test score.

For urban students (see column 2 of Table 5-1), private tutoring also has no significant effect on the NCEE Chinese score. The estimates of other variables are similar to those for the whole sample, and the magnitudes of most coefficients are larger than those of the whole sample. For rural students (see column 3 of Table 5-1), private tutoring has a significantly negative effect on the NCEE Chinese score. For one standard deviation (0.060, see Appendix) increase in the predicted probability of Chinese private tutoring participation, the NCEE Chinese score decreases by 0.08 unit[39] of standard deviation. The HSEE Chinese score is still a significantly positive predictor, but with smaller effect than that of urban students. Different from the results of urban students, parents' interaction styles with children are no longer significant predictors

[39] 0.08=0.060*(-1.267)/0.946

any more. Gender is not significant, either. The effect of study habits and ability is significant and larger than that of urban students.

In regards to class level and school level variables, the estimated effects of rural students are similar with those for urban students, but often with larger magnitudes. For example, the coefficient of student-teacher ratio index is -0.110 for rural students, and -0.057 for urban students. Generally rural students are more likely to be affected by class and school level education inputs, compared to personal characteristics including family education inputs. This phenomenon is consistent with the Heyneman-Loxley (HL) effect when considering urban areas as developed regions and rural areas as developing areas.

Table 5-1 Second Stage Estimates of 2SLS – Chinese

	All	Urban	Rural
	(1)	(2)	(3)
Predicted probability of private tutoring participation	-0.525	0.525	-1.267*
	(0.410)	(0.479)	(0.546)
Standardized HSEE Chinese score	0.390**	0.407**	0.365**
	(0.018)	(0.028)	(0.023)
SES	0.017	0.002	0.021
	(0.011)	(0.015)	(0.021)
Female	0.094**	0.157**	0.048
	(0.026)	(0.037)	(0.037)
Science track	0.025	0.056	-0.017
	(0.026)	(0.034)	(0.042)
School choice	-0.013	0.032	-0.041
	(0.026)	(0.036)	(0.037)
Parents caring about study and respecting the child	0.026**	0.031**	0.015
	(0.008)	(0.011)	(0.014)
Parents regulating	-0.007	-0.018	0.007
	(0.010)	(0.013)	(0.015)
Parents doing too much for the child	-0.027*	-0.042**	-0.015
	(0.013)	(0.016)	(0.020)
Study habits and ability	0.028**	0.021*	0.033**
	(0.008)	(0.011)	(0.012)
Class environment of personal relationship	0.047**	0.046	0.062**
	(0.017)	(0.026)	(0.024)
Key Class	0.326**	0.326**	0.348**
	(0.030)	(0.043)	(0.049)
Class average SES	-0.079**	-0.065*	-0.026
	(0.020)	(0.027)	(0.044)
Standardized total number of students in school	-0.013	-0.048	-0.040
	(0.018)	(0.033)	(0.030)
Student-teacher ratio	-0.082**	-0.062*	-0.101**
	(0.019)	(0.026)	(0.035)
Lab	0.056	-0.078	0.133*
	(0.039)	(0.071)	(0.061)
Percent of Level-1 teachers	-0.477*	-0.441	-0.935*
	(0.205)	(0.273)	(0.433)
Percent of teachers with a Master's degree	2.234**	1.855**	1.803
	(0.418)	(0.639)	(1.020)
Standardized HSEE admission line	0.135**	0.157**	0.097*
	(0.022)	(0.038)	(0.039)
School activity	0.183**	0.201**	0.195**
	(0.034)	(0.051)	(0.065)
Collegial	0.019	-0.027	0.040
	(0.017)	(0.026)	(0.033)
Outcome-oriented	-0.003	-0.118	0.075
	(0.036)	(0.063)	(0.058)
Lax principal leadership	-0.101**	-0.085*	-0.177**
	(0.025)	(0.039)	(0.047)
High authority and accountability	0.218**	0.247**	0.237**
	(0.025)	(0.050)	(0.050)
Constant	-0.033	-0.200*	0.213
	(0.072)	(0.097)	(0.134)
N	5841	2981	2835
F	131.570	83.060	176.440
Probability > 0	0.000	0.000	0.000
R^2	0.403	0.435	0.313

Standard errors in parentheses

** p>0.01, * p>0.05,

5.1.2 Math

Table 5-2 presents the second stage estimates of 2SLS model for math. As reported in column (1), private tutoring has no significant effect on the NCEE Math score. HSEE Math score has a significant and positive effect on the NCEE Math score, and the coefficient is 0.528. SES, gender, and school choice status are not significant predictors. Students in the science track perform 0.254 (=0.234/0.920) unit of standard deviation lower than their counterparts in the humanity track in the NCEE Math test. This suggests that the humanity track students make more effort in improving math, compared with the science track students. The factor that parents who care about their children's study and respect their children has a consistently significant and positive effect on the NCEE Math score. Parents' regulation has no significant effect. The variable of parents doing too much for their child has a significantly negative effect on student achievement. Study habits and ability is a significant and positive predictor.

In terms of the class level variables, both a good class environment of personal relationship and key class have significant and positive impacts on the NCEE Math score. Class average SES has no significant effect. At the school level, student-teacher ratio index has a significantly negative effect, meaning that the reduction of student-teacher ratio will increase student math achievement in the NCEE. Lab index has a positive effect, significant at the 0.1 level. Other school level education inputs such as percent of teachers with a Master's degree, the HSEE admission line, school activity, and high authority and accountability organization are all positive predictors of NCEE Math score. Lax principal leadership characteristic has a significantly negative effect. Percent of Level-1 teachers, collegial, and outcome-oriented characteristics do not have significant impact on the NCEE Math score. The results of urban and rural students are similar to those of the whole sample. In particular, private tutoring has no

effect on math score for both urban and rural students. Compared to urban students, rural students are more likely to be influenced by key class input and percent of teachers with a Master's degree, and less likely to be influenced by parents' education style.

Table 5-2 Second Stage Estimates of 2SLS – Math

	All	Urban	Rural
	(1)	(2)	(3)
Predicted probability of private tutoring participation	0.013	0.101	-0.310
	(0.120)	(0.139)	(0.188)
Standardized HSEE Math score	0.528**	0.507**	0.519**
	(0.018)	(0.023)	(0.029)
SES	-0.004	0.010	-0.013
	(0.009)	(0.012)	(0.017)
Female	-0.015	-0.004	-0.018
	(0.021)	(0.030)	(0.030)
Science track	-0.234**	-0.178**	-0.268**
	(0.024)	(0.032)	(0.036)
School choice	-0.015	0.015	-0.036
	(0.021)	(0.030)	(0.029)
Parents caring about study and respecting the child	0.045**	0.046**	0.042**
	(0.008)	(0.009)	(0.013)
Parents regulating	-0.009	-0.011	0.005
	(0.008)	(0.012)	(0.012)
Parents doing too much for the child	-0.036**	-0.037**	-0.028
	(0.009)	(0.012)	(0.015)
Study habits and ability	0.060**	0.064**	0.055**
	(0.007)	(0.009)	(0.010)
Class environment of personal relationship	0.045**	0.090**	0.024
	(0.014)	(0.022)	(0.019)
Key Class	0.370**	0.282**	0.440**
	(0.026)	(0.035)	(0.041)
Class average SES	-0.016	-0.001	-0.003
	(0.016)	(0.022)	(0.036)
Standardized total number of students in school	0.012	-0.043	-0.024
	(0.017)	(0.030)	(0.031)
Student-teacher ratio	-0.075**	0.059	-1.212**
	(0.016)	(0.230)	(0.444)
Lab	0.057	-0.125**	-0.024
	(0.032)	(0.022)	(0.038)
Percent of Level-1 teachers	-0.169	-0.058	0.102
	(0.173)	(0.061)	(0.054)
Percent of teachers with a Master's degree	1.378**	0.510	2.448**
	(0.356)	(0.550)	(0.854)
Standardized HSEE admission line	0.042*	0.079*	0.042
	(0.019)	(0.033)	(0.031)
School activity	0.207**	0.346**	0.125
	(0.028)	(0.044)	(0.066)
Collegial	0.022	0.006	-0.013
	(0.014)	(0.024)	(0.034)
Outcome-oriented	-0.042	-0.115*	0.015
	(0.032)	(0.059)	(0.047)
Lax principal leadership	-0.140**	-0.047	-0.270**
	(0.022)	(0.034)	(0.043)
High authority and accountability	0.170**	0.230**	0.158**
	(0.022)	(0.043)	(0.053)
Constant	0.057	-0.093	0.369**
	(0.059)	(0.088)	(0.122)
N	5841	2981	2835
F	263.100	179.040	243.480
Probability > 0	0.000	0.000	0.000
R^2	0.540	0.595	0.479

Standard errors in parentheses
** p>0.01, * p>0.05

5.1.3 English

According to Table 5-3, predicted probability of private tutoring participation has no significant effect on the NCEE English score of the whole sample, urban student subsample, and rural student subsample. The coefficient of the HSEE English score of the whole sample is significant and positive at 0.606, and the effect is similar for urban and rural students.

SES becomes a positive predictor in English, which is significant at 0.019.This implies that students with high SES make more improvement in English achievement. Female students perform significantly better than male students, which confirms female students' advantage in language arts. Students in the science track make more improvement than students in humanity track. Scientific track students are usually weak in English relative to humanity track students. Therefore, the former are making more effort in English. The variable of parents caring about child's study and respecting the child still has a significantly positive effect. The factors that parents regulating the child and that parents doing too much for the child are significantly negative predictors of English achievement. The effects of these three parent-related education inputs are consistent across subsamples including rural students. Study habits and ability is still a significantly positive predictor.

Key class has a significant and positive effect on student achievement, and the effect size is larger in the rural student subsample than that in urban student subsample. A good class environment of personal relationship has no significant effect in the whole sample, but has a significantly positive effect in the urban student subsample. Average class SES has no effect.

At the school level, the total number of students has no significant effect on the NCEE English score of the whole sample, but has significantly negative effects on urban and rural student bodies respectively. Student teacher ratio index has significantly negative effects across

the whole sample, urban students, and rural students, and the estimated coefficient for urban students (-0.624) is less than half of that of rural students, which is -1.414. This implies that rural students benefit more from the same amount of reduction in student teacher ratio, compared with their urban counterparts. Lab, percent of teachers with a Master's degree, school activity, and high authority and accountability organization feature all have significant and positive effects on student achievement in the NCEE English test. Among these factors, all the magnitudes of the effects for rural students are lower than those for urban students, but the coefficient of percent of teachers with a Master's degree. Percent of Level-1 teachers is a significantly negative predictor, and collegial feature has no effect. Outcome-oriented administrative style has no effect on the whole sample, but has a significantly negative effect on urban students, and a positive effect on rural students. Generally speaking, rural students are weak in taking advantage of both family inputs and school inputs to improve their English achievement in NCEE, except for student-teacher ratio and percent of teachers with a Master's degree.

Table 5-3 Second Stage Estimates of 2SLS – English

	All	Urban	Rural
	(1)	(2)	(3)
Predicted probability of private tutoring participation	0.244	0.298	-0.357
	(0.163)	(0.203)	(0.197)
Standardized HSEE English score	0.606**	0.594**	0.600**
	(0.015)	(0.021)	(0.021)
SES	0.019	0.032*	0.010
	(0.010)	(0.012)	(0.017)
Female	0.110**	0.105**	0.113**
	(0.020)	(0.029)	(0.028)
Science track	0.153**	0.142**	0.139**
	(0.022)	(0.029)	(0.032)
School choice	-0.001	0.026	-0.019
	(0.020)	(0.030)	(0.027)
Parents caring about study and respecting the child	0.036**	0.037**	0.030**
	(0.007)	(0.009)	(0.011)
Parents regulating	-0.038**	-0.031**	-0.025*
	(0.008)	(0.012)	(0.011)
Parents doing too much for the child	-0.030**	-0.044**	-0.003
	(0.009)	(0.012)	(0.013)
Study habits and ability	0.039**	0.051**	0.031**
	(0.006)	(0.009)	(0.009)
Class environment of personal relationship	0.017	0.072**	-0.002
	(0.014)	(0.021)	(0.019)
Key Class	0.401**	0.320**	0.430**
	(0.026)	(0.036)	(0.037)
Class average SES	0.015	0.019	-0.030
	(0.015)	(0.020)	(0.034)
Standardized total number of students in school	-0.018	-0.064*	-0.053
	(0.015)	(0.026)	(0.027)
Student-teacher ratio	-0.046**	-0.624**	-1.414**
	(0.015)	(0.220)	(0.380)
Lab	0.067*	-0.105**	-0.027
	(0.029)	(0.021)	(0.034)
Percent of Level-1 teachers	-0.840**	0.109*	0.092
	(0.165)	(0.051)	(0.049)
Percent of teachers with a Master's degree	1.235**	1.663**	2.600**
	(0.336)	(0.498)	(0.954)
Standardized HSEE admission line	0.094**	0.085**	0.096**
	(0.018)	(0.030)	(0.030)
School activity	0.128**	0.234**	0.129*
	(0.027)	(0.041)	(0.060)
Collegial	0.003	0.000	0.015
	(0.013)	(0.023)	(0.032)
Outcome-oriented	-0.007	-0.187**	0.115**
	(0.030)	(0.053)	(0.042)
Lax principal leadership	-0.121**	-0.035	-0.224**
	(0.022)	(0.032)	(0.043)
High authority and accountability	0.074**	0.201**	0.093*
	(0.020)	(0.039)	(0.047)
Constant	-0.096	-0.192*	0.047
	(0.058)	(0.087)	(0.113)
N	5841	2981	2835
F	341.030	193.440	180.080
Probability > 0	0.000	0.000	0.000
R^2	0.614	0.639	0.596

Standard errors in parentheses
** p>0.01, * p>0.05

5.1.4 Total NCEE Score (All Subjects)

The total NCEE score is the sum of individual scores for Chinese, math, English, and Science/Humanity. Table 5-4, Table 5-5, and Table 5-6 present the second stage estimates of all subjects, with a comparison between urban and rural students. The difference among the three sets of results is that three different measures of private tutoring participation are employed. The first one is the predicted probability of private tutoring participation. The calculation of this fitted value is as follows. First, the dummy variable is coded as one if the student has ever participated in private tutoring in any subject included in the NCEE. Second, the logit model is conducted using this dummy variable as the dependent variable. Third, the fitted value (i.e., the predicted probability) is calculated based on the logit model. The second measure is the total money spent on private tutoring. The information on private tutoring expenditure obtained from the questionnaire is censored data. The tobit model is employed to predict the latent value. The third measure is the time spent on private tutoring, using the time index constructed from questionnaire measures.

The first measure is commonly used in previous studies. The information is easy to collect, and the results of models using this measure could be used to compare with the results from previous studies. However, the main weakness of this measure is that it does not measure the exact amount of private tutoring participation, but simply reports the status. The second measure is regarded as a relatively better measure of private tutoring participation from the perspectives of both amount and quality. However, it is usually suspected because of the concern of measurement error. People may not report the real value of money spent on private tutoring due to difficulties in recall and calculation. The third measure has not been used by existing studies. It is another way to measure the amount of private tutoring participation, and it can be

used directly in the regression, without worrying about the data structure. However, it does not take into account tutoring quality. The three sets of results using different measures are presented in Table 5-4, Table 5-5, and Table 5-6 respectively.

According to Table 5-4, the predicted probability of private tutoring participation has a significantly negative effect on the NCEE total score of all students sampled, but no significant effect on urban students. The significant and larger negative coefficient of rural student subsample indicates that the negative effect on the whole sample is mainly due to the negative effect on rural students. The HSEE total score and SES have significantly positive effects on the NCEE total score. There is no gender gap, and the gap between school choice students and non-school choice students, after controlling for other variables. Students from the science track make less progress than those from the humanity track. Parents caring about child's study and respecting the child is still a consistent and significantly positive predictor across various samples. The other two parental education styles have no significant effects. The estimated coefficient of study habits and ability is significant and positive.

At the class level, a good class environment of personal relationship has a significantly positive effect on the whole sample and urban student subsample, but no effect on rural students. Key class has a significantly positive effect in improving the NCEE total score, and rural students benefit more from it than their urban counterparts. Class average SES has a significantly negative effect on the NCEE total score, but no effect on urban and rural students respectively.

School size measured by total student numbers has a significantly negative effect on student achievement. Smaller student teacher ratio and more lab resources have significantly positive effects. Percent of Level-1 teachers has a significantly negative effect on the whole sample and rural student subsample. Percent of teachers with a Master's degree, the HSEE

admission line, and school activity are all significant and positive predictors of the NCEE total score. Collegial style has no effect on student achievement, outcome-oriented and lax principal leadership styles have significantly negative effects, and high authority and accountability style has a significantly positive effect on the NCEE total score. Among all the school education inputs, rural students benefit more from study ability grouping measured by key class and the HSEE admission line, and physical input measured by lab resources, compared with urban students.

Table 5-4 Second Stage of Estimates 2SLS – All Subjects: PT Participation Status

	All	Urban	Rural
	(1)	(2)	(3)
Predicted probability of private tutoring participation	-0.385**	-0.170	-0.642**
	(0.102)	(0.116)	(0.197)
Standardized HSEE total score	0.585**	0.552**	0.596**
	(0.026)	(0.031)	(0.044)
SES	0.033**	0.030**	0.040*
	(0.009)	(0.011)	(0.020)
Female	0.008	0.017	0.010
	(0.018)	(0.025)	(0.028)
Science track	-0.252**	-0.228**	-0.270**
	(0.020)	(0.026)	(0.033)
School choice	-0.018	-0.002	-0.028
	(0.019)	(0.025)	(0.028)
Parents caring about study and respecting the child	0.041**	0.045**	0.034**
	(0.007)	(0.008)	(0.012)
Parents regulating	-0.005	-0.004	-0.004
	(0.007)	(0.010)	(0.012)
Parents doing too much for the child	-0.007	-0.024*	0.019
	(0.009)	(0.011)	(0.016)
Study habits and ability	0.055**	0.053**	0.062**
	(0.006)	(0.008)	(0.012)
Class environment of personal relationship	0.037**	0.069**	0.028
	(0.013)	(0.019)	(0.020)
Key Class	0.323**	0.285**	0.361**
	(0.026)	(0.034)	(0.044)
Class average SES	-0.034*	-0.021	-0.032
	(0.014)	(0.019)	(0.032)
Standardized total number of students in school	-0.034*	-0.081**	-0.048
	(0.014)	(0.022)	(0.027)
Student-teacher ratio	-0.096**	-0.147**	-0.034
	(0.013)	(0.019)	(0.032)
Lab	0.074**	0.024	0.091
	(0.025)	(0.049)	(0.051)
Percent of Level-1 teachers	-0.569**	-0.454*	-1.636**
	(0.159)	(0.201)	(0.359)
Percent of teachers with a Master's degree	0.568	0.355	0.966
	(0.306)	(0.465)	(0.800)
Standardized HSEE admission line	0.125**	0.130**	0.137**
	(0.020)	(0.030)	(0.032)
School activity	0.170**	0.318**	0.050
	(0.025)	(0.037)	(0.054)
Collegial	0.005	-0.003	-0.048
	(0.012)	(0.019)	(0.027)
Outcome-oriented	-0.050	-0.136**	-0.027
	(0.028)	(0.046)	(0.051)
Lax principal leadership	-0.092**	-0.032	-0.194**
	(0.020)	(0.029)	(0.043)
High authority and accountability	0.177**	0.263**	0.152**
	(0.019)	(0.038)	(0.048)
Constant	0.409**	0.221*	0.781**
	(0.065)	(0.090)	(0.121)
N	5841	2981	2835
F	381.470	272.130	140.940
Probability > 0	0.000	0.000	0.000
R^2	0.652	0.708	0.565

Standard errors in parentheses
** p>0.01, * p>0.05

According to Table 5-5, private tutoring expenditure in G12 has a significantly negative effect on the whole sample, no effect for urban students, and a significantly negative effect for rural students. Thus, the negative effect on the whole sample is mainly due to the negative effect on rural students. The Standardized HSEE total score has a significant and positive effect on the NCEE total score, and the effect is consistent for urban and rural students. SES has a significantly positive effect on the NCEE total score. There is no gender gap, and no gap between school choice students and regular students. Science track students make less improvement than humanity track students. The above results are similar with those reported in Table 5-4. The variable of parents caring child's study and respecting the child has a significant and positive effect for the whole sample and urban students, but no effect for rural students, which is different from the result in Table 5-4. Parents' regulation has no effect. The variable of parents doing too much for the child has a significant and a negative effect for the whole sample and urban students, but no effect for rural students. Good study habits and ability have significantly positive effects for both the whole and the two subsamples.

In terms of class level inputs, a good class environment of personal relationship has a significant and positive effect on the NCEE achievement for the whole sample and urban students, but no effect for rural students. Key class has a significantly positive effect for all the samples. Class average SES has no effect on the NCEE total score for both the whole sample and the two subsamples, while in Table 5-4, it has a significantly negative effect for the whole sample.

For school level variables, standardized total student numbers have a significantly negative effect only for urban students, while in Table 5-4, it has a significantly negative effect for both the whole sample and the two subsamples. A larger student teacher ratio index has a

significant, negative effect on the NCEE total score for the whole sample and urban students, but no effect for rural students, which is similar to the result presented in Table 5-4. More lab resources have a positive effect significant at the 0.1 level for the whole sample, while in Table 5-4, it is significant at the 0.01 level. A larger percentage of teachers with a Master's degree has a significant and positive effect for the whole sample and rural students. The Standardized HSEE admission line, more school activity, and high authority and accountability are all significant and positive predictors of higher NCEE total score for both the whole sample and the two subsamples. These results are similar to those presented in Table 5-4. Outcome-oriented administration style has a significant and negative effect for urban students, but a significant and positive effect for rural students. In Table 5-4, there is no effect for rural students.

Table 5-5 Second Stage of Estimates 2SLS – All Subjects: PT Expenditure

	All	Urban	Rural
	(1)	(2)	(3)
Predicted private tutoring expenditure in G12	-0.297**	-0.029	-2.041**
	(0.101)	(0.073)	(0.762)
Standardized HSEE total score	0.597**	0.559**	0.594**
	(0.027)	(0.031)	(0.048)
SES	0.032**	0.024*	0.047
	(0.011)	(0.012)	(0.025)
Female	-0.003	0.007	-0.005
	(0.018)	(0.024)	(0.031)
Science track	-0.248**	-0.228**	-0.274**
	(0.021)	(0.026)	(0.036)
School choice	-0.010	-0.003	-0.026
	(0.019)	(0.026)	(0.028)
Parents caring about study and respecting the child	0.037**	0.044**	0.020
	(0.007)	(0.008)	(0.014)
Parents regulating	-0.004	-0.007	0.000
	(0.008)	(0.010)	(0.012)
Parents doing too much for the child	-0.022**	-0.030**	-0.023
	(0.009)	(0.011)	(0.015)
Study habits and ability	0.041**	0.049**	0.035**
	(0.006)	(0.008)	(0.011)
Class environment of personal relationship	0.032*	0.067**	0.017
	(0.013)	(0.019)	(0.019)
Key Class	0.327**	0.294**	0.367**
	(0.027)	(0.035)	(0.047)
Class average SES	-0.009	-0.017	0.029
	(0.018)	(0.019)	(0.038)
Standardized total number of students in school	-0.021	-0.076**	-0.054
	(0.014)	(0.021)	(0.038)
Student-teacher ratio	-0.073**	-0.143**	-0.089
	(0.013)	(0.019)	(0.062)
Lab	0.045	0.023	0.083
	(0.025)	(0.049)	(0.060)
Percent of Level-1 teachers	-0.664**	-0.480*	-0.901
	(0.179)	(0.203)	(0.617)
Percent of teachers with a Master's degree	0.694*	0.485	5.688*
	(0.340)	(0.454)	(2.588)
Standardized HSEE admission line	0.111**	0.113**	0.122**
	(0.019)	(0.028)	(0.033)
School activity	0.161**	0.329**	0.142
	(0.028)	(0.036)	(0.081)
Collegial	0.004	0.000	0.067
	(0.014)	(0.019)	(0.062)
Outcome-oriented	-0.007	-0.132**	0.140**
	(0.027)	(0.046)	(0.053)
Lax principal leadership	-0.107**	-0.037	-0.255**
	(0.021)	(0.028)	(0.061)
High authority and accountability	0.135**	0.263**	0.165**
	(0.021)	(0.039)	(0.063)
Constant	0.237**	0.134*	-0.123
	(0.055)	(0.067)	(0.298)
N	5841	2981	2835
F	332.000	271.640	490.180
Probability > 0	0.000	0.000	0.000
R^2	0.597	0.704	0.404

Standard errors in parentheses

** p>0.01, * p>0.05

Table 5-6 presents the results of the models using the time index as the measure of private tutoring participation. Similar to the results reported in Table 5-4 and Table 5-5, private tutoring has a significant negative effect on the NCEE total score for the whole sample and rural students, but no effect for urban students. The HSEE total score is a significant and positive predictor of higher NCEE total score for different subsamples and for the whole sample as well. There is no gender gap or gap between school choice students and regular students. Science track students perform worse than humanity track students after controlling for other factors. Good study habits and ability have significant and positive effects for both the whole sample and the two subsamples. Different from the two sets of results, in Table 5-6, SES is no longer a significantly positive predictor for rural students. The effects of the three different parental education styles are similar to the effects reported in Table 5-4: if the parents care about the child's study and respect the child, this child's NCEE total score will show a statistically significantly increase, for both the whole sample and the two subsamples; for urban students, if the parents care about studying too much about the child, the NCEE total score will significantly decrease; if parents regulate the child's behavior and time schedule, there is no effect.

In regards to class level variables, different from the previous two sets of results, a good class environment of personal relationship only has a significant and positive effect for urban students, but no effect for the whole sample. Similar to the previous results, key class has a significant and positive effect on the NCEE total score for both the whole sample and the two subsamples. Class average SES has no effect.

For school level education inputs, similar to the results presented in Table 5-4, school size measured by standardized number of students has a significant and negative effect on the NCEE total score for all the students, urban students, and rural students. A smaller student-

teacher ratio has a significant and positive effect for the whole sample and urban students, but not rural students. Lab resources index is a significant and positive predictor for the whole sample, but not for the subsamples. A higher percentage of Level-1 teachers has a significant and negative effect for both the whole sample and the two subsamples. A higher percentage of teachers with a Master's degree has a significant and positive effect for rural students. Higher HSEE admission line has a significant and positive effect on the NCEE total score for all the students, urban students, and rural students. More school activities have significant and positive effect for the whole sample and urban students, but not rural students. Collegial style has no effect on NCEE total score, outcome-oriented style has a significantly negative effect for urban students, and lax principal leadership style has a significant and negative effect for the whole sample and rural students. A high authority and accountability style has a significant and positive effect for both the whole sample and the two subsamples.

Generally speaking, the estimates are robust and consistent using different measures of private tutoring participation, as presented in Table 5-4, Table 5-5, and Table 5-6. The results in Table 5-4 and Table 5-6 are more consistent, compared with those in Table 5-5. It is noteworthy that the R squared for all the models are around 0.6 for the whole sample and above 0.7 for the urban subsample. Thus, the models can explain a relatively very large amount of variation. However, it is important to note that it is mostly fit by HSEE. The R squared for HSEE alone is around 0.5. The R squared of the rural subsample model is often smaller than that of the urban subsample model, which implies that the designed strategies can explain more variation in the urban setting than in the rural setting.

Table 5-6 Second Stage of Estimates 2SLS – All Subjects: PT Time Index

	All	Urban	Rural
	(1)	(2)	(3)
Predicted private tutoring time index	-0.112**	-0.014	-0.236**
	(0.035)	(0.041)	(0.070)
Standardized HSEE total score	0.579**	0.557**	0.574**
	(0.027)	(0.032)	(0.047)
SES	0.027**	0.023*	0.031
	(0.009)	(0.011)	(0.017)
Female	-0.009	0.007	-0.023
	(0.017)	(0.024)	(0.025)
Science track	-0.260**	-0.230**	-0.279**
	(0.020)	(0.027)	(0.031)
School choice	-0.018	-0.004	-0.026
	(0.018)	(0.026)	(0.026)
Parents caring about study and respecting the child	0.040**	0.044**	0.035**
	(0.006)	(0.008)	(0.011)
Parents regulating	-0.008	-0.008	-0.004
	(0.007)	(0.010)	(0.011)
Parents doing too much for the child	-0.011	-0.029**	0.014
	(0.009)	(0.011)	(0.014)
Study habits and ability	0.056**	0.051**	0.068**
	(0.006)	(0.008)	(0.012)
Class environment of personal relationship	0.030	0.066**	0.012
	(0.012)	(0.019)	(0.017)
Key Class	0.330**	0.295**	0.390**
	(0.025)	(0.035)	(0.042)
Class average SES	-0.009	-0.016	-0.003
	(0.015)	(0.020)	(0.030)
Standardized total number of students in school	-0.026*	-0.076**	-0.041
	(0.013)	(0.021)	(0.024)
Student-teacher ratio	-0.084**	-0.144**	-0.025
	(0.012)	(0.019)	(0.028)
Lab	0.066**	0.024	0.066
	(0.024)	(0.049)	(0.043)
Percent of Level-1 teachers	-0.553**	-0.468*	-1.538**
	(0.161)	(0.209)	(0.352)
Percent of teachers with a Master's degree	0.447	0.448	1.290
	(0.310)	(0.462)	(0.750)
Standardized HSEE admission line	0.108**	0.114**	0.108**
	(0.018)	(0.028)	(0.028)
School activity	0.178**	0.329**	0.080
	(0.024)	(0.036)	(0.054)
Collegial	0.002	-0.002	-0.031
	(0.012)	(0.019)	(0.027)
Outcome-oriented	-0.025	-0.134**	0.061
	(0.025)	(0.046)	(0.040)
Lax principal leadership	-0.099**	-0.037	-0.218**
	(0.020)	(0.028)	(0.040)
High authority and accountability	0.145**	0.263**	0.106**
	(0.018)	(0.040)	(0.038)
Constant	0.228**	0.134*	0.416**
	(0.048)	(0.067)	(0.112)
N	5841	2981	2835
F	401.860	273.970	560.640
Probability > 0	0.000	0.000	0.000
R^2	0.666	0.706	0.622

Standard errors in parentheses
** p>0.01, * p>0.05

5.1.5 Comparison of Basic Model with OLS Estimates

Table 5-7 to Table 5-12 report the OLS estimates by subjects and different measures of private tutoring participation. The covariates that measure private tutoring are the dummy variables, the left-censored expenditure variable, and the time index. Neither choice models nor IV are employed to account for different hypotheses of the data structure.

For the Chinese subject, comparing Table 5-7 with Table 5-1, most of the estimates are similar. For example, in the OLS model, the effect of the standardized HSEE Chinese score for all the students is significant and is 0.390, and the same coefficient in the IV model is 0.390, too. The coefficient of the standardized HSEE Chinese score for urban students in the OLS model is significant and is 0.402, and is 0.407 (which is also significant) in the IV model. In both the models, private tutoring participation has no effect on the whole sample and urban subsample, but has a significantly negative effect on the rural subsample.

Similar to the comparison of the Chinese subject, for the math subject, comparing Table 5-8 with Table 5-2, all the results are the same. Private tutoring has no effect for both urban and rural students. For the English subject, the estimates of all the covariates are similar between the two models except for the estimates of private tutoring participation. In the OLS model, the estimates are significantly negative for the whole sample and urban students and not significant for rural students. For the IV model, the estimates are not significant. However, the magnitude of the effect in the OLS model is much smaller than that in the IV model. In regards to other variables, the results are consistent.

Table 5-7 OLS Estimates – Chinese

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring participation	-0.071	-0.032	-0.131*
(Dummy: 1=participate 0=not participate)	(0.043)	(0.058)	(0.067)
Standardized HSEE Chinese score	0.390**	0.402**	0.360**
	(0.018)	(0.028)	(0.023)
SES	0.011	0.013	0.016
	(0.009)	(0.011)	(0.019)
Female	0.104**	0.144**	0.076*
	(0.025)	(0.035)	(0.035)
Science track	0.031	0.054	0.005
	(0.025)	(0.033)	(0.041)
School choice	-0.013	0.029	-0.043
	(0.025)	(0.036)	(0.036)
Parents caring about study and respecting the child	0.026**	0.031**	0.015
	(0.008)	(0.011)	(0.013)
Parents regulating	-0.012	-0.013	-0.004
	(0.009)	(0.012)	(0.014)
Parents doing too much for the child	-0.034**	-0.034*	-0.033
	(0.011)	(0.014)	(0.017)
Study habits and ability	0.025**	0.024*	0.023
	(0.008)	(0.010)	(0.012)
Class environment of personal relationship	0.040*	0.055*	0.045*
	(0.016)	(0.025)	(0.022)
Key Class	0.331**	0.324**	0.359**
	(0.030)	(0.042)	(0.046)
Class average SES	-0.073**	-0.069**	0.000
	(0.019)	(0.027)	(0.040)
Standardized total number of students in school	-0.008	-0.056	-0.021
	(0.017)	(0.031)	(0.026)
Student-teacher ratio	-0.070**	-0.071**	-0.054*
	(0.015)	(0.025)	(0.027)
Lab	0.028	-0.068	0.038
	(0.032)	(0.070)	(0.046)
Percent of Level-1 teachers	-0.484*	-0.445	-1.118**
	(0.202)	(0.267)	(0.411)
Percent of teachers with a Master's degree	2.131**	1.788**	1.259
	(0.410)	(0.628)	(1.016)
Standardized HSEE admission line	0.132**	0.172**	0.103**
	(0.022)	(0.036)	(0.038)
School activity	0.172**	0.208**	0.133*
	(0.032)	(0.050)	(0.056)
Collegial	0.017	-0.029	0.020
	(0.016)	(0.026)	(0.032)
Outcome-oriented	0.005	-0.116	0.110*
	(0.035)	(0.061)	(0.051)
Lax principal leadership	-0.104**	-0.082*	-0.185**
	(0.025)	(0.038)	(0.045)
High authority and accountability	0.207**	0.250**	0.183**
	(0.023)	(0.050)	(0.040)
Constant	-0.066	-0.158	0.198
	(0.064)	(0.088)	(0.127)
N	5841	2981	2835
F	136.110	84.340	188.800
Probability > 0	0.000	0.000	0.000
R^2	0.416	0.457	0.386

Standard errors in parentheses

** p>0.01, * p>0.05

Table 5-8 OLS Estimates – Math

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring participation	-0.001	0.001	0.037
(Dummy: 1=participate 0=not participate)	(0.023)	(0.029)	(0.037)
Standardized HSEE Chinese score	0.528**	0.502**	0.516**
	(0.018)	(0.023)	(0.029)
SES	-0.004	0.015	-0.022
	(0.007)	(0.009)	(0.016)
Female	-0.014	0.005	-0.028
	(0.020)	(0.027)	(0.028)
Science track	-0.234**	-0.182**	-0.263**
	(0.023)	(0.031)	(0.035)
School choice	-0.015	0.015	-0.031
	(0.021)	(0.030)	(0.029)
Parents caring about study and respecting the child	0.045**	0.046**	0.043**
	(0.008)	(0.009)	(0.013)
Parents regulating	-0.009	-0.008	-0.001
	(0.008)	(0.011)	(0.011)
Parents doing too much for the child	-0.036**	-0.037**	-0.036**
	(0.009)	(0.012)	(0.013)
Study habits and ability	0.060**	0.063**	0.052**
	(0.007)	(0.009)	(0.010)
Class environment of personal relationship	0.045**	0.091**	0.016
	(0.014)	(0.022)	(0.018)
Key Class	0.369**	0.276**	0.462**
	(0.024)	(0.033)	(0.039)
Class average SES	-0.016	0.001	0.015
	(0.016)	(0.022)	(0.033)
Standardized total number of students in school	0.011	-0.050	0.011
	(0.015)	(0.028)	(0.024)
Student-teacher ratio	-0.076**	-0.127**	0.032
	(0.014)	(0.022)	(0.025)
Lab	0.059*	-0.055	0.032
	(0.028)	(0.062)	(0.041)
Percent of Level-1 teachers	-0.167	0.041	-1.698**
	(0.170)	(0.228)	(0.368)
Percent of teachers with a Master's degree	1.380**	0.469	2.216**
	(0.355)	(0.548)	(0.830)
Standardized HSEE admission line	0.042*	0.087**	0.051
	(0.019)	(0.031)	(0.030)
School activity	0.207**	0.343**	0.046
	(0.027)	(0.044)	(0.050)
Collegial	0.022	0.001	-0.050
	(0.014)	(0.023)	(0.028)
Outcome-oriented	-0.043	-0.129*	0.038
	(0.030)	(0.056)	(0.044)
Lax principal leadership	-0.139**	-0.046	-0.289**
	(0.021)	(0.033)	(0.042)
High authority and accountability	0.171**	0.233**	0.086*
	(0.020)	(0.042)	(0.036)
Constant	0.060	-0.065	0.452**
	(0.056)	(0.080)	(0.113)
N	5841	2981	2835
F	262.980	180.310	251.660
Probability > 0	0.000	0.000	0.000
R^2	0.540	0.597	0.496

Standard errors in parentheses

** p>0.01, * p>0.05

Table 5-9 OLS Estimates – English

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring participation	-0.057*	-0.065*	-0.033
(Dummy: 1=participate 0=not participate)	(0.023)	(0.030)	(0.035)
Standardized HSEE Chinese score	0.606**	0.589**	0.598**
	(0.015)	(0.021)	(0.021)
SES	0.031**	0.046**	0.000
	(0.007)	(0.009)	(0.016)
Female	0.114**	0.116**	0.115**
	(0.019)	(0.027)	(0.027)
Science track	0.141**	0.127**	0.150**
	(0.020)	(0.027)	(0.031)
School choice	-0.003	0.024	-0.013
	(0.020)	(0.029)	(0.027)
Parents caring about study and respecting the child	0.035**	0.036**	0.031**
	(0.007)	(0.009)	(0.011)
Parents regulating	-0.031**	-0.022*	-0.031**
	(0.007)	(0.010)	(0.010)
Parents doing too much for the child	-0.025**	-0.039**	-0.010
	(0.009)	(0.012)	(0.012)
Study habits and ability	0.039**	0.049**	0.029**
	(0.006)	(0.009)	(0.009)
Class environment of personal relationship	0.024	0.075**	-0.013
	(0.013)	(0.021)	(0.018)
Key Class	0.380**	0.298**	0.446**
	(0.023)	(0.033)	(0.035)
Class average SES	0.010	0.018	-0.012
	(0.014)	(0.020)	(0.031)
Standardized total number of students in school	-0.029*	-0.081**	-0.032
	(0.014)	(0.023)	(0.024)
Student-teacher ratio	-0.058**	-0.106**	0.011
	(0.013)	(0.020)	(0.026)
Lab	0.096**	0.103*	0.037
	(0.025)	(0.051)	(0.039)
Percent of Level-1 teachers	-0.793**	-0.658**	-1.711**
	(0.158)	(0.212)	(0.345)
Percent of teachers with a Master's degree	1.366**	1.604**	2.257*
	(0.323)	(0.493)	(0.914)
Standardized HSEE admission line	0.098**	0.102**	0.106**
	(0.018)	(0.028)	(0.030)
School activity	0.140**	0.225**	0.069
	(0.026)	(0.040)	(0.050)
Collegial	0.003	-0.015	-0.012
	(0.013)	(0.020)	(0.028)
Outcome-oriented	-0.027	-0.214**	0.133**
	(0.027)	(0.048)	(0.040)
Lax principal leadership	-0.108**	-0.028	-0.237**
	(0.020)	(0.031)	(0.042)
High authority and accountability	0.089**	0.206**	0.042
	(0.018)	(0.038)	(0.036)
Constant	-0.049	-0.109	0.086
	(0.051)	(0.073)	(0.111)
N	5841	2981	2835
F	354.440	206.780	185.580
Probability > 0	0.000	0.000	0.000
R^2	0.628	0.662	0.609

Standard errors in parentheses

** p>0.01, * p>0.05

For the NCEE total score, the estimated coefficients of the two models are similar using different measures of private tutoring participation. Only the estimates of private tutoring participation are different between the two models, while the estimates of other covariates are similar. Comparing Table 5-10 with Table 5-4, the OLS estimates of private tutoring participation for different samples are all significantly negative, while the IV estimates for the urban subsample are not significant. Comparing Table 5-11 with Table 5-5, the effects of private tutoring expenditure are found to be negative and significant on the rural subsample in the OLS model, and the magnitudes are quite small; while in the IV model, the effects of private tutoring expenditure are significantly negative for the whole sample and rural sample, but not significant for the urban students. In the IV model, the magnitude of the negative private tutoring effect is around -0.3 for the whole sample and is -2 for the rural sample, which is quite large. In regards to other inputs, most estimates are found to be similar in the two models except one. SES is found to have a significant and positive effect for only the urban students in the OLS model, but it has a significant effect for all three samples in the IV method. Comparing Table 5-12 with Table 5-6, most estimates are similar except the effects of time spent on private tutoring. In the OLS model, the effects are significant and negative for the three samples, but in the IV model, there are significantly negative effects for the whole sample and the rural sample, but no effect for the urban sample.

