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Author
Zhou, Fangzhu

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Fangzhu Zhou

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ABSTRACT OF THE DISSERTATION

Essays on Education in China

by

Fangzhu Zhou
Doctor of Philosophy in Economics
University of California, Los Angeles, 2021
Professor Moshe Buchinsky, Chair

This dissertation consists of three chapters that focus on policy changes related to education in China. The first chapter reviews the education and examination system in China, covering preschool education, primary education, secondary education, and higher education. Given the particular form of socialism with Chinese characteristics, understanding the context of school choice in China is rather interesting. It is clear that the education and examination system in China are strongly influenced by socio-cultural changes and conditions as well as Chinese culture. Efforts have been made by the State to improve education quality and promote equality across regions. However, challenges still remain, including disparities in education expenditures, admission rates, enrollment opportunities at the provincial level, and urban-rural education attainment.

The second chapter estimates the effect of access to quality education on house prices using difference-in-differences methods and a large-scale policy change. Exploring three different policies implemented in the 2014 Beijing Education Reform, I identify parents' valuation on the different extent of children's exposure to elite (key) elementary schools. The results show that parents are willing to pay a price premium of 5.51% or $77.36 to get

their kids full access to the benefits associated with key schools, even the admission rate to top middle school remain unchanged. I further show that parents are result-driven, which means that they are willing to pay around 9.16% more to guarantee the admission of their kids to top middle school, keeping the primary school characteristics the same.

In the third chapter, we question the effectiveness of key (magnet) school systems in China. Given that parents are paying a price premium for what they perceive to be high-quality schools, we would like to ask whether the investment into these schools is worth it. We use a set of newly released data from the China Family Panel Studies (CFPS) to explore the relationship between key school attendance and students' academic performance. We measured school quality using students' performances in mathematics and language tests, which can be considered as an important indicator of school quality in the absence of national standardized tests. The results from the OLS regression show that there is a positive relationship between attending a key primary school and test scores, but the coefficient becomes insignificant after controlling for individual characteristics and family background. Furthermore, we used propensity score matching (PSM) to alleviate the imbalance of characteristics for students who enrolled in key schools and those who did not. Based on our results, we did not find any evidence supporting that key school enrollment improves children's test scores; academic outcomes among students enrolled in key schools were not significantly different from that of those enrolled in non-key schools.

The dissertation of Fangzhu Zhou is approved.

Melanie Wasserman

Rodrigo Pinto

Michela Giorcelli

Maurizio Mazzocco

Moshe Buchinsky, Committee Chair

University of California, Los Angeles

2021

To my parents, my husband and my baby Zody...

for all the support and love

in my life.

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VITA

EDUCATION

C.Phil., Economics 2021
University of California, Los Angeles

M.A., Economics 2017
University of California, Los Angeles

B.A. Honours, Economics 2016
University of British Columbia

RESEARCH EXPERIENCE

Research Assistant 2014 - 2016
University of British Columbia Vancouver, BC
Faculty Mentor: Paul Schrimpf

- Assist Professor Schrimpf on the project of Estimating regulatory distortions of natural gas pipeline investment incentives.

Research Assistant 2019
University of California, Los Angeles Los Angeles, CA
Faculty Mentor: Melanie Wasserman

- Assist Professor Wasserman with the chapter of The Disparate Effects of Family Structure, Future of Children.

Graduate Student Researcher 2019 - 2020
WORLD Policy Analysis Center Los Angeles, CA
Faculty Mentor: Willetta Waisath

- Use structural economic model to operate research, undertake critical summaries and reviews of global literature to assess research on the impact and effectiveness of a range of law and policies.

TEACHING EXPERIENCE

Course Instructor 2018
University of California, Los Angeles

- ECON 101 & Microeconomic Theory

Teaching Assistant 2017 - 2021
University of California, Los Angeles

- ECON 101 & Microeconomic Theory

HONORS, AWARDS & SCHOLARSHIPS

Chancellor's Scholar Award	2013
Dean's List	2013 - 2016
Outstanding International Student Award	2013
Faculty of Arts International Student Scholarship	2014 - 2016
Trek Excellence Scholarship for Continuing Students	2015, 2016
UCLA Graduate Division University Fellowship	2016 - 2020
Gender and Discrimination Research Fellowship	2019
Ziman Center for Real Estate Research Grant	2019
IHS Humane Studies Fellowship	2020

CHAPTER 1

Overview of Chinese Education System

1.1 Introduction

China runs the largest education system in the world, and its student population exceeds 320 million (Wang, 2010). In July 2020, there were 10.71 million students taking the National Higher Education Entrance Examination (*Gaokao*) in China. Investment in education represents about 4% of China's gross domestic product (GDP). However, though there have been many studies and discussions of Western countries' school systems, little has been examined and published in the Chinese context. Given the particular form of socialism with Chinese characteristics, understanding the context of school choice in China is rather interesting. Therefore, this paper reviews the education and examination system in China, covering preschool education, primary education, secondary education, and higher education.

1.2 History of Education in China

Numerous Chinese researchers have claimed that the history of schooling in China began in the 16th century BC. Throughout the Spring and Autumn and the Warring States periods[1], education was the privilege of the elites. Based on Confucianism, educational curricula were mostly founded on The Four Books and The Five Classics all through this timeframe. The Four Books and The Five Classics were recognized subjects of Confucian culture in Ancient

[1]From approximately 771 to 476 BC.

China. The Four Books included *The Great Learning*, *The Doctrine of the Mean, Confucian Analects*, and *The Works of Mencius*. The Five Classics comprises *The Book of Poetry* (also known as *The Book of Songs* or *The Book of Odes*), *The Book of History*, *The Book of Rites*, *The Book of Changes*, and *The Spring and Autumn Annals*.

Confucianism has had the greatest impact on education in China throughout Chinese history. During the Han dynasty[2], a government-funded training framework and the first civil service exam were established. In addition to elites from wealthy families, common people could also avail of education to improve themselves and their social class through civil exams (*keju*). Confucianism was the main subject tested in such exams. Provincial schools were set up across the country, and Confucianism education spread all over China.

The civil exam system set up during the Han dynasty was not abolished until the Qing dynasty[3]. Though changes were made over the hundreds of intervening years, more Western influences were introduced into Chinese education during the Qing dynasty. Following the embarrassing defeat to the British in the Opium War (1840–1842), scholars and government authorities recommended a significant rebuilding of the education framework to develop new areas such as foreign languages, science, and innovation. Due to severe corruption and a strict hierarchy, the Qing government gradually lost the support of the Chinese people. In 1911, the Qing dynasty was overthrown, and a republican government was set up. Around that time, the government deserted the customary methods of instruction, and new models from Europe, the United States, and Japan were incorporated into the traditional Chinese education system.

After 37 years of the Republic of China, the People's Republic of China was found in 1949. The foundation of a new nation offered a chance to alter the previous rules and structures of the education system. With the implementation of the Chinese economic reform in 1978, fundamental education entered a new era of progress. In 1985, the Central Committee

[2]From 202 BC to 220 AD.

[3]From 1644 to 1912.

of the Chinese Communist Party issued the "Decision on the Reform of the Educational Structure," which set rules for local governments to be responsible for basic schooling. In 1986, the National People's Congress proclaimed the "Compulsory Education Law of the People's Republic of China," legally enshrining basic education in the country. Thus, China started a system of nine years of compulsory education.

In 1993, the Chinese Communist Party Central Committee and the State Council jointly issued the "Guidelines for the Reform and Development of Education in China," which established guidelines and essential arrangements for the improvement of schooling into the 21st century. In 2012, China spent more than 155 billion USD on research and development and more than 108 billion USD on higher education. As a result, research capacity and productivity have grown significantly. Between 2005 and 2012, the number of researchers in China increased by 38%, and the number of published research articles from higher education institutions in China increased by 54% [4].

1.3 Fundamental Education in Modern China

1.3.1 Preschool Education

Preschool education in China refers to education for children from 3 to 6 years old and is administered by the Ministry of Education. In contrast with primary education and junior secondary education, preschool education is non-compulsory. Though kindergartens have existed since the founding of the People's Republic of China in 1949, preschool education was developed rapidly after the Chinese economic reform (the reform and opening-up) in 1978. In 1979, the State Council held the National Conference on Child Care Work. The conference was a landmark in the history of preschool education in China as it placed preschool education high on the government's agenda and established the first preschool education management system, which was led by the government and jointly managed by various departments.

[4]Source: China Education Center.

On October 31, 1981, the Ministry of Education established the Trial Implementation of the Kindergarten Education Program, which set the first kindergarten curriculum standard in China. In 1989, the Ministry of Education issued two regulations, The Regulations on Kindergarten Management and Rules on Kindergarten Routines, guaranteeing the lawful rights and interests of kindergartens and listing the duties and commitments required for early childhood education (Zhu, 2009).

In the 1990s, the State ramped up its efforts to reform preschool education. The Law of the People's Republic of China on the Protection of Minors, the Law on Maternal and Child Health, and the Outline of China's Child Development Plan for the 1990s were promulgated, aiming to provide legal protection for the healthy development of children of preschool age. Though urban preschool education has been developing steadily since the 1990s, the development of rural preschool education was stagnated due to the limited number of teachers and outdated facilities. In response to the lack of preschool education resources in rural areas, the State launched the "Rural Preschool Education Promotion Project" in 2010, which focuses on supporting the construction of kindergartens in rural areas. Over the past three years, the central government has invested 83 million USD in building 3,149 kindergartens in rural areas of central and western China, providing access to 630,000 school-age children.

In 2019, there were 281,174 kindergartens with an enrollment of 47 million children. Since preschool education is not compulsory in China, there are many variations across districts and areas. In terms of academic years and curricula, kindergartens in urban areas mainly last from one to three years and can be either full-time or part-time. In rural areas, preschool education mainly provides irregular childcare for working parents. In addition, there are imbalances in the enrollment rate of kindergartens between urban and rural areas. Preschool education is generally universal in big and mid-sized cities with enrollment rates of almost 100%, while rural areas have enrollment rates of only 60%.

In response to the lack of preschool education resources in poor and rural areas, in 2010, the State launched the "Preschool Education Promotion Project" to support the construction

of kindergartens in rural areas at the township level. During three years of implementation, the central government invested a total of 856 million USD to build 3,149 preschools in rural areas, providing 630,000 school-age children with the opportunity to attend kindergarten.

In general, kindergartens combine childcare with teaching so that children will develop both physically and intellectually and be ready for later primary school education. The instructive exercises led in kindergartens comprise orderly, intentional, and multi-layered interactions to fortify and improve children's skills. However, as playing games is the basis of educational activities in kindergartens, teachers are not necessarily required to have a degree or license to teach in kindergartens. According to a survey conducted by the Ministry of Education in 2010, licensed teachers only represent 54.5% of total kindergarten teachers.

To improve the administration and management of kindergartens, the State issued a series of guidelines, including "Regulations on the Management of Kindergartens" and "Regulations on Kindergarten Work," to set a standardized and logical framework for kindergarten administration. The State also introduced rules concerning the qualifications of kindergarten teachers and assessments of their performance. Subsequently, the training system of preschool teachers has considerably evolved. In 2016, the ratio of licensed teachers had risen to 77.4%[5].

1.3.2 Primary and Secondary Education

1.3.2.1 The Development of Compulsory Education

The primary and secondary educational system in China is highly centralized and fairly homogeneous. It usually takes 12 years to complete the primary, junior secondary, and senior secondary stages. Under the Law on Nine-Year Compulsory Education, which took effect on July 1, 1986, all children who have reached the age of 6[6] must attend school for a

[5]Data source: Ministry of Education

[6]In some areas, the begining of school age may be postponed to the age of seven.

minimum of nine years, which typically includes six years of primary school education and three years of junior secondary school education[7]. After this, students may choose to have a standard senior secondary school education or to receive special training from a vocational school.

According to the statistics from 2019, the net enrollment rate in primary stage education is above 99%. Based on the evidence provided by the China Education Center, in 2019, there were 166,389 primary schools with an enrollment of 106 million students and a total of 77,270 secondary education schools with an enrollment of 88 million students in China. Education in China is predominantly public, and public education during the compulsory stages is tuition-free for both primary and junior secondary education. Based on the Chinese Household Income Project conducted in 2008 (Chan et al., 2020), public schools account for 95% of total enrollment across the country.

Unlike public schools in the US, in the absence of local property taxes, public schools are funded by a centralized municipal fund. Provincial-level authorities develop plans, enact decrees and rules, and distribute funds to counties. County authorities are in charge of distributing funds to township governments, supervising education and teaching, and deciding how to assign pupils and educational resources to township public schools.

