THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF EDUCATION POLICY STUDIES

THE DETERMINANTS OF SHADOW EDUCATION IN MATH: A COMPARATIVE STUDY OF HONGKONG AND SHANGHAI

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FALL 2013

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Education and Public Policy
with honors in Education and Public Policy

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ABSTRACT

Driven by the purpose of improving student academic performance, shadow education, known as the outside-school learning or private supplementary tutoring, has been a growing educational phenomenon all over the world. This study first drew on literature from other countries to identify drivers of demand and the scale of shadow education, as well as determinants. Then, this paper investigated the determinants of shadow education in Hong Kong and Shanghai by using the data from the Program for International Student Assessment (PISA) 2009. The results of the logistic regression analysis showed that in Hong Kong, having higher family socioeconomic status (SES), higher student grade level, more positive attitude towards school, taking more math classes per week, having a higher math score, studying in a class with a greater student-teacher ratio were associated with an increased likelihood of participating in shadow education on math; while in Shanghai, having a higher index of family SES, living with two parents, keeping a positive attitude toward school, studying in classrooms with better disciplinary climate, having more math classes per week, obtaining a higher math score and studying in a class with a smaller student-teacher ratio, were associated with an increased likelihood.

A comparison between determinants of Hong Kong and Shanghai suggested that the magnitudes in the relation of eight factors math tutoring were significantly different. These factors included family SES, living with two parents, student grade level, disciplinary climate, the number of math classes per week, math score, going to a public school, and student-teacher ratio. The current study discusses on social and economic implications of the findings by highlighting traditional Chinese values, the National College Entrance Exam, and other related educational phenomena in the Chinese societies.

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ACKNOWLEDGEMENTS

This moment of writing these last few words on my thesis reminds me of the time when I first met with my thesis supervisor, Dr. Soo-yong Byun, in his office. That was one of the memorable moments in my life at Penn State. At that time, I told him I would like to write my thesis about the rapid expansion of private tutoring in China. Dr. Byun suggested me to read several previous articles about shadow education, and he also introduced the PISA 2009 data to me. That was the first time I learned the term "shadow education" and quantitative research methods; and with PISA 2009 data which including statistics from Shanghai and Hong Kong, conducting a comparative research in two cities of China became feasible.

I would like to express my special thanks and deepest gratitude to my supervisor, Dr. Byun, for guiding and encouraging me throughout the whole year. As an undergraduate student, my ability of conducting an academic research was limited. In the beginning, my ideas and goals about this research were still not very clear and wide-ranging. Later, the actual processing of reaching my goals was more complicated than I thought. Thanks to Dr. Byun, I learned so much professional skills and knowledge in shadow education from him while scheduling the independent study with him. Especially, during the thesis writing process, his precise guidance and patient supports were crucial to designing my regression models and completing the data analysis. Without his help, I could not have a master thesis with quality and finally got accepted by the CIES 2014 conference in Toronto, Canada.

I also received tremendous supports from Dr. David Johnson in the Sociology Department at Penn State. He offered me an opportunity to take his graduate-level course on statistic and taught me using Stata while I was still an undergraduate, and he answered my questions every time

when I went to his office. Thanks to this valuable experience, I got myself prepared for dealing with large data sets.

I would like to thank my academic advisor, Dr. Mindy Kornhaber. Dr. Kornhaber knew me for five years. I took EDTHP 115 with her in Fall 2009, and she was the instructor at that time. And later she became my academic advisor and honors adviser. Dr. Kornhaber passion of teaching and professions always inspires me. She always encourages me and answers my questions even she is super busy. Without her recommendation and supports, I would not have caught the last opportunity to use the gateway process to join the Schreyer Honors College. I also want to thank Dr. David Baker, Dr. Liang Zhang, and Dr. Gerald LeTendre for reviewing my thesis and giving me valuable comments and suggestions.

I want to dedicate my thesis to my parents, Lingya Deng and Lu Xu, and my grandparents, Shusen Deng, and Chengyou Luo. Thanks for their unconditional love and financial support even they are far away from the United States. A special thanks also goes to my boyfriend DongQing Zheng, for being understanding and taking care of me in the last two years of my life at Penn State. Finally, I would also like to thank all of my beloved friends and relatives who have always encouraged me during my pursuit of my degrees. I am excited and happy to submit my thesis in a beautiful Fall in State College.

Chapter 1

INTRODUCTION

Education plays an important role in our lives. Schultz (1961) once pointed out that education worked as a major determinant of one's human capital. Education has a great impact on one's personal development as well as the economic growth of a country. Many studies have focused on the system and quality of public education at the primary and secondary level, trying to find out how to improve the school quality and students' academic performance. However, less attention was paid to the after-school learning. Over the past several decades, shadow education, which is sometimes called as non-formal education, private tutoring, or supplementary education and refers to a wide range of tutoring services that occurring outside of the mainstream schools, expanded in different countries within a short time. Today, shadow education has drawn increasing attention from educational researchers and policy makers not only because of its worldwide expansion within a short time, but because of potential impacts, for example, on students' academic achievement, the efficiency of mainstream schooling, teachers' payment, economic burdens among parents, and social mobility across countries.

Purpose of Study

Previous research of private tutoring looked at many countries, such as Egypt, Canada, Japan, South Korea, and Hong Kong (Bray, 2007; Choi, 2012; Davies, 2004; Elbadawy et al., 2007; Kim, 2004; Stevenson & Baker, 1992;) and examined the causal effect of shadow education on academic achievement in recent decades (Briggs, 2001; Heinrich et al., 2010; Kuan, 2011; Lauer et al., 2006). In particular, China, the birthplace of Confucinalism, has a long history of private tutoring and thus has drawn early attention from shadow education scholars

(Bray, 2007). However, surprisingly, shadow education and its determinant in China has not been well documented due largely to the lack of data.

In this paper, I address this issue by using the most recent data from the Program for International Student Assessment (PISA) 2009 to investigate the determinants of shadow education in China. PISA collected data from two locations in China: Hong Kong and Shanghai. I used both of Hong Kong and Shanghai because they are famous international cities for their economic growth, high standard of living, as well as their high quality of education. Hong Kong had been a colony of the British for 156 years before the transfer of its sovereignty to China in 1997. Today, Hong Kong is one of the Special Administrative Regions of China located on China's south coast. Shanghai is the largest city by population and the most developed urban area in Mainland China. Therefore, studying shadow education in these two Chinese cities will offer important insights into the prevalence and determinants of shadow education in China.