It is concluded that most of the OLS estimates are consistent with those derived from the IV model, except for the estimated coefficients of various measures of private tutoring participation. This is consistent with the underlying rationale that the endogeneity of private tutoring participation may bias the estimates in the OLS model and thus need to be adjusted using the IV method.

Table 5-10 OLS Estimates – All Subjects: PT Participation Status

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring participation	-0.117**	-0.128**	-0.084**
(Dummy: 1=participate 0=not participate)	(0.018)	(0.024)	(0.026)
Standardized HSEE total score	0.595**	0.554**	0.611**
	(0.026)	(0.031)	(0.044)
SES	0.015*	0.028**	-0.001
	(0.006)	(0.008)	(0.012)
Female	-0.007	0.014	-0.017
	(0.017)	(0.023)	(0.024)
Science track	-0.248**	-0.228**	-0.258**
	(0.019)	(0.026)	(0.029)
School choice	-0.019	-0.002	-0.022
	(0.018)	(0.025)	(0.026)
Parents caring about study and respecting the child	0.041**	0.045**	0.033**
	(0.006)	(0.008)	(0.011)
Parents regulating	-0.012	-0.005	-0.012
	(0.006)	(0.009)	(0.010)
Parents doing too much for the child	-0.019*	-0.026*	-0.012
	(0.008)	(0.010)	(0.011)
Study habits and ability	0.049**	0.052**	0.044**
	(0.006)	(0.007)	(0.008)
Class environment of personal relationship	0.027*	0.068**	0.002
	(0.012)	(0.019)	(0.016)
Key Class	0.346**	0.288**	0.393**
	(0.024)	(0.032)	(0.041)
Class average SES	-0.033*	-0.021	-0.021
	(0.014)	(0.019)	(0.028)
Standardized total number of students in school	-0.020	-0.080**	-0.001
	(0.013)	(0.022)	(0.019)
Student-teacher ratio	-0.082**	-0.147**	0.026
	(0.012)	(0.019)	(0.021)
Lab	0.052*	0.024	-0.012
	(0.023)	(0.049)	(0.034)
Percent of Level-1 teachers	-0.653**	-0.462*	-1.929**
	(0.151)	(0.201)	(0.299)
Percent of teachers with a Master's degree	0.650*	0.386	1.110
	(0.293)	(0.456)	(0.708)
Standardized HSEE admission line	0.104**	0.126**	0.118**
	(0.017)	(0.028)	(0.027)
School activity	0.175**	0.321**	0.011
	(0.024)	(0.036)	(0.047)
Collegial	0.008	-0.003	-0.060*
	(0.012)	(0.019)	(0.024)
Outcome-oriented	-0.023	-0.136**	0.066
	(0.025)	(0.046)	(0.037)
Lax principal leadership	-0.107**	-0.033	-0.212**
	(0.019)	(0.028)	(0.039)
High authority and accountability	0.164**	0.264**	0.064*
	(0.017)	(0.038)	(0.032)
Constant	0.293**	0.200**	0.602**
	(0.048)	(0.068)	(0.092)
N	5841	2981	2835
F	414.700	274.390	599.770
Probability > 0	0.000	0.000	0.000
R^2	0.670	0.708	0.649

Standard errors in parentheses
** p>0.01, * p>0.05

Table 5-11 OLS Estimates – All Subjects: PT Expenditure

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring expenditure in G12	-0.017	-0.015	-0.072*
	(0.009)	(0.009)	(0.035)
Standardized HSEE total score	0.600**	0.559**	0.613**
	(0.026)	(0.031)	(0.044)
SES	0.009	0.023**	-0.005
	(0.006)	(0.008)	(0.013)
Female	-0.013	0.006	-0.021
	(0.017)	(0.023)	(0.024)
Science track	-0.246**	-0.228**	-0.256**
	(0.019)	(0.026)	(0.029)
School choice	-0.019	-0.003	-0.021
	(0.018)	(0.026)	(0.026)
Parents caring about study and respecting the child	0.040**	0.044**	0.032**
	(0.006)	(0.008)	(0.011)
Parents regulating	-0.014*	-0.008	-0.013
	(0.006)	(0.009)	(0.010)
Parents doing too much for the child	-0.024**	-0.030**	-0.016
	(0.008)	(0.011)	(0.011)
Study habits and ability	0.046**	0.050**	0.041**
	(0.006)	(0.007)	(0.008)
Class environment of personal relationship	0.023	0.066**	-0.001
	(0.012)	(0.019)	(0.016)
Key Class	0.354**	0.297**	0.396**
	(0.024)	(0.032)	(0.042)
Class average SES	-0.031*	-0.018	-0.018
	(0.014)	(0.019)	(0.028)
Standardized total number of students in school	-0.014	-0.076**	0.003
	(0.013)	(0.021)	(0.019)
Student-teacher ratio	-0.076**	-0.144**	0.030
	(0.012)	(0.019)	(0.020)
Lab	0.042	0.022	-0.024
	(0.023)	(0.048)	(0.034)
Percent of Level-1 teachers	-0.689**	-0.483*	-1.936**
	(0.152)	(0.202)	(0.300)
Percent of teachers with a Master's degree	0.686*	0.482	1.292
	(0.294)	(0.453)	(0.720)
Standardized HSEE admission line	0.095**	0.113**	0.115**
	(0.017)	(0.028)	(0.027)
School activity	0.177**	0.329**	0.010
	(0.024)	(0.036)	(0.047)
Collegial	0.009	0.000	-0.057*
	(0.012)	(0.019)	(0.024)
Outcome-oriented	-0.011	-0.133**	0.082*
	(0.025)	(0.046)	(0.037)
Lax principal leadership	-0.114**	-0.038	-0.216**
	(0.019)	(0.028)	(0.039)
High authority and accountability	0.157**	0.265**	0.054
	(0.017)	(0.038)	(0.032)
Constant	0.243**	0.135*	0.551**
	(0.047)	(0.066)	(0.094)
N	5841	2981	2835
F	409.950	272.710	598.810
Probability > 0	0.000	0.000	0.000
R^2	0.667	0.705	0.648

Standard errors in parentheses

** p>0.01, * p>0.05

Table 5-12 OLS Estimates – All Subjects: PT Time Index

	All	Urban	Rural
	(1)	(2)	(3)
Private tutoring time index	-0.053**	-0.042**	-0.074**
	(0.007)	(0.008)	(0.013)
Standardized HSEE total score	0.590**	0.550**	0.601**
	(0.026)	(0.031)	(0.044)
SES	0.017**	0.029**	0.005
	(0.006)	(0.008)	(0.012)
Female	-0.012	0.009	-0.022
	(0.017)	(0.023)	(0.024)
Science track	-0.252**	-0.234**	-0.263**
	(0.019)	(0.026)	(0.029)
School choice	-0.019	-0.004	-0.023
	(0.018)	(0.025)	(0.025)
Parents caring about study and respecting the child	0.040**	0.044**	0.033**
	(0.006)	(0.008)	(0.011)
Parents regulating	-0.012	-0.006	-0.011
	(0.006)	(0.009)	(0.010)
Parents doing too much for the child	-0.018*	-0.026*	-0.007
	(0.008)	(0.011)	(0.011)
Study habits and ability	0.051**	0.053**	0.049**
	(0.006)	(0.007)	(0.008)
Class environment of personal relationship	0.026*	0.068**	0.003
	(0.012)	(0.019)	(0.016)
Key Class	0.344**	0.286**	0.395**
	(0.024)	(0.032)	(0.041)
Class average SES	-0.021	-0.011	-0.014
	(0.014)	(0.019)	(0.028)
Standardized total number of students in school	-0.020	-0.078**	-0.009
	(0.012)	(0.021)	(0.019)
Student-teacher ratio	-0.080**	-0.143**	0.016
	(0.011)	(0.019)	(0.021)
Lab	0.053*	0.028	0.001
	(0.023)	(0.049)	(0.034)
Percent of Level-1 teachers	-0.625**	-0.430*	-1.838**
	(0.151)	(0.200)	(0.299)
Percent of teachers with a Master's degree	0.573	0.381	1.181
	(0.294)	(0.456)	(0.706)
Standardized HSEE admission line	0.101**	0.119**	0.113**
	(0.017)	(0.028)	(0.027)
School activity	0.178**	0.327**	0.028
	(0.024)	(0.036)	(0.047)
Collegial	0.006	-0.004	-0.052*
	(0.012)	(0.019)	(0.024)
Outcome-oriented	-0.018	-0.135**	0.074*
	(0.025)	(0.046)	(0.037)
Lax principal leadership	-0.107**	-0.036	-0.216**
	(0.019)	(0.028)	(0.039)
High authority and accountability	0.152**	0.253**	0.068*
	(0.017)	(0.038)	(0.032)
Constant	0.236**	0.129	0.526**
	(0.047)	(0.066)	(0.093)
N	5841	2981	2835
F	416.010	273.890	610.350
Probability > 0	0.000	0.000	0.000
R^2	0.672	0.708	0.654

Standard errors in parentheses
** p>0.01, * p>0.05

5.1.6 Validity Tests of the IVs

The strength and validity of the instrumental variables are crucial to the evaluation of the empirical results derived from the Basic Model. The tests for validity lie in three aspects: relevance, exclusion restriction, and exogeneity. First, the instrumental variables should be relevant with the endogenous regressors. If the correlation between them is low, the IVs will be considered "weak instruments" and the results of the 2SLS model will be biased (Bound et al. 1995, Stock & Yogo 2002; Angrist & Pischke 2009). In this study, the correlation between the two IVs and the endogenous variables is around 0.1 to 0.3 and is significantly different from zero. In addition, the effects of the two instrumental variables are significant in the logit model, tobit model, and the first stage of the 2SLS model. Lastly, the Cragg & Donald minimum eigenvalue statistics and Stock & Yogo's critical values for tests of weak instruments are examined for each 2SLS model, and the tests reject the null hypothesis that the instruments are weak. Thus, there is no weak-instrument problem in this study.

Second, the exclusion restriction requires that the instrumental variables should be uncorrelated with any other determinants of student achievement. The instrumental variables should have no direct effect but only an indirect effect on the NCEE achievement. Although it is difficult to test the exclusion restriction directly, Card's refutability test suggested by Card (1995) could be used to evaluate whether the two IVs are legitimate from this perspective. For the IV that the number of private tutoring participants among the five closest friends, there is at least one reason that it may be correlated with other determinants. For a student with higher SES, his/her five closest friends may also have higher SES. Since SES is a significant predictor of private tutoring participation (to be discussed in section 5.2), this IV may be correlated with the student's own SES. In regards to the IV that the distance between home and the nearest private

tutoring center, it is possible that private tutoring centers are more likely to choose the location closed to the residence district where richer family and families with higher SES live. Thus, this IV may also be correlated with SES and family wealth.

The first IV discussed above is argued to have an indirect effect on private tutoring participation because a student's peers who participate in private tutoring may provide more information on PT and stronger motivation to participate in private tutoring, both often lacking for students with lower SES. Thus, more peers who participate in private tutoring should have larger effects on the NCEE scores of students with lower SES. For the second IV, it is interpreted to have an indirect effect on private tutoring participation because it may provide a lower transportation cost, more convenience, better community atmosphere of study, and more information of private tutoring to students living close to the private tutoring center, which are also lacking for students with lower SES. Thus, a shorter distance between home and the nearest private tutoring center should also have a larger effect on the NCEE scores of students with lower SES. The effect of the two IVs through low SES students is therefore considered as an indirect effect. Let *Low SES* be the dummy variable that indicates if a student's SES is below the weighted sample average, so the private tutoring participation equation can be written as

$$T_{ijk}^{*} = a_0 + aX_{ijk} + bC_{jk} + rS_k + \rho Z_{ijk} + \mu Z_{ijk} * LowSES + \varepsilon_{ijk} \quad \text{(a)}$$

where Z is the vector of the two IVs.

In this case, even if Z is included directly in the NCEE achievement equation:

$$NCEE^{*}_{ijk} = \alpha_0 + \alpha X_{ijk} + \pi_2 Z_{ijk} + \beta C_{jk} + \gamma S_k + u_{ijk} \quad \text{(b)}$$

the interaction $Z_{ijk} * LowSES$ can be used as the instrumental variables of private tutoring participation. The assumption of this identification strategy is that the direct effects of the two IVs on the NCEE score do not vary by student background. Table 5-13 below reports the

reduced form coefficients and the second stage estimates based on equation (a) and (b), using the time spent on education as the measure, and the NCEE total score as the dependent variable. The reason for choosing this model is that it is a linear 2SLS model and does not involve the new IV calculation based on the non-linear logit model and tobit model.

Column (1) of Table 5-13 presents the reduced form coefficients of the two IVs and the interactions of the IVs and Low SES. The direct effects of the two IVs are close to zero and insignificant. Column (2) shows the results for the urban subsample, and the indirect effects are also close to zero and insignificant. The reduced form estimates for the rural subsample are listed in column (3). The direct effect of the number of peers who participate in private tutoring is significant, but the magnitude is close to zero. The direct effect of the distance between home and the nearest PT center is close to zero and insignificant. Columns (4) to (6) present the second stage estimates for the whole sample, urban subsample, and rural subsample. The direct effects of the two original IVs are close to zero and insignificant, except the effect of the first IV on the whole sample, which is still small. Therefore, the two instrumental variables basically have no direct effect on the NCEE total score, and are considered to meet the exclusion restriction.

Third, exogeneity requires that the instrumental variables are exogenous, i.e. they are orthogonal to the residual in the population. Exogeneity can be test through the Hausman test for exogeneity (McFadden, 2002). However, the Hausman tested for exogeneity is not available in Stata. McFadden (2002) shows that the overidentifying restriction test is equivalent to the Hausman test for exogeneity. The overidentifying restriction test in Stata includes Sargan's and Basmann's chi-squared tests. In this study, both tests do not reject the null hypothesis that all instruments are exogenous. Thus, the two instrumental variables are considered exogenous in this study.

Table 5-13 IV Estimates of the Effect of Time Spent on Private Tutoring on NCEE Total Score Based on Interactions of the Original IVs and Low SES

	Reduced form			Second Stage		
	All	Urban	Rural	All	Urban	Rural
	(1)	(2)	(3)	(4)	(5)	(6)
Number of PT participants among peers	-0.005	0.001	-0.045*	-0.081*	0.008	0.007
	(0.008)	(0.009)	(0.022)	(0.041)	(0.058)	(0.041)
Distance	-0.008	0.000	0.003	0.041	0.001	0.001
	(0.009)	(0.010)	(0.019)	(0.022)	(0.035)	(0.019)
Peer No. * Low SES	-0.025*	-0.006	0.013	-	-	-
	(0.010)	(0.014)	(0.022)			
Distance * Low SES	0.034**	0.019	0.015	-	-	-
	(0.010)	(0.014)	(0.018)			
Time spent on PT	-	-	-	0.382	-0.046	-0.270
				(0.250)	0.349	(0.269)

Standard errors in parentheses
** p>0.01, * p>0.05

In summary, the two instrumental variables used in this study are valid. The 2SLS results are thus not biased due to the problems of the IVs.

5.1.7 Quantile Regression and the Heterogeneous Effect of Private Tutoring

The basic model finds a negative effect of private tutoring on rural students' NCEE total score. However, the reason for this negative effect is not clear, and more detailed information is needed. The quantile regression is conducted to examine the heterogeneous effect across students with different academic achievement, for the entire sample as well as the urban and rural subsamples.

According to the results on the NCEE total score discussed in previous sections, private tutoring has no significant effect on urban students but a significantly negative effect for rural students. The test score distribution of students with and without private tutoring is presented below by registered residence. According to Figure 5-1 and Figure 5-3, among urban and rural

students respectively, the shape of the HSEE total score distribution of those participated in private tutoring and that of those who did not is similar, meaning that the pre-treatment academic achievement of the two groups are similar. Figure 5-2 shows that the shape of the NCEE total score distribution of urban students who participated in private tutoring is still similar to that of urban students who did not. However, the shape of the NCEE total score distribution of rural students who participated in private tutoring is slightly different from that of those who did not (see Figure 5-4). The NCEE score distribution of rural students shows that more students are around 400 points than around 600 points, compared to the latter. This may relate to the significantly negative effect of private tutoring on rural students' academic achievement.

Figure 5-1 HSEE Total Score Distribution of Urban Students, by PT Participation

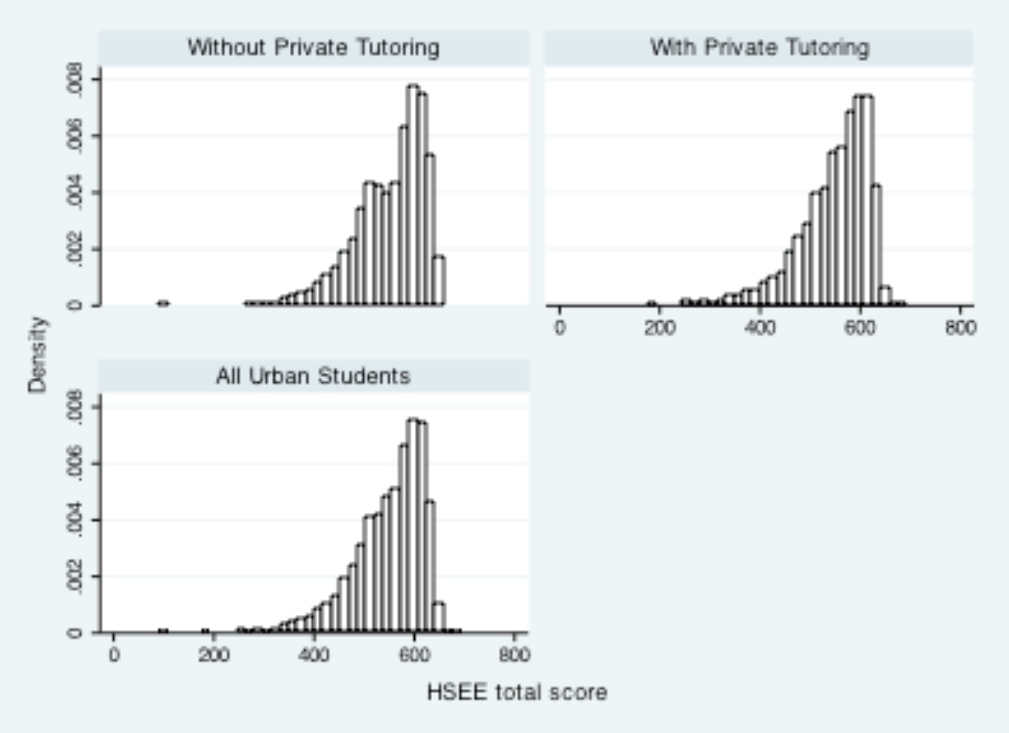


Figure 5-2 NCEE Total Score Distribution of Urban Students, by PT Participation

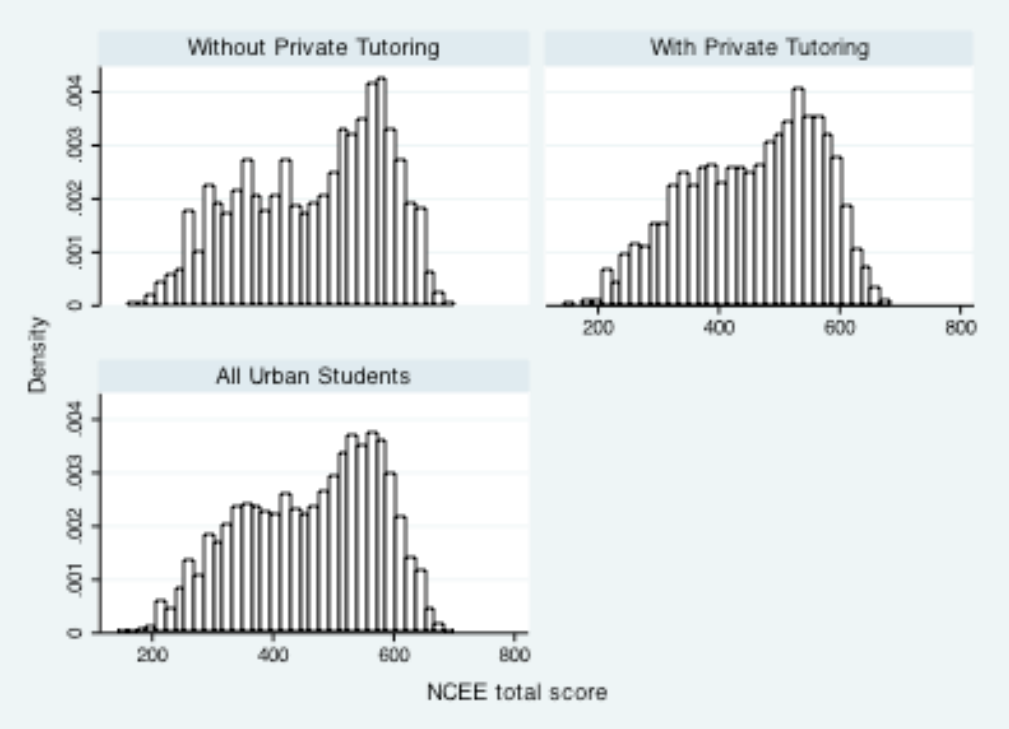


Figure 5-3 HSEE Total Score Distribution of Rural Students, by PT Participation

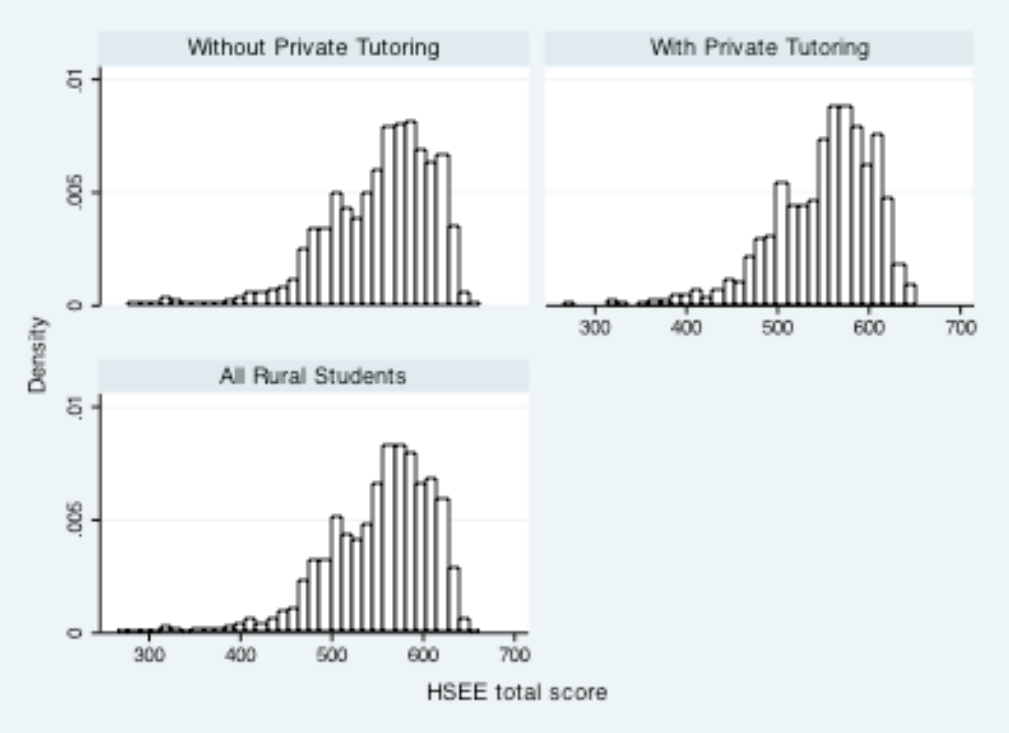
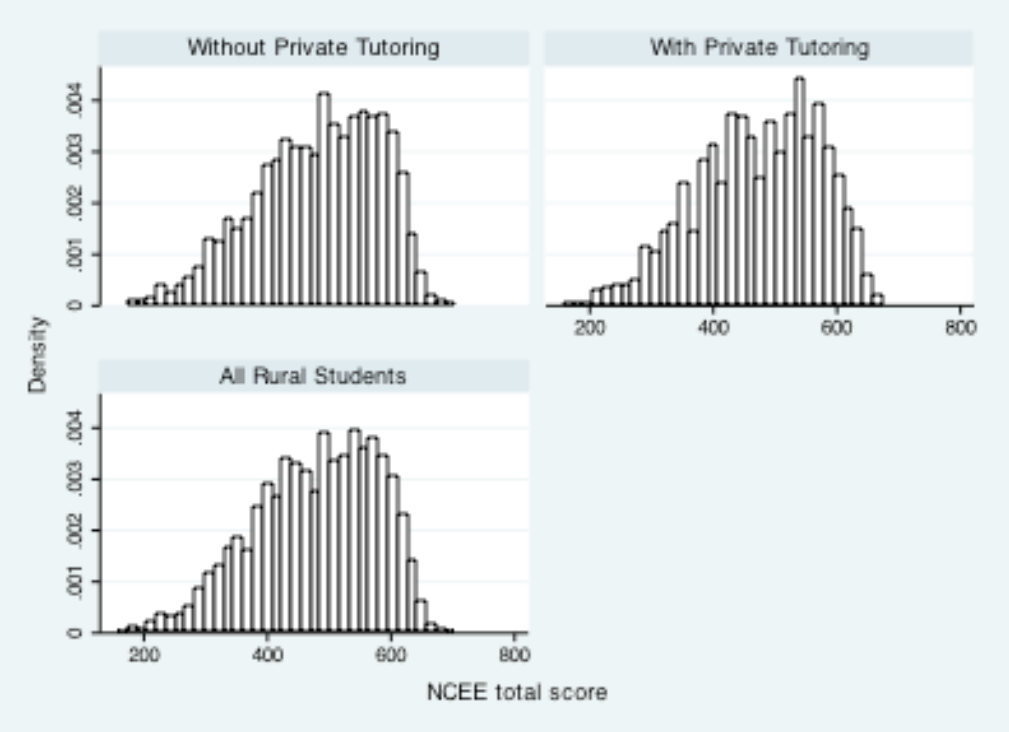


Figure 5-4 NCEE Total Score Distribution of Rural Students, by PT Participation



Column (1) of Table 5-14 reports the results of the quantile regression for all the students for each of the three subjects and for all subjects as a whole. Column (2) and (3) reports the results for urban and rural students respectively. For the NCEE Chinese score for all the students, private tutoring has no significant effect on the whole sample. When looking into the urban-rural disparity, Chinese private tutoring has no effect on urban students, but has significantly negative effects on rural students whose the NCEE Chinese scores are at 0.9, 0.75, and 0.25 quantiles. There is no effect of math private tutoring on the NCEE Math score for all the quantiles for the whole sample, urban subsample, and rural subsample. In regard to the NCEE English score of the whole sample, private tutoring has no effect for all the quantiles. There are significant and positive effect on the 0.25 quantile of urban students, and a significantly negative effect on the 0.25 and 0.1 quantiles of rural students.

In terms of the NCEE total score of the whole sample, the results using the three different measures of private tutoring participation are similar. For the whole sample and rural subsample, private tutoring has a significantly negative result for the 0.75 quantile and below[40], and the magnitude of the effect decreases from the lowest quantile to the highest quantile. It is important to note that, private tutoring measured in the three different ways has no effect on the rural students in the 0.9 quantile. The effect on urban students is consistently insignificant along the distribution.

Figure 5-5 presents the heterogeneous effects of private tutoring by subjects and by registered residence. The solid lines are the estimated coefficient of predicted probability of private tutoring participation, and the gray areas are the 95% confidence intervals. The trends of heterogeneous effects vary across subjects. There is basically no effect on urban students in all the quantiles for different subjects, except that urban students in the 0.25 quantile significantly

[40] The effect of the predicted probability of private tutoring participation is significantly negative for the 0.9 quantile, too.

benefit from English private tutoring. Chinese private tutoring has a significantly negative effect for rural students in the 0.25 quantile and above. Math private tutoring has no effect on rural students. English private tutoring has a significant and negative effect for lower achieving rural students.

Figure 5-6 summarizes the heterogeneous effect of private tutoring on the NCEE total score by measures of private tutoring participation, and by registered residence. There is no effect on urban students and the effect is basically consistent across different quantiles. However, there is a clear trend of heterogeneous effect on rural students. First, the predicted probability of private tutoring and participation and the time spent on private tutoring have significantly negative effects on the NCEE total score for rural students in the 0.75 quantile and below, while private tutoring expenditure only has a significantly negative effect on those between the 0.25 quantile and the 0.75 quantile. Second, the size of the negative effect is larger for lower achieving rural students and smaller for those with higher achievement. This may indicate that for rural students, if one cannot succeed in formal schooling, he/she cannot take better advantage of private tutoring, either. Private tutoring is duplicating the academic disparity among rural students.

Table 5-14 Coefficients of Private Tutoring Participation in Quantile Regression

	Quantile	All Students (1)	Urban (2)	Rural (3)
Chinese	0.9	-0.026	0.465	-0.930*
		(0.405)	(0.509)	(0.444)
	0.75	-0.232	0.722	-0.970**
		(0.324)	(0.425)	(0.286)
	0.5	-0.014	0.318	-0.512
		(0.329)	(0.444)	(0.335)
	0.25	-0.308	0.436	-0.940*
		(0.264)	(0.441)	(0.475)
	0.1	-1.046	-0.080	-0.557
		(0.572)	(0.733)	(0.574)
Math	0.9	-0.018	0.003	-0.002
		(0.127)	(0.181)	(0.154)
	0.75	-0.008	-0.049	-0.229
		(0.105)	(0.111)	(0.184)
	0.5	0.030	0.166	-0.221
		(0.096)	(0.127)	(0.169)
	0.25	0.104	0.114	-0.243
		(0.138)	(0.230)	(0.228)
	0.1	-0.065	-0.119	-0.590
		(0.191)	(0.244)	(0.306)
English	0.9	-0.043	0.005	-0.293
		(0.130)	(0.160)	(0.224)
	0.75	-0.009	0.019	-0.086
		(0.112)	(0.157)	(0.129)
	0.5	0.160	0.145	-0.157
		(0.147)	(0.183)	(0.181)
	0.25	0.311	0.626**	-0.755**
		(0.168)	(0.171)	(0.219)
	0.1	0.344	0.305	-0.780*
		(0.281)	(0.257)	(0.313)

The measure of private tutoring participation is the fitted value predicted from the logit model
Standard errors in parentheses
** p>0.01, * p>0.05

Table 5-14 Coefficients of Private Tutoring Participation in Quantile Regression (Cont.)

	Quantile	All Students (1)	Urban (2)	Rural (3)
All subjects – predicted probability of private tutoring	0.9	-0.286**	-0.334	-0.265
		(0.111)	(0.178)	(0.214)
	0.75	-0.297**	-0.187	-0.446**
		(0.111)	(0.121)	(0.159)
	0.5	-0.367**	-0.167	-0.624**
		(0.116)	(0.108)	(0.187)
	0.25	-0.394**	-0.283	-0.701**
		(0.093)	(0.163)	(0.183)
	0.1	-0.461*	-0.307	-0.766*
		(0.181)	(0.199)	(0.337)
All subjects – private tutoring expenditure	0.9	-0.033	-0.030	-0.111
		(0.018)	(0.023)	(0.092)
	0.75	-0.045*	-0.016	-0.166*
		(0.018)	(0.014)	(0.067)
	0.5	-0.048**	-0.013	-0.280**
		(0.018)	(0.017)	(0.066)
	0.25	-0.060**	-0.028	-0.269**
		(0.018)	(0.026)	(0.091)
	0.1	-0.063*	-0.044	-0.163
		(0.029)	(0.026)	(0.134)
All subjects – time spent on private tutoring	0.9	-0.059	-0.040	-0.089
		(0.038)	(0.058)	(0.087)
	0.75	-0.090*	-0.029	-0.146*
		(0.040)	(0.034)	(0.063)
	0.5	-0.094*	-0.030	-0.237**
		(0.038)	(0.039)	(0.070)
	0.25	-0.131**	-0.076	-0.249**
		(0.041)	(0.064)	(0.076)
	0.1	-0.162*	-0.117	-0.215*
		(0.074)	(0.063)	(0.110)

Standard errors in parentheses
** p>0.01, * p>0.05

Figure 5-5 Heterogeneous Effect of PT on NCEE Score, by Subjects and Registered Residence

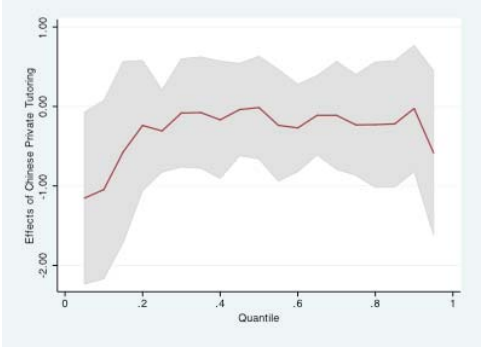
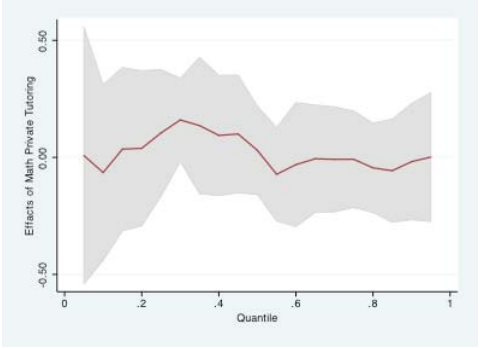
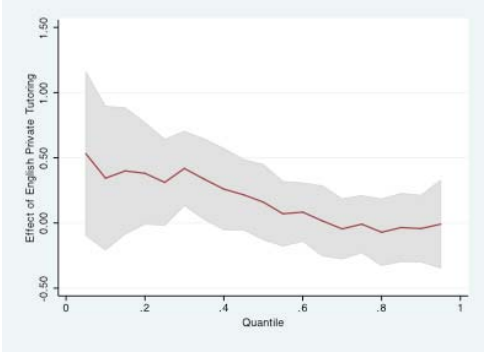
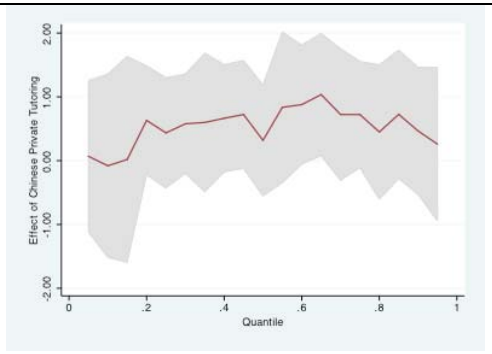
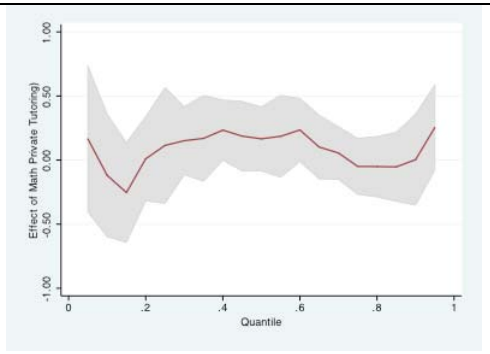
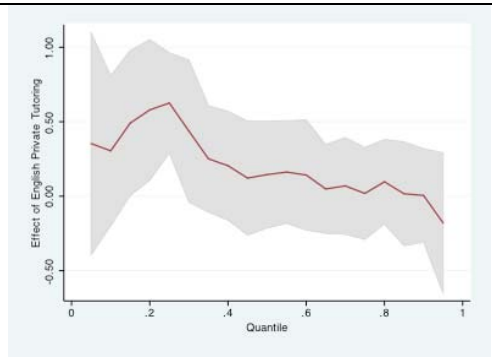
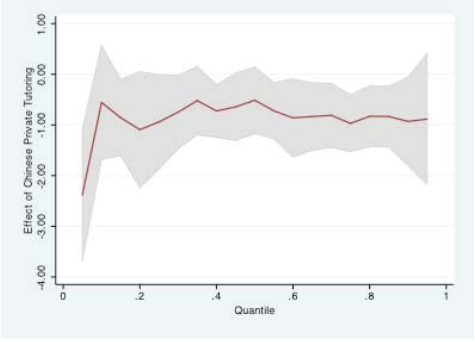
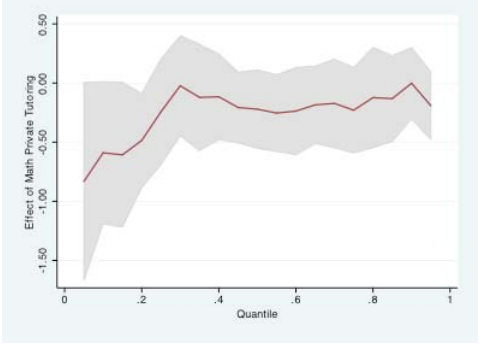
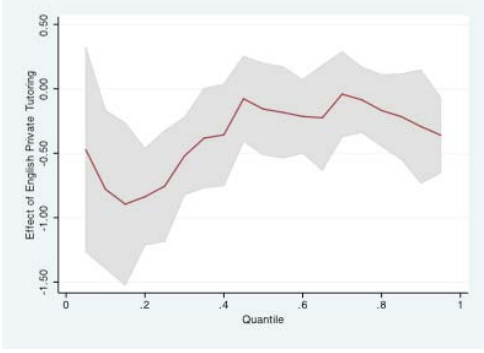
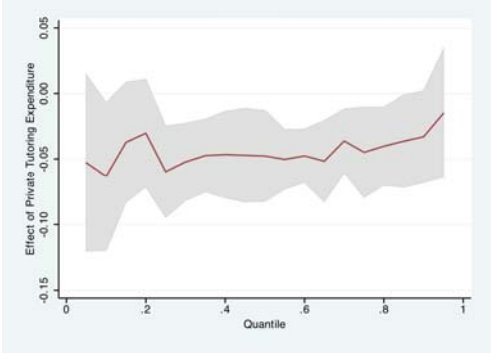
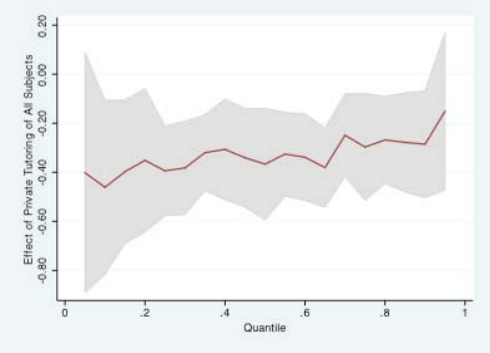
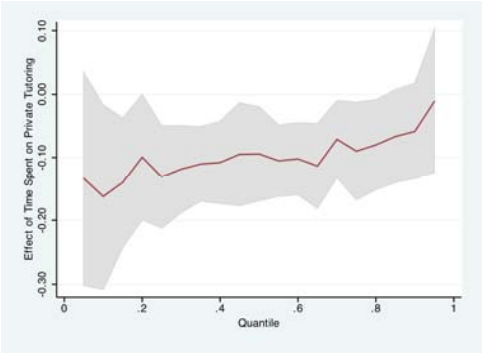
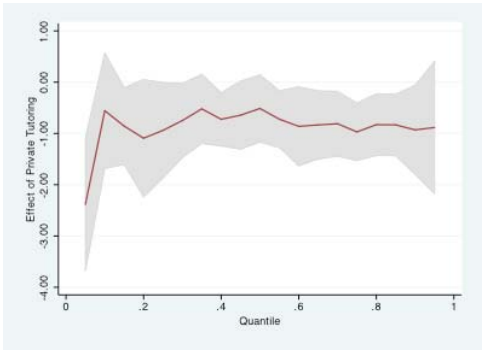
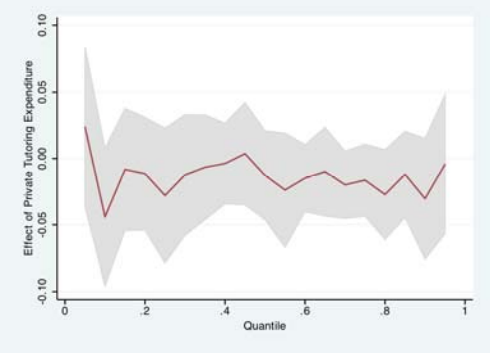
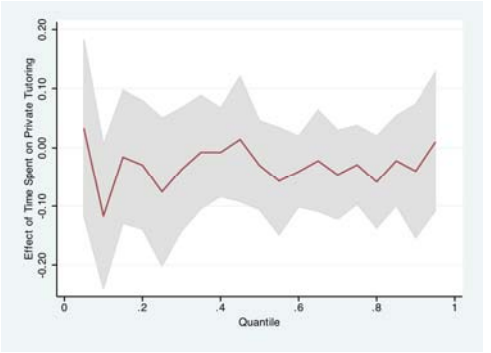
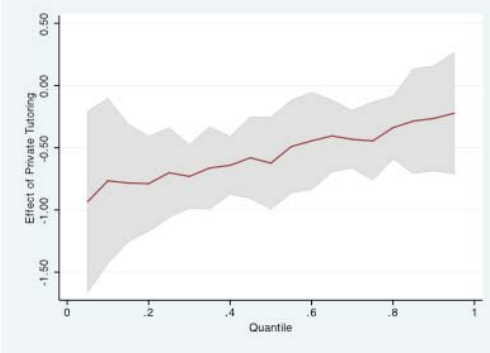
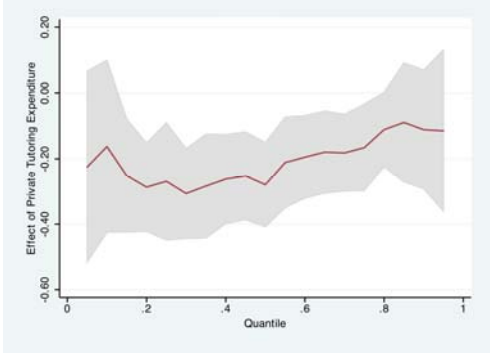
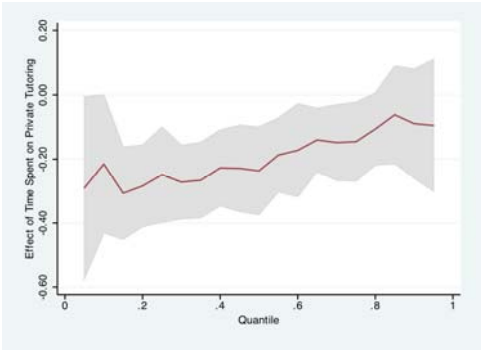
	Chinese	Math	English
All students			
Urban students			
Rural students			

Figure 5-6 Heterogeneous Effect of PT on NCEE Total Score, by Measures of PT and Registered Residence

	Probability of PT participation	PT expenditure	Time spent on PT
All students			
Urban students			
Rural students			

Generally speaking, there is no effect of private tutoring on the three subjects separately, but there are significant and negative effects on the total score for the whole sample and the rural subsample. The negative effect on the whole sample is mainly due to the negative effect on the rural subsample. One plausible reason that private tutoring may not have effect on each subject is that private tutors may teach in ways that are contrary to the schoolteacher's teaching. Students may get confused and thus make little improvement in academic performance.