The school year of primary and secondary schools consists of two semesters. The school year of primary schools involves 38 weeks of teaching and 13 weeks reserved for holidays and vacations. The school year for secondary schools comprises 39 weeks for teaching and 12 weeks for holidays and vacations. A five-day week is implemented in primary and secondary schools. Students must take end-of-term examinations and tests or progress checks at the end of each semester. In the primary education stage, Chinese language and mathematics are the required examination subjects for graduation, while graduation examination subjects in secondary schools are set by the provincial government and must include Chinese language,

[7]In some provinces, students may have five years of primary schooling but four years for junior middle school.

mathematics, and English language.

Regulations for the curricula of primary and junior secondary schools began to be implemented in 1993 and include the selection of subjects and compilation of syllabi. According to the current regulations, subjects are divided into two categories, state-arranged subjects and locally-arranged subjects, with the latter determined by provincial-level governments based on local needs.

1.3.2.2 Key School Systems

Since the founding of the People's Republic of China (PRC), the State aims to build an advanced education system for this newborn country. Development of the education system faced the dual mission of not only expanding people's right to education but also cultivating talent and producing professionals in the areas of industrialization and national defense. Scarce educational resources and lack of teachers led to the born of "key" (magnet) schools in order to select and cultivate talents to meet the needs of development. As a result, the Central Committee of the Communist Party of China proposed the establishment of key schools in 1953, which would distinguish between top students and ordinary students on the basis of scores so that those top students would get access to better education and become elites of the country.

By 1962, each city had built at least one key primary school under the instruction of the Ministry of Education. The born of key schools was resulted from the adaption to the environment at the time and also reflected the contradiction between "fairness and efficiency" in the development of education. Before the Cultural Revolution (1966–1976), the quality of education differed very little among key schools and non-key schools. In addition, not all parents choose to send their kids to school, so the competition for admission into key schools was not very intense. During this period, students were admitted to key schools based on test scores.

However, during the Cultural Revolution from 1966 to 1976, the scarce educational resources were further destroyed. In May 1977, Mao's successor Deng Xiaoping stressed the importance of establishing the key school system as a new means of rendering China a modern socialist country. In January 1978, the Ministry of Education compiled a list of key primary and secondary schools nationwide. These schools were given priority in the assignment of teachers, equipment, and funds. They also were allowed to recruit the best students for special training to compete for admission to top universities.

The nine-year compulsory education system has been implemented since 1986. Due to the popularization and expansion of basic education, admission to key schools has become increasingly competitive. Furthermore, in the 1970s, the one-child policy was implemented. During this period, most children born in big cities were the only children in their families, and they reached school age by the 1990s. Families with only one child took more care to cultivate them as that child represented the success of the whole family. With the increasing number of one-child families in China, parents paid more attention to the education of their children, increased education expenditures, and pursued high-quality educational resources. Since the 1980s and the establishment of the socialist economic system, the income gap among Chinese people has widened. Wealthy people hoped to obtain better educational resources for their kids. As a result, some key primary and secondary schools started to charge higher fees, which harmed the opportunities for less advantaged children to pursue education in key schools.

Based on an official report, the average value of extra admission fees was around $\$20,000$ dollars[8] in 2011 (Zheng et al., 2016). According to another report (Bi, 1995) published in one of the most prestigious newspapers in China, *People's Daily*, the "extra admission fees" in Beijing in the 1995 school year amounted to 28.57 million USD in 1995 dollars[9]. The

[8]For comparison, the average disposable income per capita is around $\$5,000$ in Beijing in 2011. Data source: Beijing Bureau of Statistics.

[9]The GDP of China in 1995 was 734 billion USD.

phenomenon of hefty school fees is not limited to Beijing. Based on a survey of 94 cities across China (Zhang, 2003), 41.49% of key schools in 2003 have charged "extra admission fees" or other types of costs.

Though all the public primary and middle schools, including key schools, are supposed to be tuition-free, local governments still allow schools to charge extra admission fees. As a result, the school selection problem has become controversial. In 2005, the Ministry of Education explicitly prohibited extra admission fees. Subsequently, the State Council and the relevant departments of the Ministry of Education issued documents stipulating that public elementary schools must adhere to nearby school admission. However, the tough administrative order did not solve the crux of the school selection problem. Students who were out of a school's attendance zone were encouraged to attend a pre-admission exam provided by individual key primary schools, and if they did well, they would be selected for a variety of specialized classes such as "artist class" and "sports class". The original objective in offering such classes was to find talented students who resided outside a school district's given area. However, due to the limited number of spots in these classes and based on anecdotal evidence from a popular parenting forum[10], students would take additional after-school classes in order to get the scores needed to earn a spot in a specialized class. And these classes in after-school tutoring institutions are usually affiliated with key primary schools.

The key school system has resulted in an education imbalance across districts. According to a national survey of key schools (Yang, 2006), in 1982, there are 70% of key middle schools that were located in cities, 28% of them located in towns, and 2% located in the rural area. Furthermore, another national survey in 2004 showed that 60% of students who studied in schools came from high socioeconomic status [11] families. In general, a key

[10]http://www.jzb.com/bbs/bj/

[11]Here high socioeconomic status family is defined as a family where parents are managers, engineers or professors.

school has higher per capita funding, better teacher quality, and receives students from more advantaged families at that time (Huang et al., 2020). Key school system also leads to vicious competition. Since it is widely believed that attending a key school means better education resources and a higher chance to be admitted to top universities in the future, students have to attend additional competitions to improve their resume, such as National Olympic Mathematics Competition, in order to get in key schools.

With the aim of equalizing accessibility to key schools, an amendment to the Compulsory Education Law was passed in 2006, officially removing the "key" or "non-key" classifications for primary schools. Furthermore, former key primary schools are no longer allowed to receive additional resources from the local government. Nonetheless, former key primary schools are still considered by most parents as the best schools, and they still exist under other names, such as demonstrative schools (Zheng et al., 2016).

1.3.3 Higher Education

1.3.3.1 Overview of High Education System

Over the past few decades, changes and improvements in higher education have resulted in critical accomplishments. A higher education framework with various structures – which includes all parts of learning, consolidates both degree education and non-degree education, and coordinates undergraduate training and graduate training – has come to fruition. Higher education in China has assumed a significant role in economic development and social progress by identifying and investing in talented students who can contribute to the improvement of the modern socialist system.

In the history of the popularization of higher education in China over the last century, there have been three large-scale expansions. In 1958, along with the Great Leap Forward, there was also a push to develop higher education. The Ministry of Education proposed to make higher education more accessible within 15 years, and a large-scale campaign of college

expansion began. The Great Leap Forward lasted for three years, and by 1961, enrollment in colleges and universities had reached 323,000 students, which was more than three times the number of students in 1957. The number of colleges and universities grew to more than 1,200 – an increase of 462.9%. The result of such intense expansion was that colleges and universities were overburdened. Soon after the Great Leap, the enrollment rate in colleges and universities soon fell to an all time low.

In 1978, with the implementation of the Chinese economics reform (the reforms and opening-up), there was a great shortage of skilled workers in a variety of industries. To identify suitable candidates for these openings, the college entrance examination, which shut down during the Cultural Revolution, was resumed in 1977, and as many as 5.8 million candidates took the entrance examination in 1978, far exceeding the enrollment capacities of colleges and universities. The expansion of the higher education system was demanded across the country. Beijing led the expansion, followed by Tianjin, Shanghai, and other major cities.

On January 13, 1999, the State Council approved the "Action Plan for Revitalizing Education in the 21st Century" formulated by the Ministry of Education, which proposed that enrollment rates in higher education would be close to 15% by 2010; this was the earliest Chinese government policy addressing the goal of massification of higher education. on June 16, 1999, the government issued an emergency notice that in addition to the 230,000 students enrolled in higher education at the beginning of that year, enrollment would be expanded to include another 337,000 students. Since then, the number of newly enrolled college students has increased at a rate of 400,000 or more additional students each year. The total number of freshmen rose sharply from 1.08 million in 1998 to 6.75 million in 2011. The gross enrollment rates in post-secondary schools in China increased from 26.5% in 2010 to 40% in 2015, indicating the popularization of higher education[12]. In 2019, there were a total of 2,688 higher education institutions (HEIs), including 1,265 universities, 257 independent colleges,

[12]Data soucre: the Yearbook of Chinese Education.

and 1,423 vocational colleges. There were also 268 continuing education institutions[13].

In the process of higher education expansion, colleges and universities have faced a series of changes, including adjustments to academic orientations, governance systems of universities, and knowledge dissemination. During the rapid expansion of higher education, many scholars have pointed out the potential problems embedded in this process. Tao (2011) argued that since the majority of post-secondary schools are government-run and not competitive, the large-scale expansion in enrollment risks harming the quality of higher education by putting too much focus on quantity. Yan (2006) also pointed out that the scale of expansion exceeds available resources, meaning that the on-average resources per student decrease, which may have a negative impact on education quality.

In addition, the highly centralized higher education system has also been heavily criticized by scholars. In this system, the State undertakes too many responsibilities, and schools lack the flexibility and autonomy to provide educational services based on society's needs. Therefore, a structural reform of higher education is needed. Reforms should aim to streamline the relationship between the central government and HEIs and to enhance HEIs' capacity to provide high-quality education. Under the current higher education system, the government is responsible for overall planning and macro-management, while HEIs have the independence to make adjustments based on their needs.

After several years of effort, changes to higher education have produced encouraging outcomes. The government has delegated more power to HEIs, expanding their autonomy and allowing them to use their educational resources more efficiently (Lu, Yu and Qiu, 2017). Under the guidelines set by the Ministry of Education, all faculties arrange their teaching tasks under the supervision of the authorities. Accomplishments are rewarded through individual bonuses, which motivates better teaching.

Policies have also been implemented to encourage promising students from disadvantaged

[13]Data source: China Education Center.

families. Scholarships are provided to students with strong academic records and economic difficulties. These students can also apply for student loans, tuition reductions, and part-time campus jobs. These sources of additional financial support ensure that no student is excluded for economic reasons. Moreover, the Ministry of Education is currently drafting a reform regarding examinations and recruitment in HEIs that will encourage greater enrollment of talented students from disadvantaged families, thereby promoting better education equality.

1.3.3.2 Project 211 and Project 985

Project 211 was initiated in November 1995 by the Ministry of Education and aimed to raise the research standards of high-level universities and to cultivate talent to meet the economic demands of the turn of the century. At present, there are 112 colleges and universities in Project 211, accounting for only 6% of China's colleges; however, these institutions are responsible for training 80% of doctoral students, 60% of master's students, 50% of international students, and 30% of undergraduates in China. Furthermore, they host 85% of the State's major projects, hold 96% of the State's key laboratories, and receive 70% of funding from the National Science Foundation[14]. Most of these universities are ranked among the top 1,000 universities worldwide based on the Times Higher Education World University Rankings 2019–20. The admissions opportunities of the Project 211 universities reflect candidates' access to high-quality universities. In 2012, the national average admission rate to the Project 211 universities was 4.21% (Zhang and Zhang, 2015) and the provincial-level admission rate is listed in Table 1.3.

On May 4, 1998, Project 985 was established as an extension of Project 211 and aimed to promote the development of the Chinese higher education system by founding a set of world-class universities. A total of 39 universities involved in Project 211 were selected to participate in Project 985. Large amounts of funding were allocated to these universities by

[14]Data source: *People's Daily*

both local governments and the central government to build and improve research facilities and equipment, attract world-class scholars, and help Chinese faculty attend conferences abroad. According to the latest Times Higher Education World University Rankings, most of the 39 universities in Project 985 are ranked among the top 500 universities in the world, and they are considered the most prestigious universities in China.

1.4 Examination System in China

1.4.1 Primary Schools and Middle Schools

Before the 1980s, the junior high school entrance examination system was adopted in most regions in China. Primary school graduates were enrolled in secondary school in accordance with their grades. However, with modernization, the popularization of basic education, and the implementation of the one-child policy, students were faced with an excessive burden of schoolwork during primary and secondary school. To solve this problem, the policy of nearby school admission was enacted in 1986 and enforced by the Compulsory Education Law. Since then, no written examinations have been held for admission to any junior high school.

1.4.2 Senior High School Entrance Examination (*Zhongkao*)

In contrast with the nearby school admission policy in primary and middle school education, students are required to take a standardized exam to be admitted into the senior high school, which is as known as the Senior High School Entrance Examination.

The Senior High School Entrance Examination (SHSEE), usually known as the *Zhongkao*, is an academic examination held every year in mainland China to assess middle school graduates. This assessment is essential for entrance into all educational institutions at the senior secondary school level, including normal senior secondary schools and vocational high

schools. It is normally taken by middle school students in their last year of middle school. Though the scoring systems vary by region, students are usually tested in similar subjects, including Chinese, mathematics, English, physics, chemistry, political science, and physical education.