Organization of the Thesis

The thesis is organized as follows: In chapter 2, relevant literature on the definition, dimensions, and types of education is presented. Chapter 2 also covers the drivers of demand and scale of shadow education in other countries and in China, and reviews determinants of shadow education from previous studies. Chapter 3 introduces the data, measures, and the analytic strategy of this study. Chapter 4 shows the results of three logistic regression models in terms of the significant effects of family background, student characteristic, and school background on shadow education in Hong Kong and Shanghai, and compares effects between those two cities. Chapter 5 and Chapter 6 discuss and conclude, respectively, with the discussion of policy implications, limitation of the study, and directions for future research.

Chapter 2

LITERATURE REVIEW

Definition of Shadow Education

Stevenson and Baker defined shadow education as "a set of educational activities that occur outside formal schooling and are designed to enhance the student's formal school career" (Stevenson & Baker, 1992, p.1639). Later, Bray (2007) describes private supplementary tutoring as a "shadow" education system. According to Bray, the word "shadow" implies that this kind of education "only exists because the mainstream education exists," and its size is determined by the mainstream education system (Bray, 2007, p.17). Today, shadow education is viewed as the learning activity that occurs outside of school, such as providing extra tutoring sessions and take-home assignments, in order to supplement formal schooling, and finally, to improve students' academic achievement on in-school standard curriculum (Stevenson & Baker, 1992). Existing in the shadow of the formal educational system, shadow education is easy to be unnoticed and it reflects the features of public schools, working as a systematic mechanism to help students expanding their extracurricular learning experience (Southgate, 2009; Stevenson & Baker, 1992; UNESCO, 2012).

Bray (2007) identified three characteristics of shadow education, which are supplementary, private and focusing on academic subjects. Supplementation means that shadow education only takes subjects that are already covered in mainstream school into consideration. Privateness means that shadow education is an expenditure-based activity. A fee has to be paid to private entrepreneurs and individual providers of shadow education. Although people have to pay for it, students and parents are willing to invest in it because it can provide a supplementary alternative to assist students who are left behind by the mainstream schools. Meanwhile, if the

formal education system has failed to meet students' or parents' demand, shadow education can also provide enriching materials. For the focus on academic subjects, Bray believes that instead of extending the shadow education to include pleasure or more rounded form of personal development, such as musical, artistic or sporting skills, shadow education is limited to academic subjects such as test languages, mathematics, and other examinable subjects that are taught in mainstream schools.

There are many different types of shadow education, and they differ across countries Southgate points out three most common forms, which are one-to-one private tutoring, organized after-school cram sessions, and professional tutorial centers that "used to advance academic performance in terms of both achievement and attainment" (Southgate, 2009, p.12). Even the national use of this shadow education is different across countries, this market-driven education has expanded significantly and quickly in many parts of the world (UNESCO, 2006).

Worldwide Spreading of Shadow Education

Driver of Demand

Education has always been viewed as the major force to increase human capital, to change social mobility, and to promote social status (Becker, 1975; Schultz, 1961). According to Bray and Lykins (2012), one of the main drivers of demand for shadow education is culture. People believe that by investing more in education, there would be returns from outstanding performance in academic examinations and access to high-status secondary schools and universities. For most people, poor academic performance leads to fewer employment opportunities and lower standards of living, while a longer educational period and better educational quality would increase lifetime incomes and their standard of living (Bray & Lykins,

2012). According to Bray, shadow education "can be seen as a mechanism through which pupils extend their learning and gain additional human capital, which benefits not only themselves but also the wilder societies of which they are part" (Bray, 2007, p.17).

Compared to public school education, shadow education has more "individualized instruction" than public schools (Dang & Rogers, 2008, p.163). Using a "more flexible delivery mechanism" (Dang & Rogers, 2008, p.2), shadow education is less formal and more flexible, because it can include not only one-to-one tutoring but also group classes. According to Russell (1997), providers of shadow education can be full-time tutors and teachers but may also be university students, retired teachers, university professors, and community members. Shadow education works in a supplemental way instead of replacing the public system, and when compared to the cost of a private school education, the combination of public schooling and private tutoring is also more affordable (Dang & Rogers, 2008).

James (1987, 1993) argued that private tutoring exists because there were limited public schools of average or good quality. Private tutoring therefore, may differentiate themselves from public schools by providing a higher quality of education and supplementary curricula. Based on James's research, Bray and Kwok pointed out that the demand for private tutoring and demand for private schooling should be viewed differently. They believed that the private tutoring of shadow education was "supplementary" rather than "substantive" (Bray & Kwok, 2003, p.613), and the demand of shadow education was "simultaneously both excess and differentiated" (Bray & Kwok, 2003, p.613), because sometimes shadow education offers supplemental education to make up for mainstream schools that do not meet the requirements of students and their families, and sometimes shadow education offers different content from what is taught in mainstream classrooms

According to Baker and LeTendre's (2005) study, shadow education has the purposes of "mastering curriculum, examinations, and earning grades for learning and skills used by schools to grant students further educational opportunities" (p.56). Baker et al. (2001) indicated that the use of shadow education could also vary. Struggling students participate in shadow education in order to catch up with their classes in school. For them, shadow education could be remedial; while for students who aimed to receive supplementary learning and skills beyond what has been taught in school, shadow education could be enriching (Baker & LeTendre, 2005).

Scale

Studies have shown that shadow education is very common worldwide. Lee et al. (2010) showed that 37 of 57 countries had more than a 40% participation rate in shadow education. Shadow education is particularly prevalent in Asian countries. For example, in Malaysia, approximately 83% of students reported that they had received at least one form of private tutoring by the time they reached upper secondary level (Bray 2007; Marimuthu et al., 1991). According to the Russell's (1997) study, 24% of elementary students and 60% of secondary students in Japan received shadow education in cram schools, known as *juku*. Baker and LeTendre (2005) argued that South Korea has "the largest system of shadow education known in the world" with its extremely high prevalence of and high expenditure for shadow education activities (Baker & LeTendre, 2005, p.57). Choi also reported that about 80% of Korean students received tutoring in 2008, on average participating in 7 hours of tutoring each week (Choi, 2012). Shadow education has also been increasing in Singapore: for example, surveys showed that the pupils participating in shadow education increased from 27% to 49% from 1982 to 1992; for secondary level students, this increase was from 16% to 30% (Bray, 2007; George, 1992).