In regards to the negative effect on rural students' NCEE total score, although the quantile regression provides detailed information on the effect of private tutoring participation, it cannot explain the reason for the significant and negative effects on the rural students for the total score. Several plausible reasons are proposed, although they are not completely satisfactory. First, the negative effect may be due to the measurement error of private tutoring on all subjects. For the three subjects, private tutoring refers to that for each subject respectively, which is accurate. However, for all the subjects, private tutoring participation is coded as "yes" as long as the student has participated in private tutoring of any subject. In regards to the money and time spent on private tutoring, it is not clear which subjects these resources are spent on.

Second, private tutoring in some subjects may undermine the test scores of other subjects, because it takes a lot of time and energy to participate in private tutoring for one subject, and thus reduces students' time to study on other subjects. Since private tutoring is found to have no effect on the corresponding subject and may be a cost for irrelevant subjects, it may lead to the negative effect on the total score.

Third, the weaker result for rural students may be due to the relatively low quality of private tutors faced by them, compared with that faced by their urban counterparts. According to the last row of Table 5-15, the average years of education of private tutors reported by all the

rural students are much lower than those reported by the urban students for each of the three subjects. This may indicate that the private tutor quality faced by rural students is much lower than that faced by urban students. In addition, compared with urban students, a much higher percentage of rural students who participate in private tutoring report that their private tutors are their own school teachers, and a much lower percentage of rural students claim to have teachers from other schools or professional tutors as their private tutor. Own schoolteachers may do a poor job in regular classroom to induce paid tutoring. Rural students may also face limited access to private tutoring resources and fewer choice options. Thus, the private tutor quality available for the rural students may be much lower because they do not have as much choice as the urban students do. This conclusion is also consistent with what is reported in Table 4-20. Rural students are less satisfied with the effect of private tutoring on their academic performance, compared with urban students.

Table 5-15 Urban-Rural Disparity in Private Tutors' Major Professions and Education

		Chinese		Math		English	
		Urban	Rural	Urban	Rural	Urban	Rural
Among all the students	University student	1.14%	0.81%	3.25%	1.45%	2.21%	1.31%
	My school teacher	2.75%	3.53%	6.34%	7.62%	4.26%	5.82%
	Teacher from other school	4.60%	2.08%	18.18%	6.35%	12.65%	6.42%
	Professional tutor	0.87%	0.35%	2.18%	0.67%	2.85%	0.71%
	Others	0.37%	0.18%	1.04%	0.35%	1.81%	0.39%
	Total	9.73%	6.95%	30.99%	16.44%	23.78%	14.65%
Among PT participants	University student	11.72%	11.68%	10.50%	8.80%	9.31%	8.92%
	My school teacher	28.28%	50.76%	20.45%	46.35%	17.91%	39.76%
	Teacher from other school	47.24%	29.95%	58.66%	38.63%	53.17%	43.86%
	Professional tutor	8.97%	5.08%	7.03%	4.08%	11.99%	4.82%
	Others	3.79%	2.54%	3.35%	2.15%	7.62%	2.65%
	Total	100%	100%	100%	100%	100%	100%
Average education level of private tutors	Among all the students*	0.287	0.195	0.917	0.466	0.714	0.419
	Among PT participants	3.035	2.831	3.074	2.888	3.102	2.929

Note: * this is the average of idem number in the questionnaire, 0=no private tutoring, 1= less than associate bachelor, 2=undergraduate student, 3=bachelor degree, and 4=Master and above.

5.1.8 Comparison with Previous Studies

Table 5-16 compares the effect of private tutoring identified by previous studies with that found in this study. In regards to math, private tutoring is found to have significantly positive effect on SAT and ACT score (Briggs, 2001), third graders with low achievement (Jacob & Lefgren, 2004), and rural children in Afghanistan (Burde & Linden, 2010). There is no effect of private tutoring on sixth graders in the US (Jacob & Lefgren, 2004) and the fourth graders in Indonesia (Suryadarma et al., 2006). This study also finds no effect of private tutoring on either the whole sample or the urban and rural subsamples, on the college entrance Math examination.

In regards to the effect of private tutoring on native language, Briggs (2001) finds significant and positive effects of private tutoring on SAT verbal and ACT English, but significant and negative effects on ACT reading. A positive effect is also found on third graders with low achievement (Jacob & Lefgren, 2004), and rural children in Afghanistan (Burde & Linden, 2010). There is still no effect of private tutoring on the sixth graders in the US (Jacob & Lefgren, 2004) and the fourth graders in Indonesia (Suryadarma et al., 2006). In this study, private tutoring has no effect on the whole sample and the urban sample, but has a significant and negative effect on rural students.

There are few empirical studies investigating the effect of private tutoring on foreign language. In this study, the foreign language refers to English. Private tutoring has no effect on English NCEE score for the whole sample, urban subsample, and rural subsamples respectively.

In terms of multiple subjects, Dang (2007) finds a significantly positive effect on students' academic ranking, and Burde and Linden (2010) find significant and positive effect on the total score of math and native language. In this study, the multiple subjects refer to the total NCEE score, which is the sum of Chinese, math, English, and humanity/science. Private tutoring

is found to have no effect on urban students, but a negative effect on rural students and the whole sample.

Some studies report no effect of private tutoring on math and native language, which is consistent with the results of this study. However, relatively more studies found a significant and positive effect. For English and multiple subjects, the comparison is difficult because that there is so little research on the effect of private tutoring on foreign language, and that the definition of "multiple subjects" varies across the different studies.

Table 5-16 Comparison on the Effect of Private Tutoring with Previous Studies

	Previous studies		This study	
	Literature and specification	Direction	Specification	Direction
Math	Briggs (2001)		*Urban*	*No*
	SAT – Math	+	*Rural*	*No*
	ACT – Math	+	*Total*	*No*
	Jacob & Lefgren (2004)			
	Third low achieving graders	+		
	Sixth graders	*No*		
	Suryadarma et al. (2006)			
	4th-graders in Indonesia	*No*		
	Burde & Linden (2010)			
	Rural children in Afghanistan	+		
Native language (Chinese in this study)	Briggs (2001)		*Urban*	*No*
	SAT – Verbal	+	*Rural*	-
	ACT – English	+	*Total*	*No*
	ACT – Reading	-		
	Jacob & Lefgren (2004)			
	Third low achieving graders	+		
	Sixth graders	*No*		
	Suryadarma et al. (2006)			
	4th-graders in Indonesia	*No*		
	Burde & Linden (2010)			
	Rural children in Afghanistan	+		
Foreign language (English)	No previous studies		*Urban*	*No*
			Rural	*No*
			Total	*No*
Multiple subjects	Dang (2007)		*Urban*	*No*
	Academic ranking in Vietnam	+	*Rural*	-
	Burde & Linden (2010)		*Total*	-
	Rural children in Afghanistan	+		

5.1.9 Summary of Findings in Determinants of Student Achievement

In this section, the findings are summarized by subjects, by urban/rural-registered residence, and by different measures of private tutoring. Unless stated otherwise, the summary refers to both the whole sample and the two subsamples. First, some variables have consistent effects across the three subjects: the HSEE score, parents caring about study and respect the child, good study habits and ability, key class, smaller student-teacher ratio, percent of teachers with a Master's degree, the HSEE admission line, rich school activity, and the administrative style of high authority and accountability all have significant and positive effects on student achievement of all three subjects. School choice student and collegial style have no effect on student achievement. Parents doing too much for the child, percent of Level-1 teachers, and lax principal leadership style have significant and negative effects on all three subjects.

Second, some variables have effects that vary by subjects. Private tutoring participation has no effect on math, English, and the whole sample and urban subsample of Chinese, but has a significantly negative effect on the rural subsample of Chinese. SES is found to have no effect on Chinese and math, but has significant and positive effects on the whole sample and urban subsample of English. Science track students perform significantly worse in math but significantly better in English after controlling for other factors, compared with humanity track students. There is no academic track difference in Chinese. The factor of parents regulating has no effect on Chinese and math, but a significantly negative effect on English. A good class environment of personal relationship has a significant and positive effect on Chinese, the whole sample and urban subsample of math, and only urban subsample of English. Class average SES has no effect on math and English, but a significantly negative effect on the whole sample and urban subsample. Smaller school size is found to have no effect on Chinese and math, but a

significant and positive effect on the two subsamples of English. Lab resources is found to have a significant and positive effect on the rural subsample of Chinese, and the whole sample of math and English, but a negative effect on the urban subsample of English. The outcome-oriented administrative style has a significant and negative effect on the urban subsample of the three subjects respectively, but a significant and positive effect on the rural subsample of English.

Third, in terms of the NCEE total score, the results derived from models using the three different measures of private tutoring participation are basically similar for most variables. Private tutoring has no effect on urban students, but a significant and negative effect on rural students and the whole sample. SES, parents caring about study and respect the child, good study habits and ability, key class, the HSEE admission line, and the administrative style of high authority and accountability have significant and positive effect. A good class environment of personal relationship and rich school activities have significant and positive effect for the whole sample and the urban sample, but basically have no effects for the rural sample. Lab resources have a significant and positive effect only on the whole sample. Female students, school choice students, parents regulating, class average SES, and collegial style have no effect on the NCEE total score. Science track students perform significantly worse than humanity students. The variable of parents doing too much for the child and the outcome-oriented style only have significantly negative effects on the urban subsample. Lax principal leadership style only has a significant and negative effect on the whole sample and the rural subsample.

Fourth, the effects of some variables do vary significantly across different measures of private tutoring participation. For example, smaller school size has a significant and positive effect on the three different samples when using predicted probability and time index as the measures, but has a significantly positive effect on only the urban subsample when using

expenditure as the measure. Percent of teachers with a Master's degree has a significant and positive effect on the rural sample size when using expenditure and time index as the measure, with the large effect size of 5.688 and 1.29 respectively, but has no effect when using predicted probability as the measure.

5.2 Determinants of Private Tutoring Participation

In this section, factors influencing the decision of private tutoring participation are reported and discussed. The results in regards to the three subjects are estimated from the sample weighted logit models. The results regarding all subjects as a whole are estimated from sample weighted the logit model, the tobit model, and the OLS model respectively, depending on the measure of the various dependent variable. The instrumental variables used in 2SLS models presented in section 5.1 are predicted fitted values from these six models discussed in this section. These six sets of fitted values are also used in the HLM and the CF models presented in Chapter 6. Pseudo-R-squares are not reported in the choice models with sampling weights.

5.2.1 Three Subjects

Table 5-17 presents the determinants of Chinese private tutoring. According to column (1), for the whole sample, the two instrumental variables – number of private tutoring participants among the five closest peers and the distance between home and the nearest private tutoring center are significant predictors of Chinese private tutoring participation. The HSEE Chinese score is not a significant predictor. SES predicts a significantly higher probability of Chinese private tutoring participation. Female students are significantly less likely to participate in Chinese private tutoring, compared with male students. Science track and school choice status

are not significant predictors. Among the three styles of parental education, parents caring about child's study and respecting the child has no effect on Chinese private tutoring choice. The other two all have significantly positive effects on Chinese private tutoring choice. Students with good study habits and ability are significantly more likely to participate in private tutoring.

At the class level, a good class environment of personal relationship is a significantly positive predictor of Chinese private tutoring participation, but key class is not. Students from classes with lower average SES are less likely to choose Chinese private tutoring. At the school level, smaller school size, smaller student teacher ratio, and more lab resources are all positive predictors of Chinese private tutoring participation. The percent of Level-1 teachers and the percent of teachers with a Master's degree have no significant effect. The HSEE admission line has no effect on Chinese private tutoring participation. In regards to school cultural and organization characteristics, school activity and High authority and accountability feature have positive influence on Chinese private tutoring participation, while the other three variables have no significant impacts. Generally speaking, students in schools with higher education inputs are more likely to participate in Chinese private tutoring.

Column (2) of Table 5-17 reports the determinants of Chinese private tutoring participation for urban students. In terms of student level variables, the estimates are similar with those of the whole sample. The two instrumental variables are significant determinants. Students with higher SES are more likely to participate in private tutoring. Female students are less likely to participate in Chinese private tutoring than male students. Students with parents who regulate their schedule and who care too much about their study are more likely to participate in private tutoring. In terms of school inputs, all the class level variables and school level variables are not significant determinants except HSEE admission line. Urban students enrolled in schools with a

higher admission line are more likely to participate in private tutoring, while other inputs do not matter.

In regards to rural students, according to column (3) of Table 5-17, peer effect plays a significant and larger role in Chinese private tutoring participation. SES is no longer a significant determinant of private tutoring participation for rural students. Female students are less likely to participate in private tutoring. Parents who regulate the child and care too much about child's study will increase the probability of private tutoring participation. Students with high study ability and good study habits are more likely to participate in private tutoring. Different from the urban students, rural students are more likely to be influenced by some school inputs in making the decision of private tutoring participation. A good class environment of personal relationship, smaller school size, smaller student-teacher ratio, and more lab resources will all increase the probability of private tutoring participation. Teacher quality measured by percent of teachers with a Master's degree and percent of Level-1 teachers does not influence the probability of Chinese private tutoring participation. The HSEE admission line has no effect for the rural students. More school activity and high authority and accountability will increase the probability of private tutoring participation. Outcome-oriented administration style will reduce the probability.

Table 5-17 Determinants of Private Tutoring Participation – Chinese

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.280**	0.195**	0.402**
	(0.045)	(0.059)	(0.068)
IV: Distance b/t home and PT center	-0.159**	-0.201**	-0.179*
	(0.052)	(0.068)	(0.088)
Standardized HSEE Chinese score	-0.014	-0.112	0.082
	(0.083)	(0.119)	(0.108)
SES	0.170**	0.263**	0.007
	(0.042)	(0.062)	(0.084)
Female	-0.394**	-0.350**	-0.450*
	(0.135)	(0.178)	(0.209)
Science track	-0.122	0.005	-0.267
	(0.132)	(0.173)	(0.212)
School choice	-0.013	-0.117	0.072
	(0.132)	(0.193)	(0.197)
Parents caring about study and respecting the child	0.003	0.008	-0.008
	(0.042)	(0.054)	(0.074)
Parents regulating	0.177**	0.126	0.258**
	(0.054)	(0.073)	(0.085)
Parents doing too much for the child	0.194**	0.152*	0.235**
	(0.051)	(0.070)	(0.080)
Study habits and ability	0.100*	0.063	0.133*
	(0.041)	(0.053)	(0.064)
Class environment of personal relationship	0.273**	0.202	0.291*
	(0.090)	(0.129)	(0.139)
Key Class	0.044	0.089	0.084
	(0.173)	(0.228)	(0.306)
Class average SES	-0.262*	-0.120	-0.390
	(0.114)	(0.146)	(0.299)
Standardized total number of students in school	-0.240*	-0.212	-0.228
	(0.097)	(0.149)	(0.226)
Student-teacher ratio	-0.543**	-0.228	-0.721*
	(0.104)	(0.160)	(0.304)
Lab	1.101**	0.062	2.217**
	(0.186)	(0.279)	(0.459)
Percent of Level-1 teachers	0.193	-0.152	-6.328
	(1.238)	(1.455)	(5.750)
Percent of teachers with a Master's degree	4.704	-3.042	12.838
	(2.686)	(3.359)	(9.551)
Standardized HSEE admission line	0.103	0.447*	-0.038
	(0.131)	(0.189)	(0.273)
School activity	0.538*	0.130	0.923
	(0.214)	(0.313)	(0.475)
Collegial	0.143	-0.081	-0.274
	(0.105)	(0.138)	(0.437)
Outcome-oriented	-0.301	0.044	-1.745**
	(0.227)	(0.343)	(0.659)
Lax principal leadership	0.169	0.092	0.497
	(0.147)	(0.221)	(0.418)
High authority and accountability	0.471**	0.050	1.094**
	(0.154)	(0.280)	(0.372)
Constant	-3.207**	-2.811**	-2.528
	(0.411)	(0.519)	(1.555)
N	5841	2981	2835
F	8.520	4.380	6.960
Probability > 0	0	0	0

Standard errors in parentheses. ** p>0.01, **p>0.05

Table 5-18 presents the determinants of math private tutoring participation. The results of math private tutoring participation for the whole sample are presented in column (1) of Table 5-18. The results are similar to those of Chinese private tutoring participation, except for a few estimates. Different from Chinese private tutoring choice, students with lower HSEE score are significantly more likely to participate in private tutoring. Female students are significantly more likely to participate in math private tutoring, compared to male students. Students in science track are significantly less likely to participate in math private tutoring, compared to their counterparts in the humanity track. Study habits and ability and class average SES are no longer significant predictors of math private tutoring choice. Students from key classes are significantly less likely to participate in math private tutoring. Students from outcome-oriented schools are also significantly less likely to participate in math private tutoring, while lax principal leadership organization characteristic and high authority and accountability style are significantly positive predictors.

Column (2) of Table 5-18 reports the determinants of math private tutoring participation for urban students. Most of the student level estimates are similar with those of the whole sample, except a few. For example, the variable of parents doing too much for the child is not a significant predictor for urban students. In terms of school inputs, a good class environment of personal relationship, key class, student-teacher ratio, lab resource, school activity, lax principal leadership administration style, and high authority and accountability style are no longer significant determinants for urban students. Higher HSEE admission line will significantly increase the probability of private tutoring participation. Students from collegial style schools are less likely to participate in private tutoring.

Column (3) of Table 5-18 presents the determinants of math private tutoring participation for rural students. Different from the results of the whole sample and the urban sample, the HSEE Math score and academic track are no longer significant determinants of math private tutoring participation. In addition, higher teacher quality measured by the percent of Level-1 teachers and the percent of teachers with a Master's degree is found to have a significantly positive effect on private tutoring participation. Consistent with the results of the whole sample, but different from those of the urban sample, a good class environment of personal relationship, lower class average SES, lower student-teacher ratio, more school activity, lax principal leadership style and high authority and accountability style may significantly increase the probability of private tutoring participation.

Table 5-18 Determinants of Private Tutoring Participation – Math

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.297**	0.271**	0.316**
	(0.029)	(0.038)	(0.048)
IV: Distance b/t home and PT center	-0.166**	-0.200**	-0.118*
	(0.033)	(0.042)	(0.059)
Standardized HSEE Math score	-0.101*	-0.228**	0.060
	(0.048)	(0.060)	(0.103)
SES	0.258**	0.265**	0.177**
	(0.029)	(0.036)	(0.064)
Female	0.387**	0.423**	0.307*
	(0.081)	(0.104)	(0.132)
Science track	-0.181*	-0.225*	-0.118
	(0.083)	(0.106)	(0.152)
School choice	-0.018	-0.003	-0.141
	(0.084)	(0.113)	(0.132)
Parents caring about study and respecting the child	-0.016	-0.018	-0.009
	(0.031)	(0.038)	(0.050)
Parents regulating	0.163**	0.140**	0.190**
	(0.036)	(0.046)	(0.061)
Parents doing too much for the child	0.078*	0.015	0.198**
	(0.035)	(0.045)	(0.056)
Study habits and ability	-0.018	-0.051	0.049
	(0.025)	(0.032)	(0.041)
Class environment of personal relationship	0.155**	0.040	0.269**
	(0.052)	(0.074)	(0.086)
Key Class	-0.374**	-0.233	-0.305
	(0.113)	(0.145)	(0.214)
Class average SES	-0.051	0.096	-0.541**
	(0.067)	(0.081)	(0.195)
Standardized total number of students in school	-0.408**	-0.369**	-0.703**
	(0.059)	(0.100)	(0.093)
Student-teacher ratio	-0.457**	-0.089	-1.160**
	(0.058)	(0.083)	(0.122)
Lab	0.893**	-0.109	1.760**
	(0.117)	(0.225)	(0.222)
Percent of Level-1 teachers	1.005	-0.989	7.094**
	(0.698)	(0.868)	(1.902)
Percent of teachers with a Master's degree	2.444	-3.379	8.066
	(1.517)	(2.137)	(4.595)
Standardized HSEE admission line	0.144	0.432**	0.035
	(0.077)	(0.115)	(0.170)
School activity	0.312*	-0.262	1.522**
	(0.123)	(0.180)	(0.221)
Collegial	0.032	-0.321**	0.615**
	(0.061)	(0.089)	(0.146)
Outcome-oriented	-0.624**	-0.800**	-0.778**
	(0.138)	(0.226)	(0.273)
Lax principal leadership	0.272**	0.058	0.550**
	(0.089)	(0.133)	(0.183)
High authority and accountability	0.584**	0.248	1.420**
	(0.092)	(0.165)	(0.179)
Constant	-2.023**	-1.253**	-4.685**
	(0.249)	(0.325)	(0.597)
N	5841	2981	2835
F	21.150	9.870	11.490
Probability > 0	0.000	0.000	0.000

Standard errors in parentheses. ** p>0.01, * p>0.05

Table 5-19 reports the determinants of English private tutoring choice. According to column (1), the HSEE English score and gender are not significant predictors, and science track students are significantly less likely to participate in private tutoring. If the parents regulate their the child or care too much about their the child' study, these students are significantly more likely to participate in private tutoring. Students from classes with a good class environment of personal relationship or lower class average SES, or from non-key classes, are significantly more likely to participate in English private tutoring. Smaller school size, lower student-teacher ratio, more lab resource, and more teachers with a Master's degree will increase the probability of English private tutoring participation. In regards to school administration and school culture, more school activities, less outcome-oriented culture, lax principal leadership administration style and high authority and accountability will predict higher probability of private tutoring participation.

Column (2) of Table 5-19 reports the estimates for the urban sample. Most of the estimates are similar with those of the whole sample except a few. Class level variables are not significant predictors any more. Many school level education inputs are not significant, either. Small school size and higher HSEE admission line are significant and positive predictors of English private tutoring participation. In terms of school culture and administration style, collegial style and outcome-oriented style significantly decrease the probability of private tutoring participation.

Column (3) of Table 5-19 presents the results for the rural sample. The estimates are similar with those for the whole sample. The magnitudes of the effects for the rural sample are larger than those for the whole sample.

Table 5-19 Determinants of Private Tutoring Participation – English

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.251**	0.220**	0.277**
	(0.031)	(0.040)	(0.050)
IV: Distance b/t home and PT center	-0.160**	-0.171**	-0.183**
	(0.036)	(0.046)	(0.062)
Standardized HSEE English score	0.005	-0.091	0.092
	(0.048)	(0.058)	(0.089)
SES	0.237**	0.228**	0.235**
	(0.031)	(0.040)	(0.064)
Female	0.105	0.167	0.012
	(0.089)	(0.116)	(0.143)
Science track	-0.266**	-0.197	-0.351*
	(0.087)	(0.112)	(0.154)
School choice	-0.054	-0.042	-0.187
	(0.091)	(0.123)	(0.142)
Parents caring about study and respecting the child	-0.019	-0.011	-0.028
	(0.033)	(0.043)	(0.050)
Parents regulating	0.168**	0.137**	0.205**
	(0.038)	(0.050)	(0.058)
Parents doing too much for the child	0.107**	0.079	0.161**
	(0.037)	(0.048)	(0.057)
Study habits and ability	-0.004	-0.030	0.049
	(0.027)	(0.034)	(0.044)
Class environment of personal relationship	0.193**	0.044	0.380**
	(0.055)	(0.077)	(0.093)
Key Class	-0.403**	-0.274	-0.295
	(0.122)	(0.154)	(0.226)
Class average SES	-0.188**	-0.024	-0.419*
	(0.069)	(0.084)	(0.209)
Standardized total number of students in school	-0.267**	-0.321**	-0.431**
	(0.063)	(0.107)	(0.104)
Student-teacher ratio	-0.308**	-0.008	-0.969**
	(0.061)	(0.083)	(0.130)
Lab	0.711**	-0.350	1.816**
	(0.122)	(0.240)	(0.268)
Percent of Level-1 teachers	1.096	-0.740	4.056
	(0.746)	(0.888)	(2.456)
Percent of teachers with a Master's degree	4.316**	-2.052	11.803*
	(1.624)	(2.162)	(4.939)
Standardized HSEE admission line	0.005	0.278*	-0.290
	(0.077)	(0.111)	(0.183)
School activity	0.332**	-0.172	1.497**
	(0.130)	(0.175)	(0.249)
Collegial	0.039	-0.307**	0.493**
	(0.066)	(0.095)	(0.171)
Outcome-oriented	-0.461**	-0.508*	-0.961**
	(0.146)	(0.230)	(0.332)
Lax principal leadership	0.280**	0.105	0.519*
	(0.096)	(0.134)	(0.215)
High authority and accountability	0.421**	0.137	1.364**
	(0.095)	(0.164)	(0.210)
Constant	-2.074**	-1.386**	-3.571**
	(0.264)	(0.332)	(0.693)
N	5841	2981	2835
F	13.500	5.290	9.150
Probability > 0	0.000	0.000	0.000

Standard errors in parentheses. ** p>0.01, * p>0.05

5.2.2 All Subjects

Table 5-20 reports the determinants of private tutoring participation for all subjects using the logit model, in which the dummy variable of private tutoring participation status is the dependent variable. Columns (1) to (3) report the estimates for the whole sample, the urban sample, and the rural sample respectively. According to column (1), students with lower HSEE total score and higher SES are significantly more likely to participate in some kind of private tutoring. Female student are significantly more likely to participate in private tutoring. Students with parents who regulate them or care too much about their study are more likely to participate in private tutoring. Students with good study habits and high study ability are more likely to participate in private tutoring. If students are enrolled in non-key classes or classes with a good class environment of personal relationship, they are significantly more likely to participate in private tutoring. Smaller school size, lower student-teacher ratio, more lab resource, and higher HSEE admission line will significantly increase the probability of private tutoring participation. Outcome-oriented style will reduce the probability of private tutoring participation, while lax principal leadership style and high authority and accountability will increase the probability.

According to column (2) of Table 5-20, for urban students, the estimates of the student level variables are similar with those for the whole sample. In terms of the class level variables and school level variables, key class, percent of teachers with a Master's degree, and school activity significantly decrease the probability of private tutoring participation. The HSEE admission line is a significant and positive predictor of private tutoring participation. For the rural students, as presented in column (3), the estimates of most variables are similar with those for the whole sample, and most of the magnitudes are larger than those for the whole sample. Key class and the HSEE admission line are no longer significant predictors for rural students.

Table 5-20 Determinants of Private Tutoring Participation – All Subjects

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.255**	0.248**	0.255**
	(0.028)	(0.039)	(0.041)
IV: Distance b/t home and PT center	-0.139**	-0.171**	-0.081
	(0.031)	(0.042)	(0.048)
Standardized HSEE total score	-0.176**	-0.238**	-0.116
	(0.047)	(0.071)	(0.067)
SES	0.279**	0.231**	0.313**
	(0.028)	(0.036)	(0.057)
Female	0.221**	0.224*	0.229*
	(0.072)	(0.102)	(0.102)
Science track	-0.047	0.021	-0.067
	(0.076)	(0.108)	(0.114)
School choice	0.015	0.075	-0.058
	(0.075)	(0.112)	(0.103)
Parents caring about study and respecting the child	0.007	0.019	0.001
	(0.026)	(0.035)	(0.039)
Parents regulating	0.106**	0.134**	0.069
	(0.028)	(0.039)	(0.042)
Parents doing too much for the child	0.207**	0.190**	0.233**
	(0.033)	(0.046)	(0.047)
Study habits and ability	0.105**	0.079*	0.143**
	(0.023)	(0.032)	(0.035)
Class environment of personal relationship	0.169**	0.095	0.219**
	(0.047)	(0.076)	(0.064)
Key Class	-0.259**	-0.280*	-0.152
	(0.095)	(0.132)	(0.146)
Class average SES	-0.076	-0.086	-0.114
	(0.058)	(0.077)	(0.120)
Standardized total number of students in school	-0.208**	-0.151	-0.308**
	(0.051)	(0.093)	(0.083)
Student-teacher ratio	-0.185**	-0.061	-0.390**
	(0.047)	(0.072)	(0.092)
Lab	0.294**	-0.122	0.733**
	(0.093)	(0.201)	(0.143)
Percent of Level-1 teachers	0.914	0.436	1.222
	(0.623)	(0.807)	(1.328)
Percent of teachers with a Master's degree	-1.713	-4.027*	-2.364
	(1.256)	(1.919)	(3.098)
Standardized HSEE admission line	0.306**	0.467**	0.151
	(0.065)	(0.107)	(0.109)
School activity	-0.117	-0.307*	0.165
	(0.096)	(0.150)	(0.178)
Collegial	-0.058	-0.102	0.010
	(0.050)	(0.078)	(0.106)
Outcome-oriented	-0.389**	-0.033	-0.772**
	(0.110)	(0.189)	(0.162)
Lax principal leadership	0.194**	0.123	0.138
	(0.075)	(0.116)	(0.143)
High authority and accountability	0.176*	-0.096	0.578**
	(0.072)	(0.141)	(0.132)
Constant	-0.365	-0.018	-0.812
	(0.222)	(0.304)	(0.429)
N	5841	2981	2835
F	19.030	7.570	8.360
Probability > 0	0.000	0.000	0.000

Standard errors in parentheses. ** p>0.01, * p>0.05

Table 5-21 reports the determinants of private tutoring expenditure for all subjects using the tobit model, in which the dependent variable is the left-censored private tutoring expenditure data, and has been standardized to mean of zero and standard deviation of one. Column (1) presents the results for the whole sample. Different from the estimates in the logit model, the HSEE total score has no effect on the private tutoring expenditure. Higher SES significantly increases the spending on private tutoring. Female students spend significantly more on private tutoring than male students. There is no spending gap between science track students and humanity students, or between school choice students and regular students. Parents who regulate their child significantly increase the private tutoring expenditure. Students with higher study ability spend significantly less on private tutoring. Students from classes with a good class environment of personal relationship spend significantly more on private tutoring. Students from key classes spend significantly less on private tutoring, compared with students from non-key classes. Students from schools with better education resources (including smaller school size, lower student-teacher ratio, more lab resource, better teacher quality, and higher HSEE admission line) spend significantly more on private tutoring. Lax principal leadership style and high authority and accountability also significantly increase private tutoring expenditure.

Column (2) of Table 5-21 lists the results for urban students. Most of the estimates are similar with those in column (1), except for those of the school level variables. Smaller school size significantly increases private tutoring spending. The other school level variables are not significant determinants.

For rural students, as presented in column (3) of Table 5-21, study habits and ability, key class, and the HSEE admission line are no longer significant predictors of private tutoring expenditure. The estimates of other variables are similar with those for the whole sample.

Table 5-21 Determinants of Private Tutoring Expenditure – All Subjects

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.314**	0.344**	0.123**
	(0.034)	(0.044)	(0.028)
IV: Distance b/t home and PT center	-0.256**	-0.330**	-0.069**
	(0.037)	(0.054)	(0.023)
Standardized HSEE total score	0.013	0.015	-0.010
	(0.054)	(0.078)	(0.038)
SES	0.317**	0.305**	0.112**
	(0.044)	(0.056)	(0.031)
Female	0.286**	0.331**	0.101*
	(0.081)	(0.120)	(0.046)
Science track	-0.053	-0.019	-0.039
	(0.084)	(0.124)	(0.049)
School choice	0.110	0.164	-0.011
	(0.082)	(0.128)	(0.043)
Parents caring about study and respecting the child	-0.055	-0.034	-0.044*
	(0.037)	(0.052)	(0.020)
Parents regulating	0.144**	0.184**	0.050*
	(0.039)	(0.058)	(0.021)
Parents doing too much for the child	0.028	0.038	-0.006
	(0.036)	(0.052)	(0.022)
Study habits and ability	-0.093**	-0.114**	-0.024
	(0.029)	(0.043)	(0.018)
Class environment of personal relationship	0.210**	0.144	0.113**
	(0.054)	(0.085)	(0.034)
Key Class	-0.467**	-0.477**	-0.110
	(0.129)	(0.178)	(0.075)
Class average SES	-0.011	0.087	-0.104
	(0.067)	(0.093)	(0.056)
Standardized total number of students in school	-0.246**	-0.248*	-0.179**
	(0.057)	(0.107)	(0.048)
Student-teacher ratio	-0.216**	0.012	-0.338**
	(0.058)	(0.100)	(0.081)
Lab	0.592**	0.083	0.451**
	(0.117)	(0.227)	(0.097)
Percent of Level-1 teachers	1.990**	1.083	2.712**
	(0.765)	(0.997)	(0.762)
Percent of teachers with a Master's degree	3.888**	1.374	6.994*
	(1.505)	(2.271)	(2.747)
Standardized HSEE admission line	0.179*	0.231	0.055
	(0.077)	(0.127)	(0.051)
School activity	0.027	-0.026	0.336**
	(0.127)	(0.217)	(0.101)
Collegial	0.075	-0.094	0.283**
	(0.063)	(0.097)	(0.081)
Outcome-oriented	-0.242	0.047	-0.104
	(0.140)	(0.241)	(0.073)
Lax principal leadership	0.317**	0.141	0.134
	(0.095)	(0.145)	(0.078)
High authority and accountability	0.247**	-0.063	0.409**
	(0.084)	(0.179)	(0.095)
Constant	-2.658**	-2.537**	-1.950**
	(0.320)	(0.415)	(0.337)
N	5841	2981	2835
F	5.580	4.620	3.380
Probability > 0	0.000	0.000	0.000

Standard errors in parentheses. ** p>0.01, * p>0.05,

Table 5-22 reports the determinants of time spent on private tutoring using the OLS model, in which the dependent variable is the continuous time index of private tutoring. Students with lower HSEE total score and higher SES spend more time on private tutoring. There is no significant gap between male and female students. Science track students spend significantly less time on private tutoring than humanity students. Students with higher study ability spend significantly more time on private tutoring. Students with parents regulating them or caring too much about their studies spend significantly more time on private tutoring. Students from non-key classes, or from classes with better personal relationship or higher class-average SES spend more time on private tutoring. Smaller school size, more lab resource, higher percent of Level-1 teachers, higher HSE admission line, and lax principal leadership administration style will significantly increase the time spent on private tutoring. High authority and accountability style and higher percent of teachers with a Master's degree will significantly decrease the time spent on private tutoring.

Column (2) of Table 5-22 reports the results for the urban sample. Most of the results are similar with those presented in column (1). A good class environment of personal relationship, lab resource, and lax principal leadership administration style are not significant predictors any more. Column (3) of Table 5-22 lists the estimates for rural students. Most of the results are also similar with those for the whole sample, except that key class and class average SES are not significant predictors.