After taking the SHSEE, students go through an application process where they rank their preferences for the senior secondary schools they wish to attend. These high schools set a quota and requirements for admission depending on the availability of slots and grade distribution. For example, if a school would like to admit 1,000 students in one year, the admissions office ranks students' SHSEE scores from highest to lowest and then offers admission to the first 1,000 students. If a student rejects the offer, the offer is passed on to the next student on the list; this guarantees that the school selects the top students among all who have applied in that year. Though most students earn a place in a senior high school and continue their secondary education, intense competition takes place for a spot in the most prestigious schools.

Notably, exceptions to this procedure might be made in certain top high schools. Additional slots might be given to students who do not meet the necessary standard but still want to study at the school. Such opportunities are usually granted to students whose scores are close to the required standards, and the criteria of making such exceptions might change between years and schools. To access this opportunity, students are required to pay an additional admission fee, which is usually around $\$1,500$.

1.4.3 National College Entrance Exam (NCEE)

At the beginning of the founding of New China, the State proposed to vigorously develop higher education to provide professional talents for national development. In June 1952, the Ministry of Education promulgated the notice "Regulations on the Admission of Students to National Colleges and Universities," which established the college entrance examination system in China. However, at a time when political correctness was emphasized, the score-

based admissions model was questioned. Furthermore, the college entrance examination system was even once seen as an old educational system that was inconsistent with the new socialist system.

In 1958, the test-based selection framework was influenced by the Great Leap Forward. During this period, the test-based examination was abolished and replaced with a recommendation system that focused on the political background. Meanwhile, political censorship of students was enhanced. After the end of the Cultural Revolution in 1977, the National College Entrance Examination System was re-established to correct the shortcomings of the recommendation and selection systems and to better cultivate the various skills needed within Chinese society. After that, a complete system of higher education was efficiently established, and the basic education system was developed significantly. The college entrance examination system succeeded in quickly producing a large number of students with valuable skills, but the disparity in higher education access between developed areas and less developed areas has widened.

By the end of the 20th century, China had made certain achievements in terms of reforms and opening up, and its rapid economic growth brought opportunities as well as new challenges to higher education. To meet society's demand for higher education, the Action Plan for the Revitalization of Education in the 21st Century was proposed in 1999 to expand the scale of higher education. Since then, higher education in China has expanded significantly to provide mass training. Higher education fees were gradually lowered, and more people can afford the cost of universities and colleges.

As more people apply for colleges, the National College Entrance Exam (NCEE), also known as the *Gaokao*, plays an increasingly important role in the 21st century. It is regarded as the most critical event in the lives of Chinese young people and for parents who care deeply about their children's future (Muthanna and Sang, 2015). Each year, there are around 10 million students in China who take the NCEE. The NCEE takes place in June and it is a standardized educational examination. The exam usually lasts for two or three days, and

students are required to complete a list of preferences of the university or college they wish to attend. A university usually sets a fixed admission quota for each province, and the cut-off score is set by the Ministry of Education based on the number of applicants and available positions in each province, which differs from one year to the next.

The subjects tested in the NCEE have changed over time. Traditionally, high school students are required to choose either a social sciences or natural sciences track (Table 2), with three shared compulsory subjects; they are then tested on all six subjects on the NCEE.[15]. After the education reform of higher education in 2014, the barrier between tracks was broken, and a "3+X" examination system was adopted to promote reform. The "3" refers to compulsory subjects in the previous examination system, namely Chinese, mathematics, and English, each of which accounts for 150 out of 750 points. The "X" refers to one subject from either the social sciences (including political science, history, and geography) or natural sciences (including physics, chemistry, and biology), which accounts for 300/750 points. Candidates are given full autonomy to choose the "X" subject according to their own interests and universities' entrance requirements. Initially, the goal was to allow students to highlight their strengths and avoid weaknesses so that each student can focus on their specialization. However, the students chose high-scoring subjects instead of their true interests. As a result, very few students selected difficult subjects such as physics. To overcome this problem, another reform was introduced in 2018 using a "3+3" system. Compulsory subjects still include Chinese, mathematics, and a foreign language (usually English). However, instead of choosing only one subject, students must take three subjects of their choice out of physics, chemistry, biology, geography, politics, and history. The remaining subjects are tested in the Academic Proficiency Examination for Senior High School Students, which usually takes place at the end of the second year of high school; these results are marked as a pass or fail.

[15]For example, if a student chooses social science track, then he or she would be tested on six subjects, including Chinese, Mathematics, English, Political Sciences, History and Geography.

Though NCEE scores are the main determiner for the majority of high school graduates, there is still some leeway for universities to recruit talented students outside these parameters. Since 1993, the State Education Commission has allowed some colleges and departments to recruit students based on their own requirements, and a pilot test of independent admissions in some colleges and universities was started in 2003. Some colleges and universities may admit students who pass their own independent tests but do not take the NCEE, while others use independent test results as a reference to give candidates preferential admission conditions. Independent admission makes up for the shortcomings of the unified college entrance examination, giving colleges and universities more autonomy. For the sake of educational equality, the Ministry of Education strictly limits the number of students using pilot program to be less than 5% of total enrolled students in a given year. Furthermore, some colleges and universities have explored the student recommendation system to admit students with strong academic records who failed to perform well on the NCEE. Students who are recommended by their high school can be admitted to a university if their score on the NCEE is above the minimum score for admission. The number of students admitted through the recommendation system accounts for around 2% of total national enrollment.

1.5 Challenges in the Current Education and Examination System

Though great efforts have been made by the government to alleviate education inequality in China, several problems remain. First, there are great differences in education expenditures across regions. The Chinese economics reform (reform and opening-up) in 1978 led to differences in the financial situations of different provinces, which deepened differences in education expenditures. As a result, regional differences in the development of basic education have continued to widen. Taking the average expenditure per high school student as an example (Table 1.1), the national average is $\$2,111.60$; 18 provinces are below this average. Henan Province has the lowest expenditure at only $\$1,240.90$, and Beijing has the highest

at $\$9,874.10$ – 7.96 times the average in Henan Province. Similar patterns also emerge in the primary education and junior secondary education stages. Additionally, the research funding tends to go to schools with higher reputations and these schools are mostly located in developed regions. As a result,a huge gap appears between developed and less developed regions as well as prestigious and ordinary schools in terms of higher education resources. The average spending per capita in higher education is $\$2,482.50$, but 25 provinces are below this average. Hubei Province ranks last at only $\$1,709.20$, while the average spending per capita in Beijing is as high as $\$9,026.19$ – more than five times the average per student in Hubei Province.

Regional discrimination is not restricted to allocated education expenditures but is also reflected in provincial admission rates into high-quality universities. Students from municipalities[16] enjoy more enrollment opportunities into the universities involved in Project 211 and Project 985 compared to their peers from populous provinces (Zhang and Zhang, 2015). For example, Guangdong – the most populous province in China – has an admission rate of only 2.55% for Project 211 universities, which is 1.66% lower than the national average admission rate. In comparison, Tianjin, a municipality, has a population of 14.13 million, 13% of that of Guangdong Province. However, its admission rate is as high as 12.69%, which is nearly five times the admission rate of Guangdong Province. There are further disparities in the admission rates of universities across regions, which can be delineated with an example from Hubei Province where students' test scores have been higher than those in other provinces for many years. A score for a Hubei student to reach the admission cut-off only for an average university might be sufficient for a student from another province to be admitted to a much better university and could even be high enough for a student from Beijing, for example, to gain entrance into top institutions like Tsinghua University and Peking University.

[16]A municipality is the highest level of classification for cities, which was under direct administration of central government used by the People's Republic of China. They are basically large, densely populated cities which act like provinces. There are four municipalities in China: Beijing, Shanghai, Tianjin and Chongqing.

Furthermore, the exam-oriented admission mechanism reinforces inequality by leaving no means of discovering talented students from various social backgrounds, instead favoring "those from professional families, from developed urban areas and those who have better secondary schools (Liu, 2013)." In rural areas, nearly 60 million students are considered "left-behind" kids whose parents have jobs in faraway cities. They are usually fostered by their grandparents. While a significant number of their urban peers go to schools equipped with cutting-edge facilities and high-quality teachers, rural students often cluster in dilapidated schools and struggle to progress to advanced subjects such as English due to a lack of qualified teachers. According to statistics from the Ministry of Education, for students who take the NCEE, the admission rate of urban high school students into universities is 3.1 times higher than that of rural high school students. In terms of independent admission and recommendation systems, the admission rates for students from urban high schools are 8.2 times and 17.2 times higher, respectively, than for those from rural areas.

Lastly, because students can only take the NCEE once a year, they face tremendous pressure in preparing for and taking the exam. Testing pressure has caused severe psychological problems for students (Yu and Suen, 2005) and has been linked to increasing rates of teenage clinical depression and suicide in China. Furthermore, Long and Li (2008) argued that the merit-based examination system is a barrier to individuals' social development as it makes students become obsessed with test preparation and neglect social interaction.

1.6 Conclusion

Education in China has played a fundamental role in the development of Chinese society. It is clear that the education and examination system in China is strongly influenced by socio-cultural changes and conditions as well as Chinese culture. Efforts have been made by the government to improve education quality and promote equality across regions. However, challenges still remain, including disparities in education expenditures, admission rates,

enrollment opportunities at the provincial level, and urban-rural education attainment. Additionally, there is unhealthy psychological pressure on students due to the merit-based examination system. Looking to the future, the Chinese government should further improve laws and regulations, eliminate regional discrimination in admissions and educational opportunities, and establish a better and more holistic examination system.

Table 1.1: Education Expenditure per Pupil (USD) by Province in 2018

	Primary Education	Junior Secondary Education	Senior Secondary Education
Anhui Province	1,366.9	2,006.7	1,577.3
Beijing Municipality	4,606.5	8,776.5	9,874.1
Chongqing Municipality	1,614.8	2,284.5	1,998.3
Fujian Province	1,529.3	2,434.8	2,241.3
Gansu Province	1,643.9	1,908.1	1,698.4
Guangdong Province	1,744.8	2,481.0	2,401.0
Guangxi Zhuang Autonomous Region	1,208.8	1,536.7	1,580.9
Guizhou Province	1,482.0	1,710.3	1,632.1
Hainan Province	1,710.6	2,283.6	2,599.2
Hebei Province	1,191.2	1,724.1	1,845.8
Heilongjiang Province	2,164.2	2,400.8	1,839.7
Henan Province	878.1	1,374.9	1,240.9
Hubei Province	1,654.7	2,795.4	2,455.8
Hunan Province	1,267.5	1,903.4	1,749.5
Jiangsu Province	1,969.0	3,370.3	3,597.2
Jiangxi Province	1,292.6	1,728.8	1,831.2
Jilin Province	2,090.5	2,672.2	1,836.7
Liaoning Province	1,539.5	2,188.5	1,798.7
Inner Mongolia Autonomous Region	1,992.2	2,486.1	2,267.9
Ningxia Hui Autonomous Region	1,455.6	2,081.5	1,969.8
Qinghai Province	2,137.4	2,704.8	2,575.2
Shaanxi Province	1,697.4	2,335.5	2,023.7
Shandong Province	1,377.6	2,289.8	2,031.9
Shanghai Municipality	3,103.4	4,712.4	6,071.4
Shanxi Province	1,530.0	2,040.9	1,786.7
Sichuan Province	1,466.5	2,034.5	1,665.3
Tianjin Municipality	2,814.8	4,642.5	5,179.2
Xinjiang Uyghur Autonomous Region	1,817.6	2,852.7	2,258.0
Tibet Autonomous Region	4,286.9	4,497.6	6,696.5
Yunnan Province	1,592.0	1,933.8	1,807.8
Zhejiang Province	2,127.5	3,138.4	3,649.4
National Average	1,551.7	2,228.8	2,111.6

Data Source: 2018 Statistical Yearbook of China Education Expenditure

Table 1.2: Subjects in National College Entrance Exam

	Compulsory Subjects	**Elective Subjects**
Social Science	Chinese, Mathematics and English	Political Sciences, History and Geography
Natural Science	Chinese, Mathematics and English	Physics, Chemistry and Biology

Table 1.3: Statistics of Population, Candidates and Acceptance Rate of Universities by Province in 2012

	Population (millions)	Number of Candidates (thousands)	Admission Rate (%)	
			Project 211	Project 985
Anhui Province	59.88	510	3.62	1.01
Beijing Municipality	20.69	70	12.79	5.05
Chongqing Municipality	29.45	230	5.1	2.25
Fujian Province	37.48	260	5.17	1.82
Gansu Province	25.78	300	2.55	1.18
Guangdong Province	105.94	690	2.55	1.39
Guangxi Zhuang Autonomous Region	46.82	290	3.68	1.22
Guizhou Province	34.84	250	4.53	1.16
Hainan Province	8.87	60	9.25	2.34
Hebei Province	72.88	460	3.51	1.22
Heilongjiang Province	38.34	250	4.53	1.16
Henan Province	94.06	810	2.52	0.88
Hubei Province	57.79	460	4.41	1.81
Hunan Province	66.39	360	3.94	1.57
Jiangsu Province	79.20	470	4.77	1.22
Jiangxi Province	45.04	270	5.3	1.67
Jilin Province	27.50	160	7.13	3.2
Liaoning Province	43.89	260	5.41	2.1
Inner Mongolia Autonomous Region	24.90	190	4.94	1.51
Ningxia Hui Autonomous Region	6.47	60	5.66	2.34
Qinghai Province	5.73	40	8.27	2.91
Shaanxi Province	37.53	380	4.72	1.79
Shandong Province	96.85	550	3.92	1.81
Shanghai Municipality	23.80	60	10.58	4.04
Shanxi Province	36.11	360	3.56	1.05
Sichuan Province	80.76	540	3.61	1.4
Tianjin Municipality	14.13	60	12.69	5.42
Xinjiang Uyghur Autonomous Region	22.33	150	4.42	1.68
Tibet Autonomous Region	3.08	20	3.63	1.67
Yunnan Province	46.59	210	4.07	1.33
Zhejiang Province	54.77	320	4.36	2.07
National Average			4.21	1.58

Data Source: Zhang and Zhang (2015)

CHAPTER 2

Estimating Parents' Valuation on Elite School in China

2.1 Introduction

The Chinese economy has rapidly developed over the past 25 years. While the poverty rate declined from 60% in 1978 to 10% in 2014[1], disparities have grown as people from different socioeconomic classes have benefited from the growth at different rates, leading to an increase in income inequality (Dollar, 2007). As Doepke and Zilibotti (2019) argued, greater income inequality has driven parents to be more attentive toward their children's educational success. Since the quality of primary education is a key determinant of later academic achievement (Hoekstra et al., 2018), competition for places in the best primary schools in China is increasingly intense.