Despite differences in the type and frequency of shadow education, it has become a worldwide education phenomenon. For example, in South America, according to Paiva et al., over 50% of students in Brazil received tutoring and view it as a way to reduce the likelihood of having to repeat grades. In Africa, Elbadawy et al., found that on average, 40% of Egypt students received private tutoring; and this percentage went up to 60% for students at the secondary stage. Elbadawy et al. also claimed that in Egypt, shadow education was more of an urban phenomenon: the percentages of urban and rural primary children receiving shadow education were 44% and 35%, respectively (Elbadawy et al., 2007). In Europe, according to Ireson and Rushforth (2005), of the 3515 pupils they sampled in England, 27% received shadow education. In Romania, a survey in 1994 found that 32% of Grade 12 pupils in rural areas receive shadow education, while 58% of urban Grade 12 pupils received shadow education (UNESCO, 2000).

Shadow Education in China

Drivers of Demand

Bray and Lykins (2012) paid close attention to four macro drivers of demand for shadow education in Asian countries. The first driver is the transition points in education system. In China, those "transition points" (Bray & Lykins, 2012, p.23) are entrance exams at all grade levels, such as junior secondary entrance exam, senior secondary entrance exam, and the most important one is the national college entrance exam (called "NCEE", also known as "Gaokao"). The second driver of shadow education is the cultural influence. They argued that many Asian cultures were influenced by Confucianism, which always included a high demand for mass education and private tutoring. The Chinese tradition of focus on civil examinations, academic activities, and hard work is deeply rooted through centuries of history. Chinese people believe in

ancient Chinese saying, such as “education can change one’s destiny”, and “nothing except education leads to success”. Another famous Chinese adage says: “all occupation are low in social status, except studying (or scholars) is the highest”. Chinese students and parents are obsessed with shadow education, because their belief is embedded in Chinese culture: more education is always better, for it can bring benefits and opportunities in one’s lifetime.

The third driver of demand of shadow education in Bray and Lykins’s article is school quality. According to OECD indicators in 2009, China has the largest class size of all OECD countries ith 50 students in each class on average, at the primary education and lower secondary education level (OECD, 2012). Bray and Lykins argued that Asian parents choose to invest in shadow education because they are not satisfied with the mainstream schools. Yuan and Zhang (2012) also emphasized that, as the result of the dissatisfaction with education quality in mainstream schools in China, parents have no choice but invest in shadow education. Yuan and Zhang (2012) explained that Chinese teachers have fewer incentives and responsibilities to increase the quality of education in public schools, because of their salaries. They are allowed to provide supplementary education and earn extra income outside of schools, so they would “withhold some materials in their formal instruction and only teach these during private sessions for a fee” (Yuan & Zhang, 2012, p.3).

The last driver of demand of shadow education in Asian countries that Bray and Lykins mentioned was smaller family size and increased wealth. China has been experiencing a great economic development since 1978. After the establishment of a controversial but effective law called One Child Policy in 1979, married couples had to control the birth rates, and they had fewer children than previous generations. Therefore, the family size became smaller and the standard of living increased a lot. According to Lee (2012), children from one-child families

enjoy significantly more and improved education compared with children from multiple-children families. Lee also found that the improvement of education for females was greater than that of males. Thus, although additional fees have to be paid for the supplementary tutoring, parents with fewer children can afford to pay such private tuition, while also putting more expectations on the quality of education (Liu, 2011).

Meanwhile, Stevenson and Baker noted that two factors that could stimulate the prosperity of shadow education are the existence of "formal examinations – particularly centrally administered examination" and "tight linkages between the outcomes of educational allocation… and future educational opportunities…" (Stevenson & Baker, 1992, p.1640). The NCEE system in China perfectly matches with those premises in the prior studies. Today, China's entrance exams are more competitive than ever. In 2012, there were about 9.1 million candidates across the country took the NCEE, competing for only 6.85 million admissions in Chinese universities (Ministry of Education, 2013). For years, the NCEE has been considered to be a high-stake test. This one and only criteria for college entrance has become people's only chance to climb up the social ladder, for the success or failure on the test may bring totally different results. The score of NCEE is the most influential determinant of the direction in one's life, because it directly affects students' choice of the opportunity and quality of universities, majors, and finally, their careers. In order to pass the push-out stage and grasp the opportunity to enter a good school in a higher level, students' families are willing to invest in shadow education.

Stevenson and Baker also believed that the use of "contest rules" in schools and the "tight linkage between the out-comes of educational allocation in elementary and secondary schooling and future educational opportunities, occupations, or general social status" would also lead to an increase in the participation of shadow education (Stevenson & Baker, 1992, p. 1640). In China,

top students in secondary schools always have a higher probability of going to top-ranked national universities. Under the pressure of examinations and competition, the participation of shadow education, as well as the teaching and learning in schools are directly aiming at different exams at all grades, especially in the secondary level. To become more competitive, students are pushed to jump into the shadow education system. The vigorous contest in different examinations results from limited availability of quality institutions, traditional Chinese value and culture, abundance of labor as well as the meticulous NCEE system itself. Schools, teachers, parents and most importantly, students, are allocating all their resources to prepare for this exam. More often than not, the motivation in education of Chinese students is "extrinsic", which means that students' interest to academic activity is "prompted by family or social expectations" (OECD, 2011, p.85). However, few studies have empirically examined whether indeed these factors leads to the demand for shadow education in China.

Scale

According to the data from the World Bank, the economic conditions in China today are growing, with an annual Gross Domestic Product (GDP) growth about 10%. By the year of 2012, there were almost 200 million students enrolled in primary and secondary schools in China (Ministry of Education, 2012). Chinese families has a general idea that parents should give everything they can to their children, especially investing in education and helping their children to become more competitive. Today, shadow education plays an important role in the lives of Chinese students and their families.

A national survey in 2004 found that among 4,772 urban households in mainland China, the participation rate of shadow education for primary students was 73.8%. For junior and senior

secondary students, the participation rates were 65.5% and 53.5% (Xue and Ding, 2009). According to Zhang (2011), in a sample size of 6,474 students in Jinan province, the participation rate of shadow education on mathematics was 28.8%, and for English was 29.3%.