Table 5-22 Determinants of Time Spent on Private Tutoring– All Subjects

	All	Urban	Rural
	(1)	(2)	(3)
IV: # of peers participating in PT	0.165**	0.166**	0.149**
	(0.015)	(0.022)	(0.019)
IV: Distance b/t home and PT center	-0.078**	-0.097**	-0.056**
	(0.015)	(0.023)	(0.019)
Standardized HSEE total score	-0.181**	-0.223**	-0.154**
	(0.026)	(0.038)	(0.037)
SES	0.155**	0.166**	0.137**
	(0.014)	(0.019)	(0.029)
Female	0.011	0.036	-0.016
	(0.036)	(0.060)	(0.042)
Science track	-0.104*	-0.113	-0.076
	(0.041)	(0.066)	(0.049)
School choice	0.004	0.013	-0.019
	(0.038)	(0.065)	(0.042)
Parents caring about study and respecting the child	-0.002	-0.005	0.008
	(0.013)	(0.021)	(0.014)
Parents regulating	0.050**	0.067**	0.033*
	(0.014)	(0.024)	(0.015)
Parents doing too much for the child	0.112**	0.114**	0.115**
	(0.019)	(0.029)	(0.024)
Study habits and ability	0.086**	0.073**	0.102**
	(0.012)	(0.018)	(0.014)
Class environment of personal relationship	0.059**	0.055	0.052*
	(0.022)	(0.041)	(0.025)
Key Class	-0.140**	-0.242**	0.041
	(0.047)	(0.076)	(0.060)
Class average SES	0.176**	0.176**	0.065
	(0.033)	(0.046)	(0.053)
Standardized total number of students in school	-0.091**	-0.055	-0.158**
	(0.026)	(0.053)	(0.035)
Student-teacher ratio	-0.040	0.058	-0.195**
	(0.027)	(0.044)	(0.040)
Lab	0.141**	0.019	0.317**
	(0.047)	(0.103)	(0.060)
Percent of Level-1 teachers	0.961*	1.140*	1.254
	(0.382)	(0.496)	(0.658)
Percent of teachers with a Master's degree	-2.370**	-2.790*	0.044
	(0.703)	(1.090)	(1.365)
Standardized HSEE admission line	0.074*	0.139*	-0.049
	(0.033)	(0.060)	(0.044)
School activity	-0.003	-0.079	0.246**
	(0.053)	(0.091)	(0.074)
Collegial	-0.066*	-0.100*	0.088
	(0.030)	(0.042)	(0.049)
Outcome-oriented	-0.079	-0.007	-0.072
	(0.062)	(0.113)	(0.078)
Lax principal leadership	0.089*	0.033	-0.034
	(0.042)	(0.066)	(0.062)
High authority and accountability	-0.150**	-0.318**	0.155*
	(0.040)	(0.081)	(0.062)
Constant	-0.230	-0.245	-0.680**
	(0.125)	(0.178)	(0.188)
N	5841	2981	2835
F	42.820	19.530	17.470
Probability > 0	0.000	0.000	0.000
R^2	0.256	0.209	0.164

Standard errors in parentheses ** p>0.01, * p>0.05

5.2.3 Summary and Comparison with Previous Studies

In section 5.2, the determinants of private tutoring participation are analyzed by subject, by registered residence, and by the measure of private tutoring participation. First, for the three subjects, some variables have consistent effect for the three different samples. More peers participating in private tutoring, less distance between home and the nearest private tutoring center, SES, parents regulating the child, and parents doing too much for the child have significant and positive effect on private tutoring participation. A good class environment of personal relationship, smaller student-teacher ratio, lab resource, school activity, and the administrative style of high authority and accountability significantly predict higher probability on the whole sample and rural subsample, but not on the urban subsample. The HSEE admission line predicts higher probability of private tutoring for urban students only. School choice status and parents caring about study and respect the child have no effect on the private tutoring participation.

Second, some variables have effects that vary by subjects. For example, the HSEE score has no effect on Chinese and English private tutoring, but has a significant and negative effect on the whole sample and the urban sample of math private tutoring participation. Female students are significantly less likely to receive Chinese private tutoring, but significantly more likely to receive math private tutoring. Science track students are significantly less likely to participate in math and English private tutoring, but have no significant intention to participate in Chinese private tutoring. Good study habits and ability significantly increase the probability of private tutoring for Chinese and all subjects as a whole, but have no effect for math and English. Students (of the whole sample) from non-key class are significantly more likely to participate in math and English private tutoring, but not in Chinese tutoring. Collegial and lax principal

leadership styles are found to have no effect on Chinese private tutoring participation, but have significant effect on math and English private tutoring. Collegial style has a significant and negative effect on the urban subsample, but significantly positive effect on the rural subsample. Lax principal leadership style has a significant and positive effect on the whole sample and the rural subsample.

Third, for the NCEE total score, many variables have consistent effect across the three measures of private tutoring. Besides the two instrumental variables, SES, parents regulating, parents doing too much for the child, and good study habits and ability significantly predict higher amount of private tutoring participation, using the three different samples. Non-key class and the HSEE admission line have significantly positive effect on the private tutoring participation for the whole sample and the urban subsample. Smaller school size, smaller student-teacher ratio, lab resource, and high authority and accountability significantly predict higher amount of private tutoring for the whole sample and the rural subsample. Lax principal leadership style has a significantly positive effect on the whole sample only.

Fourth, the effect of explanatory variables on private tutoring depends on the measure of private tutoring participation. For example, the HSEE total score has a significant and negative effect on the probability of private tutoring participation and on the time spent on private tutoring, but has no effect on the money spent on private tutoring. Female students are significantly more likely to participate in and spend more money on private tutoring, but do not spend more time on it. Science track students spend significantly less time on private tutoring than humanity students do, but perform indifferently regarding to the probability of private tutoring and the money spent on it. Class average SES significantly predicts higher probability of private tutoring participation and higher expenditure on it, but predicts less time spent on private tutoring. The percent of

Level-1 teachers has no effect on the probability of private tutoring participation, significant and positive effect on the whole sample and the rural sample regarding the private tutoring expenditure, and significantly positive effect on time spent on private tutoring for all the three different samples. Outcome-oriented administrative style has a significant and negative effect on the probability of private tutoring for the whole sample and the rural subsample, but has no effect on time spent on private tutoring.

Based on the summary of the determinants of private tutoring participation above, the comparison with the findings from previous studies includes two parts: the comparison of the determinants of math private tutoring participation, and the comparison of determinants of private tutoring of any subjects. There is little research done before on the determinants of English and Chinese private tutoring participation.

In regards to math, the findings that students with higher HSEE Math score are more likely to participate in math private tutoring is consistent with what Baker et al. (2001) found using TIMSS (1995) data, i.e. private tutoring was used significantly more often by students with lower Math scores than by high achievers in three-fourths of the 41 countries.

For private tutoring in any subjects, the comparison is divided into three parts according to the measures of private tutoring participation. Table 5-23 summarizes the effect directions of the determinants that have been included in both previous studies and this study. In terms of the probability of private tutoring participation, female students are found by this study to be significantly more likely to participate in private tutoring, which is consistent with the results of Kim (2007b) and Stevenson and Baker (1992), but inconsistent with the results of Assaad and El-Badawy (2004). SES, including parental education level, is found to have significant and positive effect on the probability of private tutoring participation according to all the literature

reviewed and this study. Academic performance is found to have significantly positive effect by Kim (2007b) and Stevenson and Baker (1992), no effect by Xue and Ding (2009) and this study (on the rural subsample), and a significant and negative effect on the whole sample and the urban subsample by this study. Urban students are reported by Stevenson and Baker (1992) and Assaad and El-Badawy (2004) to be more likely to participate in private tutoring, which is also supported by the descriptive statistics in this study. Student-teacher ratio is found to have significantly positive effect by Kim (2007b), has a significant and negative effect according to Assaad and El-Badawy (2004) and this study (for the whole sample and the rural subsample), and has no effect on urban students according to this study..

In regards to private tutoring expenditure, female students spend significantly more money on private tutoring, according to Kim and Lee (2004) and this study, but are found to spend the same as male students by Kim (2007b) and Dang (2007). All the studies including this one provide evidence that student with higher SES spend significantly more money on private tutoring. The effect of academic performance on private tutoring expenditure is mixed. Lei (2005), Kim (2007b) report significantly positive effect on private tutoring expenditure, Xue and Ding (2009) finds significantly negative effect using the OLS model, and Kim (2007b) and this study find no effect using the tobit model. Student-teacher ratio is found to have a significantly negative effect on rural students and no effect on urban students by this study. Kim (2007b) also finds no effect of student-teacher ratio on private tutoring expenditure. Number of books per student is found to have no effect by Dang (2007). Similarly, lab resources are found to have no effect on urban students by this study, but has a significantly positive effect on rural students and the whole sample.

There is only one study reviewed that investigates the determinants of time spent on private tutoring. Kim (2007b) studies the situation in South Korea and finds that female students spend the same amount of time on private tutoring as male students do, which is consistent with the result of this study. SES is found to have positive effect by both Kim (2007b) and this study. Academic performance is found to have a significantly positive effect by Kim (2007b), but a negative effect by this study. Student-teacher ratio is found to have a significantly positive effect by Kim (2007b). But according to this study, it has a negative effect on the rural subsample, and no effect on urban students and the whole sample.

Across the various measures of private tutoring participation, SES is found to have significantly positive effect for all settings by all studies. The effects of other determinants are mixed and should be evaluated in the specific context. In addition, there is no research that investigates the different effect of the determinants between the urban and rural students. Thus, it is difficult to compare the results for the subsamples in this study with those from previous studies. Further more, the effects of class level variables and most school level variables are not compared, because they are not included in previous studies.

Table 5-23 Comparison on the Determinants of Private Tutoring with Previous Studies

		Previous studies	This study
PT participation	Female		
	+	Kim (2007b), Stevenson & Baker (1992)	+
	No	Assaad & El-Badawy (2004)	
	SES		
	+	Kim (2007b), Stevenson & Baker (1992), Assaad & El-Badawy (2004)	+
	Academic performance		
	+	Kim (2007b), Stevenson & Baker (1992)	
	-		-
	No	Xue & Ding (2009)	No
	Urban		
	+	Stevenson & Baker (1992), Assaad & El-Badawy (2004)	+
	Student-teacher ratio		
	+	Kim (2007b)	
	-	Assaad & El-Badawy (2004)	-
	No		No
PT expenditure	Female		
	+	Kim & Lee (2004)	+
	No	Kim (2007b), Dang (2007)	
	SES		
	+	Kim & Lee (2004), Lei (2005), Tansel and Bircan (2006b), Dang (2007), Kim (2007b), Xue & Ding (2009)	+
	Academic performance		
	+	Lei (2005), Kim (2007b)	
	-	Xue & Ding (2009)	
	No	Kim (2007b)	No
	Student-teacher ratio		
			-
	No	Kim (2007b)	No
	Number of books per student/lab resource		
			+
	No	Dang (2007)	No
PT time spending	Female		
	No	Kim (2007b)	No
	SES		
	+	Kim (2007b)	+
	Academic performance		
	+	Kim (2007b)	
			-
	Student-teacher ratio		
	+	Kim (2007b)	
			-
			No

Chapter 6 Empirical Results for the Hierarchical Linear Model and the Control Function Model

In this chapter, the empirical results of the hierarchical linear model (HLM) and the control function model are reported and discussed. In section 6.1, the variance components, the level-1 fixed effect model, the 3-level intercepts-as-outcome model, and the 3-level slopes-as-outcome model are discussed one by one. In section 6.2, the results of the control function model are reported by the three subjects and all subjects. At the end of each section, the results are compared with those of the basic model, and the contribution of the corresponding model will be discussed.

6.1 Hierarchical Linear Model (Model 2)

In this section, the results of the HLM are discussed. The 3-level HLM model takes into account of the nested variance structure at student (level 1), class (level 2), and school level (level 3). The discussion begins by the analysis of covariance (ANCOVA) within the multi-level framework (Raudenbush & Bryk, 2002), which reports the proportion of variance in NCEE scores that was present among schools and classes. Three HLM models are then conducted: level-1 fixed effect model (unconditional at level-2 and level-3), intercepts-as-outcome model, and private tutoring slopes-as-outcome model.

The level-1 fixed effect model leaves the class level and school level unconditional and serves as a basic HLM level-1 model, and the results will be compared with those of the Basic Model (model 1) in Chapter 5. In addition, the level-1 estimates of the other two HLM models

presented later will be compared with those in this model. The 3-level intercepts-as-outcome model enables the analysis of the effects of class and school level factors using data with the nested variance structure. The 3-level slopes-as-outcome model assumes that the effect (slope) of private tutoring varies according to class and school level variables, and the level-2 and level-3 variables are used to model this relationship. This model helps to look more deeply into the institutional influence of the effect of private tutoring participation on student achievement in the NCEE.

All these HLM models are conducted on the entire sample, but not on the urban and rural subsamples. Because in the subsamples, there is not enough variation at class and school level. For example, in some urban schools, the majority of students are urban students, and there are only a few rural students. Thus, in the rural subsample, the variation among this kind of classes and schools is too small. Similarly, there are few urban students enrolled in schools where the majority is the rural student body. Thus, urban and rural subsamples are not analyzed in HLM model.

Table 6-1 reports the variance components of unconditional models (5778 students within 165 classes, within 25 schools) with sampling weighting. The dependent variables are the z-scored NCEE score for each subject and the total score. The within-class variance of Chinese score accounts for 51.38% of total variance, the between class variance accounts for 8.27% of total variance, and the between school variance accounts for 40.35% of total variance. The within class variance of NCEE Math score accounts for about 43.95% of the total variance, the between class variance accounts for 8.25%, and the between school variance accounts for 47.80%. The structures of variance for math and English are similar. In terms of the total score, within class variance accounts for 37.04%, while between school variance accounts for 52.17%

of total variance. Generally speaking, there are large amount of variation at student and school level, and relatively small but still significant amount of variation at the class level. The 3-level model is appropriate.

Table 6-1 Variance Components of Unconditional Model

		Variance	Proportion of variance
Chinese	Within class variance, within school	0.624	51.38%
	Between class variance, within school	0.100	8.27%
	Between school variance	0.490	40.35%
Math	Within class variance, within school	0.512	43.95%
	Between class variance, within school	0.096	8.25%
	Between school variance	0.557	47.80%
English	Within class variance, within school	0.515	43.00%
	Between class variance, within school	0.121	10.12%
	Between school variance	0.561	46.88%
All	Within class variance, within school	0.432	37.04%
	Between class variance, within school	0.126	10.79%
	Between school variance	0.609	52.17%

6.1.1 Level-1 Fixed Effect Model

Table 6-2 reports the results of level-1 fixed effect model by subjects and by different measures of private tutoring participation. In this model, student level covariates are controlled, and the level-2 and level 3 equations are left unconditional. All the covariates are grand mean centered. The variance components of unconditional level-2 and level-3 equations are examined.

Generally speaking, the results of level-1 fixed effect HLM are consistent with those of the Basic Model discussed in Chapter 5. Private tutoring has no significant effect on the three subjects respectively, but has a significantly negative effect on the total score of the entire sample, using the probability of private tutoring participation and private tutoring expenditure as the measures. The HSEE score, parents caring about study and respecting the child, and good study habits and ability are consistent significantly positive predictors across subjects and

different measures of private tutoring. The index of parents doing too much for the child has a consistent and significantly negative effect on the NCEE achievement. SES has a significantly positive effect on the NCEE English score and total score, but no effect on Chinese and Math scores. Female students perform significantly better in Chinese and English than male students, but there is no gender gap in math and all subjects as a whole. Students in science track make significant improvement in English, but regress in math, compared to their counterparts in humanity track. In regard to the NCEE total score, humanity track students make significant improvement than science track students.

The level-1 reliability is above 0.7 (and even close to 0.8) across subjects, meaning that the ratio of the true parameter variance in level 1 relative to the total variance of the class mean (the level-1 OLS estimates grouped by class) is larger than 0.7, and that the class means vary substantially across classes. The level-2 reliability is around 0.9, which indicates that the ratio of the true parameter variance in level 2 relative to the total variance of the school means (the level-2 OLS estimates grouped by school) is around 0.9, and that the school means vary substantially across schools. Because of the significant amount of variance of class means and school means, and the high reliability of the true parameters on these varying class means and school means versus on the grand mean of the whole sample, the 3-level HLM is very necessary.

The variance of level-1 residual is reported as variance component in Table 6-2. In regard to the NCEE Chinese score, compared with the level-1 variance in the unconditional model presented in Table 6-1, which is 0.624, the new level-1 variance after controlling for student and family characteristics is 0.508. Thus, the proportion variance explained at level 1 is 18.59%. Similarly, the proportion variance explained at level 2 is 57%, and is 77.76% at level 3. For math, the proportions of variance explained at level 1, 2, and 3 are 28.13%, 58.33%, and 83.3%

respectively. In regard to English score, the three proportions are 40%, 68.6%, and 87.52% from level 1 to level 3. For the NCEE total score, the proportion variance explained is 39.12% at level 1, 69.8% at level 2, and 86% at level 3.

Table 6-2 Within School Determinants of NCEE Score

	Chinese	Math	English	All subjects		
				Dummy	Expenditure	Time
	(1)	(2)	(3)	(4)	(5)	(6)
Private tutoring	-0.247	-0.072	-0.015	-0.3011*	-0.038**	-0.067
	(0.359)	(0.112)	(0.116)	(0.101)	(0.015)	(0.035)
Standardized HSEE score	0.382**	0.502**	0.583**	0.559**	0.571**	0.558**
	(0.021)	(0.038)	(0.037)	(0.044)	(0.042)	(0.043)
SES	0.013	0.001	0.031**	0.028**	0.022*	0.020
	(0.014)	(0.011)	(0.008)	(0.010)	(0.010)	(0.011)
Female	0.105**	0.002	0.126**	0.013	0.010	-0.001
	(0.034)	(0.032)	(0.023)	(0.026)	(0.025)	(0.027)
Science track	0.054	-0.205**	0.120**	-0.216**	-0.215**	-0.221**
	(0.046)	(0.034)	(0.036)	(0.030)	(0.030)	(0.030)
School choice	0.001	-0.003	0.002	-0.014	-0.010	-0.015
	(0.024)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)
Parents caring about study and respecting the child	0.022*	0.040**	0.031**	0.036**	0.033**	0.035**
	(0.009)	(0.008)	(0.006)	(0.008)	(0.007)	(0.007)
Parents regulating	-0.008	-0.005	-0.028*	-0.004	-0.005	-0.007
	(0.007)	(0.015)	(0.013)	(0.009)	(0.010)	(0.009)
Parents doing too much for the child	-0.039**	-0.042**	-0.031**	-0.015	-0.026**	-0.020
	(0.008)	(0.009)	(0.008)	(0.010)	(0.008)	(0.011)
Study habits and ability	0.027*	0.062**	0.040**	0.054**	0.044**	0.053**
	(0.011)	(0.008)	(0.010)	(0.007)	(0.007)	(0.007)
Constant	0.037	0.022	0.020	0.024	0.025	0.025
	(0.067)	(0.063)	(0.054)	(0.059)	(0.059)	(0.059)
Level 1 Standard error	0.713	0.606	0.556	0.513	0.513	0.513
Level 1 Variance component	0.508	0.368	0.309	0.263	0.263	0.263
Level 2 Standard deviation	0.206	0.201	0.194	0.195	0.195	0.198
Level 2 Variance component	0.043	0.040	0.038	0.038	0.038	0.039
Level 2 Degrees of freedom	140	140	140	140	140	140
Level 2 Chi-square	35.5	621.9	8656.2	799.2	857.6	891.3
Level 3 Standard deviation	0.3230	0.305	0.265	0.296	0.292	0.2907
Level 3 Variance component	0.109	0.093	0.070	0.087	0.085	0.085
Level 3 Degrees of freedom	24	24	24	24	24	24
Level 3 Chi-square	316.5	330.7	273.9	348.1	338.5	329.3
Level 1 Reliability estimate	0.706	0.754	0.772	0.798	0.798	0.801
Level 2 Reliability estimate	0.926	0.903	0.907	0.896	0.894	0.884
Proportion of variance explained at each level						
Level 1	18.59%	28.13%	40.00%	39.12%	39.12%	39.12%
Level 2	57.00%	58.33%	68.60%	69.84%	69.84%	69.05%
Level 3	77.76%	83.30%	87.52%	85.71%	86.04%	86.04%

Standard errors in parentheses
** p>0.01, * p>0.05

6.1.2 3-Level HLM: Intercepts-as-outcome Model

In this model, level-2 and level-3 predictors are introduced in order to explain the class mean and school mean respectively. All the covariates at the three levels are grand mean centered. Table 6-3 reports estimates of level-1 predictors. The results are consistent with those presented in Table 6-2, except that the effect of private tutoring on the NCEE total score becomes insignificant when using private tutoring expenditure and time index as the measures.

Table 6-4 presents the class and school effects on the varying class mean and school mean respectively. Key class is the only significantly positive predictor at the class level, which is also consistent across subjects and measures of private tutoring. A good class environment of personal relationship has no effect on the class mean. Class average SES has a significantly negative effect on Chinese class mean, but no effect on other subjects.

At the school level, the HSEE admission line and High authority and accountability organization feature are significantly positive predictors and their effects are consistent across subjects. Percent of teachers with a Master's degree has a significantly positive effect on Chinese NCEE score. The other school level variables are not significant predictors.

The level-1 reliability ranges between 0.6 and 0.7 for different subjects, and the level-2 reliability ranges from 0.7 to 0.8. Compared with level-1 fixed effect model, the proportion variance explained does not change at level 1, but increases significantly at level 2 and level 3.

Table 6-3 Level-1 Estimates of Intercepts-as-outcome Model

	Chinese	Math	English	All subjects		
				Dummy	Expenditure	Time
	(1)	(2)	(3)	(4)	(5)	(6)
Private tutoring	-0.345	-0.013	0.096	-0.264**	-0.028	-0.053
	(0.361)	(0.110)	(0.122)	(0.096)	(0.013)	(0.035)
Standardized HSEE score	0.373**	0.497**	0.577**	0.553**	0.563**	0.553**
	(0.022)	(0.040)	(0.038)	(0.045)	(0.044)	(0.045)
SES	0.015	-0.003	0.025***	0.024*	0.017*	0.016
	(0.013)	(0.011)	(0.009)	(0.011)	(0.010)	(0.011)
Female	0.105**	-0.003	0.124**	0.011	0.006	-0.002
	(0.034)	(0.032)	(0.023)	(0.026)	(0.025)	(0.026)
Science track	0.032	-0.212**	0.134**	-0.227**	-0.225**	-0.229**
	(0.047)	(0.037)	(0.039)	(0.034)	(0.035)	(0.035)
School choice	-0.002	-0.006	0.001	-0.015	-0.013	-0.016
	(0.024)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)
Parents caring about study and respecting the child	0.021*	0.040**	0.031**	0.036**	0.034**	0.035**
	(0.009)	(0.008)	(0.006)	(0.008)	(0.007)	(0.007)
Parents regulating	-0.007	-0.006	-0.031*	-0.005	-0.007	-0.008
	(0.007)	(0.015)	(0.013)	(0.010)	(0.010)	(0.009)
Parents doing too much for the child	-0.036**	-0.041**	-0.031**	-0.016	-0.026**	-0.021*
	(0.008)	(0.009)	(0.008)	(0.010)	(0.008)	(0.011)
Study habits and ability	0.027*	0.061	0.038**	0.052**	0.044**	0.051**
	(0.011)	(0.008)	(0.010)	(0.007)	(0.007)	(0.007)
Constant	-0.020	-0.018	-0.013	-0.014	-0.014	-0.012
	(0.029)	(0.033)	(0.025)	(0.028)	(0.028)	(0.028)
Level 1 Standard error	0.713	0.607	0.556	0.513	0.513	0.513
Level 1 Variance component	0.509	0.368	0.309	0.263	0.263	0.263
Level 2 Standard deviation	0.147	0.145	0.124	0.144	0.144	0.144
Level 2 Variance component	0.022	0.021	0.015	0.021	0.021	0.021
Level 2 Degrees of freedom	137	137	137	137	137	137
Level 2 Chi-square	232.2	513.1	620.8	762.6	762.2	766.1
Level 3 Standard deviation	0.119	0.136	0.106	0.114	0.114	0.114
Level 3 Variance component	0.014	0.018	0.011	0.013	0.013	0.013
Level 3 Degrees of freedom	13	14	13	13	13	13
Level 3 Chi-square	96.4	112.7	106.1	101.5	101.0	101.5
Level 1 Reliability estimate	0.563	0.63	0.6	0.694	0.695	0.696
Level 2 Reliability estimate	0.697	0.817	0.746	0.778	0.776	0.777
Proportion of variance explained at each level						
Level 1	18.43%	28.13%	40.00%	39.12%	39.12%	39.12%
Level 2	78.00%	78.13%	87.60%	83.33%	83.33%	83.33%
Level 3	97.14%	96.77%	98.04%	97.87%	97.87%	97.87%

Outcome is z-scored (mean=0, standard deviation =1)
The number of level-1 units = 5778
The number of level-2 units = 165
The number of level-3 units = 25
Standard errors in parentheses
** p>0.01, * p>0.05

Table 6-4 Class and School Effects on NCEE Class and School Means

	Chinese	Math	English	All subjects		
				Dummy	Expenditure	Time
	(1)	(2)	(3)	(4)	(5)	(6)
Class level effects on private tutoring slope						
Class environment of personal	0.045	0.032	0.014	0.024	0.021	0.018
relationship	(0.031)	(0.027)	(0.019)	(0.023)	(0.023)	(0.023)
Key Class	0.351**	0.365**	0.402**	0.352**	0.356**	0.362**
	(0.052)	(0.066)	(0.042)	(0.044)	(0.046)	(0.046)
Class average SES	-0.100**	-0.006	-0.011	-0.012	-0.009	0.001
	(0.035)	(0.037)	(0.028)	(0.032)	(0.033)	(0.037)
School level effects on Private tutoring slope						
Standardized total number of students	0.002	0.000**	-0.007	-0.005	0.000	0.003
in school	(0.034)	(0.000)	(0.034)	(0.041)	(0.041)	(0.041)
Student-teacher ratio	-0.071	-0.078	-0.042	-0.082	-0.076	-0.072
	(0.044)	(0.042)	(0.033)	(0.047)	(0.047)	(0.048)
Lab	0.054	0.046	0.068	0.051	0.050	0.042
	(0.059)	(0.065)	(0.058)	(0.059)	(0.059)	(0.059)
Percent of Level-1 teachers	-0.359	-0.193	-0.793	-0.751	-0.768	-0.772
	(0.453)	(0.590)	(0.476)	(0.462)	(0.456)	(0.459)
Percent of teachers with a Master's	2.150*	1.197	1.356	0.273	0.472	0.246
degree	(0.815)	(1.149)	(0.919)	(1.003)	(1.012)	(1.008)
Standardized HSEE admission line	0.182*	0.063	0.142*	0.134*	0.120*	0.119*
	(0.068)	(0.065)	(0.057)	(0.054)	(0.055)	(0.055)
School activity	0.132	0.182	0.085	0.123	0.130	0.129
	(0.074)	(0.093)	(0.082)	(0.104)	(0.105)	(0.105)
Collegial	0.007	0.008	-0.005	-0.006	0.000	-0.006
	(0.044)	(0.039)	(0.033)	(0.036)	(0.036)	(0.036)
Outcome-oriented	-0.042	-0.070	-0.045	-0.066	-0.049	-0.046
	(0.124)	(0.112)	(0.104)	(0.094)	(0.094)	(0.094)
Lax principal leadership	-0.117	-0.160	-0.121	-0.107	-0.111	-0.116
	(0.055)	(0.079)	(0.058)	(0.056)	(0.056)	(0.056)
High authority and accountability	0.220**	0.194**	0.084	0.174*	0.169*	0.154*
	(0.070)	(0.061)	(0.060)	(0.071)	(0.071)	(0.071)
Constant	-0.020	-0.018	-0.013	-0.014	-0.014	-0.012
	(0.029)	(0.033)	(0.025)	(0.028)	(0.028)	(0.028)
Level 1 Standard error	0.713	0.607	0.556	0.513	0.513	0.513
Level 1 Variance component	0.509	0.368	0.309	0.263	0.263	0.263
Level 2 Standard deviation	0.147	0.145	0.124	0.144	0.144	0.144
Level 2 Variance component	0.022	0.021	0.015	0.021	0.021	0.021
Level 2 Degrees of freedom	137	137	137	137	137	137
Level 2 Chi-square	232.2	513.1	620.8	762.6	762.2	766.1
Level 3 Standard deviation	0.119	0.136	0.106	0.114	0.114	0.114
Level 3 Variance component	0.014	0.018	0.011	0.013	0.013	0.013
Level 3 Degrees of freedom	13	14	13	13	13	13
Level 3 Chi-square	96.4	112.7	106.1	101.5	101.0	101.5
Level 1 Reliability estimate	0.563	0.63	0.6	0.694	0.695	0.696
Level 2 Reliability estimate	0.697	0.817	0.746	0.778	0.776	0.777
Proportion of variance explained at each level						
Level 1	18.43%	28.13%	40.00%	39.12%	39.12%	39.12%
Level 2	78.00%	78.13%	87.60%	83.33%	83.33%	83.33%
Level 3	97.14%	96.77%	98.04%	97.87%	97.87%	97.87%

Outcome is z-scored (mean=0, standard deviation =1)
The number of level-1 units = 5778
The number of level-2 units = 165
The number of level-3 units = 25
Standard errors in parentheses
** p>0.01, * p>0.05

6.1.3 3-Level HLM: Slopes-as-Outcome Model

Instead of the intercept, the level-1 estimated coefficient of private tutoring is modeled at level 2 and level 3. In this model, private tutoring is group centered at level 1, and it is assumed that the effect of private tutoring varies across classes within school and cross schools. Table 6-5 presents the estimates of level-1 variables. The results are still consistent with those of previous models.

Table 6-6 reports the class and school effects on the private tutoring slopes. According to column (1), students from classes with higher average SES will enjoy significantly better effect of Chinese private tutoring on their NCEE Chinese scores. This is also the case in regard to all subjects: the effects of private tutoring participation in any subjects and the total private tutoring expenditure increase as long as the class average SES increases.

At the school level, students from schools with higher HSEE admission line will enjoy a significantly negative effect of Chinese private tutoring on the NCEE achievement. For math, smaller class size, smaller student teacher ratio, and higher percentage of Level-1 teachers are found to have significantly positive effects on private tutoring slope. For English, higher percentage of Level-1 teachers and the administration style of high authority and accountability have significantly positive effects on private tutoring effect, but the HSEE admission line, lax principal leadership style and outcome-oriented style have significantly negative effects.

In regards to all the subjects, smaller class size, smaller student teacher ratio, more lab resources, school activity, and the administration style of high authority and accountability predict significantly higher effects of the probability of private tutoring participation; while HSEE admission line, lax principal leadership style and outcome-oriented style predict significantly lower effects. The effect of private tutoring expenditure is significantly increased by

smaller student teacher ratio and higher percentage of Level-1 teachers, and decreased by the HSEE admission line. Smaller school size and more lab resources have significantly positive effects on the slope of time spent on private tutoring. The HSEE admission line, lax principal leadership style and outcome-oriented style have negative effects on the same slope.

The reliability and proportion of variance explained at each level do not change compared with the level-1 fixed effect model, because all the level-2 and level-3 variables are used to explain one slope of level-1 model, but not the group mean as a whole.

Table 6-5 Level-1 Estimates of Slopes-as-outcome Model

	Chinese	Math	English	All subjects		
				Dummy	Expenditure	Time
	(1)	(2)	(3)	(4)	(5)	(6)
Standardized HSEE score	0.381**	0.503**	0.581**	0.562**	0.570**	0.566**
	(0.021)	(0.038)	(0.036)	(0.044)	(0.043)	(0.042)
SES	0.010	0.005	0.025**	0.021*	0.018	0.012
	(0.012)	(0.011)	(0.008)	(0.010)	(0.010)	(0.011)
Female	0.109**	0.008	0.125**	0.008	0.006	-0.002
	(0.033)	(0.031)	(0.023)	(0.026)	(0.025)	(0.026)
Science track	0.056	-0.213**	0.120**	-0.199**	-0.205**	-0.205**
	(0.046)	(0.035)	(0.037)	(0.033)	(0.032)	(0.032)
School choice	-0.002	-0.005	0.001	-0.015	-0.012	-0.016
	(0.024)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)
Parents caring about study and respecting the child	0.021*	0.040**	0.031**	0.035**	0.033**	0.034**
	(0.009)	(0.008)	(0.006)	(0.008)	(0.007)	(0.008)
Parents regulating	-0.009	-0.002	-0.030*	-0.005	-0.006	-0.010
	(0.007)	(0.014)	(0.014)	(0.010)	(0.010)	(0.009)
Parents doing too much for the child	-0.043**	-0.041**	-0.033**	-0.019*	-0.027**	-0.025**
	(0.008)	(0.009)	(0.008)	(0.010)	(0.008)	(0.010)
Study habits and ability	0.026*	0.063**	0.040**	0.051**	0.045**	0.049**
	(0.010)	(0.008)	(0.010)	(0.007)	(0.007)	(0.008)
Constant	0.038	0.009	0.021	0.025	0.025	0.026
	(0.067)	(0.061)	(0.055)	(0.060)	(0.060)	(0.060)
Level 1 Standard error	0.712	0.605	0.554	0.512	0.512	0.511
Level 1 Variance component	0.507	0.366	0.307	0.262	0.262	0.261
Level 2 Standard deviation	0.207	0.194	0.195	0.202	0.201	0.202
Level 2 Variance component	0.043	0.038	0.038	0.041	0.040	0.041
Level 2 Degrees of freedom	140	140	140	140	140	140
Level 2 Chi-square	78.9	659.6	1244.5	815.8	838.5	819.3
Level 3 Standard deviation	0.328	0.300	0.268	0.297	0.295	0.297
Level 3 Variance component	0.108	0.090	0.072	0.088	0.087	0.088
Level 3 Degrees of freedom	24.000	24.000	24.000	24	24	24
Level 3 Chi-square	312.0	342.5	277.9	329.9	329.4	330.9
Level 1 Reliability estimate	0.708	0.743	0.774	0.809	0.807	0.809
Level 2 Reliability estimate	0.925	0.913	0.907	0.937	0.937	0.937
Proportion of variance explained at each level						
Level 1	18.75%	28.52%	40.39%	39.35%	39.35%	39.58%
Level 2	57.00%	60.42%	68.60%	67.46%	68.25%	67.46%
Level 3	77.96%	83.84%	87.17%	85.55%	85.71%	85.55%

Outcome is z-scored (mean=0, standard deviation =1)
The number of level-1 units = 5778
The number of level-2 units = 165
The number of level-3 units = 25
Standard errors in parentheses
** p>0.01, * p>0.05

Table 6-6 Class and School Effects on Private Tutoring Slope

	Chinese	Math	English	All subjects		
				Dummy	Expenditure	Time
	(1)	(2)	(3)	(4)	(5)	(6)
Class level effects on private tutoring slope						
Class environment of personal	0.002	0.148	0.160	0.067	0.020	0.025
relationship	(0.357)	(0.082)	(0.155)	(0.082)	(0.014)	(0.029)
Key Class	0.586	-0.315	-0.350	0.089	0.005	0.043
	(0.459)	(0.237)	(0.197)	(0.088)	(0.023)	(0.036)
Class average SES	0.452*	0.061	0.105	0.185*	0.030	0.090*
	(0.204)	(0.074)	(0.106)	(0.072)	(0.016)	(0.035)
School level effects on Private tutoring slope						
Standardized total number of students in	0.174	-0.242*	-0.068	-0.166**	-0.011	-0.077**
school	(0.265)	(0.096)	(0.070)	(0.047)	(0.010)	(0.022)
Student-teacher ratio	0.290	-0.331**	-0.085	-0.164**	-0.035**	-0.037
	(0.331)	(0.106)	(0.094)	(0.040)	(0.011)	(0.019)
Lab	-0.023	0.048	0.110	0.222*	0.033	0.098*
	(0.609)	(0.162)	(0.143)	(0.114)	(0.021)	(0.047)
Percent of Level-1 teachers	-1.872	2.274**	2.496**	0.640	0.303*	-0.411
	(2.848)	(0.801)	(0.755)	(0.801)	(0.136)	(0.409)
Percent of teachers with a Master's						
degree	6.577	-1.038	0.407	0.139	-0.270	-0.158
	(8.122)	(2.310)	(1.866)	(0.930)	(0.276)	(0.454)
Standardized HSEE admission line	-0.987*	-0.122	-0.317*	-0.274**	-0.040*	-0.076*
	(0.394)	(0.111)	(0.142)	(0.085)	(0.019)	(0.039)
School activity	0.825	0.108	0.297	0.208**	0.009	0.059
	(0.756)	(0.187)	(0.161)	(0.077)	(0.027)	(0.041)
Collegial	-0.333	0.006	-0.137	0.012	0.005	-0.038
	(0.210)	(0.103)	(0.096)	(0.051)	(0.011)	(0.027)
Outcome-oriented	-0.335	-0.197	-0.469**	-0.239*	-0.040	-0.140**
	(0.623)	(0.174)	(0.171)	(0.114)	(0.024)	(0.051)
Lax principal leadership	-0.442	-0.106	-0.263**	-0.219*	-0.011	-0.097*
	(0.350)	(0.144)	(0.089)	(0.097)	(0.016)	(0.042)
High authority and accountability	0.418	0.090	0.215*	0.169**	0.019	0.038
	(0.523)	(0.126)	(0.097)	(0.061)	(0.018)	(0.030)
Intercept	-0.058	-0.078	0.130	-0.145	-0.015	0.000
	(0.361)	(0.079)	(0.113)	(0.094)	(0.014)	(0.035)
Level 1 Standard error	0.712	0.605	0.554	0.512	0.512	0.511
Level 1 Variance component	0.507	0.366	0.307	0.262	0.262	0.261
Level 2 Standard deviation	0.207	0.194	0.195	0.202	0.201	0.202
Level 2 Variance component	0.043	0.038	0.038	0.041	0.040	0.041
Level 2 Degrees of freedom	140	140	140	140	140	140
Level 2 Chi-square	78.9	659.6	1244.5	815.8	838.5	819.3
Level 3 Standard deviation	0.328	0.300	0.268	0.297	0.295	0.297
Level 3 Variance component	0.108	0.090	0.072	0.088	0.087	0.088
Level 3 Degrees of freedom	24.000	24.000	24.000	24	24	24
Level 3 Chi-square	312.0	342.5	277.9	329.9	329.4	330.9
Level 1 Reliability estimate	0.708	0.743	0.774	0.809	0.807	0.809
Level 2 Reliability estimate	0.925	0.913	0.907	0.937	0.937	0.937
Proportion of variance explained at each level						
Level 1	18.75%	28.52%	40.39%	39.35%	39.35%	39.58%
Level 2	57.00%	60.42%	68.60%	67.46%	68.25%	67.46%
Level 3	77.96%	83.84%	87.17%	85.55%	85.71%	85.55%

Outcome is z-scored (mean=0, standard deviation =1)
The number of level-1 units = 5778
The number of level-2 units = 165
The number of level-3 units = 25
Standard errors in parentheses
** p>0.01, * p>0.05

6.1.4 Summary of HLM Model

To summarize, the findings on the student level determinants of the NCEE score from the HLM model are consistent among the three HLM models and with the findings from the Basic Model. Private tutoring has no significant effect on the three subjects respectively. The money and time spent on private tutoring also have no significant effects on the NCEE total score, either. Only the probability of private tutoring in any subjects has a significantly negative effect on NCEE total score. Besides, the size of the private tutoring effect reported by the HLM model is smaller than that identified by the Basic Model. The HSEE score, parents caring about study and respecting the child, and good study habits and ability are consistent and significant positive predictors across subjects and different measures of private tutoring. The variable of parents caring too much significantly undermines the NCEE achievement. SES has a significantly positive effect on the NCEE English score and the total score, but has no effect on Chinese and Math scores. Female students perform significantly better in Chinese and English than male students, but there is no gender gap in the NCEE Math achievement and the total score. Compared with the humanity track students, students in the science track make significant improvement in English, but regress in math and total score, after controlling for other factors.