Furthermore, though admission to public primary schools is residence-based in urban areas, homeowners have precedence over renters in the admissions process. In practice, parents must own a property within the school attendance zone to send their kids to the most desirable schools, which contributes to skyrocketing housing prices (Chan et al., 2020).

There is substantial literature exploring how much parents value school quality. Most studies have found a positive relationship between school quality and house prices; one standard deviation increase in school test scores usually raises local housing prices by 2–4%. (Black and Machin, 2011; Nguyen-Hoang and Yinger, 2011). However, in China, there are no standardized tests at the primary and middle school level, and schools are forbidden to

[1]Data Source: the Word Bank.

release the test scores to the public. Therefore, in contrast to the tradition of research using student standardized test scores (e.g., Black, 1999; Figlio and Lucas, 2004; Gibbons et al., 2009; Fack and Grenet, 2010) as the measurement of school quality, it is unlikely to use test scores to measure school quality in China. Therefore, little rigorous research has been done to estimate the school-quality premium in housing markets in China. In this paper, we aim to provide an estimation for house price premium associated with better school quality based on the historical classification of key (magnet) schools and non-key schools using the best available data on urban areas of China.

In China, the key (magnet) school system began in the late 1970s, and it has exerted a profound influence on basic and higher education. Historically, key primary schools were given priority in the assignment of teachers, equipment, and funds. These schools constituted only a small percentage of all schools[2] and were considered the most prestigious schools in China. However, the system raised serious problems, such as harming the goal of education equity and fostering vicious competition among young children. As a result, the authorities formally prohibited key schools at the primary and junior secondary education stages in the 1990s. Zheng et al. (2016) found that a historical key school contributed an average house price premium of about 8.1% in Beijing, while Zhang and Chen (2018) found a price premium of 6.5% in Shanghai. However, these studies mainly relied on simple OLS regressions and failed to prove a causal relationship between key school classification and housing prices.

In this paper, we use the Beijing 2014 Education Reform as a quasi-experiment and apply an event-study-style estimation of parents' valuation in the access to key school resources by comparing the housing price differences between historical key schools and non-key schools. Furthermore, we also utilize the variation of policy changes in this reform to isolate parents' valuation of exposure to (perceived) better and (perceived) worse education resources. Based on the estimation results, parents are willing to pay 5.51% or $77.36 per square foot to

[2]According to the National Education Survey in 2004, there are approximately 30,000 key primary schools out of 36,620,000 primary schools nationwide.

obtain full access to the benefits associated with key schools for their children. Meanwhile, parents with kids enrolled in key schools seem to be insensitive about sharing the educational resources with peers from non-key schools. The results are robust to various specifications.

The rest of the paper is organized as follows. Section 2 provides an overview of related literature. Section 3 describes the background and details of the Beijing 2014 Education Reform. Sections 4 and 5 introduce the methodology and data collected. Section 6 provides the empirical results, and Section 7 outlines the robustness check results. Lastly, Section 8 presents the conclusion.

2.2 Literature Review

There is a long tradition of economists using data on housing prices as a means of eliciting the prices of local amenities (Sheppard, 1999). Tiebout's model (1956) provides a theoretical foundation for the capitalization of public goods such as education into housing prices. Rosen's model (1974) describes a market equilibrium in which consumers choose an optimal bundle of commodities, such as house characteristics and local amenities (e.g., school quality). In this equilibrium, given consumer preferences and income set the marginal benefit of improving any part of the bundle (e.g., living in a location with a better school) and equal the utility costs of the additional expenditure involved. Therefore, holding all else equal and estimating how much housing expenditures change with marginal changes to one attribute (e.g., school quality) can be interpreted as the marginal willingness to pay for that particular attribute (Black and Machin, 2011).

A great deal of literature has been devoted to the effect of school quality on housing prices. However, estimating the causal relationship between school quality and housing prices is complicated by the endogeneity of school performance in residential choice; this is because paying different housing prices causes people to sort themselves into diverse residential communities, and pupils from wealthier neighborhoods tend to have higher academic

achievements. Therefore, in a traditional hedonic approach, housing prices are simply regressed on school performance and controlled for housing and neighborhood characteristics, and they are likely to be biased due to endogeneity problems. Additionally, unobservable neighborhood and housing attributes may also lead to bias in the estimation process. To control for potential endogeneity bias, Black proposed the method of adopting a boundary discontinuity design (BDD). She compared housing prices on different sides of the shared border of a primary school attendance zone and found that parents were willing to pay 2.5% more for a 5% increase in test scores. This result relies on the crucial assumption that while school quality changes discontinuously across the borders of school districts, other housing and neighborhood characteristics are sufficiently similar along the boundaries.

However, Kane et al. (2006) noted that there might be systematic differences in the characteristics of the population and quality of housing on either side of a school district boundary, which could lead to biased results when simply applying BDD. As a result, several empirical papers have sought to examine the relationship between school choice and property value by further developing the BDD approach using matching. Fack and Grenet (2010) developed a matching framework to compare sales across school attendance boundaries in Paris and found that one standard deviation of public school test score raises housing prices by 1.4%. Similarly, using British data, Gibbons, Machin and Silva (2013) found significant effects of school quality on housing price by matching identical properties across school admission boundaries. Alternatively, Bayer et al.'s (2007) work embedded BDD in a heterogeneous residential choice model to estimate household preferences for school and neighborhood attributes in the presence of sorting and their results were substantially lower than the previous finding[3]. Moreover, in contrast with the cross-sectional estimations in previous empirical studies, a few papers (Bogart and Cromwell, 2000) have also examined changes in school boundaries over time and adopted the difference-in-difference approach

[3]In their paper, they found that households are willing to pay less than 1% more in house prices when the average performance of the local school increases by 5%.

to deal with endogeneity. However, some studies found significant effects of test scores on housing prices (Brunner et al., 2002; Clapp, Nanda and Ross, 2008), whereas others did not (Clapp and Ross, 2004).

Even in previous studies documenting a positive relationship between test scores and housing prices, the magnitude has varied significantly across data and models. Furthermore, as pointed out by Black and Machin (2010), one potential limitation of using such simple difference-in-difference (DID) estimation is that the changes in test scores might also coincide with unobserved changes in neighborhood characteristics. Some studies have relied on exogenous policy change to overcome the endogeneity issue. For example, Machin and Salvanes (2010) explored the housing price difference before and after the introduction of a new policy where students were able to select their preferred school. Their results showed that the impact of school performance on housing values was lower following the reform.

In the existing literature, it is standard to measure school quality using test scores, and the analyses mentioned above have all been based on the assumptions that test scores are an accurate measurement for school quality and that parents know about them. Several papers have also tried to identify which school characteristics are valued by parents. A few school characteristics have been tested, including parental valuations of expenditures per pupil (Oates, 1969; Rosen and Fullerton, 1977; Hayes et al., 1996; Brunner et al., 2002; Dobbie and Fryer, 2013), peer quality (Rothstein, 2006; Clapp et al., 2008; Dobbie and Fryer, 2013; Burgess et al., 2015), teacher and principal qualifications (Rothstein, 2006; Dobbie and Fryer, 2013), and student-teacher ratio (Weimer and Wolkoff, 2001). However, mixed evidence has been found for parents' preferences regarding individual school characteristics.

However, in China, there is no standardized test at the primary school and middle school levels to discourage intense competition among children, and primary schools are forbidden from publicizing test results. Furthermore, there is only limited data on school characteristics. As a result, little rigorous research has been done to estimate the school quality premium in housing markets in China. Previous studies have tried several different measure-

ments for school quality. For example, Chan et al. (2020) used mathematics and language tournament performances as an indicator of school quality. However, tournament performance may not be an accurate measure for schools where students enter such tournaments voluntarily. Furthermore, from 2006 to 2016, only 38 schools out of 1,239 schools in Beijing participate in tournament competitions, which further indicates the limitation of using tournament performance due to the potential selection problem. Other attempts have also been made using the historical classification of key schools and non-key schools. Zheng et al. (2016) found that, on average, a historical key school contributed a price premium of about 8.1% in Beijing, while Zhang and Chen (2018) found a price premium of 6.5% in Shanghai. However, these studies largely relied on simple OLS regressions and did not prove a causal relationship between key school classification and housing prices.

In this study, we utilized a natural experiment based on the Beijing 2014 Education Reform and adopted a DID-style empirical strategy to estimate the reform's impact on housing prices. This paper contributes to the literature of capitalization of school quality into housing prices, as well as parents' valuation of school characteristics. This study approach offers several advantages. Firstly, there is no property tax in China and public schools are funded through municipal funding, which prevents the endogeneity of school quality. Secondly, one residential address is affiliated with only one primary school, which avoids estimation bias because of school selection. Lastly, only homeowners—and not renters—have the privilege of sending their children to local public schools. Therefore, holding all else equal, housing price differences across school type accurately reflect parents' valuation of different schools.

2.3 Background

2.3.1 Housing Market in China

When the People's Republic of China was founded in 1949, a system of public housing allocation was in place, with housing construction financed mainly by both local and central governments. Residents in urban areas only had to pay a small rent to obtain the right to live in these houses. Most urban residents lived in housing units constructed and owned by their employers (Huang et al., 2020).

Since 1978, China has carried out reforms of housing commercialization that can be divided into the following phases. In the first phase from 1978 to 1998, the State carried out exploratory reforms of housing commercialization, gradually sold public housing to individuals, and began to establish a multi-level housing supply system with guaranteed housing and commercial housing. In 1998, the State issued further regulations to deepen the housing market reforms, stopping the distribution of housing and gradually monetizing housing distribution. In line with other reforms that transformed the public housing system into a private housing system during this period, housing provisions were less frequently included in employee compensation, and the private housing market therefore expanded (Hiroshi, 2006).

The second phase lasted from 1999 until 2005. After the liberalization of the real estate market, China's housing investments maintained rapid double-digit growth for seven consecutive years and gradually became a pillar industry of the national economy. According to Fang et al. (2015), the residential housing market, as measured by residential house sales volume, grew by about 15% per annum between 2002 and 2013.

Lastly, the third phase has lasted from 2006 to the present and is mainly characterized by State macro control. Housing market supply is dominated by enterprises, while the State regulates the price of housing mainly through the adjustment of real estate policies. Currently, housing that was formerly public but that has since been privatized can also be traded in the market.

2.3.2 "*Hukou*" and School Admission

Hukou is the household registration system in China, which dates to the Qin dynasty (375 BC). It serves as a means for population counting, taxation, and the recruitment of soldiers. Hukou provides basic information about the population, such as citizenship, kinship, and the legal address of residents living in the country (Wang, 2004).

In mainland China, citizens are required from birth to choose the hukou registration location of one of their parents as their hukou. They can move their hukou location for schooling and employment, but this is strictly regulated by local governments, and certain other restrictions (e.g., paying tax to local governments for over three years) are imposed. Each person's hukou file and self-held hukou book are the basis for establishing citizenship, issuing identity cards and passports, and declaring legal status and kinship. Like the population registration system in other countries (e.g., Social Security Number in the US), hukou provides individuals with legal proof of citizenship and serves an important role in enumerating demographic information.