Similarly, in the Special Administrative Region of Hong Kong, the phenomenon of shadow education is also visible. In 1996, 34% of junior secondary students and 40% of senior secondary students participated in shadow education (Lee, 19960. In Taipei, China, of 20,000 high school students, 72.9% of them spent an average of 6.5 hours on shadow education per week (Liu, 2012).

Although there were some surveys and studies done about shadow education in China, many of those previous studies relied on conventional sampling. They chose limited sample size from only one place in China at one time. Thus, it was not feasible to compare the different determinants of shadow education from cities to cities. By contrast, this study drew on data from a representative sample of 4,837 15 year-old-students in Hong Kong and 5,115 15 year old students from Shanghai from PISA 2009. By using these data, we could better understanding the prevalence and determinants of shadow education in these two countries.

Determinants of Shadow Education from Prior Studies

The participation of shadow education can be affected by various factors, and the determinants of shadow education vary from country to country. According to Stevenson and Baker (1999), parental education and family socioeconomic status increased the likelihood of the participation in all types of shadow education. They also found that Japanese male students were more likely to receive shadow education than female students and that scholastic characteristics,

such as better grades and staying academic curriculum-tracks, and living in urban area were positively related to participation of shadow education in Japan (Stevenson & Baker, 1999).

Kanellopoulos and Psacharopoulos (1997) found that the amount of money invested in shadow education in Greece depended on: the location of the household, the household's total expenditure, and the occupation and educational level of the head of the household. Factors such as the household size, and the number of children under six years old were negatively associated with the likelihood of participating in shadow education, while positively significant factors are the head of household's years of education and his/her income. Psacharopoulos and Papakonstantinous (2005) also found that families spend privately more than the state in order to prepared for the entrance examinations and while studying at the university.

Davies (2004) found that in Canada, "two-thirds of the parents who employ tutors had children in high school" (p.247). After controlling for other demographic factors, older and more educated parents were more likely to purchase in shadow education for their children. He also pointed out that after controlling for other variables, parents who had the desire for private schools are almost four times more likely to hire tutors, compared with parents who do not desire private schools.

Referring to shadow education in Korea, Kim (2005) reported that in Korea, besides high-stake tests and academic achievement incentives, institutional features in student's learning environments, such as school type and school quality, were also important factors for the determinants of participating in shadow education. He also found that lower school quality would significantly increase the participation of shadow education. Other determinants include higher parental education, higher family income, living in urban areas.

Tansel and Fatma (2006) also found that shadow education was more prevalent in urban areas of Turkey. They concluded that determinants of shadow education in Turkey included the age of the head of the household, and the mother's education level. These two factors were positively associated with the likelihood of students receiving shadow education. They also found that single mothers and urban households would invest more in shadow education (Tansel & Fatma, 2006).

According to Elbadawy et al. (2007), although shadow education was technically illegal in Egypt, it was still growing. Among the individual characteristics of Egypt students, students' age, whether he or she was the eldest child in the family, and whether the student was in a diploma year had significant positive effect on the probability of receiving shadow education. Household characteristics, including parental education, parental absence, and the total household expenditure, also had significant effects on participation of shadow education. Community characteristics, such as living in urban areas, also increased the probability of receiving shadow education. The teacher pupil ratios in primary and secondary level were negatively related to shadow education, meaning that as the teacher-pupil ratio increased, the probability for students to receive shadow education would decrease (Elbadawy et al., 2007).

In summary, predictors of shadow education may come from three areas. They may result from (1) the family background, which includes the family class, family wealth, parental education and occupation, family structure, number of siblings, and the location and the size of the household; (2) the student's characteristics, such as gender, age, grade, and other scholastic characteristics; and (3) the school background, which including the school type, school quality, and teacher-pupil ratio.

Chapter 3

METHODOLOGY

Data

To examine the determinants of shadow education in Hong Kong and Shanghai, the current study draws on the PISA, which is an international assessment directed by the Organization for Economic Cooperation and Development (OECD). It measures the knowledge and skills of 15-year-old students in school in grade 7 or higher on reading, mathematics, and science. The main concern of PISA is to examine whether students are well prepared for the society while they are making the transition from school to post-compulsory education (OECD, 2012).

In the 2009 PISA, about 470,000 students in 65 countries and economies participated, representing approximate 26 million 15-year-olds students (OECD, 2012). For most participating countries, schools and students were selected using a two-stage stratified sampling design: first, individual schools were sampled from a participating country by using the Proportional to Size sampling; then, students were randomly drawn within the selected schools with equal probability.

The original samples for Hong Kong and Shanghai were 4,837 and 5,115, respectively. However, for the analysis of the determinants of shadow education, all respondents with missing data on the variables included in the analyses were excluded (i.e., listwise deletion). This resulted in analytic sample sizes of 4,346 for Hong Kong and 4,472 for Shanghai. Appendix A shows the percentages of missing data for all variables in Hong Kong and Shanghai.

The PISA 2009 study is particularly relevant for this thesis research for three reasons:

First, compared with PISA 2003 and 2006, the year of 2009 was the first time that

Shanghai participated in the PISA survey. In other words, prior to 2009, there were no available data from Mainland China in any other international database for within or across country research.

Second, PISA 2009 included questions related to specific types and purposes of tutoring, such as Question 31: "What type of <out-of-school-time lessons> do you attend currently?" with answers like: "<Enrichment lessons> in mathematics" and "<Remedial lessons> in mathematics". It also asked questions about hours spent on tutoring, such as Question 32: "How many hours do you typically spend per week attending <out- of-school-time lessons> in the following subjects (at school, at home or somewhere else)?" (More questionnaires see Appendix).

Finally, being the most comprehensive international study to measuring student performance and hours spending on private tutoring, PISA did collect data not only on the student characteristics and attitudes, but also on family background and school factors, which makes it possible to examine the patterns of associations between all the explanatory variables and shadow education on math (OECD, 2012).