In terms of the class level variables, only key class has consistently significant and positive effect on the NCEE achievement across subjects and measures of private tutoring participation. Comparing the results in the Basic Model, a good class environment of personal relationship is no longer a significant predictor. At the school level, according to the 3-level intercepts-as-outcome model, only the HSEE admission line and the administrative style of high authority and accountability have significant and positive effects on the class mean of the NCEE score for each subjects and the total score. The other variables are basically not significant.

The 3-level slopes-as-outcome HLM model goes beyond the Basic Model by providing in-depth analysis of the institutional influence on the effect of private tutoring on the NCEE scores. Students from classes with higher class average SES are more likely to experience a better impact of private tutoring. Students from schools with greater education inputs (such as smaller school size, lower student-teacher ratio, more lab resource, and higher percent of Level-1 teachers) are likely to benefit more from private tutoring. Students from schools with a lower HSEE admission line are significantly more likely to benefit from private tutoring. High authority and accountability significantly increase the effect of English private tutoring and private tutoring in any subjects. Outcome-oriented style and lax principal leadership style significantly decrease the effect of private tutoring on English and the NCEE total score.

The HLM model requires sufficient variation at each level, which is not always guaranteed. In addition, most HLM models only have two levels, and fewer studies use 3-level models. The data used by this study enables the use of a 3-level HLM model on the whole sample. The urban and rural subsamples are not analyzed because of the limited variation at the class level and the school level.

Lessons learned from using the HLM model as opposed to the Basic Model are as follows. (1) HLM model takes into account the nested structure of education data. The results at the student level are consistent with those in the Basic Model. The effects identified at the class level and the school level are also consistent with those in the Basic Model. Thus, the HLM model enhances the robustness of the results. (2) The effects of money and time spent on private tutoring are found to have no effects on the NCEE total score in the HLM model. This may raise suspicion that the negative effect reported by the Basic Model is not true and is due to measurement error or the uncontrolled private tutoring quality, which cannot be addressed in the

Basic Model. (3) The 3-level slopes-as-outcome model enables the researchers to connect the class and school level factors with the effect of private tutoring, and see how these factors influences this effect, while controlling for other factors and the hierarchical structure. This is a unique contribution of the HLM model and cannot be obtained from the Basic Model.

6.2 Control Function (Model 3)

In this section, results of control function are reported and discussed. Since the determinants of NCEE achievement have been discussed in detail in previous sections, the main task of this section is to identify new findings due to the introduction of school selection control. Before discussing the results, two points need to be explained carefully. First, in the school selection model, the 25 schools are reduced into 4 school categories based on the HSEE admission lines and the HSEE school means. School category 1 has the highest admission lines and HSEE average, and school category 4 has the lowest admission lines and HSEE average. Table 6-7 reports the detailed information for each school, in which column (2) indicates the school category each school belongs to.

There are several reasons to group the 25 schools into 4 categories. First, if the 25 schools are taken as 25 categories of selection without grouping, school level variables will be deleted due to collinearity when introducing the Heckman correction term into the second stage equation. Second, even if there is no concern about collinearity, 25 selection equations are too many to be calculated in the software. This study uses Stata 11 to conduct analysis, which can only run this model with a few selection categories. Third, according to the historical reputation of the high schools in local community, the HSEE admission line, and the sample average HSEE score of each school, the 25 schools are divided into 4 groups. In detail, the whole HSEE admission interval is equally divided into four intervals first, and the 25 schools fall into these intervals respectively. The school indexed with number 125 is then moved from the second interval to the third because it is more closed to the one just below it than the one just above it in terms of the HSEE admission line.

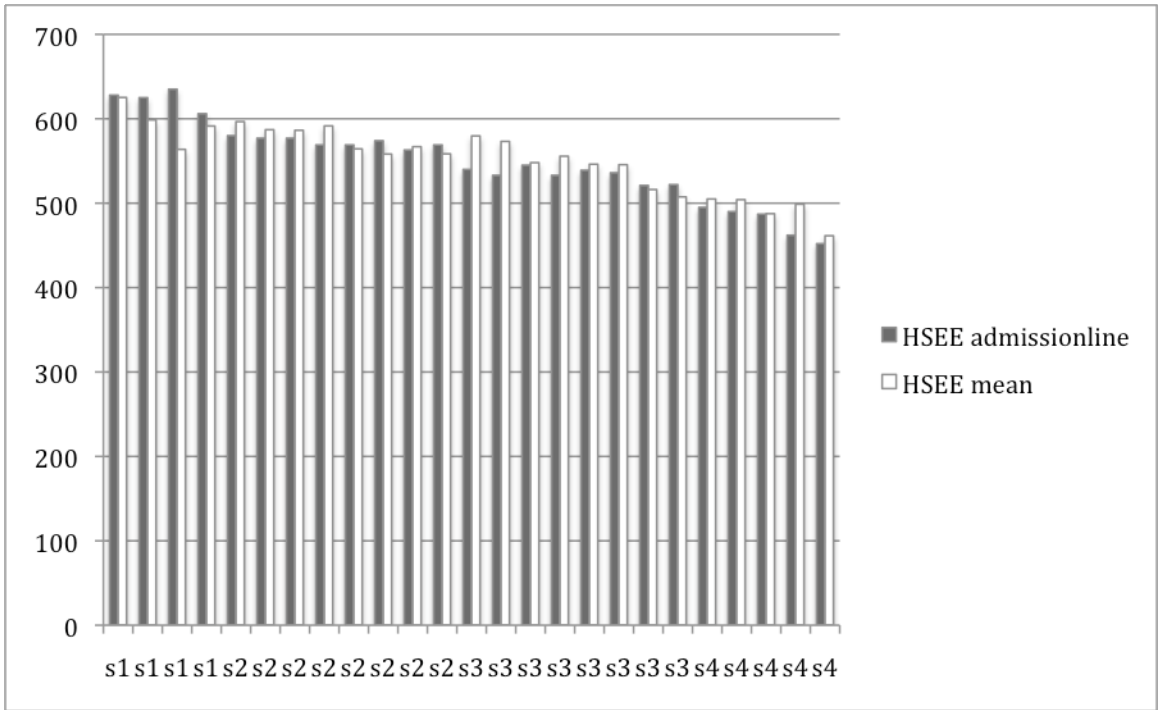
Table 6-7 HSEE Admission Line and School Average for Each School

School index (1)	School category (2)	HSEE admission line (3)	Mean (4)	Min. (5)	Max. (6)
106	s1	628	625	526	677
101	s1	625	599	392	641
109	s1	635	564	255	653
105	s1	606	591	435	640
113	s2	580	597	392	653
112	s2	577	587	288	663
102	s2	577	586	509	637
123	s2	569	592	427	649
124	s2	569	564	385	637
119	s2	574	558	325	640
108	s2	563	567	358	642
122	s2	569	558	401	639
121	s3	540	580	313	662
117	s3	533	573	332	655
125	s3	545	548	375	636
115	s3	533	556	315	638
116	s3	539	546	193	631
118	s3	536	546	92	629
103	s3	521	516	259	615
107	s3	522	507	291	603
110	s4	495	505	343	588
114	s4	490	504	292	574
104	s4	487	488	334	566
120	s4	462	499	255	592
111	s4	452	461	257	615

As shown in Figure 6-1, the first four schools from the left (marked as s1) are grouped as the first group. These four schools are the best well-known four schools in Jinan City and are given more enrollment autonomy and priority by the Jinan Education Bureau. These four schools also have the highest HSEE admission lines. The next 8 schools (marked as s2) have lower HSEE admission lines and school means, and their admission lines are very closed. They are thus grouped as the second category. The third and fourth groups are defined in the same way. The empirical results are robust when one or two schools at the margin are moved to the nearby school category.

In the empirical results of the second stage, the standard errors are not adjusted for the first stage (school selection model) because the adjusted standard error equation is too complex to compute by hand and Stata does not provide the procedure, either. However, the standard errors reported in the following tables have been adjusted using bootstrapping method based on the sampling weights. By doing this, the data can be regarded as a random sample from the population. Thus, the standard errors and the level of statistical significance reported in this section are still considered accurate (Davison & Hinkley, 2006).

Figure 6-1 HSEE Admission Lines and HSEE Sample Means



6.2.1 Three Subjects

Table 6-7 reports the results for Chinese by school category. A few school level variables are omitted by the program automatically due to collinearity. According to column (1), if a student is enrolled in school category 1, private tutoring will have no effect on the NCEE Chinese score, and HSEE Chinese score will have significantly positive effect. After controlling for the school selection process, the direct effect size of the HSEE score is smaller than what is reported in the Basic Model and the HLM model. SES will have no effect on student achievement. Female students will perform significantly better than male students. Humanity track students have significantly higher Chinese score than science track students. The indices of parents' education styles will have no effect on Chinese achievement. A good class environment of personal relationships has significantly positive effects on the NCEE Chinese score. The HSEE admission line has a significantly negative effect if students are enrolled in school category 1.

If a student is enrolled in school category 2, private tutoring has no significant effect on the NCEE Chinese score. The HSEE Chinese score is still a significant and positive determinant. SES becomes an insignificant predictor of the NCEE Chinese score. Female students perform significantly better than male students. Lower student teacher ratio will have a significantly negative effect. Collegial and outcome-oriented styles have significantly positive effects. If a student is enrolled in school category 3, private tutoring has a negative effect on the NCEE Chinese score. Both SES and key class are not significant predictors. Study habits and ability becomes significant. If a student is enrolled in school category 4, private tutoring has no effect. Female students perform significantly better than male students. Students in science track have significantly lower Chinese score than those in humanity track. Study ability, key class, and

lower student teacher ratio are all significantly positive predictors. HSEE admission line has a significantly positive effect on Chinese achievement. Lax principal leadership style has a significantly negative effect, while High authority and accountability feature has a significantly positive effect on NCEE Chinese score.

According to Bourguignon et al. (2007) and the help information in Stata, the Heckman correction term i (i=1, 2, 3, 4) in each column is the expected values of the transformed normally distributed residuals in the outcome equation if a student selects school category i, conditional on the corresponding school category of that column (which is different from school category i) being made. For example, in column (1) of Table 6-7, the Heckman correction term 2 is the expected values of the transformed normally distributed residuals in the outcome equation if a student selects school category 2 conditional on school category 1 being selected in reality. Similarly, the Heckman correction term 3 in column 4 is the expected value of the residual in the outcome equation if a student selects school category 3 conditional on school category 4 being selected. The Heckman corrections terms are computed from the first-step multinomial logit model and depend only on the corresponding conditional probabilities. The products of the Heckman correction terms and their corresponding coefficients show the bias from school selection. The coefficients of the Heckman correction terms 2 and 3 in column (1) of Table 6-7 and the Heckman correction term 1 in column (4) are significant, meaning that the bias from the school selection process is significant and should be controlled for.

Generally speaking, private tutoring has no effect on the NCEE Chinese score. The HSEE Chinese score is consistent and significantly positive predictor across schools. Gender and school selection status have no effect. Parents' educational styles on their child have modest

effects only if the students are enrolled in certain school categories. Key class is a consistent and significant predictor, but most school level inputs have heterogeneous effects across schools.

Table 6-8 Second Stage Estimates of Control Function – Chinese

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Predicted probability of private tutoring participation	0.475	-0.549	-1.493*	-0.538
	(0.383)	(0.706)	(0.681)	(0.901)
Standardized HSEE Chinese score	0.136**	0.084*	0.126**	0.157**
	(0.033)	(0.039)	(0.036)	(0.028)
SES	0.003	0.027	0.038	0.003
	(0.013)	(0.020)	(0.021)	(0.018)
Female	0.219**	0.169**	0.097	0.240**
	(0.035)	(0.050)	(0.051)	(0.044)
Science track	-0.129**	-0.064	-0.248**	-0.335**
	(0.042)	(0.060)	(0.051)	(0.049)
School choice	0.048	0.012	-0.045	0.038
	(0.036)	(0.052)	(0.046)	(0.038)
Parents caring about study and respecting the child	0.011	0.028	0.031	0.001
	(0.012)	(0.017)	(0.018)	(0.014)
Parents regulating	-0.017	-0.014	0.006	0.006
	(0.014)	(0.018)	(0.022)	(0.018)
Parents doing too much for the child	-0.029	-0.015	-0.016	-0.046*
	(0.017)	(0.024)	(0.027)	(0.020)
Study habits and ability	0.007	0.013	0.031*	0.029*
	(0.011)	(0.017)	(0.015)	(0.014)
Class environment of personal relationship	0.065*	0.048	0.034	0.040
	(0.029)	(0.035)	(0.037)	(0.033)
Key Class	0.076	0.259**	0.188	0.143*
	(0.047)	(0.075)	(0.128)	(0.067)
Class average SES	-0.019	0.045	-0.129	-0.116
	(0.044)	(0.097)	(0.153)	(0.080)
Standardized total number of students in school	0.009		-0.037	-0.236
	(0.024)		(0.031)	(0.148)
Student-teacher ratio	0.016	0.152*	-0.034	-0.531**
	(0.029)	(0.062)	(0.138)	(0.097)
Lab			0.024	-0.964**
			(0.052)	(0.186)
Standardized HSEE admission line	-0.201**			1.050**
	(0.072)			(0.185)
School activity			-0.099	
			(0.190)	
Collegial	0.026	0.109**	-0.281	-0.134
	(0.035)	(0.041)	(0.157)	(0.078)
Outcome-oriented	0.098	0.189*		
	(0.066)	(0.086)		
Lax principal leadership	-0.064			-0.733**
	(0.056)			(0.146)
High authority and accountability		0.101		0.667**
		(0.072)		(0.165)
Heckman correction term 1		1.290	1.286	0.653*
		(1.065)	(0.674)	(0.333)
Heckman correction term 2	18.196*		-2.798	-2.484
	(8.197)		(1.504)	(7.294)
Heckman correction term 3	-20.220*	-2.906		1.415
	(9.093)	(2.760)		(7.260)
Heckman correction term 4	0.071	0.535	0.349	
	(0.249)	(0.905)	(0.523)	
Constant	2.514	-1.141*	-2.056**	0.117
	(1.597)	(0.489)	(0.516)	(1.675)
N	1666	1121	1385	1669
F	29.2	.	33.96	367.39
Probability > 0	0	.	0	0
R^2	0.347	0.435	0.485	0.349

Standard errors in parentheses, ** p>0.01, * p>0.05

Table 6-9 reports the results for math by school category. A few school level variables are omitted by the program automatically due to collinearity. Private tutoring has no effect no matter which school category is chosen. The HSEE Math score has a significant and positive effect on the NCEE Math score, but the effect size is smaller than that in the Basic Model. SES has no effect on the NCEE Math achievement. Science track students perform worse than humanity track students no matter which school category is chosen. Gender and school choice status basically have no effect, except that if school choice students are enrolled in school category 2, their NCEE Math scores are significant higher. Parents caring about study and respecting the child have significantly positive effect if students are enrolled in school category 1 or 3. Parents' regulation has no effect for all school categories. The variable of parents doing too much for the child has a significantly negative effect if students are enrolled in school category 4. No matter being admitted by which school category, study ability has a significant and positive effect.

At the class level, if students are enrolled in school category 2, 3, or 4, key class will be a significantly positive predictor of the NCEE Math score. The effects of school level education inputs vary by school categories. For example, the HSEE admission line has a significantly negative effect if students select school category 1, but positive effect if students choose school category 4. This may imply that for students enrolled in the schools with the best junior middle school graduates, school level study ability grouping may have a negative effect on math achievement, which may due to the competition force from peers. But if students are in the schools with the worst junior middle school graduates measured by academic performance, they may benefit from peers with higher academic achievement. The coefficients of most Heckman

correction terms are significant, meaning that the bias from the school selection process is significant and should be controlled for.

Table 6-9 Second Stage Estimates of Control Function – Math

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Predicted probability of private tutoring participation	-0.059	-0.087	-0.105	-0.037
	(0.146)	(0.245)	(0.214)	(0.233)
Standardized HSEE Math score	0.224**	0.166**	0.330**	0.215**
	(0.054)	(0.045)	(0.061)	(0.028)
SES	0.008	-0.015	-0.013	-0.005
	(0.011)	(0.020)	(0.017)	(0.018)
Female	-0.001	-0.044	-0.047	0.004
	(0.030)	(0.040)	(0.040)	(0.041)
Science track	-0.295**	-0.207**	-0.263**	-0.382**
	(0.038)	(0.047)	(0.048)	(0.044)
School choice	-0.024	0.091*	-0.018	0.028
	(0.030)	(0.039)	(0.039)	(0.037)
Parents caring about study and respecting the child	0.034**	0.020	0.061**	0.023
	(0.011)	(0.013)	(0.018)	(0.013)
Parents regulating	0.007	-0.002	-0.016	0.022
	(0.013)	(0.016)	(0.017)	(0.016)
Parents doing too much for the child	-0.009	-0.019	-0.028	-0.081**
	(0.012)	(0.018)	(0.020)	(0.018)
Study habits and ability	0.040**	0.037**	0.062**	0.057**
	(0.009)	(0.012)	(0.013)	(0.013)
Class environment of personal relationship	0.001	0.073**	-0.025	0.058
	(0.023)	(0.028)	(0.032)	(0.032)
Key Class	0.039	0.439**	0.320**	0.326**
	(0.042)	(0.064)	(0.111)	(0.065)
Class average SES	-0.003	-0.043	-0.103	-0.020
	(0.037)	(0.076)	(0.121)	(0.071)
Standardized total number of students in school	0.162**		0.074*	-0.529**
	(0.021)		(0.031)	(0.127)
Student-teacher ratio	0.104**	0.039	0.130	-0.285**
	(0.026)	(0.048)	(0.113)	(0.092)
Lab			-0.171**	0.037
			(0.043)	(0.174)
Standardized HSEE admission line	-0.197**			0.513**
	(0.063)			(0.167)
School activity			-0.213	
			(0.160)	
Collegial	-0.064*	-0.078*	-0.056	0.046
	(0.031)	(0.034)	(0.131)	(0.069)
Outcome-oriented	0.154**	-0.154*		
	(0.057)	(0.070)		
Lax principal leadership	-0.250**			0.281*
	(0.049)			(0.139)
High authority and accountability		-0.038		0.953**
		(0.055)		(0.148)
Heckman correction term 1		2.262*	1.178*	0.517*
		(0.949)	(0.484)	(0.264)
Heckman correction term 2	33.519**		-2.689*	1.525
	(9.138)		(1.061)	(5.307)
Heckman correction term 3	-37.115**	-5.752*		-2.807
	(10.127)	(2.505)		(5.226)
Heckman correction term 4	0.609*	1.471	0.411	
	(0.263)	(0.804)	(0.363)	
Constant	6.026**	-1.662**	-2.033**	-0.362
	(1.761)	(0.511)	(0.382)	(1.289)
N	1666	1121	1385	1669
F	50.41	.	70.35	.
Probability > 0	0	.	0	.
R^2	0.452	0.586	0.583	0.437

Standard errors in parentheses, ** p>0.01, * p>0.05

Table 6-10 reports the results for English by school category. A few school level variables are omitted by the program automatically due to collinearity. Private tutoring has no effect for all school categories. The HSEE English score has a significant and positive effect for all school categories. SES has a significant and positive effect if a student is enrolled in school category 1. Female students perform significantly better than male students for all the categories. Science track students perform better if enrolled in school category 2. School choice students perform the same with non-school choice students for all categories. Parents caring about study and respecting the child have significantly positive effect if the students are enrolled in school category 3 or 4. Parents regulating have a negative effect if students are enrolled in school category 1 or 2. Parents doing too much for the child have a negative effect if the students are enrolled in school category 4. Good study habits and ability have significantly positive effect if students are enrolled in school category 1 2, or 3.

Key class has a significantly positive effect if students are enrolled in school category 1, 2, or 4. Class average SES has a significantly negative effect if students are enrolled in school category 2 or 3. A good class environment of personal relationship has no effect for any category. The school level variables also have various effects if students are admitted by different school categories. Smaller school size and the HSEE admission line only have significant and positive effect if a student is enrolled in school category 4. Student-teacher ratio has a significantly positive effect if a student is enrolled in school category 1 or 3. Lab resources and school activity is found to have a negative effect if a student is enrolled in school category 3. School activity has a negative effect if a student is enrolled in school category 3. Collegial style has a negative effect if a student is enrolled in school category 1 or 3, but significant and positive effect if a student is enrolled in school category 4. Outcome-oriented style has a significantly positive effect if a

student is enrolled in category 1. Lax principal leadership style has a negative effect if a student is enrolled in category 1, but positive effect for category 4. High authority and accountability has a significantly positive effect if a student is enrolled in category 4, but a negative effect for category 2.

The coefficients of the Heckman correction terms 1, 2, and 3 in column (4) are significant, meaning that the bias from the school selection process is significant and should be controlled for.

Table 6-10 Second Stage Estimates of Control Function – English

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Predicted probability of private tutoring participation	0.180	-0.159	-0.121	0.368
	(0.155)	(0.280)	(0.273)	(0.273)
Standardized HSEE English score	0.696**	0.507**	0.493**	0.359**
	(0.057)	(0.049)	(0.039)	(0.021)
SES	0.023*	0.031	-0.003	0.005
	(0.010)	(0.018)	(0.017)	(0.016)
Female	0.120**	0.116**	0.164**	0.210**
	(0.025)	(0.041)	(0.037)	(0.034)
Science track	-0.047	0.123**	0.020	0.036
	(0.032)	(0.048)	(0.041)	(0.037)
School choice	0.024	-0.012	-0.013	0.046
	(0.027)	(0.043)	(0.037)	(0.030)
Parents caring about study and respecting the child	0.017	0.009	0.046**	0.022*
	(0.009)	(0.013)	(0.017)	(0.011)
Parents regulating	-0.026*	-0.042**	-0.024	0.001
	(0.011)	(0.015)	(0.018)	(0.014)
Parents doing too much for the child	-0.015	-0.019	-0.005	-0.049**
	(0.011)	(0.019)	(0.020)	(0.015)
Study habits and ability	0.026**	0.023*	0.037**	0.020
	(0.008)	(0.012)	(0.011)	(0.011)
Class environment of personal relationship	-0.005	0.043	0.009	-0.001
	(0.021)	(0.031)	(0.032)	(0.024)
Key Class	0.155**	0.341**	0.068	0.280**
	(0.037)	(0.073)	(0.119)	(0.061)
Class average SES	-0.005	-0.168*	-0.331**	0.049
	(0.033)	(0.078)	(0.113)	(0.054)
Standardized total number of students in school	-0.018		-0.003	-0.505**
	(0.017)		(0.026)	(0.101)
Student-teacher ratio	0.071**	-0.050	0.385**	-0.141
	(0.021)	(0.049)	(0.111)	(0.075)
Lab			-0.098*	0.220
			(0.039)	(0.137)
Standardized HSEE admission line	0.023			0.435**
	(0.055)			(0.139)
School activity			-0.554**	
			(0.153)	
Collegial	-0.094**	-0.026	-0.333**	0.257**
	(0.026)	(0.033)	(0.123)	(0.057)
Outcome-oriented	0.150**	0.011		
	(0.050)	(0.070)		
Lax principal leadership	-0.123**			0.408**
	(0.042)			(0.102)
High authority and accountability		-0.171**		0.703**
		(0.054)		(0.118)
Heckman correction term 1		-1.260	-0.048	0.997**
		(1.069)	(0.436)	(0.296)
Heckman correction term 2	4.587		-0.343	-14.286*
	(7.622)		(0.981)	(6.303)
Heckman correction term 3	-5.786	2.723		13.165*
	(8.444)	(2.804)		(6.258)
Heckman correction term 4	-0.046	-1.360	-0.501	
	(0.232)	(0.902)	(0.338)	
Constant	-0.780	-1.347*	-2.396**	-4.616**
	(1.506)	(0.540)	(0.362)	(1.459)
N	1666	1121	1385	1669
F	54.73	.	103.06	.
Probability > 0	0	.	0	.
R^2	0.550	0.613	0.647	0.531

Standard errors in parentheses, ** p>0.01, * p>0.05

6.2.2 All Subjects

Table 6-11 to Table 6-13 report the results for the NCEE total score by school category and by measure of private tutoring. A few school level variables are omitted by the program automatically due to collinearity. The results are generally consistent across different measures of private tutoring participation. The effect of private tutoring is insignificant if students choose school category 1, or 4, but is significantly negative if a student selects school category 2 or 3, depending on which measure is used. The HSEE total score has a significantly positive effect on NCEE total score if school category 1 is chosen, and a negative effect if school category 4 is chosen. SES has a significant and positive effect if students are enrolled by school category 1 or 2. Female students perform significantly better than male students if they select school category 4. School choice status is not a significant predictor for students enrolled in any school categories. Parents caring about study and respecting the child and study habits and ability have significantly positive effects on the NCEE achievement for all school categories and for all the three measures of private tutoring participation.

At the class level, key class has a significant and positive effect on the NCEE total score for all school categories and for all the three measures of private tutoring participation. A good class environment of personal relationship only has a significant and positive effect if students are enrolled in school category 2. The school level variables still have various effects on students enrolled in different school categories. The school scale measured by student number has a significantly positive effect if students select school category 1, but a significantly negative effect if students choose school category 4. Lower student teacher ratio has a negative effect if a student selects one of the first three school categories, but has a significantly positive effect if a student selects school category 4. Lab resources have a negative effect if students are enrolled in

school category 3, but no effect if students select other categories. The HSEE admission line has a significantly positive effect if students are enrolled in school category 4. School activity has negative effects if students are in school category 3. Collegial, lax principal leadership, and high authority and accountability styles are positive predictors if a student selects school category 4. Collegial and lax principal leadership have a negative effect if a student selects school category1. Outcome-oriented style has positive effect if a student selects school category 1.

The coefficients of the Heckman correction term 4 in column (1) of Table 6-11 and the Heckman correction terms 1, 2, and 3 are significant, meaning that the bias from the school selection process is significant and should be controlled for.

Table 6-11 Second Stage Estimates of Control Function – All Subjects (1)

	School Category 1	School Category2	School Category 3	School Category 4
	(1)	(2)	(3)	(4)
Predicted probability of private tutoring participation	-0.181	-0.627**	-0.166	-0.062
	(0.131)	(0.213)	(0.206)	(0.173)
Standardized HSEE total score	1.972*	1.724	1.501	-8.213**
	(0.815)	(1.181)	(1.331)	(3.179)
SES	0.026*	0.049*	0.004	-0.002
	(0.011)	(0.021)	(0.018)	(0.016)
Female	0.012	0.010	0.009	0.074*
	(0.024)	(0.037)	(0.034)	(0.031)
Science track	-0.261**	-0.132**	-0.294**	-0.559**
	(0.029)	(0.046)	(0.040)	(0.033)
School choice	-0.003	0.038	-0.031	0.023
	(0.025)	(0.037)	(0.035)	(0.027)
Parents caring about study and respecting the child	0.025**	0.027*	0.051**	0.021*
	(0.008)	(0.012)	(0.015)	(0.010)
Parents regulating	-0.009	-0.014	-0.011	0.021
	(0.010)	(0.014)	(0.015)	(0.012)
Parents doing too much for the child	-0.003	0.016	-0.011	-0.063**
	(0.011)	(0.018)	(0.020)	(0.016)
Study habits and ability	0.045**	0.040**	0.050**	0.047**
	(0.008)	(0.012)	(0.012)	(0.011)
Class environment of personal relationship	0.006	0.077**	0.005	0.024
	(0.019)	(0.029)	(0.032)	(0.024)
Key Class	0.167**	0.339**	0.248*	0.322**
	(0.035)	(0.067)	(0.116)	(0.052)
Class average SES	-0.016	0.031	-0.191	0.057
	(0.031)	(0.074)	(0.119)	(0.052)
Standardized total number of students in school	0.107**		0.026	-0.602**
	(0.018)		(0.027)	(0.094)
Student-teacher ratio	0.121**	0.090*	0.251*	-0.381**
	(0.020)	(0.045)	(0.110)	(0.068)
Lab			-0.144**	0.012
			(0.034)	(0.129)
Standardized HSEE admission line	-0.060			0.731**
	(0.053)			(0.131)
School activity			-0.429**	
			(0.155)	
Collegial	-0.091**	-0.009	-0.266*	0.164**
	(0.024)	(0.031)	(0.127)	(0.052)
Outcome-oriented	0.157**	-0.067		
	(0.047)	(0.063)		
Lax principal leadership	-0.268**			0.337**
	(0.040)			(0.099)
High authority and accountability		0.045		1.037**
		(0.050)		(0.110)
Heckman correction term 1		-1.922	-0.907	15.301**
		(2.019)	(1.730)	(5.489)
Heckman correction term 2	6.866		0.280	-81.678**
	(13.311)		(2.276)	(29.218)
Heckman correction term 3	-10.427	2.835		63.851**
	(13.704)	(3.785)		(23.028)
Heckman correction term 4	1.698**	-0.397	0.067	
	(0.569)	(0.803)	(0.458)	
Constant	0.558	0.521	-0.896	-24.922**
	(2.520)	(1.090)	(1.202)	(8.873)
N	1666	1121	1385	1669
F	80.55	.	94.59	244.06
Probability > 0	0	.	0	0
R^2	0.576	0.650	0.665	0.572

Standard errors in parentheses, ** p>0.01, * p>0.05

Table 6-12 Second Stage Estimates of Control Function – All Subjects (2)

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring expenditure	-0.024	-0.083*	-0.037	-0.003
	(0.020)	(0.033)	(0.034)	(0.027)
Standardized HSEE total score	1.991*	1.764	1.523	-8.221**
	(0.816)	(1.185)	(1.332)	(3.173)
SES	0.023*	0.037	0.007	-0.005
	(0.010)	(0.019)	(0.018)	(0.015)
Female	0.010	0.002	0.012	0.071*
	(0.024)	(0.037)	(0.034)	(0.030)
Science track	-0.260**	-0.126**	-0.295**	-0.559**
	(0.029)	(0.046)	(0.040)	(0.033)
School choice	-0.001	0.047	-0.028	0.023
	(0.025)	(0.038)	(0.034)	(0.027)
Parents caring about study and respecting the child	0.023**	0.022	0.049**	0.021*
	(0.009)	(0.012)	(0.015)	(0.010)
Parents regulating	-0.009	-0.016	-0.009	0.020
	(0.010)	(0.014)	(0.015)	(0.012)
Parents doing too much for the child	-0.010	-0.009	-0.016	-0.066**
	(0.010)	(0.018)	(0.018)	(0.014)
Study habits and ability	0.039**	0.018	0.043**	0.045**
	(0.007)	(0.012)	(0.011)	(0.010)
Class environment of personal relationship	0.005	0.070*	0.008	0.023
	(0.019)	(0.028)	(0.032)	(0.024)
Key Class	0.166**	0.336**	0.236*	0.324**
	(0.036)	(0.069)	(0.117)	(0.053)
Class average SES	-0.014	0.045	-0.190	0.057
	(0.031)	(0.075)	(0.119)	(0.052)
Standardized total number of students in school	0.107**		0.023	-0.600**
	(0.018)		(0.027)	(0.095)
Student-teacher ratio	0.116**	0.097*	0.248*	-0.375**
	(0.020)	(0.045)	(0.110)	(0.067)
Lab			-0.127**	0.009
			(0.041)	(0.133)
Standardized HSEE admission line	-0.067			0.720**
	(0.052)			(0.129)
School activity			-0.424**	
			(0.154)	
Collegial	-0.083**	-0.006	-0.268*	0.162**
	(0.023)	(0.031)	(0.127)	(0.053)
Outcome-oriented	0.160**	-0.052		
	(0.047)	(0.063)		
Lax principal leadership	-0.255**			0.332**
	(0.040)			(0.101)
High authority and accountability		0.039		1.031**
		(0.050)		(0.110)
Heckman correction term 1		-1.961	-0.922	15.317**
		(2.024)	(1.724)	(5.478)
Heckman correction term 2	6.771		0.291	-81.714**
	(13.327)		(2.261)	(29.159)
Heckman correction term 3	-10.342	2.912		63.868**
	(13.719)	(3.797)		(22.982)
Heckman correction term 4	1.710**	-0.416	0.073	
	(0.569)	(0.807)	(0.455)	
Constant	0.407	0.039	-1.045	-24.985**
	(2.519)	(1.073)	(1.152)	(8.839)
N	1666	1121	1385	1669
F	80.15	.	94.65	.
Probability > 0	0	.	0	.
R^2	0.576	0.649	0.665	0.572

Standard errors in parentheses. ** p>0.01, * p>0.05

Table 6-13 Second Stage Estimates of Control Function – All Subjects (3)

	School Category 1	School Category2	School Category 3	School Category 4
	(1)	(2)	(3)	(4)
Private tutoring time index	-0.047	-0.211**	-0.108	0.010
	(0.045)	(0.076)	(0.076)	(0.063)
Standardized HSEE total score	1.984*	1.751	1.511	-8.226**
	(0.815)	(1.183)	(1.323)	(3.170)
SES	0.022*	0.043*	0.012	-0.008
	(0.011)	(0.020)	(0.018)	(0.015)
Female	0.003	-0.019	0.002	0.069*
	(0.023)	(0.036)	(0.033)	(0.028)
Science track	-0.264**	-0.144**	-0.305**	-0.558**
	(0.029)	(0.048)	(0.041)	(0.034)
School choice	-0.004	0.038	-0.032	0.023
	(0.025)	(0.037)	(0.035)	(0.027)
Parents caring about study and respecting the child	0.024**	0.026*	0.051**	0.021*
	(0.008)	(0.012)	(0.015)	(0.010)
Parents regulating	-0.010	-0.018	-0.009	0.019
	(0.010)	(0.014)	(0.015)	(0.012)
Parents doing too much for the child	-0.006	0.012	-0.005	-0.067**
	(0.011)	(0.018)	(0.019)	(0.015)
Study habits and ability	0.046**	0.044**	0.056**	0.044**
	(0.008)	(0.012)	(0.013)	(0.012)
Class environment of personal relationship	0.003	0.066*	0.007	0.021
	(0.019)	(0.027)	(0.031)	(0.023)
Key Class	0.172**	0.345**	0.236*	0.327**
	(0.035)	(0.066)	(0.116)	(0.052)
Class average SES	-0.006	0.083	-0.167	0.055
	(0.033)	(0.078)	(0.118)	(0.052)
Standardized total number of students in school	0.109**		0.023	-0.596**
	(0.018)		(0.024)	(0.094)
Student-teacher ratio	0.124**	0.109*	0.255*	-0.370**
	(0.021)	(0.045)	(0.110)	(0.068)
Lab			-0.132**	0.013
			(0.034)	(0.130)
Standardized HSEE admission line	-0.063			0.709**
	(0.053)			(0.134)
School activity			-0.424**	
			(0.154)	
Collegial	-0.098**	-0.020	-0.256*	0.162**
	(0.027)	(0.031)	(0.125)	(0.052)
Outcome-oriented	0.165**	-0.060		
	(0.046)	(0.063)		
Lax principal leadership	-0.272**			0.331**
	(0.041)			(0.099)
High authority and accountability		0.000		1.028**
		(0.053)		(0.111)
Heckman correction term 1		-1.991	-0.935	15.325**
		(2.023)	(1.718)	(5.474)
Heckman correction term 2	6.717		0.309	-81.703**
	(13.338)		(2.252)	(29.136)
Heckman correction term 3	-10.285	2.955		63.845**
	(13.731)	(3.791)		(22.963)
Heckman correction term 4	1.710**	-0.410	0.072	
	(0.569)	(0.804)	(0.453)	
Constant	0.439	0.259	-0.958	-24.995**
	(2.522)	(1.078)	(1.167)	(8.841)
N	1666	1121	1385	1669
F	80.04	.	94.77	.
Probability > 0	0	.	0	.
R^2	0.576	0.649	0.666	0.572

Standard errors in parentheses, ** p>0.01, * p>0.05

6.2.3 Results by Urban and Rural Subsamples

The estimates of control function model using the urban and rural subsamples are given in appendix. For the urban subsample, private tutoring basically has generally no effect on the NCEE score for all the three subjects and all subjects as a whole, but may have significantly positive effect for some subjects if a student is enrolled in certain school categories. Specifically, Chinese private tutoring has a significantly positive effect if an urban student is enrolled in school category 1. English private tutoring has a significant and positive effect if an urban student selects school category 4. Both time and money spent on private tutoring have significant and positive effect on the NCEE total score if an urban student is enrolled in school category 4.

For rural students, Chinese private tutoring has no effect if one selects school category 1 or 2, but has a negative effect if one selects school category 3 or 4. Math private tutoring has no effect for school category 1, 3, and 4, but has a negative effect if a rural student is enrolled in school category 2. English private tutoring has no effect across all school categories. In regards to the NCEE total score, the effects of private tutoring measured in the three different ways are consistent. Private tutoring has a negative effect for school categories 1 and 2. Therefore, private tutoring basically has no effect on 62%[41] of the rural students after controlling for school selection bias, and has no effect on all the rural students in English.

Parents caring study and respecting the child, good study habits and ability, and key class are the significant and positive predictors for urban students for all school categories. Good study habits and ability and key class are the significant and positive predictors for rural students for all school categories. Science track students perform worse than humanity students in Chinese, English and total score for both urban and rural subsamples.

[41] 62%=1735/2835

6.2.4 Summary

According to the analysis in section 6.2, private tutoring has no effect on achievement for all the three subjects, no matter which school category is selected. For the NCEE total score, private tutoring has no effect if a student selects school category 1, 3, or 4. Its effect is negative if a student selects school category 2. This may be caused by the definition of school category 2, which includes higher proportion of schools located in the counties or other less developed areas. It is plausible to assume that the quality of private tutoring in the counties and other less developed areas is lower than that in the more developed urban districts.

Two variables have consistent effect on the NCEE achievement across school categories and subjects. The HSEE score has a significant and positive effect on all the three subjects respectively across the four school categories, and on the NCEE total score if a student selects school categories 1 or 4. School choice status has no effect for the three subjects separately and for all the subjects.

Besides, some variables also have effects that are quite consistent, although not significant in one or two settings. For example, parents' regulation has no effect for all the different settings except that it has a negative effect on English score if a student select school category 1 or 2. Good study habits and ability have significant and positive effects for all settings except that its effect is not significant on Chinese if a student is enrolled in school category 1 or 2. Key class also has a significantly positive effect across subjects for most school categories across subjects. Class average SES basically has no effect for all settings, except that it has a negative effect on English if a student is enrolled in school category 2 or 3.

In addition, some variables have effects that vary by category and are consistent across subjects. The variable of parents doing too much for the child has a negative effect across

subjects only if a student select school category 4. A good class environment of personal relationship has a significant and positive effect if a student is enrolled in school category 2. School size has a significantly positive effect if a student is enrolled in school category 1, but significantly a negative effect if in school category 4. Smaller student-teacher ratio and collegial style have significantly positive effect if a student is enrolled in school category 4, but a negative effect or no effect for other categories. Lab resources have a negative effect if a student selects school category 3, and basically no effect otherwise. Outcome-oriented style has a significantly positive effect if a student selects school category 1, except that it has a negative effect using private tutoring expenditure as the measure. The administrative style of high authority and accountability has a significantly positive effect if a student selects school category 4, and basically no effect otherwise.