Hukou was also designed to facilitate the distribution of public goods under the planned economy. From the 1950s to the 1980s, China implemented a planned economy, creating a system of universal rationing of individual goods and relying on a household registration system for ration management. In 1958, the central government promulgated the first household registration law, which established a strict system of household registration that included seven population registration systems (permanent residence, temporary residence, birth, death, moving out, moving in, and other change). All individuals were divided into two categories: "agricultural hukou" and "non-agricultural hukou". The authorities imposed a permanent subsidized rationing supply of basic necessities for non-agricultural hukou holders, who made up a minority of the population (between 15% and 25%). In contrast, the rural population, which comprised the majority of the population, had largely been left out of the rationing supply because it had been allocated with land to take on the role of food

producers.

Notably, the classification of "agricultural hukou" and "non-agricultural hukou" is purely location-based rather than occupation-based. Many people who live in suburban areas are not engaged in agriculture at all but still have an agricultural hukou; there are also many people from rural areas who work in cities but cannot obtain a non-agricultural hukou. The transition between hukou types can only happen under certain circumstances, such as by marriage. Over the past three decades, as the market economy has evolved, the function of allocating food and other necessary goods under the hukou system has deteriorated. Nonetheless, the allocation of other resources to the urban population remains significant, particularly in the areas of housing, healthcare, education, employment, and eldercare. As a result, hukou somewhat hinders the development of cities and the urbanization of rural areas because of the inefficient distribution of resources. Starting in 2005, a series of policies have been introduced to abolish the boundaries between agricultural and non-agricultural hukou and to begin the establishment of a unified urban and rural hukou registration system.

On the other hand, even within the same type of hukou, if someone lives in a place other than their hukou-registered city, they are considered an alien and cannot enjoy the various welfare benefits available in that place, including adequate schooling and employment opportunities. To resolve this problem, on July 30, 2014, the State Council initiated a reform to liberalize the restrictions on hukou registration in cities. The reform aims to abolish the hukou restrictions in towns and small cities, gradually remove the restrictions on middle-sized cities, and relax the restrictions in big cities. However, the restrictions on hukou in megacities like Beijing and Shanghai will remain strict.

Following the economic reforms and opening up of 1978, economic growth has maintained a high demand for labor in cities, and this demand is filled by migrant workers from rural areas or small towns. However, migrants' children are usually left in their hometowns and are cared for by a remaining parent or grandparents. According to the Fifth National Population Census, 22.9 million children between the ages of 0 to 14 live without either one or both of

their parents. For those children who migrate with their parents without a local hukou, they have much more limited access to educational opportunities than their local counterparts. Restricted space and the desire to ensure local interests discourage local governments from enrolling migrant children in public schools. As a result, the children of migrant workers are sent to private schools that specifically cater to migrants. However, these institutions usually have lower education quality. School facilities are often in poor condition, and many teachers are unqualified. The difficulties faced by migrant children cause high dropout rates, particularly in the middle school years: in 2010, only 30% of migrant children were enrolled in secondary education (Chan, 2015).

2.3.3 School District Houses (*Xuequfang*) in China

School District House (*Xuequfang*) in China refers to a property, which resides within a school (mainly key primary and secondary schools) attendance zone that enrolls students in the affiliated school without having to meet other conditions (e.g., tests, extra fees, etc.).

Before 1986, school admission was based on standardized test scores, and students with high scores were admitted to key (magnet) schools. However, the flaws of this exam-oriented education system, including its intense focus on examinations, rote memorization, and cramming instead of cultivating knowledge and responsibility (Pepper, 2000), were widely criticized. Furthermore, the implementation of the one-child policy in 1979 also increased the expectations parents put on their children and further exacerbated the pressure to succeed in school.

As a result, the central government enacted the Compulsory Education Law in 1986. Since then, entrance exams have been abolished for compulsory education stages, and a nearby school admission policy has been implemented. The original intent of this policy was to enable children from ordinary families to gain access to quality educational resources, but it did not work as intended. School admission is now based on hukou location (Feng and Lu, 2020; Huang et al., 2020), resulting in the emergence of school district houses and driving

high prices for the real estate market. Since key schools are regarded as a scarce resource, the property within the school district becomes a valuable investment commodity. On the one hand, the investor's children can enjoy the high-quality education resources affiliated with the school district. On the other hand, the investor also obtains the benefits of property appreciation. Even when the real estate market is down, school district houses are less affected by the business cycle because of the inelastic demand for quality education.

Moreover, unlike typical residence-based admission systems in other countries, homeowners and renters are not treated the same way regarding the right to school attendance. In practice, because renters have a hukou registration with another city, only homeowners can send their children to schools that are in high demand (Chan et al., 2020), strengthening the relationship between housing prices, access to education, and school quality.

Previously, the location-based rule was widely condemned as parents used power, money, and connections to send their children to prestigious schools (Dello-Iacovo, 2009). However, in the past decade, education policy has required that students attend nearby schools, thereby strengthening the link between school quality and housing prices (Feng and Lu, 2020). With the introduction of the second-child policy, the demand for quality education resources continues to expand, and the price of school district housing is bound to rise accordingly. People who own a (key) school district house enjoy capital appreciation, while people who cannot afford a house are further blocked from the market, exacerbating household wealth inequality.

2.3.4 Beijing 2014 Education Reform

As in the rest of China, education in Beijing is predominantly public. According to the Beijing Municipal Commission of Education, there were only 24 private schools out of a total of 1,160 schools in Beijing (Zheng et al., 2016). Compared to tuition-free public schools, these private schools charge annual tuition fees ranging from $\$10,000$ to $\$50,000$ and aim to send students overseas for high school and university.

The capital of China, Beijing, consists of 16 districts that can be divided into 137 subdistricts. In contrast with the United States, a district is regarded as a county-level division, and a subdistrict is regarded as a township-level division. As shown in Table 2.1, even at the same division level, district size and population density can vary substantially. For example, Dongcheng District and Xicheng District have a similar density to Manhattan, while Chaoyang, Haidian, Fengtai, and Shijingshan Districts have a similar density to Queens in New York City[4]. As noted in the previous chapter, education in China is funded by a centralized municipal fund. The district-level governments are responsible for supervising public schools and the assignment of pupils and educational resources.

There are no standardized tests at the primary school level. Furthermore, to discourage competition, no performance statistics like test scores or rankings are publicly available for the compulsory education stages. Since there are no entrance examinations for primary or middle schools, residence-based enrollment to local public schools can be violated by charging extra admission fees and opening specialized classes to attract out-of-district students. To equalize access to public schools, the government of Beijing passed a strict policy to guarantee students' enrollment in nearby schools. An information collection system was put into effect that records the entire process of student enrollment, including information regarding students' residences, current school, and how they enrolled in the primary and middle schools. As a result, the whole enrollment process has become much more transparent, eliminating potential manipulation of school choice. Furthermore, a number of educational policies have been enacted by the district-level government to further improve school quality in primary education.

Firstly, numerous formerly non-key schools were shut down, and students were assigned to corresponding key schools (a process termed "Re-designation"). Each pair of schools were in the same neighborhood at an average distance of 150 meters. The original campuses of non-

[4]Manhattan County's population density is 71,341 people per square mile versus 20,767 per square mile for Queens. Data source: 2010 US Census.

key schools were reconstructed and taken over by the corresponding key school. Additionally, teachers from the non-key schools were randomly reassigned to other primary schools in the city. Students in the same grade from both schools were shuffled around to create new classes.

Secondly, a "School Federation" was established to ally low-quality schools with existing elite schools, enabling the key school to share teaching resources and best practices with non-key schools (Huang et al., 2020). As a result, students who are enrolled in non-key schools can also obtain partial access to the educational resources in a key school. These key schools must share all educational resources with affiliated non-key schools. Teachers from key schools are obliged to give lectures half of the time to students in allied non-key schools, and students from non-key schools are granted access to resources and equipment in the paired key schools, including libraries and labs. Meanwhile, pupils in both key schools and non-key schools have remained the same.

Lastly, the policy of creating a couple of "Nine-Year-Straight" schools has resulted in increases from 50% to 100% in the admission rates of non-key primary schools to top middle schools[5]. The detailed policy descriptions are listed in Table 2.5. Before the establishment of "Nine-Year-Straight" schools, the admission from primary schools to middle schools is residence-based; one residential address is linked with several in-zone middle schools, and a lottery will be run by the local government to randomly assign students to each middle school. The admission rate to top middle schools is similar across school districts with an average of 50%. With the creation of "Nine-Year-Straight" schools, students who live in the corresponding middle-school district will be directly admitted to top middle schools.

[5]Here, I define "top" middle schools as those with scores in the 1st quartile of the high school entry exam grade distribution.

2.4 Data

We constructed our dependent variable, school district house price, from transaction-level secondhand housing sales data from Beijing. The data was purchased from Lianjia.com, which is one of the biggest real estate brokerage companies in China and which covers more than 60% of the market share of the Beijing real estate market. For each transaction, we obtained detailed information, including addresses, coordinates, the number of bathrooms and bedrooms, building year, and lot size. Due to constraints of data availability, the sample period was set from January 2012 to January 2019 and contained 32,387 transactions in total.

Similar to megacities in the United States, it is most common for people in Chinese megacities to live in condominiums in medium or high-rise buildings, and a residence complex (*xiaoqu*) can be defined as the most fundamental organization unit of the neighborhood (Huang et al., 2020). Furthermore, school admission is usually affiliated with residence complexes (RCs). Prior to open enrollment each year, each public primary school distributes admission brochures specifically listing the names of designated RCs eligible to enroll students. Therefore, we manually matched RCs to corresponding schools using the school admission brochure from the sample period and recorded changes in corresponding schools if they were subject to any policy impacts mentioned in the last section. After excluding RCs with less than three transactions in any year within the sample period and removing outliers in the top or bottom 1% of the price distribution, we obtained a final sample of year-RC-level observation and the sample size is 4,438. Standard errors were all clustered at the RC level.

For school data, we applied web scraping techniques to extract individual primary school information from government websites, including address, coordinates, number of classes, number of teachers, number of elite teachers[6], number of students, and admission rate to

[6]Teachers in China are evaluated by local governments each year. Based on their teaching quality, top teachers will be awarded with titles of "Elite Teacher".

each middle school. In total, we obtained detailed information for 85 primary schools, 28 of which were former key schools. The summary statistics are shown in Table 2.2.

However, it is important to note that the former key primary schools did not appear to be superior to ordinary schools in most observed school characteristics (see Table 2.2), but these schools did have better performances as measured by tournament medals (see Table 2.4). However, using tournament performance may not be an accurate measure since participation in tournaments is voluntary (Chan et al., 2020). However, due to the lack of public data on standardized test scores, it can reflect the difference between key schools and non-key schools to an extent (Huang et al., 2020).

2.5 Methodology

This study employed an event study approach to examine the effects of the three policy options mentioned in the previous section on housing prices. The baseline model specification is defined as

$$p_{istg} = \lambda_s + \delta_t + \sigma_g + \alpha X_i + \beta_{2011\text{–}2013} D_{istg} + \beta_{2015\text{–}2018} D_{istg} + \epsilon_{istg} \tag{2.1}$$

where p is the mean house price of residential complex i in subdistrict s in year t under policy option g. λ_s controls for subdistrict FE; δ_t controls for year FE; σ_g controls for treatment group FE and X_i is a set of housing characteristics. D_{istg} are dummy variables assuming value one on event year t and zero otherwise, where t can take the value from 2011 to 2013 and 2015 to 2018.

Based on Section 2.3.4 and Table 2.5, we exploited the impact of different policy options on housing prices. Though on average, there is no significant difference in multiple observable school characteristics between key primary schools and non-key primary schools (as shown in Table 2.2), we disentangle the treatment effects by interpreting these as changes in par-

ents' perceptions of school quality. For example, regarding the policy of "Re-designation," pupils have full access to the educational resources of corresponding key primary schools, which can be used to estimate parental valuation of full exposure to more elite schools. Under the "School Federation" policy, we can identify parents' valuation of pupils' partial accessibility to the benefits associated with a key school. Lastly, the policy regarding "Nine-Year-Straight" schools indicates parents' valuation of admission to top middle schools without changing perceptions of the quality of primary school their child is currently enrolled in.

Furthermore, the "Re-designation" and "School Federation" policies enable the identification of the treatment effects for both key schools and non-key schools. After the implementation of the reform, parents perceive key schools more negatively because they need to share educational resources with non-key schools. On the other hand, non-key schools gain access to (perceived) better educational resources from key schools, so expected teaching quality increases due to the reform.