Measures

Outcome Variable

In the PISA 2009 student questionnaire, Question 32 asked students how many hours they spent per week attending out-of-school-time lessons on math. The original options given to students included (1) Do not attend, (2) Less than 2 hours a week, (3) 2 – 4 hours a week, (4) 4 – 6 hours a week, and (5) more than 6 hours a week. This ordinal variable was recoded as 1 if attending math tutoring (i.e., hours > 0), or 0 do not attending math tutoring (i.e., hours = 0). For

this study, I am interested in the factors that predict whether or not shadow education was used. Collapsing this question into a dichotomous variable allows me to consider whether or not shadow education was used, rather than looking at intensity of usage.

Explanatory Variables

Building on prior literature, the current study considered the following groups of variables: (1) family background; (2) individual student characteristics; and (3) school factors.

The family background variables include family socioeconomic status (SES) and family structure. For family SES, PISA 2009 provided a standardized composite index across countries, which was based on the following main factors: (1) parental education measured as estimated years of schooling (PARED), (2) highest parental occupational status (HISEI), (3) an index of home possessions (HOMEPOS), (4) an index family wealth (WEALTH), (5) an index of cultural possessions (CULTPOS), (6) an index of home educational resources (HEDRES), and (7) number of books in the home. Note that the home possessions index included the possession of a desk, student's individual room, a quiet study place, educational software, internet access, own calculator, classic literature, books of poetry, works of art, books to help with school work, a dictionary, a dishwasher, a DVD or VCR player, cellular phones, televisions, computers, cars, and number of books. Family wealth measured the possession of an individual room, internet access, a dishwasher, a DVD or VCR player, cellular cellphones, televisions, computers, cars and number of books. Cultural possessions included the items on the classic literature, the books of poetry and the works of art. Finally, home educational resources included the items on a desk, a quiet study place, a computer used for school work, the educational software, an own calculator, books to help with school work, and a dictionary.

Family structure (FAMSTRUC) was measured by students' report on who they live with, and the original scale included (1) living with a single parent (mother, father, male guardian, female guardian), (2) living with two parents (with a father or step/foster father and a mother or step/foster mother), and (3) other situation (except the non-responses, which are coded as missing or nor applicable). In this study, the original scale of family structure was collapsed into a dichotomous variable indicating whether students lived in both parents (= 1) or not (= 0).

For student characteristics, this study included (1) grade, (2) gender, (3) attitudes toward school, (4) disciplinary climate, (5) student-teacher relationships, (6) number of math class per week, and (7) students' math score. Grade was measured by students' self-report of their grade, ranging from 7 to 12. Gender was measured by students' self-report of their sex and was recoded as follows: female =1 and male = 0. Attitudes toward school were measured by a standardized composite index across countries, which was created by the following four items: "school has done little to prepare me for adult life when I leave school", "school has been a waste of time", "school helped give me confidence to make decisions", and "school has taught me things which could be useful in a job". Higher scores indicate better attitudes (OECD, 2012). The scale of disciplinary climate in the classroom was also measured by students' self-report of 5 item parameters. They were: (1) get along well with most of teachers; (2) most of teachers are interested in students' well-being; (3) most of teachers really listen to what students have to say; (4) receiving extra help from teachers when students need it; (5) most of teachers treat students fairly (OECD, 2012). Higher scores indicate a better disciplinary climate. The number of math class per week was also measured by students' self-report of the total number of math classes in a week. Finally, the variable math score is taken from a variable created by the PISA researchers by taking five plausible values of students' performance scores in math. Those plausible values

are not actual test scores. Rather, they are "random numbers drawn from the distribution of scores that could be reasonably assigned to each individual" (OECD, 2012, p.142). It "includes random error variance components", and it can "better suited to describing the performance of the population", then "produces consistent estimators of population parameters" (OECD, 2012, p.142).

For school factors, this study included (1) school sector and (2) student-teacher ratio. The school sector variable was based on principals' report on the school type as either public (= 1) or private (= 0). The variable of student-teacher ratio was measured by dividing the school size by the total number of teachers (OECD, 2012). Table 1 presents the detailed information about the variable coding.

Table 1. The Coding Schemes for the Variables Included in Analyses

Variables	**Original Variable name**	**Construction of Variables** Hong Kong	**Construction of Variables** Shanghai
Outcome Variable			
Out-of-school math tutoring	ST32Q02	1 = Participated 0 = not participated	1 = Participated 0 = not participated
Explanatory Variables			
Family SES	ESCS	Scale score Ranges from -3.93 to 2.51	Scale score Ranges from -5.24 to 2.38
Two parents	FAMSTRUC	1 = Living with two parents 0=otherwise	1 = Living with two parents 0 = otherwise
Grade	ST01Q01	Ranges from 7 to 11	Ranges from 7 to 12
Female	ST04Q01	1 = Female 0 = Male	1 = Female 0 = Male
Attitude towards school	ATSCHL	Scale score Ranges from -2.99 to 2.01	Scale score Ranges from -2.99 to 2.01
Disciplinary	DISCLIMA	Scale score	Scale score

climate			
		Ranges from -2.81 to 1.84	Ranges from -2.81 to 1.84
No. of math class weekly	ST29Q02	Ranges from 2 to 12	Ranges from 2 to 15
Math Score	PV1MATH PV2MATH PV3MATH PV4MATH PV5MATH	Scale score Average Ranges from 275.83 to 798.186	Scale score Average Ranges from 252.774 to 851.078
Public school	SC02Q01	1 = Go to a public school 0 = otherwise	1 = Go to a public school 0 = otherwise
Student-teacher ratio	STRATIO	Scale score	Scale score
		Ranges from 8.93 to 22.64	Ranges from 1.81 to 54.86
N		4,346	4,472

Analytic Strategies

First, I completed descriptive statistics for Hong Kong and Shanghai to examine differences in the variables used in the analyses. Chi-square tests or t-tests were conducted to test whether there were significant differences in the explanatory variables between Hong Kong and Shanghai.

Next, I conducted logistic regression analyses for each city using the dichotomous measure of math tutoring as the dependent variable. The characteristics of a binary dependent variable violate the ordinary least squares model (OLS) assumption, because the values of 0 and 1 of the dependent variable tend to be non-linearly related to all the independent variables (Long & Freese, 2001). The traditional OLS model assumes equal variance among all the variables. It uses cross-sectional variations and simply summarizes the correlation amongst variables. Using OLS regression for a binary dependent variable can result in predicted values of the outcome variable that do not make sense for interpretation, because values of probability may be greater than 1 or less than 0. By contrast, using the logistic regression with the dichotomize variable does not violate assumptions and is easier to interpret the results in a substantive way.