Further more, a few variables have effects that vary by subject and are consistent across categories. Female students perform significantly better than male students in English and Chinese, not there is any gender disparity in math and the NCEE total score. Science track students perform significantly worse than humanity students in Chinese, math, and NCEE total score, but not in English.

In the end, some variables have effects that vary by both subject and category. The variable of parents caring about study and respect the child has a significant and positive effect on math, English, and the NCEE total score for certain school categories, but has no effect on Chinese score. The HSEE admission line has a significantly positive effect across subjects if a student is enrolled in category 4, but has a negative effect on Chinese and math if one selects school category 1. School activity has a significantly negative effect on English and all subjects as a whole if a student is enrolled in school category 3. Lax principal leadership style has a

significantly negative effect if a student is enrolled in school category 1, and a positive effect if one selects school category 4, for all different subjects except Chinese.

Generally speaking, larger amount of variables have no effect on the Chinese score, compared with those for other subjects. The R-squared of the Chinese model is around 0.4, which is smaller than the R-squared of the Math model (around 0.5), the English model (around 0.6), and the all-subject model (around 0.6). More school level physical inputs have a significantly positive effect if a student is enrolled in school category 4, compared with those if a student is enrolled in other categories. This may due to the fact that school category 4 includes schools with the lowest quality which are more likely to face more severe education input deficit.

Lessons learned from using the Control Function model as opposed to the Basic Model are as follows. (1) The effects of student and class level variables identified in the Basic Model are robust because they are consistent with those reported in the CF model after controlling for school selection bias. (2) The heterogeneous effects of school level inputs are explored by school quality and subject. According to the CF model, the effects of school inputs vary by school categories. (3) The CF model finds that private tutoring has no effect on all the three subjects for all school categories and has no effect on the total score if a student is enrolled in school category 1, 3, or 4. Thus, private tutoring may have no effect for the NCEE total score for 81% of the students sampled and a negative effect for only 19%[42] of the students sampled. This is a major difference in finding between the Basic Model and the CF model.

[42] 19%=1121/5841

Chapter 7 Conclusions and Policy Implications

As discussed in chapters 1 and 2, the National College Entrance Exam in China is the most influential exam and plays a crucial role in not only higher education resource allocation, but also in education equity and social mobility. However, the determinants of NCEE performance are not clear in the literature, and the question on how to improve education achievement has not been fully discussed from the academic perspective. This study attempts to address this issue by trying to answer two research questions: (1) what are the determinants of the NCEE performance in China, and (2) what are the determinants of private tutoring and its effect on the NCEE score?

The research gap in this field is partially due to the lack of data. This study addresses this problem by collecting first hand data, which relaxes the constraint from several aspects. First, the new data collected by this study enables the analysis on the determinants of the NCEE performance, which are otherwise not available. Second, it provides detailed information on private tutoring that has not been reported by previous studies. The three different measures of private tutoring participation are also derived from this data. Third, this new dataset allows the analysis by different school subjects, urban and rural subsamples, different measures of private tutoring, and different models, which need detailed information on the hierarchical structure and school enrollment. The information of the two instrumental variables designed for this study was also collected during the fieldwork, which is crucial to the Basic Model and is not available elsewhere.

In this chapter, the key findings are summarized first, followed by the discussion on the significance and limitations of this study. Areas of further research are discussed. Based on the key findings, education policy implications are explored.

7.1 Summary of Key Findings

The key findings are organized in a way that could explicitly answer the two key research questions. First, the determinants (other than private tutoring) of the National College Entrance Exam performance in China are summarized one by one. Second, the determinants and effects of private tutoring participation are discussed separately and address the second key research question. Tables 7-1 to 7-3 summarize the findings of each determinant on each school subject for each of the three models and by subsamples. The signs of the effects that are significant are reported. “No” means no significant effect. For the Control Function model, most effects are heterogeneous across school categories. The tables below only present the signs of the effects that are consistent in at least two school categories and are not significant for the rest of the categories. Mixed effects with both positive and negative effects are presented as “No effect” for simplicity. If a variable has a significant effect in only one school category but an insignificant effect in the other three categories, the result is considered weak and is reported as “No effect,” too. Table 7-4 summarizes the findings on the determinants of private tutoring participation. The signs of the effects that are significant are reported. Columns 1 to12 present the results from the logit model, columns 13 to 15 report the results from the Tobit model, and columns 16 to 18 show the results from the OLS model.

Table 7-1 Findings on the Determinants of NCEE Performance for the Whole Sample

	Basic Model						HLM						Control Function					
	CN	MA	EN	Total score			CN	MA	EN	Total score			CN	MA	EN	Total score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Private tutoring participation: Probability	No	No	No	–			No	No	No	–			No	No	No	No		
Expenditure					–						No						No	
Time index						–						No						No
Standardized HSEE score	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	No	+	No
SES	No	No	No	+	+	+	No	No	+	+	+	No	No	No	No	+	No	+
Female	+	No	+	No	No	No	+	No	+	No	No	No	+	No	+	No	No	No
Science track	No	–	+	–	–	–	No	–	+	–	–	–	–	–	No	–	–	–
School choice	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Parents caring about study and respecting the child	+	+	+	+	+	+	+	+	+	+	+	+	No	+	+	+	+	+
Parents regulating	No	No	–	No	No	No	No	No	–	No	No	No	No	No	–	No	No	No
Parents doing too much for the child	–	–	–	No	–	No	–	–	–	No	–	–	No	No	No	No	No	No
Study habits and ability	+	+	+	+	+	+	+	No	+	+	+	+	No	+	+	+	+	+
Class environment of personal relationship	+	+	No	+	+	No	No	No	No	No	No	No	No	No	No	No	No	No
Key Class	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Class average SES	–	No	No	–	No	No	–	No	No	No	No	No	No	No	–	No	No	No
Standardized total number of students in school	No	No	No	–	No	–	No	No	No	No	No	No	No	+	–	No	No	No
Student-teacher ratio	–	–	–	–	–	–	No	No	No	No	No	No	–	No	+	No	No	No
Lab	No	No	+	+	No	+	No	No	No	No	No	No	No	No	No	No	No	No
Percent of Level-1 teachers	–	No	–	–	–	–	No	No	No	No	No	No	No	No	No	No	No	No
Percent of teachers with a Master's degree	+	+	+	No	+	No	+	No	No	No	No	No	No	No	No	No	No	No
Standardized HSEE admission line	+	+	+	+	+	+	+	No	+	+	+	+	No	No	No	No	No	No
School activity	+	+	+	+	+	+	No	No	No	No	No	No	No	No	No	No	No	No
Collegial	No	No	No	No	No	No	No	No	No	No	No	No	No	–	No	No	No	No
Outcome-oriented	No	No	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No
Lax principal leadership	–	–	–	–	–	–	No	No	No	No	No	No	No	No	No	No	No	No
High authority and accountability	+	+	+	+	+	+	+	+	No	+	+	+	No	No	No	No	No	No

Notes: CN = NCEE Chinese score, MA = NCEE Math score, EN = NCEE English score, Total score = NCEE total score

Table 7-2 Findings on the Determinants of NCEE Performance for the Urban Subsample

		Basic Model						Control Function					
		CN	MA	EN	Total score			CN	MA	EN	Total score		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Private tutoring participation:	Probability	No	No	No	No			No	No	No	No		
	Expenditure					No						No	
	Time index						No						No
Standardized HSEE score		+	+	+	+	+	+	+	+	+	+	+	+
SES		No	No	+	+	+	+	No	No	No	No	No	No
Female		+	No	+	No	No	No	+	No	+	No	No	No
Science track		No	–	+	–	–	–	–	–	No	–	–	–
School choice		No	No	No	No	No	No	No	No	No	No	No	No
Parents caring about study and respecting the child		+	+	+	+	+	+	No	+	+	+	+	+
Parents regulating		No	No	–	No	No	No	No	No	No	No	No	No
Parents doing too much for the child		–	–	–	–	–	–	–	No	No	No	No	No
Study habits and ability		+	+	+	+	+	+	No	+	+	+	+	+
Class environment of personal relationship		No	+	+	+	+	+	No	No	No	No	No	No
Key Class		+	+	+	+	+	+	No	+	+	+	+	+
Class average SES		–	No	No	No	No	No	No	No	No	No	No	No
Standardized total number of students in school		–	No	–	–	–	–	No	No	No	No	No	No
Student-teacher ratio		–	No	–	–	–	–	No	No	No	No	No	No
Lab		No	–	–	No	No	No	No	No	No	No	No	No
Percent of Level-1 teachers		No	No	+	–	–	–	No	No	No	No	No	No
Percent of teachers with a Master’s degree		+	No	+	No	No	No	No	No	No	No	No	No
Standardized HSEE admission line		+	+	+	+	+	+	No	No	No	No	No	No
School activity		+	+	+	+	+	+	No	No	No	No	No	No
Collegial		No	No	No	No	No	No	No	–	No	No	No	No
Outcome-oriented		No	–	–	–	–	–	No	No	No	No	No	No
Lax principal leadership		–	No	No	No	No	No	No	No	No	No	No	No
High authority and accountability		+	+	+	+	+	+	No	No	No	No	No	No

Notes: CN = NCEE Chinese score, MA = NCEE Math score, EN = NCEE English score, Total score = NCEE total score

Table 7-3 Findings on the Determinants of NCEE Performance for the Rural Subsample

		Basic Model						Control Function					
		CN	MA	EN	All	Exp.	Time	CN	MA	EN	All	Exp.	Time
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Private tutoring participation:	Probability	–	No	No	–			–	No	No	–		
	Expenditure					–						–	
	Time index						–						–
Standardized HSEE score		+	+	+	+	+	+	+	+	+	No	+	No
SES		No	No	No	+	No	No	No	No	No	No	No	No
Female		No	No	+	No	No	No	+	No	+	No	No	No
Science track		No	–	+	–	–	–	–	–	No	–	–	–
School choice		No	No	No	No	No	No	No	No	No	No	No	No
Parents caring about study and respecting the child		No	+	+	+	No	+	No	No	No	No	No	No
Parents regulating		No	No	–	No	No	No	No	No	No	No	No	No
Parents doing too much for the child		No	No	No	No	No	No	No	No	No	No	No	No
Study habits and ability		+	+	+	+	+	+	No	+	No	+	+	+
Class environment of personal relationship		+	No	No	No	No	No	No	No	No	No	No	No
Key Class		+	+	+	+	+	+	+	+	+	+	+	+
Class average SES		No	No	No	No	No	No	No	No	–	No	No	No
Standardized total number of students in school		No	No	No	No	No	No	No	No	No	No	No	No
Student-teacher ratio		–	–	–	No	No	No	No	No	No	No	No	No
Lab		+	No	No	No	No	No	No	No	No	–	No	–
Percent of Level-1 teachers		–	No	No	–	No	–	No	No	No	No	No	No
Percent of teachers with a Master’s degree		No	+	+	No	+	No	No	No	No	No	No	No
Standardized HSEE admission line		+	No	+	+	+	+	No	No	No	No	No	No
School activity		+	No	+	No	No	No	No	No	No	No	No	No
Collegial		No	No	No	No	No	No	No	No	No	No	No	No
Outcome-oriented		No	No	+	No	+	No	No	No	No	No	No	No
Lax principal leadership		–	–	–	–	–	–	No	No	No	No	No	No
High authority and accountability		+	+	+	+	+	+	No	No	No	No	No	No

Notes: CN = NCEE Chinese score, MA = NCEE Math score, EN = NCEE English score, Total score = NCEE total score

Table 7-4 Findings on the Determinants of Private Tutoring Participation

	Chinese			Math			English			Any subjects			PT Expenditure			PT time		
	A	U	R	A	U	R	A	U	R	A	U	R	A	U	R	A	U	R
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
IV: # of peers participating in PT	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
IV: Distance b/t home and PT center	–	–	–	–	–	–	–	–	–	–	–	No	–	–	–	–	–	–
Standardized HSEE score	No	No	No	–	–	No	No	No	No	–	–	No	No	No	No	–	–	–
SES	+	+	No	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Female	–	–	–	+	+	+	No	No	+	+	+	+	+	+	+	No	No	No
Science track	No	No	No	–	–	No	–	No	–	No	No	No	No	No	No	-	No	No
School choice	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Parents caring about study and respecting the child	No	No	No	No	No	No	No	No	No	No	No	No	No	No	–	No	No	No
Parents regulating	+	No	+	+	+	+	+	+	+	+	+	No	+	+	+	+	+	+
Parents doing too much for the child	+	+	+	+	No	+	+	No	+	+	+	+	No	No	No	+	+	+
Study habits and ability	+	No	+	No	No	No	No	No	No	+	+	+	–	–	No	+	+	+
Class environment of personal relationship	+	No	+	+	No	+	+	No	+	+	No	+	+	No	+	+	No	+
Key Class	No	No	No	–	No	No	–	No	No	–	–	No	–	–	No	–	–	No
Class average SES	–	No	No	No	No	–	–	No	–	No	No	No	No	No	No	+	+	No
Standardized total number of students in school	–	No	No	–	–	–	–	–	–	–	No	–	–	–	–	–	No	–
Student-teacher ratio	–	No	–	–	No	–	–	No	–	–	No	–	–	No	-	No	No	–
Lab	+	No	+	+	No	+	+	No	+	+	No	+	+	No	+	+	No	+
Percent of Level-1 teachers	No	No	No	No	No	+	No	No	No	No	No	No	+	No	+	+	+	No
Percent of teachers with a Master's degree	No	No	No	No	No	No	+	No	+	No	–	No	+	No	+	–	–	No
Standardized HSEE admission line	No	+	No	No	+	No	No	+	No	+	+	No	+	No	No	+	+	No
School activity	+	No	No	+	No	+	+	No	+	No	–	No	No	No	+	No	No	+
Collegial	No	No	No	No	–	+	No	–	+	No	No	No	No	No	+	–	–	No
Outcome-oriented	No	No	–	–	–	–	–	–	–	–	No	–	No	No	No	No	No	No
Lax principal leadership	No	No	No	+	No	+	+	No	+	+	No	No	+	No	No	+	No	No
High authority and accountability	+	No	+	+	No	+	+	No	+	+	No	+	+	No	+	–	–	+

Notes: A = all students, U = urban subsample, R = rural subsample

7.1.1 The Determinants of NCEE Performance in China

High School Entrance Exam score

The High School Entrance Exam score has a significantly positive effect on the NCEE score, and the effect is consistent across subjects, urban and rural subsamples, models using different measures of private tutoring, and the three identification strategies (i.e. the Basic Model, the HLM model, and the Control Function model). The effect size is also relatively large. In addition, among the three subjects, the effect size of the HSEE score on the corresponding NCEE score is larger in English and smaller in Chinese. After controlling for the high school selection bias in the CF model, the effect size decreases for the three subjects respectively, but increases for the total score.

SES

SES as constructed from parental education levels and parents' professions, has no effect on the NCEE Chinese score and Math score, but has a significant and positive effect on the NCEE total score and urban students' English score. This result is supported by the Basic Model and the HLM model. In the CF model, SES has a significant and positive effect on student achievement in English and NCEE total score if a student is enrolled in the top one or two school categories. This phenomenon is also the case for the urban subsample. Fur rural students SES has no effect on student performance across school categories after controlling for school selection bias.

Gender

Female students perform significantly better in Chinese and English than male students. There is no gender gap in math and the NCEE total score. This result is consistent across the

three models. The disappearance of gender gap in academic performance has been observed by the Chinese educational researchers and policymakers. Some argue that because of the one-child policy in China, when girls become the only child of a family especially in the urban areas, and gender discrimination is thus minimized. Girls are educated in the same way as boys.

Academic track

Science track students usually have higher academic performance than humanity track students in China, which is also supported by the descriptive statistics of the NCEE scores in Chapter 4. However, after controlling for other determinants, science students perform the same as humanity students do in Chinese; perform worse in math, better in English, and worse in the NCEE total score. This may imply that the science track students work harder to improve their "weak courses" such as their English score, and the humanity track students work harder to improve their Math score.

School choice student

The school choice student is a common status in China, where students with HSEE score a few points lower than the HSEE admission of certain school can pay for school choice fee to get into that school. There are no statistically significant differences in findings among the three models. This result is consistent for the urban and rural subsamples, by subjects, and across the three different models.

Parental education styles

The effects of three different parental styles of educating their child are evaluated in this study. The index "parents caring about study and respecting the child" has high loadings on the statements in the student questionnaire including "my parents go to the Parent Meeting every time," "my parents trust me to do what they expect without checking up on me," and "my

parents respect my opinion." This parental educational style has a consistent and significantly positive effect on the NCEE scores across subjects, various models, and urban and rural subsamples. But it has no effect on the rural students' NCEE Chinese score and total score when using private tutoring expenditure as the measure. The effect size is not large and is similar with that of SES.

The index "parents regulating" describes a kind of parental educational style that parents care about child's studying, have high expectations, and control child's time spent on TV, personal computers, and going out with friends. It has no effect on the NCEE scores, after controlling for other factors. This result is consistent across the subjects, the urban and rural subsamples, models using different measures of private tutoring, and the three models.

The index "parents doing too much for the child" describes the kind of parental education style that makes the child count on their parents to solve many of the problems for him/her. This factor has a significant and negative effect on the NCEE score of urban students and the whole sample across subjects and different models, but has no effect on the rural subsample.

Thus, among the three different ways of educating the children, parents who care about the study and respect the child can receive positive results in the NCEE performance, while parents who do too much for their child and make their child rely too much on them to solve problems will have a negative effect on their child's NCEE scores.

Study habits and ability

The measure of study habits and ability is the index with high loadings on the self-evaluation statements including (1) I am good at summing up knowledge and mistakes, (2) I usually do preparation before the lesson, (3) I usually review the material after the lesson, (4) I have a correct attitude toward studying, and (5) I have a strong ability to concentrate and

persevere. Good study habits and ability measured in this way have a significant and positive effect on the NCEE score, which is consistent across subjects, the urban and rural subsamples, models using different measures of private tutoring, and the three different identification strategies.

Good class environment of personal relationship

The index of a good class environment of personal relationship has high loadings on the statements saying that the study atmosphere of the class is very good, the head teacher is very responsible, open-minded, and very kind, and that most of the teachers care about the students. This index has negative loading on the statement that "I was treated unfairly by my teachers or classmates." According to the Basic Model, this index has a significant and positive effect on the urban students' NCEE Math, English, and total score, and on the rural students' NCEE Chinese score and total score when using time spent on private tutoring as the measure. However, as reported in the HLM model and the CF model, this index has no effect on the NCEE scores.

Key class

Key class is a dummy variable that indicates whether a student is in a key class with a school. Key class usually has the top performance students and is assigned with high performance teachers. Key classes sometimes have more rigid academic training than non-key classes. Thus, key class is considered as the instrument of class level peer effect as well as the class level teacher resource allocation. Recently, due to the advocacy of education equity, key classes are forbidden to run in most public primary and lower secondary schools and in some high schools. Key classes still exist in this cohort of students sampled in this study. Key class is found to have a consistent and significantly positive effect on student achievement in the NCEE

across subjects, urban and rural subsamples, and models using different measures of private tutoring.

Class average SES

Class average SES is designed as another measure of peer characteristics at the class level and is suspected to have some kind of effect on student achievement. However, after controlling for other determinants, class average SES basically has no effect on the NCEE scores.

School size

School size is the standardized measure of the total student number in the school. Smaller school size is found to have significant positive effect on urban students' NCEE English score and total score, but has no effect on other subjects and on rural students.

Student-teacher ratio

Small student-teacher ratio represents higher education inputs and is found to have significant and positive effect on the NCEE Chinese and English score for all the different samples, on the Math score for the whole sample and rural subsample, and on the NCEE total score for the whole sample and urban subsample. It is found to have no effect in the HLM model and heterogeneous effect in different school categories in the CF model.

Lab resources

The lab resources index has high loadings on schools' physics lab, chemistry lab, and biology lab. This index also has high correlation with school computer resources, which is therefore deleted from the analysis. Thus, the lab resources index measures the school's physical inputs that could facilitate students' study. The lab resources is found to have a significantly positive effect on rural students' NCEE Chinese score, the whole sample's English score and total score, according to the Basic Model, is found to have no effect according to the HLM

model, and is found to have no effect or a negative effect in different contexts according to the CF model. The effect size reported by the Basic Model is quite small. Thus, lab resources have a positive but relatively weak effect on the NCEE performance. This may due to the fact that most high schools in Jinan have meet the basic requirement of lab resources and that the NCEE does not test so much on experiment based skills.

Teacher quality

Teacher quality is difficult to define and hard to measure. Various questions have been designed in the student's questionnaire, the teacher's questionnaire, and the principal's questionnaire in order to measure the quality of teachers. However, student level evaluation on the teacher quality is highly suspected to be endogenous. Teachers' position rankings, education levels, and honors are not consistent with each other and thus cannot be used to construct a high quality measure. This study uses school level percentage of teachers with a Master's degree and percentage of Level-1 teachers as the two measures of teacher quality. The Basic Model finds that the percent of teachers with a Master's degree has a significant and positive effect on the NCEE Chinese score for the whole sample and urban subsample, Math score for the whole sample and rural subsample, and English score for all the different samples. It also has a significantly positive effect on rural students' NCEE total score when using private tutoring expenditure as the measure of private tutoring participation. The positive effects of teacher credentials may not indicate that teachers with a Master's degree have higher quality, but rather that schools with a higher percentage of teachers with a Master's degree are high performing schools. Since most of the teachers do not have Master's degree, new teachers with a Master's degree are scarce and are likely to choose the high performing schools with high reputation. Thus, teacher credentials may serve as a signal of school quality. The percent of Level-1 teachers has a

significantly positive effect on urban students' English score, but has no effect or a negative effect in other contexts.

HSEE admission line

The effect of the HSEE admission line is considered as the measure of school level peer effect from the academic perspective. The HSEE admission line is found to have significant and positive effect on the NCEE score across subjects and models using different measures of private tutoring, according to the Basic Model and the HLM model. In the Control Function model, the HSEE admission line has a significant and positive effect only if a student is enrolled in the bottom performing school category.

School activity

The school activity index measures the amount of school activities such as museum visits or science center visits, theatrical performances, school magazines, and psychological consulting. According to the Basic Model, school activity has consistent and significantly positive effect on the NCEE scores across subjects, the whole sample and the urban subsample, and models using different measures of private tutoring. It also has a significant and positive effect on rural students' NCEE Chinese and English scores. The HLM model finds no effect of school activity on the NCEE achievement, and the CF model finds no effect or negative effect after controlling for the school selection bias.

School administrative styles

There are four school administrative styles identified from the principal component analysis and included in the empirical analysis. Collegial style has high loadings on the teachers' statements such as "*teachers in this school have a high teaching autonomy*," "*I think the school leaders often listen to teachers' advice and opinions*," "*the school leaders usually make*

requirement on teachers through discussion," and other statements about teachers' career development and welfare. Outcome-oriented style has high loadings on the statements including "*this school evaluates my teaching mainly by my students' test score*," "*this school evaluates my teaching ability mainly by my teaching assessment*," and "*the school leaders value most on the NECC score and the promotion rate to the college*." The lax principal leadership style has high loadings on "*I don't think this school evaluates teachers teaching ability at all*" and "*the school leaders usually make requirements on teachers through negotiation*." The high authority and accountability style has high loadings on the statements including "*I feel like this school's leaders have a high standard on teaching quality*," "*I think this school has high authority and clear hierarchy*," and "*the school leaders usually make requirement on teachers through the authority*."

According to the Basic Model, collegial style has no effect on the NCEE score. Outcome-oriented administrative style has a negative effect on the urban students but a positive effect on the rural students on English and total scores. It has no effect on the Chinese score, and a negative effect on urban students' math score. This identifies the heterogeneous effect of outcome-oriented style on the urban and rural subsamples – rural students may benefit from the outcome-oriented style while urban students may face a negative influence from this style. The lax principal leadership style has a negative effect on the whole sample and the rural subsample across different subjects and models using various measures of private tutoring. It has no effect on urban students' NCEE achievement except the a negative effect on the Chinese score. It is important to note that lax principal leadership is found to have no effect by the HLM model and the CF model. The administrative style of high authority and accountability has a consistent and significantly positive effect on the NCEE score across subjects, models using different measures,

and the three identification strategies. The effect size is as large as that of school activity. Therefore, among the four different administrative styles, high authority and accountability has the strongest and positive effect on the NCEE achievement, and weak principal leadership has negative effect. Outcome-oriented style has a negative effect on urban students but positive effect on rural students. Although collegial style has no direct effect on the NCEE score, it is important to the foundation of school management on teachers and teachers' professional development.

Summary

To sum up, the prominent determinants of the NCEE performance include the HSEE score, key class, school activity, the administrative style of high authority and accountability, and the HSEE admission line. The effects of these determinants are all significantly positive. Lax principal leadership style and parents doing too much for the child are the main negative predictors of NCEE scores. The effects of other factors vary by subjects, subsamples, and models.

7.1.2 The Determinants of Private Tutoring and Its Effects in Student Performance in China

Private tutoring has been emerging rapidly in China in basic education. The determinants of private tutoring participation are analyzed using the logit model for the dependent variable as dummy variable, the tobit model for private tutoring expenditure, and the OLS model for the time index spent on private tutoring. The key findings are reported by variables. The effect of private tutoring will be presented after the determinants.

The determinants of private tutoring participation

In regards to the student characteristics, the HSEE score has a negative effect on the participation of private tutoring in math and any subjects for the whole sample and the urban

subsample. It also has a negative effect on the time spent on private tutoring for not only the whole sample and the urban subsample, but also the rural subsample. The HSEE score has no effect on the participation of private tutoring in Chinese and English. Basically, students with a lower HSEE score are more likely to participate in private tutoring. SES has a significant and positive effect on private tutoring participation in the three subjects respectively (and in any subjects). It also significantly predicts more money and time spent on private tutoring. This positive effect is consistent across the different samples, except that SES has no effect on rural students' private tutoring participation in Chinese. Female students are significantly more likely to participate in math private tutoring or private tutoring for any subjects, and significantly less likely to participate in Chinese private tutoring. Female students also spent more money on private tutoring. There is no gender gap in English private tutoring participation or time spent on private tutoring. Science track students are significantly less likely to participate in math and English private tutoring. There is no difference between the school choice students and non-school choice students in private tutoring participation across subjects and subsamples. Students with good study habits and ability are significantly more likely to participate in private tutoring in Chinese and any subjects, and spend more time on private tutoring, but spend less money on it.

In regards to parental educational styles of their child, parents who regulate their child's time schedule significantly increase the probability of private tutoring participation in all the three subjects and any subjects, and the time and money spent on private tutoring. This result is consistent among the whole sample, the urban subsample, and the rural subsample. Parents doing too much for their the child also predict a larger probability of private tutoring in all the three subjects and any subjects for the whole sample and the rural students, but have no effect on the urban students. This parental educational style has a significantly positive effect on the time

spent on private tutoring, but no effect on the money spent on private tutoring. Parents caring about study and respecting the child have no effect on private tutoring in any subject.

At the class level, a good class environment of personal relationship has a significantly positive effect on private tutoring participation for the whole sample and the rural subsample, but no effect on the urban subsample. This result is consistent across subjects and different measures of private tutoring. Key class has no effect on Chinese private tutoring, a negative effect on math private tutoring for the whole sample, and a positive effect on English private tutoring for the whole sample. It also has a significantly positive effect on private tutoring participation in any subjects, and the money and time spent on private tutoring, for the whole sample and the urban subsample. Class average SES has a negative effect on private tutoring participation in Chinese for the whole sample, in math for the rural subsample, and in English for both the whole sample and the rural subsample. It has no effect on the private tutoring participation in any subjects or money spent on private tutoring, but has a significantly positive effect on time spent on private tutoring for the whole sample and the urban subsample.

At the school level, smaller school size measured by the total number of students has a significantly positive effect on private tutoring participation in Chinese for the whole sample, in math, English and any subjects for all the different samples, and has a significantly positive effect on the time and money spent on private tutoring. Smaller student-teacher ratio also has a significantly positive effect on private tutoring participation for the whole sample and the rural subsample across subjects and different measures of private tutoring. Lab resources have a significant and positive effect on private tutoring participation for the whole sample and the rural subsample across the subjects and different measures of private tutoring. The percent of Level-1 teachers has a positive effect on rural students' private tutoring in math, urban and all students'

money spent on private tutoring, and rural and all students' time spent on private tutoring. The percent of teachers with a Master's degree has no effect on private tutoring in Chinese or math, a significantly positive effect on English private tutoring participation and private tutoring expenditure for the whole sample and rural subsample, and a negative effect on urban students' private tutoring participation in any subjects and time spent on private tutoring. The HSEE admission line basically has a significant and positive effect on urban students' private tutoring participation in all the three subjects and any subjects, and time spent on private tutoring. It has no effect on the rural subsample.

School activity has a significantly positive effect on private tutoring participation in Chinese for the whole sample and in math and English for the whole sample and rural subsample. It also predicts significantly more money and time spent on private tutoring for rural students. Collegial style of administration has no effect on Chinese private tutoring participation, a negative effect on private tutoring participation in math and English for urban and rural subsamples, and no effect on private tutoring participation in any subjects. It has a significantly positive effect on rural students' private tutoring expenditure, and negative effects on the time spent on private tutoring for the whole sample and the urban subsample. Outcome-oriented style has a negative effect on private tutoring participation in math and English for different samples, in Chinese for the rural subsample, and in any subjects for the whole sample and rural subsample. It has no effect on the time and money spent on private tutoring. Lax principal leadership style has a significantly positive effect on private tutoring participation in math, English, and any subjects for the whole sample and the rural subsample. It also predicts significantly more money and time spent on private tutoring for the whole sample. The administrative style of high authority and accountability has a significantly positive effect on private tutoring participation in

all the three subjects and any subjects for the whole sample and the rural subsample. It also predicts more money spent on private tutoring for the whole sample and the rural subsample and more time spent on private tutoring. However, it has a negative effect on the time spent on private tutoring for the whole sample and the urban subsample.

Generally speaking, SES, parents regulating and doing too much for the child, more school level educational inputs and lax principal leadership are the main predictors of more private tutoring participation. Students with higher HSEE or from key classes are less likely to participate in private tutoring.

The effect of private tutoring on NCEE performance

Private tutoring is found to have no effect on Chinese, math, and English respectively for the whole sample, the urban subsample, and the rural subsample. Private tutoring participation measured by the three different ways has no effect on the NCEE total score for the urban subsample, either. The results of the effect of private tutoring on rural students' NCEE total score are mixed, varying by various identification strategies, different measures, and school categories. Although private tutoring is found to have a negative effect on rural students' NCEE total score by the Basic Model, it has no effect using money and time spent on private tutoring as the measures in the HLM model. It also has no effect if a student is enrolled in school category 1, 3, or 4, according to the CF model. Therefore, the negative result of private tutoring on rural students' NCEE total score identified by the Basic Model is weakened by the HLM model and CF model. Overwhelmingly, private tutoring has no effect on the NCEE performance.

The insignificant effect of private tutoring is only an average effect of the sample. When looking deeply into the sample, the effect of private tutoring is heterogeneous in the sense that it changes according to the student academic achievement and varies by the registered residence.

As identified in the quantile regression, urban students with their NCEE scores in the median and the 0.25 quantile are more likely to receive positive effect from private tutoring in Chinese, math, and English. This is consistent with the common expectation from urban parents. However, the situation for rural students is the opposite. Rural students with NCEE scores in the 0.9 quantile receive no effect from private tutoring, while those with NCEE scores below the 0.9 quantiles receive a negative effect from private tutoring, and this negative influence becomes larger for students with NCEE scores in the lower quantiles. This indicates that private tutoring may increase the academic disparity among rural students.

7.2 Significance

The significance of this study lies in several aspects. First, it conducts primary data analysis by colleting raw data. It relaxes the data constraint faced by most education researchers and policymakers in China. The individual level data with the linkage to the corresponding teacher information and school information is usually not available in China. In addition, existing datasets in China usually have the problem of low quality due to the problems in questionnaire design and the less strict data collection processes. This study made strenuous effort in instrument design, questionnaire design, and data collection, with the generous support from the Center on Chinese Education of Teachers College Columbia University and Jinan Education Bureau. The data quality is satisfactory in the aspects of high response rate, high reliability of the measures, and clear data structure. The data collected allows different kinds of analysis including the use of three different models, the analysis by different school subjects and various measures of private tutoring, and the investigation by urban and rural subsamples. Thus this research effort is relatively uncommon in research on student performance in China.

Second, methodologically, it applies three different analytical models and tries to identify causal relationships. The instrumental variable model, the quantile regression model, the hierarchical linear model, and the control function model are conducted, with the validity test of the IVs. For the determinants with consistent effects across those models, this study provides robust results. For those with mixed results, this study provides analysis that is more comprehensive than what can be provided by a single identification strategy. This study is more comprehensive than previous studies in terms of identification strategies.

Third, this study is the first one to evaluate the effect of private tutoring on the NCEE in China. Given the rapid expansion of the private tutoring industry and its potential influence on student achievement and education equity, it is important and urgent to learn about the effect of private tutoring on NCEE performance. As the first study that evaluates the private tutoring effect, not only by subject but also by urban-rural residence, and measure of private tutoring participation, this study finds that there is basically no effect of private tutoring on the NCEE score. This result will provide the most up-to-date evidence to parents, educational researchers, and policymakers.

Fourth, this study uses three different measures of private tutoring participation, which not only enhance the robustness of the results, but also enrich the understanding of private tutoring participation from different aspects. The information on participation status, private tutoring expenditure, and time spent on private tutoring is collected and analyzed. In addition, more detailed information including private tutors' main professions and education levels, private tutoring agency types, and the hourly fee for private tutoring are reported for the first time in this study. This study is more comprehensive than previous studies of private tutoring in terms of the different measures of private tutoring participation.

Fifth, this study successfully assesses the parents' education styles and school cultural and administrative styles and identifies their effects on them on the NCEE score. These variables have rarely been considered in previous studies in student achievement in China, and never as a collective. This is especially meaningful in the Chinese context, in which most parents only have one child and deeply devote themselves to their child's education. The most common ways of parental education for their child are through regulating child's schedule and helping the child to solve most of the problems. However, many parents do not know whether these methods work or not. This study provides robust evidence that regulating or doing too much for the child may have no effect or a negative effect on student achievement after controlling for other factors. Caring about study and respecting the child may significantly and positively affect the NCEE score. Schools have a similar problem in the sense that school administrators may place too much emphasize on student outcomes and neglect school activities, which are not suggested by this study. In fact, very few studies have investigated these "soft inputs" because of data constraint.

Last but not least, this study is also the first one to identify the heterogeneous effects of educational inputs for different subjects, students with different study achievements, students with urban/rural residence, and different school categories. With these detailed specifications, this study provides more precise results that take into account the heterogeneous nature of various subjects, students with different academic achievement and from different areas, and schools with different performance levels.

7.3 Limitations and Suggestions for Further Studies

7.3.1 Limitations

There are several limitations of this study. First, the data used by this study is collected from one metropolis, which may undermine the external validity of the results. However, it is important to notice that Jinan is an above-the-average city in China with over 6 million people of diversified socioeconomic background and over 50% of whom are rural residents. Given the size of China, the findings may still be applicable to a large student population.

Second, this research only studies the quantity of private tutoring in terms of participation status and time and money spent on private tutoring, but does not involve the quality of private tutoring into the analysis. Although this study has tried to collect quality information from the aspects of hourly fee, tutor's educational background and main professions, and agency type, it is difficult to decide which measure is better due to the lack of knowledge in the teaching dynamics of private tutoring and the fragmented private tutoring market. Getting access to private tutoring interview is not easy. The potential heterogeneous effect of private tutoring generated by the different quality is thus omitted by this study.

Third, the current study overwhelmingly uses a quantitative approach, but very limited qualitative analysis. This study has made some effort to learn more about private tutoring and the learning dynamics of high school students, but basically the quality analysis is very limited. Some of the empirical results need explanations from the qualitative analysis, which is not available in this study.

Lastly, this study does not construct a good measure of teacher quality at the individual level. Although several questions have been asked in the student questionnaire to obtain students' evaluations on their teachers, these evaluations are heavily influenced by students'

academic performance and other characteristics and are therefore endogenous. In addition, the position ranks, education levels, and honors of the teacher are not consistent with each other according to the reliability test. Thus, it is also difficult to decide which measure is better. This study uses school level percentage of teachers with a Master's degree and the percentage of Level-1 teachers as the two aggregated measures of teacher quality. Further study on teacher quality evaluation in China is needed to address this problem.

7.3.2 Suggestions for Further Studies

Based on this research, further studies could contribute to the scholarship in this field in at least three aspects. First, the research should be replicated in other cities in order to improve the external validity of the conclusion. The samples should cover cities and counties in both advanced areas and less advanced areas. The sample size should be much larger than this one in order to guarantee enough observations in different subsamples.

Second, the measure of private tutoring quality should be improved and the classroom dynamics of private tutoring should be studied. Qualitative research methods could be used in further studies in order to better understand how private tutoring is conducted and to develop new theories to explain the procedure. Better measures of private tutoring quality may be designed based on the theoretical development in private tutoring. Empirical studies based on the improved instruments of private tutoring will be more precise and plausible.

Third, improved teacher quality assessment should be included in further research in order to better understand teacher's effect on student achievement. Since the evaluation reported by students and the teacher's position rank and educational level are problematic for use as the measure of teacher quality, more sophisticated evaluation in Chinese context should be designed based on existing theories, and new classroom observations.

Last, the study of the NCEE from the perspective of evaluation should be included into further research. This study assumes that the NCEE is a good measure of student educational outcomes, which is not yet test. There may be measurement errors of the NCEE as an assessment of educational outcomes. Better efforts to improve the design of the NCEE is needed. Empirical studies that adjust the measurement errors of the NCEE will be more convincing.

7.4 Implications for Education Policy

The findings in this study are preliminary and need to be supported by further research. The policy implications are based on the key findings of this study. Suggestions regarding educational inputs are proposed to students and parents, school administrators, and education policymakers. Basically, this study wants to stimulate the discussion of appropriate educational policy in improving student performance.

First, private tutoring is generally found to have no effect on student academic achievement. In detail, private tutoring has no effect on urban students for each subject and the NCEE total score, but may have a negative effect on rural students' NCEE total score. Private tutoring may have positive effect on urban students with academic ranking around the median and the 25^{th} percentile from the bottom, but may not be helpful for students at the top and at the bottom. Students at the top usually have strong study habits and ability and can make good use of school resources. Thus, more tutoring after school may be useless for them. Students at the bottom usually lack study skills as well as motivation. Rural students are not encouraged to participate in private tutoring by this study. They may have limited information on better tutors and face limited access to them as well. Thus, private tutoring may be a waste of money and time for rural students.

Since there may be demands for tutoring from low performing students, schoolteachers may still provide supplemental instruction to their students, but not for pay, not for everybody, and not be systemized. It should be free and limited to tutoring on the weekends. By doing this, there is no incentive for teachers to create private tutoring demand by not doing their regular job.

Second, this study finds that different leadership styles of principals may affect student achievement according to the Basic Model. High authority and accountability significantly increase student the NCEE score, while lax principal leadership may undermine student performance in the NCEE. But the results of the HLM model and the CF model are weaker. Thus, there is a call for discussion among school principals on school leadership and that the government could provide more training for them. Appropriate school principal training may help to improve the leadership skills and the school administration.

Third, school activities are found to have a significant and positive effect on the NCEE performance in the Basic Model, but no effect in the HLM model and the CF model. Thus, it is suggested that appropriate school activities should be designed in a cost effective way. The discussions on how school activities can improve educational outcomes may be needed among students and school principals.