2.6 Empirical Results

2.6.1 Results for Non-key School

The baseline regression results regarding "Re-designation" are shown in Table 2.6. As seen in the corresponding figures (Figure 1 through Figure 2.3), the parallel trend between the treatment group and control group holds for all three policy groups. As shown in Table 2.6, relative to the control group, housing prices associated with non-key schools increased significantly after the reform ($68.73 per sq. ft, $p < 0.01$) and the increment is consistent in the following years.

The estimated difference-in-difference estimate for non-key schools involved in the "School Federation" reform is shown in Table 2.7. The estimated coefficients are not as significant as those under the "Re-designation" policy. However, the magnitude is still very large, ranging

from $68.65 per square foot to $132.39 per square foot in the years following the reform. Lastly, Table 2.8 reports the estimation results of the "Nine-Year-Straight Admission" policy. After controlling for pre-reform admission rates to top middle school, the coefficients are still large, significant, and long-lasting.

To assess the magnitude of the effect of each policy on housing prices for non-key schools, we pooled all the treatments into a single difference-in-difference regression and plotted the results 2.4 using the percentage change in housing price (with log housing price as the outcome variable). Based on Figure 2.4, the average housing price is 9.16% higher under the policy of "Nine-year Straight Admission", while the premium is 5.51% for "Re-designation" and 1.43% for "School Federation". This implies that keeping all other things equal, parents are willing to pay 9.16% ($131.78 per square foot) more to guarantee their children's admission to a top middle school. Furthermore, keeping the probability of admission to a top middle school equal, parents are still willing to pay 5.51% ($77.36 per square foot) to grant their children full access to the resources of key schools, while the housing premium of partial access is small and insignificant. Our results have similar magnitude comparing to other studies[7] (Zheng et al., 2016; Chen, 2018).

2.6.2 Results for Key School

In contrast with our original expectation, sharing resources with pupils from non-key schools did not seem to significantly affect parents' valuation of the quality of key schools. According to Table 2.6 and Table 2.7, housing prices associated with affected key schools did not respond significantly to either "Re-designation" or "School Federation," which indicates that parents are not concerned with whether key schools become more accessible to pupils from non-key schools. From Figure 2.4, we can also observe that there is no significant deterioration of parents' valuation on key schools when access to their resources is shared with pupils from

[7]Zheng et al. (2016) found that a historical key school con- tributed an average house price premium of about 8.1% in Beijing, while Zhang and Chen (2018) found a price premium of 6.5% in Shanghai.

non-key schools.

2.7 Robustness Check: Excluding the One-Bedroom Sample

Due to a lack of data on the characteristics of homebuyers, we were unable to classify families with school-age children and those without. Therefore, under the assumption that a family with children would be more likely to purchase a condo with more than one bedroom, we can check the robustness of the estimation results by excluding the sample data with less than two bedrooms. The difference-in-difference coefficients are plotted in Figures 2.5 through 2.9.

The figures reveal that for both key schools and non-key schools, the parallel trend of housing prices holds in the reduced sample. Furthermore, the magnitude and significance remain almost the same in the reduced sample to their results in the full sample.

2.8 Conclusion

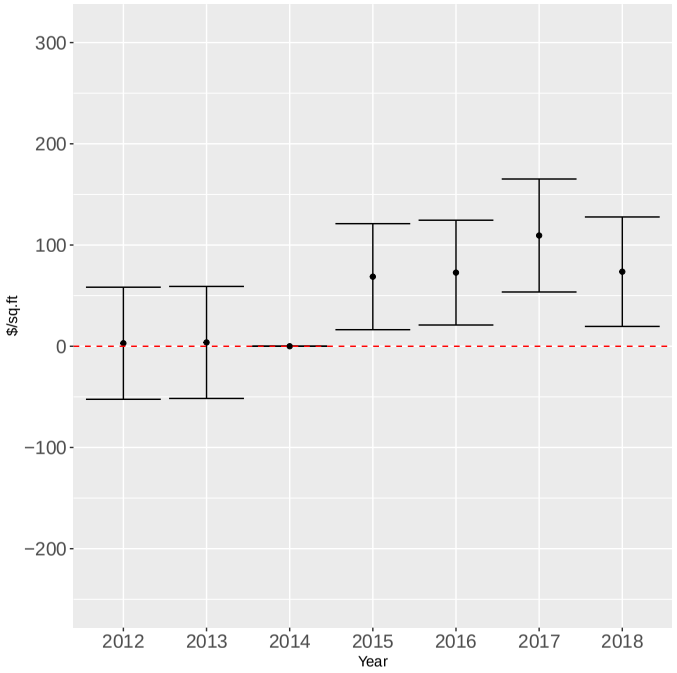
This paper aimed to provide an estimate of the housing premium for school quality as perceived by parents. We used three different policy options and studied the individual DID estimates for each policy to capture the quality premium. Based on the best available data, there is no significant observable difference in educational resources between key schools and non-key schools in terms of expenditures per pupil, student-teacher ratios, teacher qualifications, and so on. However, based on the estimation results, parents are still willing to pay 5.51% or $77.36 per square foot to provide their kids with full access to the benefits associated with key schools. The largest premium indicates that parents are results-driven: they are willing to pay a premium of approximately 9.16% to guarantee their kids' admission to top middle schools while keeping everything else equal. Our estimates also suggest that parents are not sensitive to increased accessibility of key schools to pupils from non-key

schools.

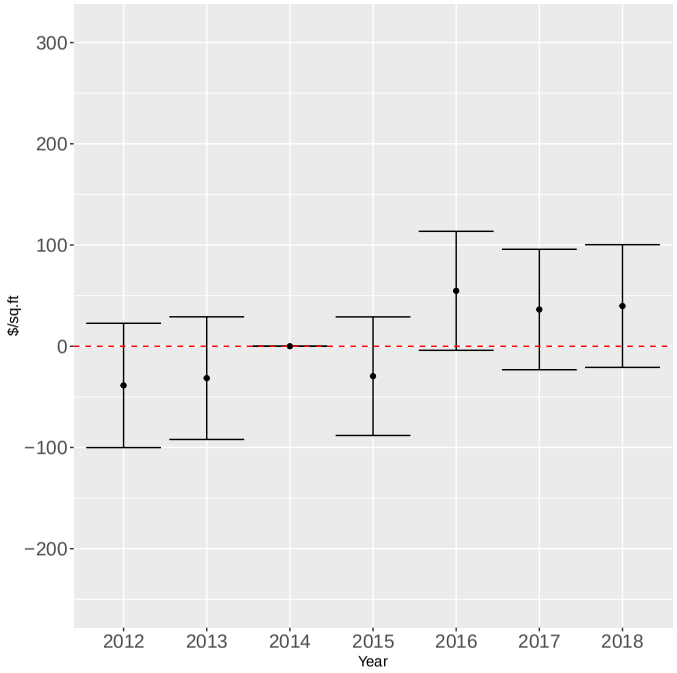
Our empirical findings present important policy implications. Although the reforms aim to regulate extra admission fees and to equalize access to education for students in Beijing, they actually strengthen the education-housing prices relationship and drive housing prices up for properties associated with "better" education resources. As a result, people compete for education resources through housing markets, which further increases inequality in accessing education. Therefore, in future educational policy reforms, policymakers must be more careful in evaluating the potential capitalization of parents' valuation of education into housing prices.

There are a few limitations to this study to note. Firstly, the selection of schools impacted by each policy might not be random, and the decision-making process of the government is unknown and inaccessible. However, we compared the characteristics of in-zone housing prices affected by each policy and did not find any significant difference across policy groups (Table 2.3). Secondly, since there are no standardized exams during the compulsory education stages (primary and middle school), we lack direct measures of school quality. Under the current quasi-experiment set-up, we identified the intensity of parents' valuation of perceived school quality. Lastly, we do not have individual-level data that can be linked with the school that pupils attended. As a result, it is hard to interpret the motivation for parents' willingness to pay for access to resources in key schools. In the next chapter, we use national panel data to uncover the underlying causes of the housing price premiums estimated here.