To examine more systematically the determinants of shadow education use, three models were estimated for both Hong Kong and Shanghai. Model 1 included family SES and family structure. Model 2 added the student characteristic variables (i.e., grade, gender, attitudes toward school, disciplinary climate, student-teacher relationships, and number of math class per week). Finally, Model 3 additionally introduced the variables of school sector and student-teacher ratio. Finally, a z-test was used to examine differences in the magnitudes of the relationships between the explanatory variables and the likelihood of shadow education participation.

Chapter 4

RESULTS AND FINDINGS

Descriptive Findings

Table 2 presents a descriptive statistics for all study variables by two countries. Results showed that there was a significant difference in the degree to which students participated in shadow education for math between Shanghai and Hong Kong. Specifically, about a half of students in Hong Kong received in math tutoring, while about seven out of 10 students in Shanghai did so.

There was also a significant difference in family SES index between Hong Kong and Shanghai, with Shanghai students (-0.465) showing a higher SES index of than Hong Kong students (-0.818). Yet, the percentage of living with two parents in Hong Kong (86 %) and Shanghai (87%) was similar.

Next, the mean grade of students in Hong Kong (9.56) and Shanghai (9.54) were similar. The percentage of female students was smaller in Hong Kong (47%) than in Shanghai (51%). There was a significant difference in the attitudes toward school between Hong Kong and

Shanghai, with students in Shanghai showing more positive attitudes towards school (-0.39) than students in Hong Kong (-0.48). Similarly, the index of disciplinary was higher in Shanghai (0.49) than it was in Hong Kong (0.40). In addition, students' math score are also significantly different between Hong Kong and Shanghai. Students in Shanghai (607.46) have a higher average math score than students in Hong Kong (559.12). However, there was no significant difference in the amount of math classes per week between Hong Kong and Shanghai.

Finally, there was a significant difference in the type of school that students attended: only 6% of student in Hong Kong attended public schools, whereas almost 90% of students went to public schools in Shanghai.

Table 2. Descriptive Statistics by City

Variables	**Hong Kong**[a]		**Shanghai**[b]		**Significance Test**
	Mean	**SD**	**Mean**	**SD**	
Dependent Variable					
Math tutoring[c] *** (dummy)	0.485	0.500	0.714	0.452	***
Family Background					
SES[d]***	-0.818	1.000	-0.465	1.036	***
Two parents[c] (dummy)	0.858	0.349	0.869	0.338	
Student Characteristics					
Student Grade[d]	9.556	0.702	9.541	0.618	
Female[c] * (dummy)	0.478	0.500	0.513	0.500	*
Attitude toward school[d] ***	-0.483	0.737	-0.391	0.874	***
Disciplinary climate[d] ***	0.396	0.864	0.486	0.839	***
No. of math class[d]	6.548	1.843	6.636	2.383	
Math score ***	559.1214	1.322	607.456	1.392	***
School Background					
Public school[c] *** (dummy)	0.067	0.251	0.896	0.305	***
Student teacher ratio[d] ***	16.880	2.128	14.032	7.722	***
N	4346		4472		

a. Descriptive statistics for Hong Kong above include only those students who had valid information about all the variables (n=4346)

b. Descriptive statistics for Shanghai above include only those students who had valid information about all the variables (n=4472)
c. For dummy variables, test statistics are Pearson chi square
d. For continuous variables, test statistics are t-statistics
* p<0.05, ***p<0.001 (two-tailed tests)

Determinants of shadow education

Hong Kong. Table 3 presents logistic regression results for Hong Kong. Results of Model 1, which included only the family background variables, showed that every one-unit increase in the index of family SES increased the odds of students receiving math tutoring by about 41%. However, living with two parents was not a significant predictor of students' participation in math tutoring.

In Model 2, the student characteristic variables were added. To summarize key results, first, family SES remained significant even after controlling for the student variables. Second, every additional unit increase in student grade level increased the odds of getting math tutoring by 35%. Third, for every unit increase in the index of attitudes towards school, the odds of participating in math tutoring increased by 11%. Fourth, taking an additional math class in school increases the odds of receiving out-of school math tutoring by 5%. Fifth, for every unit increase in student achievement score, the odds of receiving math tutoring will decrease by 0.3%. Gender and the index of disciplinary climate in the classroom did not significantly predict participation of math tutoring.

In Model 3, the school type and the student-teacher ratio variables were also added. The significance of the predictors included in Model 2 did not change much in Model 3. In addition, for every unit increase in the student-teacher ratio, the odds of receiving math tutoring will increase by 5%. However, going to a public school had no significant effect on the likelihood of receiving out-of-school math tutoring.

Table 3. Odds Ratios and Standard Errors of Logistic Regression Models for Hong Kong

Variable	**Model 1**	**Model 2**	**Model 3**
Family Background			
Social economic status	1.406***	1.441***	1.454***
	(0.044)	(0.046)	(0.049)
Two parents	1.088	1.121	1.106
	(0.096)	(0.101)	(0.010)
Student Characteristics			
Student grade		1.351***	1.373***
		(0.067)	(0.069)
Female		1.022	0.990
		(0.065)	(0.063)
Attitude towards school		1.111*	1.115*
		(0.0478)	(0.0481)
Disciplinary climate		1.016	1.014
		(0.038)	(0.038)
No. of math class		1.055*	1.048*
		(0.018)	(0.018)
Math score		0.997***	0.996***
		(0.000)	(0.000)
School Background			
Public school			1.219
			(0.153)
Student teacher ratio			1.051**
			(0.0172)
Pseudo R-square	0.0206	0.0364	0.0385
Observations	4346	4346	4346

Exponentiated coefficients
Standard Errors in parentheses
Source: PISA 2009 Data
* p<0.05, ** p<0.01, ***p<0.001 (two-tailed tests)

Shanghai. Table 4 presents logistic regression results for Shanghai. Results of Model 1

showed that, like in Hong Kong, family SES was a significant predictor of shadow education participation in Shanghai: every one unit increase in the index of family SES increased the odds of students receiving math tutoring by about 16%. However, unlike in Hong Kong, living with two parents was a significant predictor of students' participation in math tutoring in Shanghai. Specifically, living with two parents increased the odds of receiving tutoring by 38%.