Fourth, key class is found to have significant and positive effect on NCEE achievement in this study. This may imply that high performing students may benefit from their high performing peers. However, this study does not examine the effect of high performing peers on relatively low performing students, nor does it evaluate the effect of low performing peers on high performing peers. Hoxby (2000) shows that higher peers' reading scores can raise students' own score, which may indicate that lower performing students can benefit from their higher performing peers. But Zimmerman (2003) reports that if the students have peers who are among

the lowest 15% in verbal SAT performance, their own verbal SAT scores may undermined by the peers. Therefore, how to make use of peer effects needs more discussions among the teachers and principals and more research should be conducted.

Last, this study reports that different parental styles can make difference. Parents who care about study and respect the child may help to improve student performance. While parents who do too much for their child may undermine student performance. Therefore, there is a call for in-depth discussion. Schools could get parents together and talk about the findings through seminars or parent meetings. Parental training on how to educate the students in a better way could be designed based on these findings and discussions.

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APPENDIX

Appendix 1. High School Entrance Exam (HSEE)

Table A1 High School Entrance Exam in Jinan in 2007

Exam dates	Type	Subject		Full mark
6/12-6/14	Paper based	Chinese		120
		Math		120
		English		120
		Science	Physics	70
			Chemistry	50
			Biography	30
		Humanity	Political Science	60
			History	60
			Geography	30
4/7-4/24	Physical training exam			30
3/17-4/30	Information technology exam			Pass/Fail

Data source: Primary and Secondary School Enrollment Policy of Jinan City in 2007

Appendix 2. Location of Shandong Province in China

Appendix 3: Location of Jinan in Shandong Province

Appendix 4. Questionnaire Design

Grade 12 Student Questionnaire

This questionnaire is only for purely academic research.
Personal privacy and information is strictly protected.

As a matter of policy, we are concerned with protecting the privacy of individuals who participate in voluntary surveys. We want to let you know that

1. The only reason that we ask you to complete the questionnaire is to gather information that related to studying preparation for NECC and family background of G12 students currently studying in high school.
2. Your response will be merged with those of others, and the answers you give will never be identified as yours.
3. We need to know your name and student ID in order to connect with your transcript and other administrative records.
4. You may skip any questions you do not wish to answer.

Part A. Basic Information

A2. What is your name?_____
A3. What is your student ID number?_____
A4. What is your school name? _____
A5. What is your class number? _____
A6. What is your class type?
(1)Key class (2) Regular class (3) Parallel class (no ability grouping)
A7. What is your academic track? (1) Science (2) Humanity
A8. Did you transfer to the current school after the spring semester of G11?
(1) Yes (2) No
A9. Are you board at school? (1) Yes (2) No (3) Occasionally yes
A10. What is your birthday? (yyyymmdd) _____
A11. What is your gender? (1) Male (2) Female
A12. What is your ethnicity? (1) Majority(Han) (2) Minority
A13. What is your political status? (1) Party member (2) League member (3) None
A14. Which junior middle school did you graduate from? _____
A15. What was your class type in junior middle school?
(1) Key class (2) Regular class (3)Parallel class (no ability grouping)
A16. Which district is your home located at?
(1) Lixia (2) Shizhong (3) Huaiyin (4) Tianqiao (5) Lichen (6) Changqing (7)Pingyin (8)Jiyang (9)Shanghe (10) Zhangqiu (11) Outside Jinan

A17. What is your registered residence? (1) Urban (2) Rural
A18. Are you migrant student? (1) Yes (2) No
A19. Is your family single-parent family? (1) Yes (2) No
A20. How many people do you have in your family? _____

A21. How many siblings do you have?
(1) 0 (2) 1 (3) 2 (4) 3 or more than 3

A22. Please check one statement that fits you.
(1) I am the only child in my family
(2) I am the oldest child in my family (there are more than one child)
(3) I am the second oldest child in my family
(4) I am the third or even younger child in my family

A23. How many children in your family are at school age? _____

A24. How large is your house/apartment?
(1) under 50m^2 (2) 50-70 m^2 (3) 71-90 m^2 (4) 91-120 m^2 (5) more than 120 m^2

A25. How far is your school from your home?
(1) Within 5 km
(2) 6-10 km
(3) 11-20 km
(4) Beyond 20 km

A26. What is the highest education level of your father/ other male guardian：

(1) Did not finish primary education	(2)Primary education	(3)Middle school	(4)High school
(5)Associate bachelor	(6)Bachelor degree	(7)Master's degree	(8)Doctoral degree

A27. What is the highest education level of your mother/ other female guardian：

(1) Did not finish primary education	(2)Primary education	(3)Middle school	(4)High school
(5)Associate bachelor	(6)Bachelor degree	(7)Master's degree	(8)Doctoral degree

A28. What is your Father (or other male guardian)'s occupation?
(1) Government (including state owned company) officials
(2) Managers in private company
(3) Private entrepreneurs
(4) Professional and technical personnel (including faculty in higher education institutions, other researchers, school teachers, engineers, doctors, lawyers, designers, etc.)
(5) Clerk and related workers
(6) Individual business
(7) Military personnel and police
(8) Business service personnel
(9) Industrial workers
(10) Agricultural Laborers
(11) Unemployed
(12) Others

A29. What is your Mother (or other female guardian)'s occupation?
(1) Government (including state owned company) officials
(2) Managers in private company

(3) Private entrepreneurs
(4) Professional and technical personnel (including faculty in higher education institutions, other researchers, school teachers, engineers, doctors, lawyers, designers, etc.)
(5) Clerk and related workers
(6) Individual business
(7) Military personnel and police
(8) Business service personnel
(9) Industrial workers
(10) Agricultural Laborers
(11) Unemployed
(12) Others

How many of the following do you have in your family?

No.	Item	0	1	2	3	No less than 4
A30.	TV	◎	(1)	(2)	(3)	(4)
A31.	Cell phone	◎	(1)	(2)	(3)	(4)
A32.	Air conditioner	◎	(1)	(2)	(3)	(4)
A33.	Computer	◎	(1)	(2)	(3)	(4)
A34.	Car	◎	(1)	(2)	(3)	(4)
A35.	Motorcycle					
A36.	Paintings on the wall	◎	(1)	(2)	(3)	(4)

A37. Can you get access to the internet at home? (1) Yes (2) No
A38. Do you have your own room to study? (1) Yes (2) No
A39. How many kinds of magazines and newspapers do you have?
(1) 0 (2) 1-2 (3) 3-4 (4) no less than 5
A40. How many books do you have in your family (exclude magazines, newspapers, and textbooks)?
(1) 0-10 (2) 11-25 (3) 26-50 (4) 51-100 (5) 101-200 (6) 201

B. About Your Study

How do you feel about each of the following statements of your teachers in the three subjects respectively? (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

		5	4	3	2	1
B1. The teacher has strong academic background and the instruction is very clear.	Chinese	(5)	(4)	(3)	(2)	(1)
	Math	(5)	(4)	(3)	(2)	(1)
	English	(5)	(4)	(3)	(2)	(1)
B2. The teachers below know how to stimulate my enthusiasm on study.	Chinese	(5)	(4)	(3)	(2)	(1)
	Math	(5)	(4)	(3)	(2)	(1)
	English	(5)	(4)	(3)	(2)	(1)
B3. The teacher has very charming personality.	Chinese	(5)	(4)	(3)	(2)	(1)
	Math	(5)	(4)	(3)	(2)	(1)

English	(5)	(4)	(3)	(2)	(1)

B4. Please indicate your own interest in the following subjects.

	Like it very much	Like it	Not sure	Dislike it	Dislike it very much
Chinese	(5)	(4)	(3)	(2)	(1)
Math	(5)	(4)	(3)	(2)	(1)
English	(5)	(4)	(3)	(2)	(1)

B5. Please indicate your confidence in studying the following subjects well.

	Very confident	Confident	Not sure	Not confident	Not confident at all
Chinese	(5)	(4)	(3)	①	①
Math	(5)	(4)	(3)	①	①
English	(5)	(4)	(3)	(2)	(1)

Please select your time allocation during a typical school day:

Unit: hour	never	0-1	1-2	2-3	3-5	5-6	6-8	More than 8
B6. Have classes at school	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B7. Do homework	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B8. Participate in private tutoring	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B9. Watch TV or use PC	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B10. Play with friends	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B11. Part time job or work for my family	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B12. Read news reports	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B13. Sport	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B14. Read books or participate in clubs）	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B15. Sleep	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Please select your time allocation during a typical weekend day:

Unit: hour	never	0-1	1-2	2-3	3-5	5-6	6-8	More than 8
B16. Have classes at school	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B17. Do homework	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B18. Participate in private tutoring	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B19. Watch TV or use PC	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B20. Play with friends	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B21. Part time job or work for my family	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B22. Read news reports	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B23. Sport	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B24. Read books or participate in	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)

clubs）								
B25. Sleep	◎	(1)	(2)	(3)	(4)	(5)	(6)	(7)

B26. What kind of college do you want to go to? (1) elite college (2) regular college (3) 2-3 year college (4) I don't want to go to college

B27. What is your highest expected degree? (1) high school (2) associate bachelor (3) bachelor (4) Master (5) Doctor

Bellows are some questions about private tutoring.

B28. Please check if you participated in some kind of tutoring in school in certain grades.

	Middle school	Grade 10	Grade 11	Grade 12
Chinese				
Math				
English				

B29. Please check if you participated in some kind of private tutoring outside school in certain grades.

	Middle school	Grade 10	Grade 11	Grade 12
Chinese				
Math				
English				

B30. If you have ever participated in some kind of private tutoring, please choose one main reason for it. If you never participated in any kind of private tutoring, please jump to question B34 directly.

(1) For remediation
(2) For enrichment
(3) My teachers/parents want me to participate in private tutoring
(4) A lot of my classmates participate in private tutoring
(5) To cultivate my study interest

B31. If you have ever participated in private tutoring in G12 in some of the following subjects, please fill out the relevant information.

	Hours per week	Student # in tutoring class				Agency type who provides your private tutoring			
		1 to 1	Below 5	6-25	Above 26	Personal	Private institution	Higher education institute	Internet
	a	b	c	d	e	f	g	h	i
Chinese		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Math		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
English		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)

B32. If you have ever participated in private tutoring in G12 in some of the following subjects, please fill out the relevant information about the tutors.

	Gender	Education degree	Major occupation	Fee per hour
Chinese	(1) M (2) F	(1) Less than associate bachelor (2) Undergraduate student (3) Bachelor (4) Master or above	(1) Undergraduate student (2) My school teacher (3) Teacher from other school (4) Professional tutor (5) Others	(1) Below 20 RMB (2) 20-30 RMB (3) 30-40 RMB (4) 40-60 RMB (5) 60-80 RMB (6) Above 80 RMB
Math	(1) M (2) F	(1) Less than associate bachelor (2) Undergraduate student (3) Bachelor (4) Master or above	(1) Undergraduate student (2) My school teacher (3) Teacher from other school (4) Professional tutor (5) Others	(1) Below 20 RMB (2) 20-30 RMB (3) 30-40 RMB (4) 40-60 RMB (5) 60-80 RMB (6) Above 80 RMB
English	(1) M (2) F	(1) Less than associate bachelor (2) Undergraduate student (3) Bachelor (4) Master or above	(1) Undergraduate student (2) My school teacher (3) Teacher from other school (4) Professional tutor (5) Others	(1) Below 20 RMB (2) 20-30 RMB (3) 30-40 RMB (4) 40-60 RMB (5) 60-80 RMB (6) Above 80 RMB

B33. If you have ever participated in private tutoring in G12 in some of the following subjects, please indicate how satisfied with the effects of private tutoring. (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

Subject	Private tutoring is very helpful to my study.				
	5	4	3	2	1
Chinese	(5)	(4)	(3)	(2)	(1)
Math	(5)	(4)	(3)	(2)	(1)
English	(5)	(4)	(3)	(2)	(1)

B34. If you never participated in any kind of private tutoring, what is the most important reason?

(1) I can study very well by myself and I don't need tutor.
(2) I am too tired and I don't have time for tutoring.
(3) The tutoring fee is too expensive for me.
(4) I don't think the effects of tutoring are good enough.
(5) My teachers/parents don't encourage me to do this.

B35. How many private tutoring advertisements are you exposed to every week from all kinds of forms (including poster, TV, newspaper, internet, walk by, etc.?

(1) 0 (2) 1-3 (3) 4-6 (4) 7-9 (5) above 10

B36. As far as you know, what is the distance between your home and the nearest private tutoring center?

(1) within 1 km (2) within 5 km (3) within 15 km (4) I don't know

B37. Among the five closest classmates, how many of them participate in private tutoring?

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

B38. Do you feel it quite easy to find satisfied private tutoring at a good price?

(1) Very easy (2) Quite easy (3) Not easy (4) Very difficult (5) I don't know

How do you feel about the statement on your last summer vocation? (Mark one on each line. 5 is strongly agree, and 1 is strongly disagree).

	5	4	3	2	1
B39. I spent a lot of time relax and on hobbies.	(5)	(4)	(3)	(2)	(1)
B40. I spent a lot of time study by myself.	(5)	(4)	(3)	(2)	(1)
B41. I spent a lot of time on private tutoring.	(5)	(4)	(3)	(2)	(1)
B42. I spent a lot of time on part-time job or working for my family.	(5)	(4)	(3)	(2)	(1)
B43. I studied very effectively and efficiently.	(5)	(4)	(3)	(2)	(1)
B44. I was well prepared for the new semester.	(5)	(4)	(3)	(2)	(1)

C. Your School Experience

Are you in the following position now?

No.	Position	Yes	No
C1.	President of Student Senate	(1)	(2)
C2.	President of the class	(1)	(2)
C3.	League branch secretary	(1)	(2)
C4.	Student leaders in clubs	(1)	(2)
C5.	Class committee member	(1)	(2)
C6.	Student teaching assistant	(1)	(2)
C7.	Group leader	(1)	(2)

How do you feel about each of the following statements? (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

No.		5	4	3	2	1
C8.	I like going to school.	(5)	(4)	(3)	(2)	(1)
C9.	The study atmosphere of my class is very good.	(5)	(4)	(3)	(2)	(1)
C10.	The study atmosphere of my school is very good.	(5)	(4)	(3)	(2)	(1)
C11.	I was treated unfairly by my teachers or classmates.	(5)	(4)	(3)	(2)	(1)
C12.	My head teacher is very responsible.	(5)	(4)	(3)	(2)	(1)
C13.	My head teacher is very open-minded.	(5)	(4)	(3)	(2)	(1)
C14.	My head teacher is very kindness.	(5)	(4)	(3)	(2)	(1)
C15.	Most of my teachers care about me.	(5)	(4)	(3)	(2)	(1)
C16.	I have high prestige among my classmates.	(5)	(4)	(3)	(2)	(1)
C17.	I have very few good friends at school.	(5)	(4)	(3)	(2)	(1)
C18.	I am good at summing up knowledge and mistakes.	(5)	(4)	(3)	(2)	(1)
C19.	I usually do preparation before the lesson.	(5)	(4)	(3)	(2)	(1)
C20.	I usually review the material after the lesson.	(5)	(4)	(3)	(2)	(1)
C21.	I have a correct attitude to study.	(5)	(4)	(3)	(2)	(1)
C22.	I like playing more than studying.	(5)	(4)	(3)	(2)	(1)
C23.	My EQ is very high, especially in important tests.	(5)	(4)	(3)	(2)	(1)
C24.	I don’t have a clear goal for my life.	(5)	(4)	(3)	(2)	(1)
C25.	I am very optimistic.	(5)	(4)	(3)	(2)	(1)
C26.	I have a clear life goal.	(5)	(4)	(3)	(2)	(1)
C27.	I have a strong ability to concentrate and persevere.	(5)	(4)	(3)	(2)	(1)
C28.	I am not interested in participating NCEE and going to college.	(5)	(4)	(3)	(2)	(1)
C29.	I often receive misconduct penalty.	(5)	(4)	(3)	(2)	(1)
C30.	I once fell in love during high school.	(5)	(4)	(3)	(2)	(1)
C31.	I can use the city library very conveniently.	(5)	(4)	(3)	(2)	(1)
C32.	My school has organized some museum visits or science center visits for us students.	(5)	(4)	(3)	(2)	(1)
C33.	My school organizes theatrical performances every year.	(5)	(4)	(3)	(2)	(1)
C34.	The school magazine is very popular among students.	(5)	(4)	(3)	(2)	(1)
C35.	The psychological consulting provide by school is very effective.	(5)	(4)	(3)	(2)	(1)

D. About Your Family

How do you feel about each of the following statements? (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

No.		5	4	3	2	1
D1.	My parents go to the Parent Meeting every time.	(5)	(4)	(3)	(2)	(1)
D2.	My parents limit the amount of time I can spend on TV, PC, and going out with friends.	(5)	(4)	(3)	(2)	(1)
D3.	My parents trust me to do what they expect without checking up on me.	(5)	(4)	(3)	(2)	(1)
D4.	It is difficult to communicate with my parents.	(5)	(4)	(3)	(2)	(1)
D5.	I often count on my parents to solve many of the problems for me.	(5)	(4)	(3)	(2)	(1)
D6.	My parents have high expectation on me.	(5)	(4)	(3)	(2)	(1)
D7.	I spent most of my time with my grand parents when I was young.	(5)	(4)	(3)	(2)	(1)
D8.	My parents taught me some school knowledge before I went to primary school.	(5)	(4)	(3)	(2)	(1)
D9.	My parents were very busy and did not have time to take care of me when I was in primary school.	(5)	(4)	(3)	(2)	(1)
D10.	My parents pay special attention to training my self-care ability.	(5)	(4)	(3)	(2)	(1)
D11.	My parents respect my opinion.	(5)	(4)	(3)	(2)	(1)
D12.	I admire my father.	(5)	(4)	(3)	(2)	(1)
D13.	I admire my mother.	(5)	(4)	(3)	(2)	(1)
D14.	I care about my parents' work.	(5)	(4)	(3)	(2)	(1)
D15.	My parents are my role models in terms of working hard.	(5)	(4)	(3)	(2)	(1)
D16.	My parents are my role models to be an upright person.	(5)	(4)	(3)	(2)	(1)
D17.	My parents take me to the museums, science centers, and performance every year.	(5)	(4)	(3)	(2)	(1)
D18.	The study atmosphere at home is very good.	(5)	(4)	(3)	(2)	(1)
D19.	There is a rich collection of books in literature, science, history, geography, English, and arts at my home.	(5)	(4)	(3)	(2)	(1)

E. About Education Expenditure

E1. How much allowance does your family give you every month?
(1) Within 100 RMB (2) 101-200 RMB (3) 201-400 RMB
(4) 401-700 RMB (5) 701-1000 RMB (6) above 1000 RMB

E2. Does your allowance include money spent on meals? (1) Yes (2) No

E3. If it does, how much is your board expenditure every month?

(1) Within 100 RMB (2) 101-200 RMB (3) 201-300 RMB (4) 301-500 RMB (5)above 500 RMB

Please fill out the following expenditure.

No.	Item	Expenditure (unit: RMB)
E4.	Expenditure on academic oriented private tutoring in G12	
E5.	Expenditure on art/music tutoring	
E6.	Expenditure on Computer purchase	
E7.	Other education related expenditure	

THANK YOU

Parent Questionnaire

This questionnaire is only for purely academic research.
Personal privacy and information is strictly protected.

As a matter of policy, we are concerned with protecting the privacy of individuals who participate in voluntary surveys. We want to let you know that

1. The only reason that we ask you to complete the questionnaire is to gather information that related to studying preparation for NECC and family background of G12 students currently studying in high school.
2. Your response will be merged with those of others, and the answers you give will never be identified as yours.
3. We need to know your child's name and student ID in order to connect with your child's questionnaire and his/her transcript and other administrative records.
4. You may skip any questions you do not wish to answer.

Part A. Family Basic Information

A1. What's the name of your child: _____
A2. What's the school ID number of your child: _____
A3. What's the name of your child's school? _____
A4. Which class is your child in? _____

B. Information about Household Expenditure on Educational

B1. What's your monthly income in your family? (including salaries, welfare incomes, subsides, returns on investment, etc.)

① Below 500 RMB	② 501-1000 RMB	③ 1001-2000 RMB
④ 2001-3000 RMB	⑤ 3001-4000 RMB	⑥ 4001-5000 RMB
⑦ 5001-6000 RMB	⑧ 6001-7000 RMB	⑨ 7001-9000 RMB
⑩ 9001-11000 RMB	⑪ 11001-15000 RMB	⑫ Above 15000 RMB

B2. How much money did you spend on your children's education last year?

① Below 200 RMB	② 201-500 RMB	③ 501-800 RMB
④ 801-1000 RMB	⑤ 1001-1500 RMB	⑥ 1501-2000 RMB
⑦ 2001-3000 RMB	⑧ 3001-5000 RMB	⑨ 5001-7000 RMB
⑩ 7001-9000 RMB	⑪ 9001-11000 RMB	⑫ 11001-13000 RMB
⑬ 13001-15000 RMB	⑭ 15001-20000 RMB	⑮ Above 20000 RMB

B3. How much is your household property worth? (Unit: 10 thousands RMB)

① We don't have our own house	② Below 5	③ 5-10
④ 10-15	⑤ 15-20	⑥ 20-25
⑦ 25-30	⑧ 30-40	⑨ 40-50
⑩ 50-60	⑪ 60-70	⑫ 70-80
⑬ 80-90	⑭ 90-100	⑮ Above 100

B4. What is the total value of your car(s), tractor(s)(or other large agricultural machine(s) approximately? (Unit: 10 thousands RMB)

① I don't have a car.	② Below 5	③ 5-10
④ 10-15	⑤ 15-20	⑥ 20-25
⑦ 25-30	⑧ 30-40	⑨ Above 40

C. About Your Communication with Your Child.

How do you feel about each of the following statements? (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

No.		5	4	3	2	1
C1.	You invested a lot of energy or time on your child's pre-school education, interest inspirations and intellectual development before your child went to primary school.	(5)	(4)	(3)	(2)	(1)
C2.	You were too busy to educate your child when he or she was in primary school.	(5)	(4)	(3)	(2)	(1)
C3.	You had a high standard on your child's academic performance when he or she was in primary school.	(5)	(4)	(3)	(2)	(1)
C4.	You were too busy to educate your child when he or she was in middle school.	(5)	(4)	(3)	(2)	(1)
C5.	You had a high standard on your child's academic performance when he or she was in middle school.	(5)	(4)	(3)	(2)	(1)
C6.	You had a high standard on your child's academic performance when he or she was in high school.	(5)	(4)	(3)	(2)	(1)
C7.	You highly expect that your child can go to college	(5)	(4)	(3)	(2)	(1)
C8.	Your child is usually very cooperative with you when he or she was in senior high school.	(5)	(4)	(3)	(2)	(1)
C9.	You don't really know what your child is thinking.	(5)	(4)	(3)	(2)	(1)
C10.	You can communicate with your child very well.	(5)	(4)	(3)	(2)	(1)
C11.	You child usually counts on you to solve his or her studying problems or pressures.	(5)	(4)	(3)	(2)	(1)
C12.	Your child usually discuses with you about what's happening at school.	(5)	(4)	(3)	(2)	(1)
C13.	You are very clear about your child's rank in his or her class.	(5)	(4)	(3)	(2)	(1)
C14.	You are very clear about your child's rank in the whole city.	(5)	(4)	(3)	(2)	(1)
C15.	You value a lot on your child's moral and virtue development.	(5)	(4)	(3)	(2)	(1)

C16.	You educate your child by yourself / send your child to private tutoring class to cultivate broad interest.	(5)	(4)	(3)	(2)	(1)

C17. According to your child's academic ability and your economic capacity, what's the highest education degree do you expect your child to receive in the future?

(1) High school
(2) Associate bachelor
(3) Bachelor
(4) Master
(5) Doctor

C18. What kind of college do you expect your child to go in the further?

(1) Elite university
(2) Regular university
(3) 2-3 year college
(4) Universities abroad
(5) Private college or other professional oriented colleges

THANK YOU

Teacher Questionnaire

This questionnaire is only for purely academic research.
Personal privacy and information is strictly protected.

As a matter of policy, we are concerned with protecting the privacy of individuals who participate in voluntary surveys. We want to let you know that

1. The only reason that we ask you to complete the questionnaire is to gather information that related to studying preparation for NECC and family background of G12 students currently studying in high school.
2. Your response will be merged with those of others, and the answers you give will never be identified as yours.
3. You may skip any questions you do not wish to answer.

A. Teacher Basic Information

A1. Which school are you currently working at? _____
A2. Your name? _____
A3. Your working ID? _____
A4. Which subject do you teach? (1) Chinese (2) Math (3) English
A5. Which classes do you teach? _____
A6. Are you head teacher? (1) Yes （For which class? _____） (2) No
A7. Your gender: (1) M (2) F
A8. Your education level?
(1) High school or below (2) Non-teacher-training associate bachelor
(3) Teacher-training associate bachelor (4) Non-teacher-training bachelor
(5) Teacher-training bachelor (6) Master and above
A9. Your political status? (1) Party member (2) League member (3) Democratic party (4) None
A10. Your age_____
A11. Years of teaching experience_____
A12. Your positional rank
① No title now ② 2nd or 3rd level of high school teacher
③ 1st level of high school teacher ④ Advanced high school teacher
A13. Have you ever received the honors below?
① School level *academic leader / teaching expert* ② County level *academic leader / teaching expert*
③ Provincial level *academic leader / teaching expert* ④ Provincial level *special class teacher*
A14. Which quartile is the average NCEE score of your class in among all the classes in the same grade in history?
(1) First quartile (2) Second quartile (3) Third quartile (4) highest quartile (5) I don't know
A15. Do you have an administrative position in your school? (1) Yes (2) No
A16. What's the share of merit-pay in your salary?
(1) We don't have merit-pay (2) Below 5%
(3) 6%-15% (4) 16%-25% (5) Above 26%

A17. What is your basic salary per month? _____

A18. What is your average bonus per month and subsidy per month? _____

A19. What is your other income per month? _____

B. About Teaching

How do you feel about each of the following statements? (Mark one on each line. 5 is strongly agree and 1 is strongly disagree).

No.		5	4	3	2	1
B1.	I always discuss with my colleagues teaching the same subject on how to teach some specific concepts.					
B2.	I always prepare lessons with my colleagues.					
B3.	I always observe the class of my colleagues of the same subject.					
B4.	I sometimes ask my colleagues of same subject to observe my class informally and give me feedbacks.					
B5.	I always discuss about the students' performance with colleagues teaching the same class.					
B6.	I always discuss about pedagogy with teachers teaching the same grade.					
B7.	Generally speaking, I get along very well with my colleagues.					
B8.	I usually don't talk about pedagogy with my colleagues.					
B9.	This school emphasis a lot on the cooperation among teachers.					
B10.	I'm very strict with my students, which can help establishing my authority.					
B11.	I have a very high requirement on my teaching outcomes					
B12.	I feel fine if I do my best, I don't really care about my students' scores.					
B13.	I'm popular among students.					
B14.	I usually organize my class by lecturing most of the time.					
B15.	I usually organize my class by letting students doing exercise and tests.					
B16.	This school evaluates my teaching mainly by my students' test score.					
B17.	This school evaluates my teaching ability mainly by my teaching assessment.					
B18.	I don't think this school evaluates teachers teaching ability at all.					
B19.	I feel like this school's leaders have a high standard on teaching quality.					
B20.	Teachers in this school have a high teaching autonomy.					
B21.	I think the school leaders often listen to teachers' advice and opinions.					

B22.	I think this school has high authority and clear hierarchy.					
B23.	The school leaders usually make requirement on teachers through the authority.					
B24.	The school leaders usually make requirement on teachers through discussion.					
B25.	The school leaders usually make requirement on teachers through negotiation.					
B26.	The school leaders are very efficient.					
B27.	This school provides me with good on-the-job training which improved my expertise.					
B28.	The school leaders value most on the NECC score and the promotion rate to the college.					
B29.	The school leaders value a lot on the extracurricular activities.					
B30.	The school leaders care a lot on teacher welfare and career development.					
B31.	I like my working environment and atmosphere.					
B32.	I like being a teacher.					
B33.	I might consider changing career if I can get better offer.					

THANK YOU

Principal Questionnaire

This questionnaire is only for purely academic research.
Personal privacy and information is strictly protected.

As a matter of policy, we are concerned with protecting the privacy of individuals who participate in voluntary surveys. We want to let you know that

1. The only reason that we ask you to complete the questionnaire is to gather information that related to studying preparation for NECC and family background of G12 students currently studying in high school.
2. Your response will be merged with those of others, and the answers you give will never be identified as yours.
3. You may skip any questions you do not wish to answer.

A. Basic School Information

A1. What is your school name? _____

A2. Name of the person who fills out this questionnaire: _____ Telephone_____

A3. Check the grade levels included in your school

(12) G1-6 (13) G7-9 (14) G10-12

A4. Which district is your school located at?

① Lixia ② Shizhong ③ Huaiyin ④ Tianqiao ⑤ Licheng
⑥ Changqing ⑦ Pingyin ⑧ Jiyang ⑨ Shanghe ⑩ Zhangqiu

B. Principal's Information

B1. Your gender? (1) M (2) F

B2. Your latest education degree:
(1) High school or below (2) Non-teacher-training associate bachelor
(3) Teacher-training associate bachelor (4) Non-teacher-training bachelor
(5) Teacher-training bachelor (6) Master and above

B3. Your education degree when you first started teaching:
(1) High school or below (2) Non-teacher-training associate bachelor
(3) Teacher-training associate bachelor (4) Non-teacher-training bachelor
(5) Teacher-training bachelor (6) Master and above

B4. Your positional rank?

① No title now ② 2nd or 3rd level of high school teacher
③ 1st level of high school teacher ④ Advanced high school teacher

B5. Have you ever participated in principal training? (1)Yes (2)No

B6. If yes, what's the highest level of principal training did you participate?
(1) County level (2) City level (3) Province level (4) National level (5) Other

B7. How many years have you taught? _____

B8. How many years have you been a principal? _____

B9. How many years have you been a vice principal? _____

B10. How many years have you been a principal in this school? _____

C. About Education inputs

Please fill out the exact numbers below.

Item		No.
C1. Total number of teachers		
C2. Total number of full-time teachers		
C3. Total number of substitute teachers		
C4. Number of provincial level *special class teachers*		
C5. Number of provincial level *academic leader*		
C6. Number of county level *academic leader*		
C7. Number of school level *academic leader*		
C8. Number of provincial level *teaching expert*		
C9. Number of county level *teaching expert*		
C10. Number of school level *teaching expert*		
# of teachers in term of position rank	C11. Advanced high school teacher	
	C12. 1st level of high school teacher	
	C13. 2nd or 3rd level of high school teacher	
	C14. No rank now	
# of teachers in term of education level	C15. Associate bachelor	
	C16. Bachelor	
	C17. Master	
	C18. Doctor	
# of teachers in the last two years who…	C19. Transferred to other schools	
	C20. Resigned from the school	
	C21. Transferred from other schools	
	C22. Assigned to you as new graduates	
C23. Total number of male students		
C24. Total number of female students		
C25. Total number of male students in G12		
C26. Total number of female students in G12		

Please fill out the relevant information about library and laboratories.

Item		Number
C27. # of computers		
C28. # of computers that could be used for instruction		
C29. # of computers that could get access to internet		
C30. Capacity of physics lab		
C31. Capacity of chemistry lab		
C32. Capacity of biology lab		
C33. Capacity of explore lab		
Library	C34. Total area	（m^2）
	C35. # of books	

C36.	Total area of sports field	（m^2）
C37.	Total area of teaching building	（m^2）

Please fill out the relevant information about student graduation and promotion.

C38.	The graduate rate last year	%
C39.	The promotion rate to elite colleges last year	%
C40.	The promotion rate to regular colleges last year	%
C41.	# of students could be recommended to college this year	

Please fill out the school revenue by source. (Unit: RMB)

C42.	Government appropriation	
C43.	Tuition	
C44.	among which handed in to the government	
C45.	School choice fee/ donation	
C46.	among which handed in to the government	
C47.	Other fees (such as board fee)	
C48.	Revenue from school-run enterprise	
C49.	Loan from the bank	
C50.	Other	

Please fill out the school expenditure by function. (Unit: RMB)

C51.	Teacher salary	
C52.	Administration and staff salary	
C53.	Daily office expenditure	
C54.	Rewards and welfare for teachers	
C55.	Student scholarship and assistantship	
C56.	Student activities	
C57.	Fixed assets	
C58.	Others	

C59. Please choose which of the following situation is true for your school.

a) There are no less than two schools around us to compete for students.
b) There is only one school around us to compete for students.
c) No school around us competes for students.

Please fill out relevant information for the G12 cohort students.

No.	Item	
C60.	The admission line of HSEE for within plan students in 2007	
C61.	The admission line of HSEE for school choice students in 2007	
C62.	Tuition every academic year	

C63.	School choice fee in 2007	

Please fill out the relevant information by class for the G12 cohort students.

No.	Class	Class type: (1) Key class (2) Regular class (3) Panel class (5) Special class for art and sport	Academic track: (1)Science (2)Humanity	# of male students	# of female students	# of all students	Name of Math teacher	Name of Chinese teacher	Name of English teacher
C64.	Class 1								
C65.	Class 2								
C66.	Class 3								
C67.	Class 4								
C68.	Class 5								
C69.	Class 6								
C70.	Class 7								
C71.	Class 8								
C72.	Class 9								
C73.	Class 10								
C74.	Class 11								
C75.	Class 12								
C76.	Class 13								
C77.	Class 14								
C78.	Class 15								

THANK YOU

Appendix 5. Descriptive Statistics without Sampling Weight

Table A2 NCEE Score by Urban Rural Residence

	N	Mean				Median			
		Chinese	Math	English	Total*	Chinese	Math	English	Total
Urban residence	2981	98.5	89.5	94.1	463.5	100	95	100	481
Rural residence	2835	99.2	97.2	94.4	480.3	100	102	98	491
Total	5816	98.8	93.3	94.2	471.7	100	99	99	486

Note: * Total score is the total score of all subjects included in NCEE, not only including Chinese, Math, and English.