Figure 2.1: Re-designation

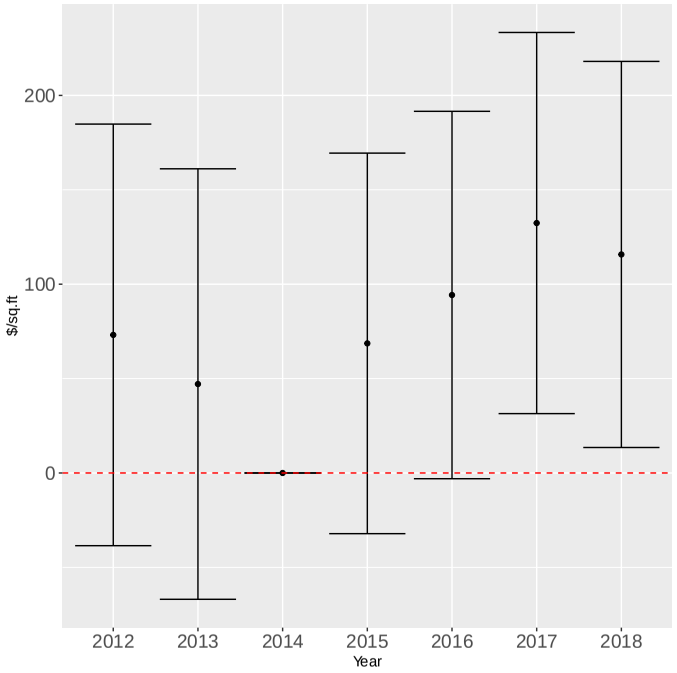


(a) Non-key school

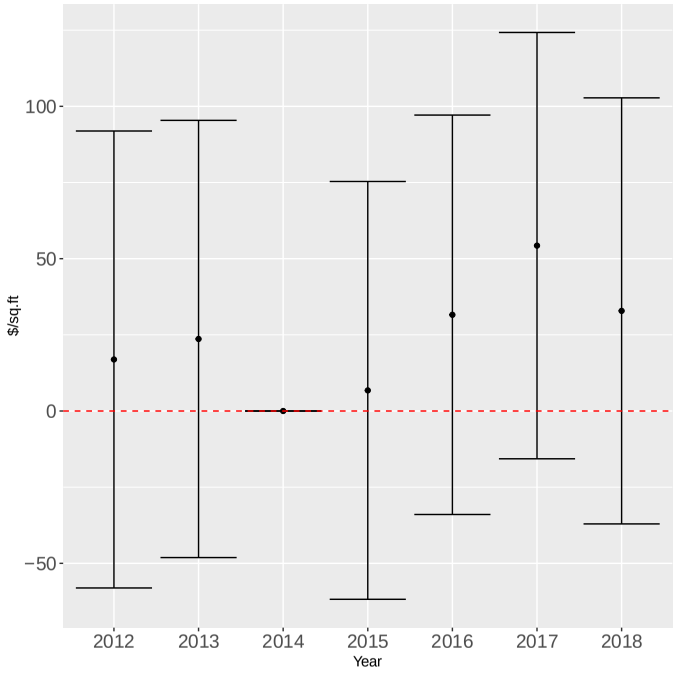


(b) Key school

Figure 2.2: School Federation



(a) Non-key school



(b) Key school

Figure 2.3: Nine-year Straight Admission

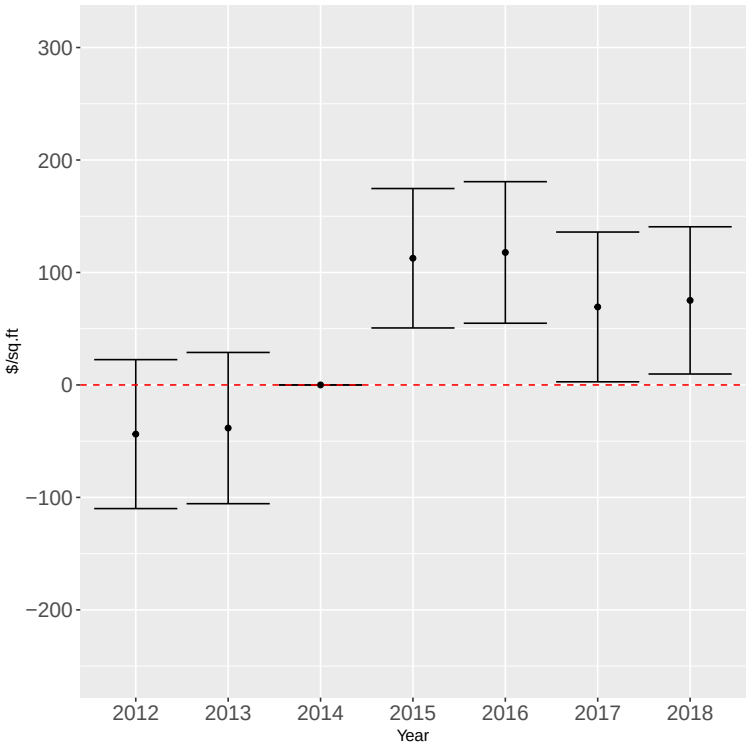


Figure 2.4: Regression Results for All Policy Option

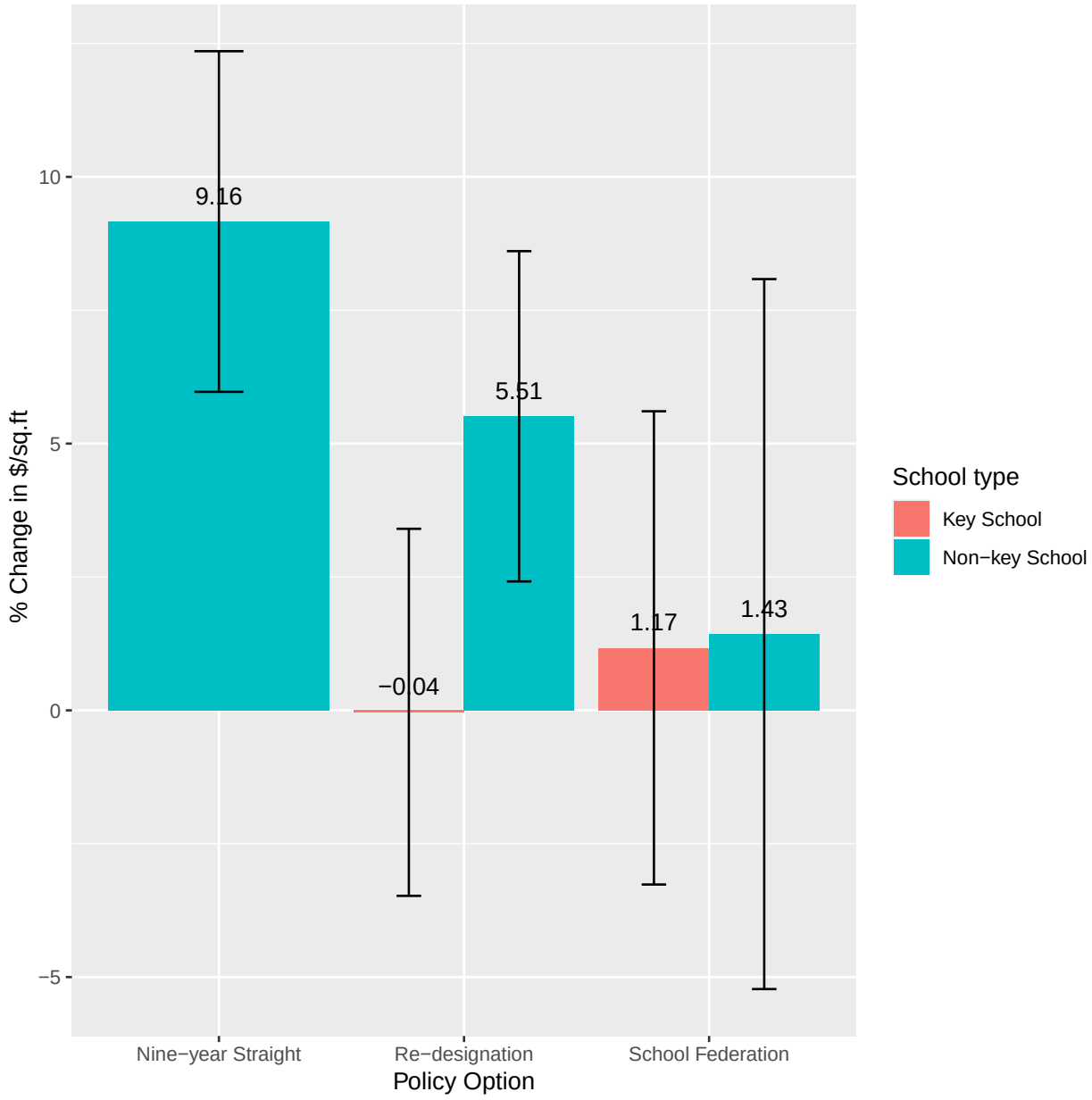
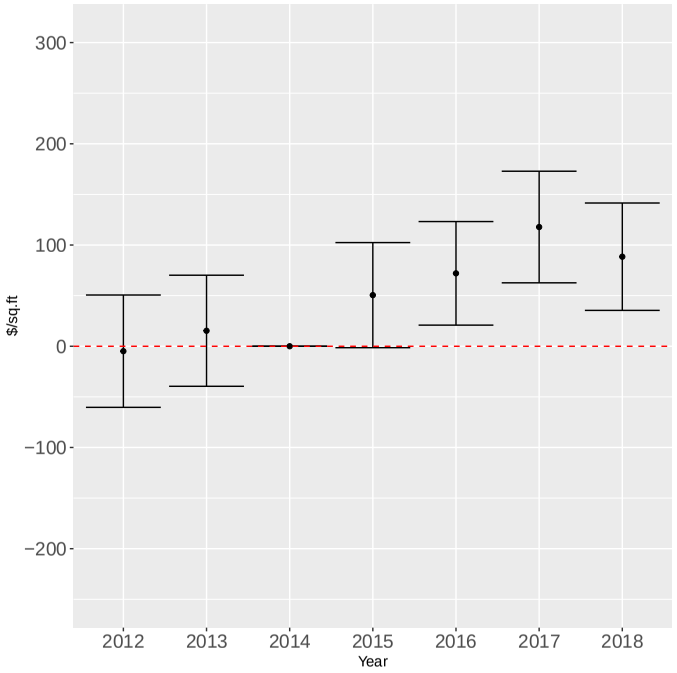
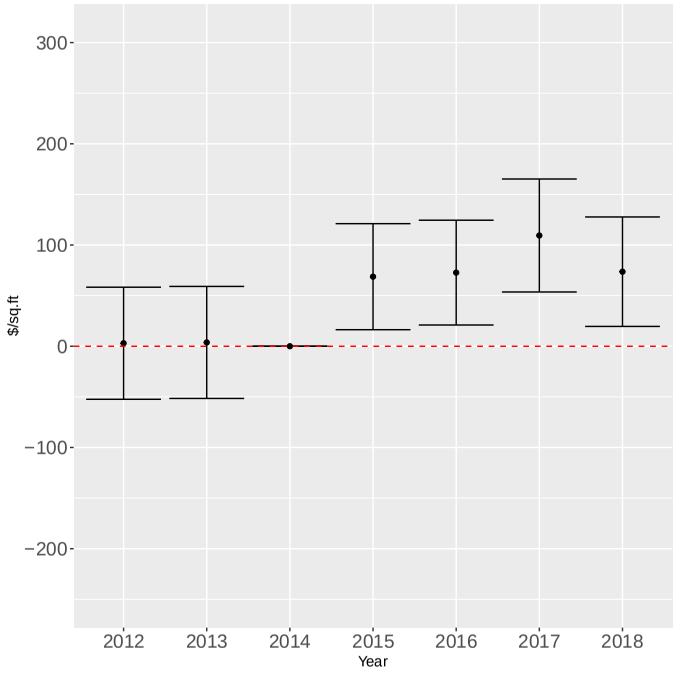