In Model 2, both family SES and family structure remained significant even after the student characteristic variables. The magnitudes of SES increase a little bit. Like for Hong Kong, the student grade level was a significant predictor of shadow education use in Shanghai, but the direction was different. In other words, in Shanghai, students in an upper grade were less likely to use math tutoring, compared to students in a lower grade, whereas the opposite was true for Hong Kong. Meanwhile, like in Hong Kong, there was no gender difference in the likelihood shadow education participation in Shanghai. In addition, attitudes towards school, disciplinary climate in classroom, and taking an additional math class in school were also significantly related to the odds of receiving out-of school math tutoring. Like in Hong Kong, students with high math score were less likely to have math tutoring: for every unit increase in student math achievement, the odds of receiving math tutoring decrease by 0.1%.

In Model 3, the magnitudes of the relationship between predictors and the likelihood of receiving math tutoring found in Model 2 somewhat changed. Compared to Model 1 and Model 2 in Table 4, the student grade factor lost its significance in Model 3. Except for being a female and the student grade predictor, all other family and school predictors remained significant. In addition, attending a public school was not significantly related to the likelihood of participation in math tutoring, but the student-teacher ratio was significantly related. Students attending schools with a larger student-teacher ratio were less likely to participate in shadow education,

compared to students attending with a smaller student-teacher ratio.

Table 4. *Odds Ratios and Standard Errors of Logistic Regression Models for Shanghai*

Variables	**Model 1**	**Model 2**	**Model 3**
Family Background			
Social economic status	1.162***	1.173***	1.168***
	(0.038)	(0.042)	(0.042)
Two parents	1.376***	1.362**	1.372**
	(0.129)	(0.131)	(0.133)
Student Characteristics			
Student grade		0.838*	0.879
		(0.058)	(0.062)
Female		1.131	1.132
		(0.078)	(0.079)
Attitude towards school		1.151***	1.157***
		(0.047)	(0.048)
Disciplinary climate		1.272***	1.254***
		(0.054)	(0.054)
No. of math class		1.129***	1.105***
		(0.021)	(0.021)
Math score		0.999*	0.999*
		(0.000)	(0.000)
School background			
Public school			0.814
			(0.102)
Student teacher ratio			0.983**
			(0.005)
Pseudo R-square	0.0064	0.0394	0.0424
Observations	4472	4472	4472

Exponentiated coefficients
Standard Errors in parentheses
Source: PISA 2009 Data
* p<0.05, ** p<0.01, ***p<0.001 (two-tailed tests)

Comparison between Hong Kong and Shanghai

Table 5 shows differences in the extent to which the explanatory variables were related to the likelihood of receiving math tutoring between Hong Kong and Shanghai. Except for gender and attitudes toward school, other predictors of receiving math tutoring were significantly different in the directions and magnitudes of the relationship with the likelihood of shadow education participation between Hong Kong and Shanghai. These include family SES, living with two parents, student grade levels, disciplinary climate factor in the classroom, the number of math class per week, going to a public school, and finally the student-teacher ratio. First, although students from high SES families were more likely than students from low SES families to participate in shadow education for math in both Hong Kong and in Shanghai, the degree to which students from high SES families received math tutoring was much stronger in Hong Kong than in Shanghai. Second, students with two-parents are more likely than those not living with both parents to receive math tutoring in both Hong Kong and Shanghai, but the degree to which students from two-parents families received math tutoring was stronger in Shanghai than in Hong Kong.

When it comes to the student characteristics, results show that grade level has the opposite effect in Hong Kong as it does in Shanghai. Students in an upper grade level were more likely than students in a lower grade level to participate in shadow education in Hong Kong, whereas students in an upper grade level were less likely than students in a lower grade to do so in Shanghai. Second, students attending a school with a positive disciplinary climate were more likely to participate in shadow education in Shanghai, whereas this factor was not significant for Hong Kong. Third, students who have high math scores were less likely to participate in shadow

education in both Hong Kong and Shanghai. Forth, although students attending a schools that offer a greater number of math class per week were more likely to participate in shadow education in both Hong Kong and Shanghai, the magnitude of the relationship between the number of math class per week and the likelihood of participating in shadow education was much stronger in Shanghai than in Hong Kong.

Referring to the school background, there was a significant difference in the effect of public school between Hong Kong and Shanghai: public school students in Hong Kong were more likely to receive math tutoring, while public school students in Shanghai were less likely to do so. However, this predictor was not significant in those two cities. Finally, in Hong Kong, students in schools with greater student-teacher ratio were more likely to receive math tutoring, while in Shanghai, students with greater student-teacher ratio were less likely to do so.

Table 5. Comparison between Hong Kong and Shanghai

Variables	**Hong Kong**		**Shanghai**	
	Coefficients	Odds Ratio	Coefficients	Odds Ratio
Family Background				
Social economic status ***	0.374 (0.034)	1.359***	0.156 (0.036)	1.126**
Two parents *	0.101 (0.090)	1.078	0.316 (0.097)	1.355**
Student Characteristics				
Student grade ***	0.317 (0.050)	1.191***	-0.129 (0.071)	0.820
Female	-0.010 (0.064)	1.089	0.124 (0.069)	1.147
Attitude towards school	0.109 (0.043)	1.096*	0.146 (0.041)	1.168***

Disciplinary climate ***	0.014	0.98	0.227	1.225***
	(0.037)		(0.043)	
Math score *	-0.004	0.999***	-0.001	0.999***
	(0.000)		(0.000)	
No. of math class ***	0.047	1.040**	0.010	1.095***
	(0.017)		(0.019)	
School Background				
Public school *	0.198	1.143	-0.206	0.845
	(0.125)		(0.125)	
Student teacher ratio **	0.0499	0.995**	-0.0136	0.987***
	(0.016)		(0.005)	
Pseudo R-square	0.0385	0.0424	0.0385	0.0424
Observations	4346	4346	4472	4472

Exponentiated coefficients

Standard Errors in parentheses

Source: PISA 2009 Data

* means there is a significant difference of this predictor between Hong Kong and Shanghai

* p<0.05, ** p<0.01,*** p<0.001 (two-tailed tests)

Chapter 5

CONCLUSION

Summary of Main Findings

Results showed similarities and differences in the determinants of shadow education between Hong Kong and Shanghai. First, family SES has a significant effect on math tutoring in both Hong Kong and Shanghai. This result is consistent with previous research (Stevenson & Baker. 1992; Kanellopoulos and Psacharopoulos, 1997; Kim, 2005; Elbadawy et al., 2007).