Table A3 NCEE Score by Gender

	N	Mean				Median			
		Chinese	Math	English	Total	Chinese	Math	English	Total
Male	2728	97.1	93.5	90.4	468.8	98	100	95	486
Female	3099	100.4	93.0	97.5	474.1	102	98	102	486
Total	5827	98.8	93.2	94.2	471.6	100	99	99	486

Table A4 NCEE Score by Private Tutoring Participation

			NCEE score			
		N	All subjects	Chinese	Math	English
PT participation for all subjects	No	2861	477.9	99.4	95.1	95.1
	Yes	2980	465.2	98.2	91.4	93.3
Chinese PT participation	No	5453		98.8		
	Yes	388		99.0		
Math PT participation	No	4481			93.3	
	Yes	1360			92.9	
English PT participation	No	4779				94.2
	Yes	1062				93.9

Table A5 NCEE Score by Private Tutoring Participation and Registered Residence

		NCEE score		Sample size	
		PT participation		PT participation	
		Yes	No	Yes	No
All subjects	Urban residence	459.48	470.10	1838	1143
	Rural residence	474.91	483.89	1133	1702
Chinese	Urban residence	99.40	98.43	226	2755
	Rural residence	98.41	99.22	161	2674
Math	Urban residence	90.17	89.27	907	2074
	Rural residence	98.26	96.97	453	2382
English	Urban residence	93.50	94.26	680	2301
	Rural residence	94.51	94.39	381	2454

Table A6 NCEE Score by Father's Highest Education Level

	N	Mean				Median			
		Chinese	Math	English	Total	Chinese	Math	English	Total
Did not finish primary education	32	98.3	92.8	90.2	462.9	100	102	98	505
Primary education	452	98.7	95.3	92.8	471.7	100	101	97	485
Junior high school	2,331	97.5	92.3	91.0	464.2	99	97	94	472
Senior high school	1,377	97.5	88.3	89.5	453.0	99	93	92	457
Associate or vocational high school	728	99.9	93.9	97.7	479.4	102	100	104	503
Bachelor degree	753	103.2	100.9	106.7	510.2	105	107	116	533
Master’s degree	98	104.5	106.0	112.0	527.0	107	114	118	548
Doctor degree	32	107.0	109.0	120.5	550.3	109	113	128	575
Total	5,803	98.8	93.2	94.2	471.5	100	99	99	486

Table A7 NCEE Score by Mother's Highest Education Level

	N	Mean				Median			
		Chinese	Math	English	Total	Chinese	Math	English	Total
Did not finish primary education	163	99.7	99.8	96.5	489.4	101	105	102	504
Primary education	1,008	98.9	96.3	94.0	477.1	100	101	98	487
Junior high school	2,264	97.4	91.0	90.2	460.2	99	95	93	468
Senior high school	1,176	98.1	88.5	91.7	457.5	99	94	96	473
Associate or vocational high school	678	100.7	95.1	98.6	483.6	102	101	107	504
Bachelor degree	466	103.4	102.5	110.2	518.1	106	108	119	544
Master’s degree	39	104.6	114.7	118.4	558.2	107	118	125	575
Doctor degree	13	103.1	104.6	112.2	514.5	102	114	126	566
Total	5,807	98.8	93.2	94.2	471.6	100	99	99	486

Table A8 NCEE Score by Father's Profession

	N	Mean				Median			
		Chinese	Math	English	Total	Chinese	Math	English	Total
Government officials*	678	101.2	97.2	102.4	494.7	103	105	111	518
Managers in private company	159	98.9	90.5	95.4	471.5	101	94	104	484
Private entrepreneurs	187	97.6	88.6	90.3	455.1	99	94	96	477
Professional and technical personnel **	472	102.6	100.5	103.9	503.9	105	107	114	530
Clerk and related workers	308	98.9	91.7	95.4	469.8	99	98	101	490
Individual business	702	96.8	87.2	88.7	448.8	98	89	90	455
Military personnel and police	97	101.5	94.7	99.1	485.9	104	99	106	508
Business service personnel	224	98.3	91.2	92.5	462.1	99	98	96	480
Industrial workers	679	98.2	89.2	90.6	457.4	98	95	94	467
Agricultural Laborers	1,418	100.1	100.3	96.7	492.1	101	105	101	499
Unemployed	241	96.0	86.0	85.1	441.1	96	89	87	436
Others	575	94.5	85.2	85.3	436.0	95	88	87	437
Total	5,740	98.9	93.4	94.2	472.0	100	99	99	487

Note: * Including state owned company
** Including faculty in higher education institutions, other researchers, school teachers

Table A9 NCEE Score by Mother's Profession

	N	Mean				Median			
		Chinese	Math	English	Total	Chinese	Math	English	Total
Government officials*	344	100.6	96.4	102.4	493.6	104	105	113	525
Managers in private company	82	99.7	90.2	96.2	472.6	100	96	102	490
Private entrepreneurs	86	93.8	81.4	83.8	427.5	95	77	88	433
Professional and technical personnel **	398	104.0	105.3	108.9	523.5	106	112	119	550
Clerk and related workers	470	100.2	94.6	99.5	480.8	101	99	108	503
Individual business	714	96.2	84.8	87.7	442.5	97	88	90	446
Military personnel and police	17	103.1	94.2	102.4	491.1	104	95	104	494
Business service personnel	291	97.7	85.5	88.2	448.3	98	88	91	450
Industrial workers	424	98.7	89.8	91.9	460.5	99	95	95	471
Agricultural Laborers	1,639	100.2	100.0	96.4	491.4	101	105	100	498
Unemployed	696	97.9	90.7	91.0	458.9	99	96	96	474
Others	603	94.8	85.8	86.8	438.8	95	89	87	438
Total	5,764	98.8	93.3	94.2	471.7	100	99	99	486

Note: * Including state owned company
** Including faculty in higher education institutions, other researchers, school teachers

Table A10 Private Tutoring Participation Outside School

		N	Percent
Chinese	Junior middle school	704	11.6
	G10	244	4.0
	G11	312	5.2
	G12	401	6.6
Math	Junior middle school	1,740	28.8
	G10	943	15.6
	G11	1,341	22.2
	G12	1,397	23.1
English	Junior middle school	1,773	29.3
	G10	806	13.3
	G11	1,193	19.7
	G12	1,101	18.2
Total student number		6,043	100.0

Appendix 6. Predicted Probability of Private Tutoring Participation from Logit Model

Table A11 Predicted Probability of Private Tutoring Participation from Logit Model

	N	Mean	Standard Deviation	Min	Max
Chinese	5841	0.063	0.060	0.002	0.688
Math	5841	0.230	0.165	0.013	0.853
English	5841	0.180	0.118	0.016	0.742
All subjects	5841	0.505	0.196	0.079	0.977

Appendix 7. Urban and Rural Subsample Analysis Using the Control Function Model

Table A12 Second Stage Estimates of Control Function – Chinese/ Urban Subsample

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring	1.152*	-0.929	0.883	0.903
	(0.501)	(0.990)	(1.052)	(1.498)
Standardized HSEE Chinese score	0.163**	0.075	0.232**	0.168**
	(0.036)	(0.072)	(0.079)	(0.036)
SES	-0.016	0.044	0.011	-0.006
	(0.018)	(0.035)	(0.036)	(0.024)
Female	0.238**	0.198*	0.089	0.280**
	(0.041)	(0.088)	(0.099)	(0.058)
Science track	-0.112*	-0.093	-0.294*	-0.294**
	(0.045)	(0.095)	(0.123)	(0.062)
School choice	0.065	-0.048	0.000	0.101*
	(0.042)	(0.111)	(0.091)	(0.050)
Parents caring study and respect the child	0.010	0.048	0.058*	0.004
	(0.014)	(0.028)	(0.029)	(0.018)
Parents regulating	-0.017	0.026	-0.052	-0.026
	(0.017)	(0.032)	(0.034)	(0.021)
Parents doing too much for the child	-0.057**	0.032	-0.067	-0.053*
	(0.018)	(0.041)	(0.052)	(0.024)
Study habits and ability	0.011	0.012	0.014	0.039*
	(0.012)	(0.030)	(0.029)	(0.017)
Class environment of personal relationship	0.013	0.012	-0.036	0.027
	(0.033)	(0.060)	(0.064)	(0.049)
Key Class	0.096	0.218	0.196	0.008
	(0.055)	(0.148)	(0.181)	(0.079)
Class average SES	-0.016	0.045	0.026	-0.121
	(0.048)	(0.114)	(0.236)	(0.095)
Standardized total number of students in school	0.025		-0.052	-0.022
	(0.026)		(0.090)	(0.240)
Student-teacher ratio	0.032	0.115	0.014	-0.305
	(0.031)	(0.091)	(0.262)	(0.174)
Lab			-0.145	-0.917**
			(0.105)	(0.239)
Standardized HSEE admission line	-0.254**			0.722*
	(0.082)			(0.304)
School activity			-0.166	
			(0.442)	
Collegial	0.032	0.045	-0.179	-0.133
	(0.043)	(0.066)	(0.287)	(0.093)
Outcome-oriented	0.141	-0.063		
	(0.074)	(0.170)		
Lax principal leadership	-0.042			-0.759**
	(0.067)			(0.199)
High authority and accountability		0.203		0.225
		(0.104)		(0.379)
Heckman correction term 1		4.407	4.263*	2.524
		(6.424)	(1.793)	(1.636)
Heckman correction term 2	12.426		-8.861*	11.559
	(119.509)		(3.836)	(11.650)
Heckman correction term 3	-11.244	-8.147		-14.947
	(107.255)	(12.630)		(13.569)
Heckman correction term 4	-1.672	2.128	2.850	
	(11.061)	(4.077)	(1.512)	
Constant	0.326	-5.208	-6.194**	-0.770
	(14.782)	(6.799)	(2.180)	(0.622)
N	1269	407	309	996
F	.	.	18.5	.
Probability > 0	.	.	0	.
R2	0.354	0.460	0.603	0.352

Standard errors in parentheses ** p>0.01, * p>0.05

Table A13 Second Stage Estimates of Control Function – Chinese/ Rural Subsample

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring	0.556	-0.750	-1.433*	-2.485**
	(0.649)	(0.584)	(0.576)	(0.958)
Standardized HSEE Chinese score	0.137*	0.094*	0.083*	0.170**
	(0.059)	(0.046)	(0.036)	(0.043)
SES	-0.016	0.018	0.056	0.018
	(0.031)	(0.033)	(0.031)	(0.036)
Female	0.195**	0.156**	0.116*	0.183**
	(0.068)	(0.058)	(0.057)	(0.065)
Science track	-0.244*	-0.073	-0.247**	-0.373**
	(0.119)	(0.076)	(0.055)	(0.075)
School choice	0.066	0.036	-0.047	-0.017
	(0.070)	(0.060)	(0.053)	(0.057)
Parents caring study and respect the child	0.008	0.009	0.018	-0.015
	(0.026)	(0.023)	(0.022)	(0.022)
Parents regulating	-0.010	-0.018	0.015	0.068*
	(0.029)	(0.020)	(0.026)	(0.030)
Parents doing too much for the child	-0.002	-0.034	-0.002	-0.049
	(0.035)	(0.028)	(0.032)	(0.032)
Study habits and ability	-0.013	0.012	0.040*	0.002
	(0.021)	(0.019)	(0.018)	(0.022)
Class environment of personal relationship	0.153*	0.076	0.054	0.049
	(0.062)	(0.043)	(0.043)	(0.044)
Key Class	0.078	0.234**	0.203	0.447**
	(0.096)	(0.085)	(0.168)	(0.128)
Class average SES	-0.114	0.054	-0.175	-0.130
	(0.127)	(0.168)	(0.185)	(0.148)
Standardized total number of students in school	-0.153		-0.008	-0.500
	(0.130)		(0.037)	(0.380)
Student-teacher ratio	-0.038	0.180	-0.092	-0.309
	(0.128)	(0.101)	(0.166)	(0.313)
Lab			0.041	-0.270
			(0.058)	(0.420)
Standardized HSEE admission line	0.218			0.847
	(0.223)			(0.507)
School activity			-0.067	
			(0.226)	
Collegial	0.029	0.141	-0.295	0.132
	(0.126)	(0.077)	(0.187)	(0.127)
Outcome-oriented	0.159	0.237*		
	(0.273)	(0.107)		
Lax principal leadership	-0.010			
	(0.217)			
High authority and accountability		0.141		0.721
		(0.151)		(0.432)
Heckman correction term 1		0.688	1.030	1.500
		(0.547)	(0.819)	(1.117)
Heckman correction term 2	39.396**		-2.698	-15.713
	(11.330)		(2.283)	(14.550)
Heckman correction term 3	-49.202**	-2.158		15.170
	(14.057)	(1.794)		(14.620)
Heckman correction term 4	3.099**	0.304	0.292	
	(1.012)	(0.631)	(0.753)	
Constant	8.245**	-0.646	-1.389**	-2.049
	(2.753)	(0.484)	(0.470)	(2.540)
N	389	711	1068	667
F	7.33	20.97	.	46.98
Probability > 0	0	0	.	0
R2	0.353	0.443	0.444	0.357

Standard errors in parentheses ** p>0.01, * p>0.05

Table A14 Second Stage Estimates of Control Function – Math/ Urban Subsample

	School Category 1 (1)	School Category 2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring	-0.157	0.207	0.280	0.267
	(0.162)	(0.319)	(0.486)	(0.249)
Standardized HSEE Math score	0.281**	0.108	0.310**	0.203**
	(0.048)	(0.064)	(0.100)	(0.033)
SES	0.031*	-0.023	-0.024	-0.004
	(0.014)	(0.030)	(0.037)	(0.020)
Female	0.021	-0.058	-0.128	-0.017
	(0.038)	(0.063)	(0.079)	(0.050)
Science track	-0.278**	-0.146*	-0.231*	-0.209**
	(0.042)	(0.069)	(0.109)	(0.052)
School choice	-0.010	0.033	0.052	0.019
	(0.037)	(0.085)	(0.075)	(0.044)
Parents caring study and respect the child	0.037**	0.022	0.077**	0.028
	(0.012)	(0.020)	(0.027)	(0.015)
Parents regulating	0.016	-0.008	-0.038	-0.014
	(0.015)	(0.027)	(0.032)	(0.018)
Parents doing too much for the child	-0.019	-0.007	-0.041	-0.061**
	(0.013)	(0.027)	(0.040)	(0.021)
Study habits and ability	0.049**	0.052*	0.072**	0.037*
	(0.010)	(0.023)	(0.025)	(0.015)
Class environment of personal relationship	-0.011	0.133**	0.019	0.055
	(0.027)	(0.048)	(0.056)	(0.040)
Key Class	-0.002	0.498**	0.269	0.315**
	(0.047)	(0.116)	(0.177)	(0.077)
Class average SES	-0.010	-0.031	-0.146	0.024
	(0.042)	(0.088)	(0.196)	(0.081)
Standardized total number of students in school	0.136**		0.129	-0.233
	(0.024)		(0.084)	(0.170)
Student-teacher ratio	0.100**	0.078	0.291	0.014
	(0.030)	(0.077)	(0.220)	(0.131)
Lab			-0.258**	0.178
			(0.098)	(0.209)
Standardized HSEE admission line	-0.186**			0.043
	(0.071)			(0.233)
School activity			-0.482	
			(0.382)	
Collegial	-0.093*	-0.112*	-0.175	0.057
	(0.041)	(0.046)	(0.262)	(0.075)
Outcome-oriented	0.170**	-0.278*		
	(0.065)	(0.136)		
Lax principal leadership	-0.244**			0.189
	(0.065)			(0.166)
High authority and accountability		-0.038		0.265
		(0.086)		(0.261)
Heckman correction term 1		22.435**	1.964	1.673
		(5.887)	(1.463)	(1.154)
Heckman correction term 2	-205.512		-4.244	5.710
	(112.043)		(3.037)	(8.439)
Heckman correction term 3	184.341	-43.901**		-8.186
	(100.561)	(11.605)		(9.751)
Heckman correction term 4	18.637	13.601**	1.104	
	(10.364)	(3.733)	(1.186)	
Constant	-26.143	-24.779**	-3.875*	-2.346**
	(13.858)	(6.293)	(1.678)	(0.497)
N	1269	407	309	996
F	38.35	.	30.1	38.04
Probability > 0	0	.	0	0
R2	0.436	0.657	0.706	0.383

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A15 Second Stage Estimates of Control Function – Math/ Rural Subsample

	School Category 1 (1)	School Category 2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring	-0.486	-0.875**	-0.075	-0.916
	(0.491)	(0.332)	(0.226)	(0.706)
Standardized HSEE Math score	0.286**	0.190**	0.334**	0.254**
	(0.082)	(0.059)	(0.064)	(0.051)
SES	-0.054*	0.019	0.008	-0.025
	(0.026)	(0.031)	(0.025)	(0.039)
Female	-0.028	0.005	-0.024	0.033
	(0.051)	(0.045)	(0.046)	(0.063)
Science track	-0.434**	-0.295**	-0.280**	-0.547**
	(0.087)	(0.055)	(0.054)	(0.074)
School choice	-0.032	0.089*	-0.049	0.061
	(0.051)	(0.043)	(0.044)	(0.058)
Parents caring study and respect the child	0.027	0.010	0.051*	0.019
	(0.020)	(0.017)	(0.023)	(0.022)
Parents regulating	0.030	0.021	-0.017	0.084**
	(0.022)	(0.018)	(0.019)	(0.028)
Parents doing too much for the child	-0.010	0.008	-0.020	-0.100**
	(0.025)	(0.024)	(0.024)	(0.033)
Study habits and ability	0.017	0.034*	0.064**	0.073**
	(0.016)	(0.014)	(0.015)	(0.022)
Class environment of personal relationship	0.011	0.088*	-0.044	0.059
	(0.046)	(0.036)	(0.038)	(0.043)
Key Class	0.104	0.380**	0.404**	0.440**
	(0.076)	(0.064)	(0.123)	(0.113)
Class average SES	0.056	-0.187	-0.057	-0.052
	(0.104)	(0.135)	(0.148)	(0.133)
Standardized total number of students in school	0.035		0.073	-0.299
	(0.093)		(0.038)	(0.348)
Student-teacher ratio	0.125	0.007	0.065	-0.387
	(0.093)	(0.095)	(0.140)	(0.295)
Lab			-0.162**	-0.178
			(0.057)	(0.375)
Standardized HSEE admission line	-0.066			0.686
	(0.226)			(0.462)
School activity			-0.101	
			(0.194)	
Collegial	-0.091	-0.035	0.022	0.007
	(0.096)	(0.077)	(0.158)	(0.128)
Outcome-oriented	0.192	-0.139		
	(0.210)	(0.085)		
Lax principal leadership	-0.431*			
	(0.177)			
High authority and accountability		0.076		0.855*
		(0.157)		(0.410)
Heckman correction term 1		0.390	1.000*	0.371
		(0.461)	(0.480)	(0.774)
Heckman correction term 2	39.047*		-2.673*	0.073
	(15.478)		(1.351)	(9.659)
Heckman correction term 3	-48.903*	-1.376		-1.192
	(19.219)	(1.606)		(9.622)
Heckman correction term 4	3.202*	0.065	0.444	
	(1.367)	(0.525)	(0.446)	
Constant	8.652*	-0.692*	-1.103**	0.371
	(3.683)	(0.335)	(0.326)	(1.753)
N	389	711	1068	667
F	9.09	35.31	.	.
Probability > 0	0	0	.	.
R2	0.480	0.571	0.531	0.432

Standard errors in parentheses ** p>0.01, * p>0.05

Table A16 Second Stage Estimates of Control Function – English/ Urban Subsample

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring	0.158	-0.028	0.422	0.894*
	(0.189)	(0.420)	(0.682)	(0.355)
Standardized HSEE English score	0.758**	0.482**	0.577**	0.382**
	(0.063)	(0.110)	(0.064)	(0.024)
SES	0.030*	0.045	-0.005	-0.006
	(0.012)	(0.031)	(0.036)	(0.020)
Female	0.106**	0.104	0.104	0.129**
	(0.031)	(0.065)	(0.072)	(0.047)
Science track	-0.031	0.065	0.095	0.060
	(0.035)	(0.073)	(0.093)	(0.048)
School choice	0.028	0.054	0.013	0.024
	(0.032)	(0.098)	(0.077)	(0.039)
Parents caring study and respect the child	0.008	0.015	0.070*	0.029*
	(0.010)	(0.019)	(0.033)	(0.015)
Parents regulating	-0.030*	-0.018	-0.033	-0.018
	(0.013)	(0.029)	(0.040)	(0.017)
Parents doing too much for the child	-0.020	-0.035	-0.064	-0.064**
	(0.012)	(0.033)	(0.039)	(0.019)
Study habits and ability	0.042**	0.018	0.050*	0.026
	(0.009)	(0.023)	(0.021)	(0.015)
Class environment of personal relationship	0.020	0.086	0.048	-0.040
	(0.024)	(0.048)	(0.053)	(0.037)
Key Class	0.119**	0.299*	-0.038	0.290**
	(0.044)	(0.129)	(0.174)	(0.079)
Class average SES	-0.011	-0.095	-0.351	0.077
	(0.035)	(0.087)	(0.190)	(0.074)
Standardized total number of students in school	-0.014		-0.025	-0.355*
	(0.021)		(0.077)	(0.166)
Student-teacher ratio	0.069**	-0.045	0.391	0.073
	(0.023)	(0.076)	(0.205)	(0.123)
Lab			-0.098	0.297
			(0.087)	(0.182)
Standardized HSEE admission line	0.002			0.117
	(0.060)			(0.216)
School activity			-0.590	
			(0.335)	
Collegial	-0.083*	-0.027	-0.376	0.303**
	(0.033)	(0.050)	(0.242)	(0.073)
Outcome-oriented	0.113*	-0.105		
	(0.055)	(0.131)		
Lax principal leadership	-0.091			0.399*
	(0.053)			(0.159)
High authority and accountability		-0.085		0.264
		(0.078)		(0.267)
Heckman correction term 1		8.734	-0.070	-1.500
		(6.377)	(1.227)	(1.470)
Heckman correction term 2	61.850		-0.473	-15.114
	(84.657)		(2.568)	(10.597)
Heckman correction term 3	-56.164	-17.762		16.190
	(75.944)	(12.543)		(12.317)
Heckman correction term 4	-5.904	5.129	-0.378	
	(7.853)	(4.028)	(1.019)	
Constant	5.839	-11.667	-2.513	-2.783**
	(10.493)	(6.795)	(1.444)	(0.459)
N	1269	407	309	996
F	.	.	43.96	.
Probability > 0	.	.	0	.
R2	0.550	0.623	0.709	0.530

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A17 Second Stage Estimates of Control Function – English/ Rural Subsample

	School Category 1	School Category2	School Category 3	School Category 4
	(1)	(2)	(3)	(4)
Private tutoring	-0.277	-0.574	-0.269	-1.019
	(0.549)	(0.347)	(0.242)	(0.711)
Standardized HSEE English score	0.620**	0.557**	0.453**	0.346**
	(0.122)	(0.058)	(0.047)	(0.040)
SES	-0.001	0.026	-0.024	-0.009
	(0.028)	(0.028)	(0.027)	(0.034)
Female	0.120**	0.129**	0.189**	0.310**
	(0.042)	(0.048)	(0.043)	(0.050)
Science track	-0.108	0.097	-0.013	0.036
	(0.091)	(0.055)	(0.045)	(0.056)
School choice	0.052	-0.057	-0.030	0.061
	(0.047)	(0.049)	(0.041)	(0.046)
Parents caring study and respect the child	0.035*	0.001	0.030	0.001
	(0.017)	(0.017)	(0.020)	(0.016)
Parents regulating	0.011	-0.044*	-0.025	0.036
	(0.018)	(0.017)	(0.019)	(0.023)
Parents doing too much for the child	-0.006	0.006	0.026	-0.029
	(0.020)	(0.020)	(0.022)	(0.023)
Study habits and ability	-0.009	0.023	0.044**	0.018
	(0.013)	(0.013)	(0.013)	(0.017)
Class environment of personal relationship	-0.065	0.030	-0.006	0.042
	(0.046)	(0.039)	(0.038)	(0.035)
Key Class	0.190**	0.356**	0.172	0.312**
	(0.073)	(0.073)	(0.136)	(0.091)
Class average SES	0.035	-0.418**	-0.307*	-0.001
	(0.105)	(0.127)	(0.134)	(0.089)
Standardized total number of students in school	-0.133		-0.015	-0.628
	(0.082)		(0.030)	(0.457)
Student-teacher ratio	0.058	-0.116	0.295*	-0.575
	(0.112)	(0.087)	(0.133)	(0.334)
Lab			-0.068	-0.285
			(0.051)	(0.498)
Standardized HSEE admission line	0.181			0.886
	(0.251)			(0.550)
School activity			-0.431*	
			(0.178)	
Collegial	-0.090	-0.024	-0.293*	0.111
	(0.109)	(0.070)	(0.142)	(0.110)
Outcome-oriented	0.389*	0.005		
	(0.192)	(0.087)		
Lax principal leadership	-0.184			
	(0.208)			
High authority and accountability		-0.153		1.056*
		(0.142)		(0.442)
Heckman correction term 1		-1.365**	-0.015	-0.950
		(0.484)	(0.336)	(0.753)
Heckman correction term 2	22.343		-0.344	14.829
	(13.432)		(0.897)	(9.763)
Heckman correction term 3	-28.595	3.927*		-15.579
	(16.597)	(1.598)		(9.815)
Heckman correction term 4	1.793	-1.820**	-0.536	
	(1.174)	(0.544)	(0.306)	
Constant	3.625	-2.685**	-2.402**	2.326
	(3.306)	(0.414)	(0.261)	(1.724)
N	389	711	1068	667
F	17.86	54.31	.	183.37
Probability > 0	0	0	.	0
R2	0.602	0.645	0.619	0.534

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A18 Second Stage Estimates of Control Function – All Subjects/ Urban (1)

	School Category 1	School Category 2	School Category 3	School Category 4
	(1)	(2)	(3)	(4)
Predicted probability of private tutoring participation	-0.085	-0.427	-0.006	0.326
	(0.135)	(0.315)	(0.393)	(0.191)
Standardized HSEE total score	2.261**	2.224*	0.261	-1.728
	(0.458)	(1.102)	(0.950)	(1.304)
SES	0.030**	0.050	-0.006	-0.006
	(0.012)	(0.029)	(0.028)	(0.016)
Female	0.026	0.002	-0.011	0.045
	(0.030)	(0.061)	(0.063)	(0.038)
Science track	-0.237**	-0.155*	-0.251**	-0.539**
	(0.032)	(0.068)	(0.085)	(0.039)
School choice	-0.005	0.061	-0.030	0.004
	(0.030)	(0.085)	(0.066)	(0.035)
Parents caring study and respect the child	0.026**	0.036	0.072**	0.020
	(0.010)	(0.019)	(0.024)	(0.012)
Parents regulating	-0.007	-0.007	-0.013	-0.004
	(0.013)	(0.027)	(0.028)	(0.015)
Parents doing too much for the child	-0.015	0.005	-0.050	-0.070**
	(0.012)	(0.029)	(0.036)	(0.017)
Study habits and ability	0.050**	0.038	0.034	0.031*
	(0.009)	(0.021)	(0.019)	(0.013)
Class environment of personal relationship	-0.007	0.085	0.019	0.018
	(0.022)	(0.045)	(0.055)	(0.033)
Key Class	0.153**	0.378**	0.264	0.299**
	(0.040)	(0.125)	(0.195)	(0.066)
Class average SES	0.000	0.030	0.013	0.067
	(0.034)	(0.083)	(0.167)	(0.064)
Standardized total number of students in school	0.128**		0.056	-0.289
	(0.019)		(0.073)	(0.153)
Student-teacher ratio	0.141**	0.090	0.220	-0.064
	(0.023)	(0.070)	(0.209)	(0.130)
Lab			-0.216*	0.160
			(0.084)	(0.177)
Standardized HSEE admission line	-0.106			0.194
	(0.058)			(0.230)
School activity			-0.454	
			(0.360)	
Collegial	-0.119**	-0.027	-0.139	0.146*
	(0.029)	(0.047)	(0.227)	(0.060)
Outcome-oriented	0.210**	-0.180		
	(0.050)	(0.119)		
Lax principal leadership	-0.293**			0.233
	(0.048)			(0.132)
High authority and accountability		0.064		0.363
		(0.071)		(0.269)
Heckman correction term 1		1.335	1.805	5.231
		(8.672)	(2.361)	(2.884)
Heckman correction term 2	66.770		-3.914	2.792
	(97.006)		(3.900)	(6.763)
Heckman correction term 3	-63.015	-5.404		-10.123
	(87.258)	(16.051)		(8.854)
Heckman correction term 4	-4.292	2.661	0.928	
	(8.844)	(4.668)	(1.117)	
Constant	6.464	-2.751	-3.557	-6.979*
	(11.925)	(9.169)	(2.675)	(3.240)
N	1269	407	309	996
F	.	.	47	192.42
Probability > 0	.	.	0	0
R2	0.560	0.686	0.763	0.542

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A19 Second Stage Estimates of Control Function – All Subjects/ Rural (1)

	School Category 1 (1)	School Category 2 (2)	School Category 3 (3)	School Category 4 (4)
Predicted probability of private tutoring participation	-0.691*	-0.905**	-0.313	-0.605
	(0.327)	(0.288)	(0.256)	(0.362)
Standardized HSEE total score	2.045	3.301	2.797	1.930
	(1.381)	(3.664)	(3.797)	(1.262)
SES	0.006	0.060	0.028	-0.010
	(0.032)	(0.032)	(0.029)	(0.037)
Female	-0.031	0.043	0.028	0.117*
	(0.044)	(0.043)	(0.040)	(0.048)
Science track	-0.328**	-0.169**	-0.317**	-0.564**
	(0.074)	(0.052)	(0.045)	(0.053)
School choice	0.021	0.003	-0.031	0.036
	(0.045)	(0.041)	(0.039)	(0.042)
Parents caring study and respect the child	0.021	0.013	0.037*	0.019
	(0.016)	(0.016)	(0.018)	(0.016)
Parents regulating	0.012	-0.012	-0.016	0.052*
	(0.018)	(0.014)	(0.017)	(0.021)
Parents doing too much for the child	0.022	0.038	0.020	-0.056
	(0.024)	(0.023)	(0.023)	(0.031)
Study habits and ability	0.044**	0.045**	0.069**	0.063**
	(0.015)	(0.015)	(0.015)	(0.019)
Class environment of personal relationship	0.053	0.101**	0.001	0.045
	(0.042)	(0.037)	(0.037)	(0.036)
Key Class	0.195**	0.317**	0.260*	0.410**
	(0.071)	(0.061)	(0.118)	(0.082)
Class average SES	0.012	-0.005	-0.211	0.062
	(0.101)	(0.123)	(0.140)	(0.094)
Standardized total number of students in school	-0.099		0.009	-0.725**
	(0.089)		(0.035)	(0.184)
Student-teacher ratio	0.101	0.145	0.232	-0.862**
	(0.099)	(0.086)	(0.126)	(0.187)
Lab			-0.109*	-0.454*
			(0.048)	(0.203)
Standardized HSEE admission line	0.250			1.366**
	(0.196)			(0.297)
School activity			-0.397*	
			(0.173)	
Collegial	-0.110	0.059	-0.290*	0.062
	(0.097)	(0.075)	(0.146)	(0.099)
Outcome-oriented	0.336	-0.090		
	(0.206)	(0.078)		
Lax principal leadership	-0.347			
	(0.189)			
High authority and accountability		0.247		1.479**
		(0.155)		(0.258)
Heckman correction term 1		-2.296	-0.731	-2.218
		(2.386)	(2.865)	(2.009)
Heckman correction term 2	22.536		-1.273	14.273
	(14.953)		(3.842)	(13.826)
Heckman correction term 3	-30.989	3.232		-13.100
	(17.404)	(2.884)		(12.662)
Heckman correction term 4	3.441**	0.128	1.113	
	(1.123)	(1.167)	(1.259)	
Constant	5.117	-0.447	-1.187	3.153
	(3.199)	(0.539)	(1.182)	(2.062)
N	389	711	1067	667
F	17.43	55.4	65.06	104.2
Probability > 0	0	0	0	0
R2	0.607	0.654	0.626	0.567

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A20 Second Stage Estimates of Control Function – All Subjects/ Urban (2)

	School Category 1 (1)	School Category 2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring expenditure	-0.008	-0.053	-0.005	0.060*
	(0.019)	(0.042)	(0.055)	(0.027)
Standardized HSEE total score	2.269**	2.219*	0.261	-1.750
	(0.459)	(1.099)	(0.951)	(1.297)
SES	0.029*	0.045	-0.005	-0.009
	(0.011)	(0.028)	(0.027)	(0.016)
Female	0.023	-0.005	-0.009	0.041
	(0.029)	(0.060)	(0.062)	(0.038)
Science track	-0.237**	-0.158*	-0.251**	-0.534**
	(0.032)	(0.068)	(0.086)	(0.039)
School choice	-0.005	0.066	-0.029	0.000
	(0.030)	(0.086)	(0.066)	(0.035)
Parents caring study and respect the child	0.025**	0.033	0.072**	0.023
	(0.010)	(0.019)	(0.025)	(0.012)
Parents regulating	-0.008	-0.009	-0.013	-0.006
	(0.013)	(0.027)	(0.028)	(0.014)
Parents doing too much for the child	-0.018	-0.007	-0.050	-0.059**
	(0.011)	(0.031)	(0.033)	(0.016)
Study habits and ability	0.048**	0.025	0.033	0.043**
	(0.009)	(0.023)	(0.019)	(0.013)
Class environment of personal relationship	-0.007	0.084	0.020	0.017
	(0.022)	(0.044)	(0.054)	(0.033)
Key Class	0.155**	0.378**	0.260	0.308**
	(0.041)	(0.125)	(0.197)	(0.066)
Class average SES	0.002	0.045	0.013	0.053
	(0.034)	(0.084)	(0.166)	(0.064)
Standardized total number of students in school	0.129**		0.054	-0.265
	(0.019)		(0.071)	(0.154)
Student-teacher ratio	0.141**	0.102	0.221	-0.069
	(0.023)	(0.070)	(0.206)	(0.128)
Lab			-0.214*	0.212
			(0.088)	(0.181)
Standardized HSEE admission line	-0.111			0.206
	(0.057)			(0.222)
School activity			-0.455	
			(0.353)	
Collegial	-0.117**	-0.033	-0.140	0.162**
	(0.029)	(0.048)	(0.226)	(0.060)
Outcome-oriented	0.211**	-0.190		
	(0.050)	(0.118)		
Lax principal leadership	-0.291**			0.265*
	(0.048)			(0.131)
High authority and accountability		0.064		0.367
		(0.071)		(0.267)
Heckman correction term 1		1.483	1.802	5.265
		(8.710)	(2.360)	(2.869)
Heckman correction term 2	67.989		-3.909	2.988
	(97.010)		(3.898)	(6.747)
Heckman correction term 3	-64.116	-5.665		-10.357
	(87.262)	(16.135)		(8.829)
Heckman correction term 4	-4.400	2.722	0.926	
	(8.844)	(4.699)	(1.116)	
Constant	6.551	-3.276	-3.568	-6.666*
	(11.928)	(9.196)	(2.666)	(3.200)
N	1269	407	309	996
F	58.09	.	47.06	193.13
Probability > 0	0	.	0	0
R2	0.560	0.685	0.763	0.543

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A21 Second Stage Estimates of Control Function – All Subjects/ Rural (2)

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Private tutoring expenditure	-0.305*	-0.353**	-0.146	-0.205
	(0.124)	(0.120)	(0.112)	(0.142)
Standardized HSEE total score	2.109	3.200	2.730	1.896
	(1.394)	(3.647)	(3.780)	(1.257)
SES	-0.003	0.037	0.025	-0.028
	(0.028)	(0.029)	(0.026)	(0.033)
Female	-0.030	0.034	0.030	0.110*
	(0.044)	(0.043)	(0.040)	(0.048)
Science track	-0.332**	-0.164**	-0.319**	-0.565**
	(0.074)	(0.052)	(0.045)	(0.053)
School choice	0.026	0.011	-0.029	0.040
	(0.045)	(0.041)	(0.039)	(0.042)
Parents caring study and respect the child	0.007	-0.003	0.030	0.009
	(0.017)	(0.016)	(0.019)	(0.018)
Parents regulating	0.019	-0.007	-0.013	0.054*
	(0.018)	(0.015)	(0.018)	(0.022)
Parents doing too much for the child	-0.013	-0.010	0.005	-0.089**
	(0.018)	(0.018)	(0.020)	(0.024)
Study habits and ability	0.018	0.008	0.057**	0.040*
	(0.013)	(0.013)	(0.013)	(0.016)
Class environment of personal relationship	0.059	0.094*	0.006	0.043
	(0.042)	(0.037)	(0.038)	(0.036)
Key Class	0.181*	0.304**	0.249*	0.408**
	(0.073)	(0.063)	(0.119)	(0.082)
Class average SES	-0.006	-0.020	-0.228	0.048
	(0.101)	(0.123)	(0.140)	(0.096)
Standardized total number of students in school	-0.115		0.002	-0.847**
	(0.091)		(0.039)	(0.189)
Student-teacher ratio	-0.064	0.091	0.226	-0.784**
	(0.105)	(0.092)	(0.126)	(0.186)
Lab			-0.082	-0.684**
			(0.065)	(0.217)
Standardized HSEE admission line	0.160			1.354**
	(0.193)			(0.296)
School activity			-0.385*	
			(0.173)	
Collegial	0.070	0.055	-0.287*	0.086
	(0.102)	(0.076)	(0.145)	(0.100)
Outcome-oriented	0.228	-0.041		
	(0.216)	(0.074)		
Lax principal leadership	-0.133			
	(0.181)			
High authority and accountability		0.193		1.393**
		(0.156)		(0.262)
Heckman correction term 1		-2.246	-0.678	-2.218
		(2.372)	(2.857)	(2.004)
Heckman correction term 2	22.645		-1.333	14.764
	(14.925)		(3.834)	(13.763)
Heckman correction term 3	-31.191	3.232		-13.646
	(17.333)	(2.864)		(12.596)
Heckman correction term 4	3.505**	0.055	1.094	
	(1.107)	(1.164)	(1.251)	
Constant	4.784	-1.234**	-1.500	2.590
	(3.172)	(0.477)	(1.189)	(2.112)
N	389	711	1068	667
F	17.41	55.67	.	.
Probability > 0	0	0	.	.
R2	0.609	0.653	0.627	0.566

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A22 Second Stage Estimates of Control Function – All Subjects/ Urban (3)

	School Category 1 (1)	School Category2 (2)	School Category 3 (3)	School Category 4 (4)
Time spent on Private tutoring	-0.011	-0.148	-0.080	0.151*
	(0.047)	(0.104)	(0.143)	(0.067)
Standardized HSEE total score	2.267**	2.207*	0.237	-1.745
	(0.458)	(1.099)	(0.943)	(1.301)
SES	0.028*	0.054	0.008	-0.016
	(0.013)	(0.032)	(0.031)	(0.018)
Female	0.021	-0.016	-0.006	0.055
	(0.028)	(0.059)	(0.059)	(0.036)
Science track	-0.238**	-0.172*	-0.262**	-0.520**
	(0.032)	(0.070)	(0.090)	(0.040)
School choice	-0.006	0.060	-0.030	0.007
	(0.030)	(0.086)	(0.066)	(0.035)
Parents caring study and respect the child	0.025**	0.034	0.071**	0.022
	(0.010)	(0.019)	(0.025)	(0.012)
Parents regulating	-0.009	-0.009	-0.008	-0.005
	(0.012)	(0.027)	(0.028)	(0.014)
Parents doing too much for the child	-0.017	0.008	-0.040	-0.074**
	(0.012)	(0.030)	(0.036)	(0.017)
Study habits and ability	0.049**	0.042*	0.039	0.025
	(0.009)	(0.021)	(0.021)	(0.014)
Class environment of personal relationship	-0.008	0.084	0.027	0.017
	(0.022)	(0.045)	(0.055)	(0.033)
Key Class	0.157**	0.366**	0.233	0.315**
	(0.042)	(0.125)	(0.202)	(0.067)
Class average SES	0.003	0.067	0.025	0.030
	(0.036)	(0.088)	(0.168)	(0.065)
Standardized total number of students in school	0.130**		0.049	-0.270
	(0.019)		(0.068)	(0.154)
Student-teacher ratio	0.143**	0.109	0.245	-0.055
	(0.023)	(0.070)	(0.212)	(0.130)
Lab			-0.206*	0.208
			(0.087)	(0.180)
Standardized HSEE admission line	-0.110			0.132
	(0.058)			(0.234)
School activity			-0.477	
			(0.357)	
Collegial	-0.119**	-0.047	-0.139	0.145*
	(0.033)	(0.049)	(0.224)	(0.060)
Outcome-oriented	0.210**	-0.203		
	(0.052)	(0.118)		
Lax principal leadership	-0.294**			0.233
	(0.048)			(0.131)
High authority and accountability		0.026		0.384
		(0.079)		(0.266)
Heckman correction term 1		1.265	1.795	5.341
		(8.699)	(2.338)	(2.875)
Heckman correction term 2	68.603		-3.885	3.102
	(97.040)		(3.862)	(6.722)
Heckman correction term 3	-64.667	-5.268		-10.570
	(87.289)	(16.107)		(8.803)
Heckman correction term 4	-4.457	2.610	0.915	
	(8.847)	(4.687)	(1.108)	
Constant	6.643	-2.909	-3.549	-6.991*
	(11.931)	(9.188)	(2.641)	(3.222)
N	1269	407	309	996
F	57.24	.	47.51	193.27
Probability > 0	0	.	0	0
R2	0.560	0.685	0.763	0.543

Standard errors in parentheses. ** p>0.01, * p>0.05

Table A23 Second Stage Estimates of Control Function – All Subjects/ Rural (3)

	School Category 1	School Category2	School Category 3	School Category 4
	(1)	(2)	(3)	(4)
Time spent on Private tutoring	-0.270*	-0.344**	-0.133	-0.195
	(0.119)	(0.113)	(0.100)	(0.141)
Standardized HSEE total score	2.063	3.225	2.755	1.872
	(1.396)	(3.655)	(3.779)	(1.257)
SES	-0.001	0.044	0.027	-0.025
	(0.029)	(0.029)	(0.027)	(0.035)
Female	-0.065	-0.006	0.012	0.085*
	(0.043)	(0.041)	(0.038)	(0.043)
Science track	-0.338**	-0.178**	-0.324**	-0.572**
	(0.075)	(0.053)	(0.046)	(0.055)
School choice	0.024	0.008	-0.030	0.039
	(0.045)	(0.041)	(0.039)	(0.042)
Parents caring study and respect the child	0.022	0.015	0.037*	0.019
	(0.016)	(0.016)	(0.018)	(0.016)
Parents regulating	0.013	-0.013	-0.016	0.051*
	(0.018)	(0.014)	(0.017)	(0.021)
Parents doing too much for the child	0.020	0.031	0.021	-0.065*
	(0.023)	(0.022)	(0.022)	(0.030)
Study habits and ability	0.053**	0.052**	0.074**	0.065**
	(0.018)	(0.017)	(0.017)	(0.022)
Class environment of personal relationship	0.037	0.074*	-0.004	0.028
	(0.040)	(0.034)	(0.036)	(0.032)
Key Class	0.226**	0.359**	0.271*	0.436**
	(0.069)	(0.058)	(0.117)	(0.082)
Class average SES	0.043	0.040	-0.200	0.086
	(0.103)	(0.123)	(0.140)	(0.091)
Standardized total number of students in school	-0.101		0.016	-0.752**
	(0.091)		(0.030)	(0.182)
Student-teacher ratio	0.070	0.161	0.236	-0.797**
	(0.096)	(0.085)	(0.124)	(0.185)
Lab			-0.114**	-0.519**
			(0.044)	(0.197)
Standardized HSEE admission line	0.208			1.319**
	(0.193)			(0.296)
School activity			-0.383*	
			(0.174)	
Collegial	-0.087	0.065	-0.261	0.079
	(0.093)	(0.075)	(0.142)	(0.099)
Outcome-oriented	0.368	-0.037		
	(0.208)	(0.073)		
Lax principal leadership	-0.337			
	(0.184)			
High authority and accountability		0.194		1.392**
		(0.155)		(0.262)
Heckman correction term 1		-2.281	-0.706	-2.203
		(2.380)	(2.855)	(2.003)
Heckman correction term 2	22.623		-1.308	14.540
	(15.001)		(3.830)	(13.772)
Heckman correction term 3	-31.150	3.247		-13.421
	(17.426)	(2.875)		(12.609)
Heckman correction term 4	3.496**	0.095	1.109	
	(1.111)	(1.168)	(1.253)	
Constant	4.865	-0.964*	-1.371	2.802
	(3.190)	(0.485)	(1.179)	(2.079)
N	389	711	1068	667
F	17.35	55.15	.	103.74
Probability > 0	0	0	.	0
R2	0.608	0.653	0.627	0.566

Standard errors in parentheses. ** p>0.01, * p>0.05