Second, among those student characteristics, this study found student grade level was significant in Hong Kong: as students' grade level increase, their likelihood of receiving math tutoring increase. This was not the case for Shanghai: the grade level factor was not significant in Shanghai. Besides the grade level, the female factor was not significant in both Hong Kong and Shanghai. This suggests that gender may not matter as much for shadow education in those two cities as it does for other countries. Students with positive attitudes toward school were more likely to receive math tutoring in both Hong Kong and Shanghai. Disciplinary climate was significantly related to the likelihood of using shadow education among Shanghai students, but it was not significantly related among students in Hong Kong. Interestingly, the more math classes students took in schools, the more math tutoring they were going to receive in both Hong Kong and Shanghai. In addition, high-achieving students in math were more likely to participate in math tutoring than low-achieving students in both Hong Kong and Shanghai.

Turning to the school factors, attending public schools had no significant effect on receiving math tutoring in both Hong Kong and Shanghai. Almost everyone in Shanghai goes to public school, and almost no one in Hong Kong does. Students sitting in classrooms with smaller student-teacher ratios were more likely to use math tutoring in Hong Kong, but less likely to use

it in Shanghai. Other significant predictors of math tutoring in Shanghai included living with two parents and the disciplinary climate in the classroom.

Limitation of This Study

This study has several limitations that need to be addressed in future studies. First, because PISA 2009 only has data from two locations in China, the results are not representative of rural Chinese students. There could be differences between shadow education in developed cities like Hong Kong and Shanghai compared to rural areas, or even to other cities in the west part or in the middle of China.

Second, although this study found the significant relationship between math tutoring and achievement, it did not claim the causal relationship, given the cross-sectional nature of PISA. In order to better understand about the role of shadow education in improving academic achievement, future studies should test the causal relationship between shadow education and Chinese students' test scores by using longitudinal data.

Third, the student questionnaire of PISA 2009 asked students to choose hours spending on out-of-school-time lessons by giving options in ranges (such as 0 hours, < 2 hours, 2-4 hours, 4-6 hours, and > 6 hours). However, because this study mainly focused on the determinants of the use of math tutoring in Hong Kong and Shanghai, the dichotomous outcome of interest was created as participating in math tutoring or not. Yet, to better understand the relationship and magnitude between all the explanatory variables and the amount of shadow education, future study should use more detailed information about hours spending on shadow education.

Forth, PISA data do not offer information about forms of shadow education (i.e. cram school, private education, or one-to-one tutoring) students used. As a result, this study was not

able to examine potential differences in the determinants of shadow education across different forms. Finally, this study focused on a limited number of determinants from family background, students' characteristics and school background. However, other psychological factors such as peer pressure may also matter to shadow education. Future should take into account a more comprehensive set of factors that may affect shadow education.

Conclusion

Knowing the determinants of shadow education is helpful to better understand its impacts on Chinese students. Shadow education is shaped by the system of mainstream school, but as it expands, it will act like an independent institution and brings other economic and social impacts China's society as a whole. Thus, scholars, educators, especially policy makers need to pay close attention to the spreading of shadow education, and ensure the quality of education in mainstream schools to enable more students to enjoy educational resources in China.

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Appendix A

Percentage of Missing Data for All Variables, Hong Kong (N = 4,837)

Variables	% of Missing
Math (dummy)	2.17
Social Economic Status (SES)	0.50
Two parents (dummy)	0.48
Student Grade	0
Female (dummy)	0
Attitudes toward school	4.80
Disciplinary climate	0.37
No. of math class per week	3.35
Math score	0
Public school (dummy)	0.68
Student-teacher ratio	0.68

Appendix B

Percentage of Missing Data for All Variables, Shanghai (N = 5,115)

Variables	% of Missing
Math (dummy)	3.83
Social Economic Status (SES)	0.04
Two parents (dummy)	0.53
Student Grade	0
Female (dummy)	0
Attitudes toward school	5.08
Disciplinary climate	0.02
No. of math class per week	1.97
Math score	0
Public school (dummy)	0
Student-teacher ratio	1.23

Academic Vitae

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Education

Pennsylvania State University **August 2009-December 2013**
Major: Educational Theory and Policy (M.A)
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Work Experience

Part-time Faculty at Penn State Altoona - Chinese Instructor **August 2013 - Present**
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- Coached students with pronunciation, vocabulary, grammar and character writing in Chinese
- Set and graded regular homework
- Conducted oral and written exams
- Helped students in improving Chinese communication skills in class
- Offered fixed office hours
- Assisted students to prepare for study abroad programs before they go to China

Research Assistant & Teaching Assistant (Paid-Internship) **May 2012-July 2012**
Department of Foreign Languages and International Studies, Hunan University, China

- Conducted literature searches via electronic database
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- Partnered in National Education Project about Student Performance and Teaching Evaluation
- Presented lectures on educational system and educational environment in the U.S.

Teaching Assistant for Undergraduate Sociology Courses **August 2011-May 2012**
Department of Sociology & Crime, law and justice, Pennsylvania State University

- Served as teaching assistant for SOC 001(Introduction to Sociology) and SOC 023 (Population and Policy Issues)
- Evaluated students' in-class assignments and essay questions in exams
- Organized review sessions for students before exams
- Offered office hours every week

Teaching Assistant for Orientation and Preparation for Study in U.S. **May 2010-June 2010**
American College Testing and Global Assessment Certification-Hunan International School, China

- Launched seminars about effective communication skills in English
- Advised students and sharing academic and life experience in U.S. with students
- Guided student with learning English as a foreign language (Preparing for TOEFL / IELTS)

Awards

Dean's List Every Semester **December 2009-Present**
Schreyer Honors Travel and Research Grant ($2,200) **May 2013**

Skills

Language Skills: Fluent in English and Chinese speaking, reading, and writing
Computer Skills: Windows System; Mac OS X; Microsoft Office; Basics of Web Design
Statistics Programming: Stata; SPSS; Minitab; R Foundation R