Figure 2.5: Re-designation for Non-key Schools

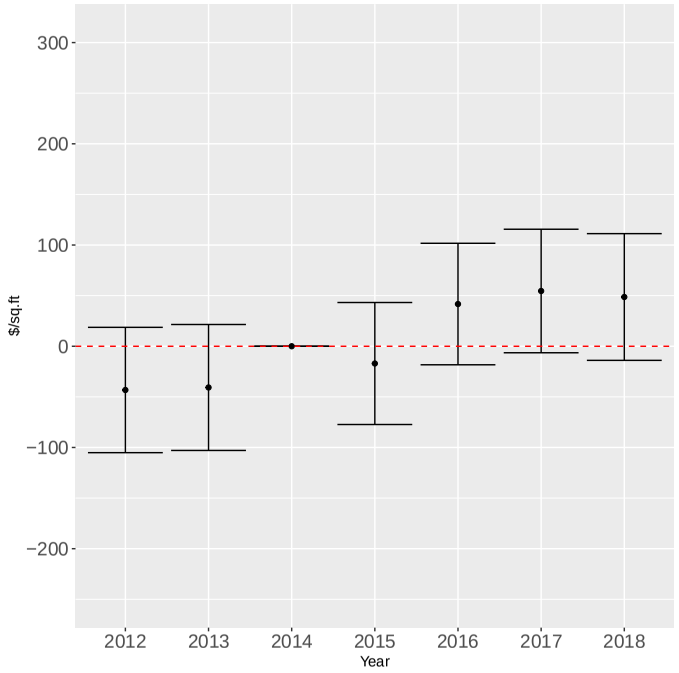


(a) Sample with ≥ 2 bedrooms

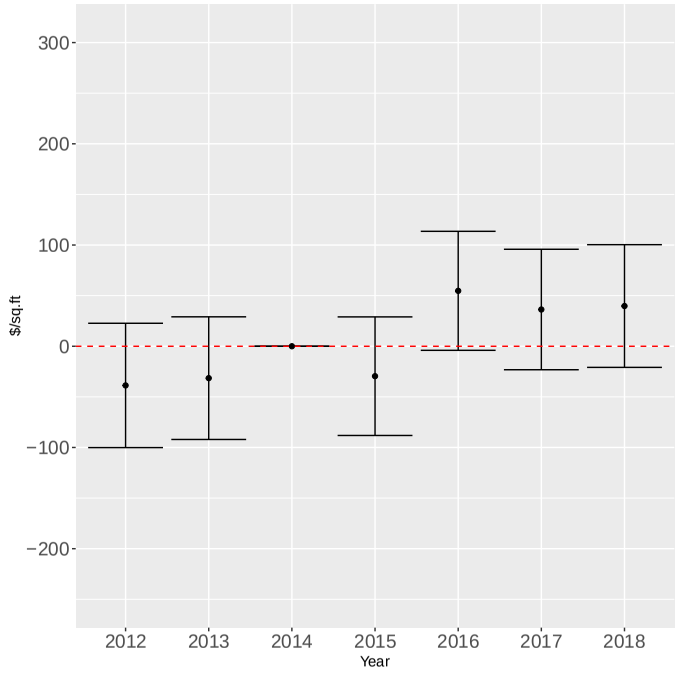


(b) Full Sample

Figure 2.6: Re-designation for Key Schools

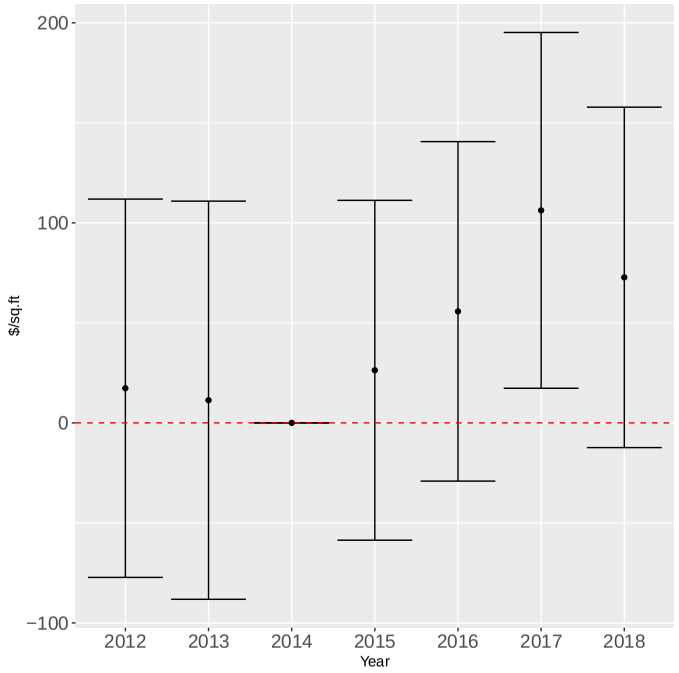


(a) Sample with ≥ 2 bedrooms

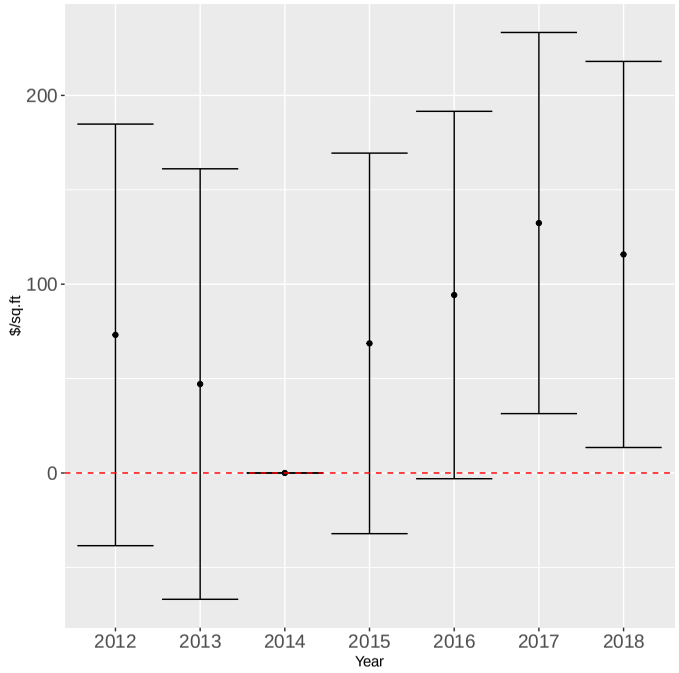


(b) Full Sample

Figure 2.7: School Federation for Non-key Schools

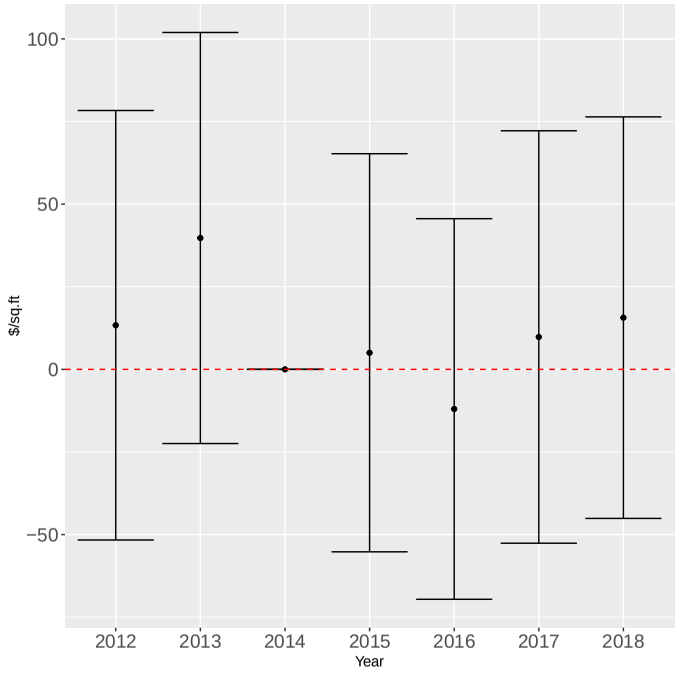


(a) Sample with ≥ 2 bedrooms

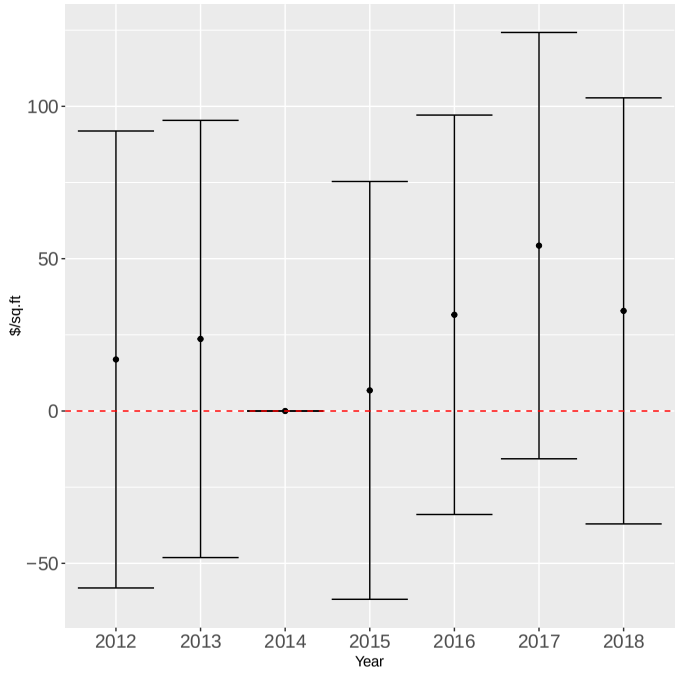


(b) Full Sample

Figure 2.8: School Federation for Key Schools

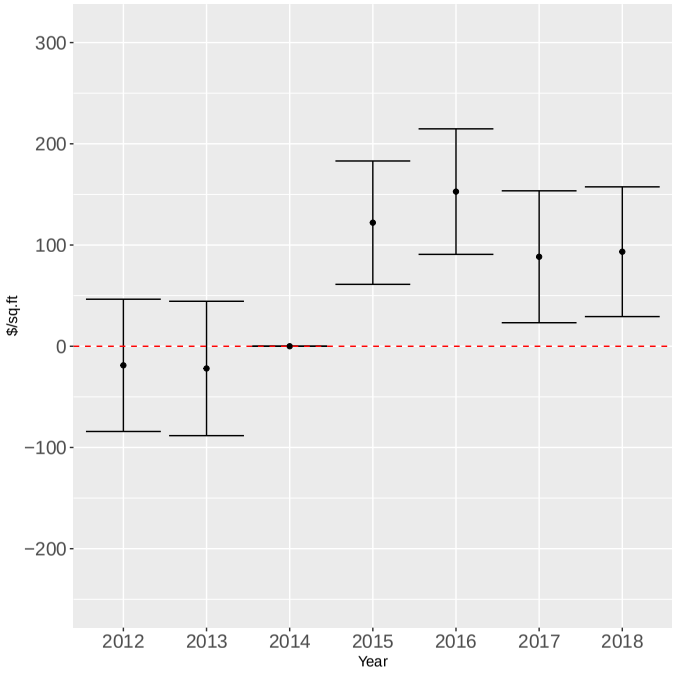


(a) Sample with ≥ 2 bedrooms

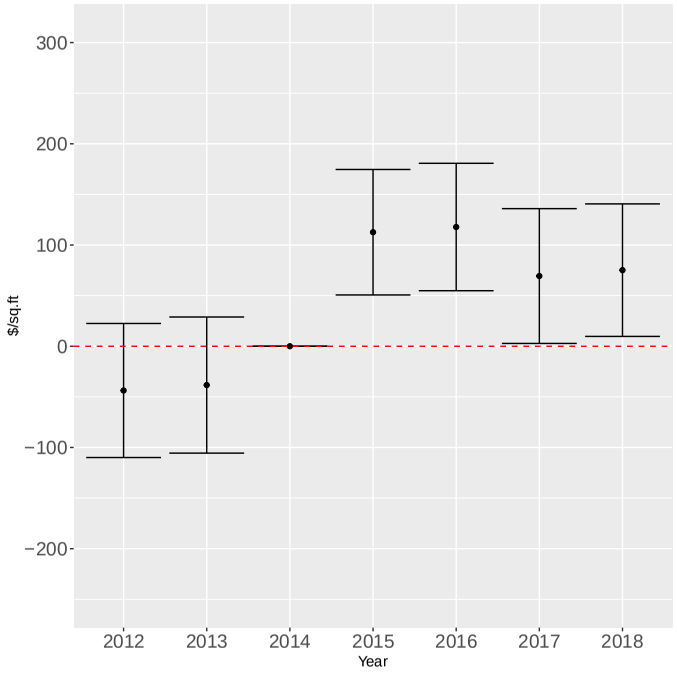


(b) Full Sample

Figure 2.9: Nine-year Straight Admission



(a) Sample with ≥ 2 bedrooms



(b) Full Sample

Table 2.1: Demographics in Beijing (by district)

District Name	Area ($mile^2$)	Population (2010 census)	Density ($\backslash mile^2$)
Dongcheng	15.68	919,000	58,609.69
Xicheng	17.95	1,243,000	69,247.91
Chaoyang	181.78	3,545,000	19,501.60
Haidian	164.48	3,281,000	19,947.71
Fengtai	117.45	2,112,000	17,982.12
Shijingshan	34.67	616,000	17,767.52
Mentougou	514.02	290,000	564.18
Fangshan	720.74	945,000	1,311.15
Tongzhou	335.91	1,184,000	3,524.75
Shunyi	378.38	877,000	2,317.78
Changping	552.13	1,661,000	3,008.35
Daxing	390.74	1,365,000	3,493.37
Huairou	987.38	373,000	377.77
Pinggu	415.05	416,000	1,002.29
Miyun	901.78	468,000	518.97
Yanqing	764.48	317,000	414.66
City of Beijing	6,492.62	19,612,000	3,020.66

Data Source: National Bureau of Statistics of China

Table 2.2: Comparison of School Characteristics

	Year of Found	No.Teacher	No.Elite Teacher	No.Students	No.Classes	T-S Ratio	Elite T-S Ratio	Expenditure Per Pupil
Non-key	1978.03	140.76	8.86	1897.50	53.55	0.08	0.00	1.75
Key	1766.00	170.29	9.14	2226.18	57.96	0.08	0.00	2.77
p-value	0.29	0.29	0.94	0.40	0.65	0.38	0.56	0.31

Data Source: Beijing Municipal Commission of Education

Table 2.3: Comparison of Housing Characteristics

Treatment Group	Policy Option	Whether affiliated to Key School	$/sq. ft	Lot Size (sq. ft)	# of Bedroom	# of Bathroom	Year Built
1	Re-designation	N	656.42	689.64	1.93	1.04	1989.82
			(166.83)	(277.23)	(0.71)	(0.23)	(10.46)
1	Re-designation	Y	694.28	729.89	1.96	1.06	1990.70
			(199.03)	(271.84)	(0.68)	(0.26)	(9.08)
2	School Federation	N	536.80	673.39	1.65	1.12	1998.21
			(153.68)	(331.58)	(0.75)	(0.33)	(9.87)
2	School Federation	Y	640.60	641.44	1.85	1.00	1990.75
			(216.84)	(176.78)	(0.69)	(0.15)	(6.31)
3	Nine-year Straight	N	647.49	745.58	1.96	1.07	1993.50
			(202.41)	(275.89)	(0.71)	(0.27)	(9.93)
Full Sample			614.89	728.26	1.88	1.08	1993.34
			(184.08)	(307.35)	(0.74)	(0.29)	(10.41)

Data Source: Lianjia.com from 2012 to 2014.

Table 2.4: Number of Tournament Medals by School Type in Beijing

Number of awards	Non-key Primary Schools	Key Primary Schools	Total
0	2,404	1,114	3,518
1	20	76	96
2	0	12	12
3	0	20	20
4	14	60	74
5	0	14	14
6+	18	62	80
Total	2,456	1,358	3,814

Data Source: Huang et al. (2020), Table 1

Table 2.5: Policy Details in Beijing 2014 Education Reform

Abbreviation	Policy Option	Num. of Treated Key Schools	Num. of Treated Non-key Schools	Total Treated Schools
Re-designation	Shut down non-key primary schools and assign students to corresponding key primary schools	10	10	20
School Federation	Key schools are required to share teaching resources with assigned non-key schools.	5	5	10
Nine-year Straight	Elaborate the admission rate of non-key schools to top middle schools from 50% to 100%	0	12	12

Table 2.6: Event Study Results for "Re-designation"

	Dependent variable: USD per square foot	
	(1)	(2)
	Non-key School	Key School
Treated Non-key School	−30.909	
	(19.685)	
Treated Key School		73.708***
		(21.745)
2012 × *Treated*	2.966	−38.706
	(28.241)	(31.323)
2013 × *Treated*	3.766	−31.515
	(28.222)	(30.897)
2015 × *Treated*	68.729**	−29.570
	(26.715)	(29.876)
2016 × *Treated*	72.753***	54.745*
	(26.407)	(29.983)
2017 × *Treated*	109.411***	36.301
	(28.467)	(30.355)
2018 × *Treated*	73.649***	39.733
	(27.578)	(30.915)
2012	−860.918***	−862.768***
	(10.063)	(9.800)
2013	−666.690***	−669.692***
	(10.052)	(9.807)
2014	−655.717***	−662.916***
	(9.963)	(9.711)
2015	−558.250***	−552.750***
	(9.556)	(9.294)
2016	−258.853***	−260.343***
	(9.577)	(9.288)
2017	37.889***	40.468***
	(9.867)	(9.669)
Observations	4,130	4,130
R^2	0.977	0.977
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 2.7: Event Study Results for "School Federation"

	Dependent variable: USD per square foot	
	(1)	(2)
	Non-key School	Key School
Treated Non-key School	−46.879	
	(35.963)	
Treated Key School		−73.878***
		(24.807)
2012 × *Treated*	73.144	16.911
	(56.937)	(38.241)
2013 × *Treated*	47.104	23.644
	(58.142)	(36.587)
2015 × *Treated*	68.646	6.762
	(51.394)	(34.964)
2016 × *Treated*	94.262*	31.581
	(49.618)	(33.425)
2017 × *Treated*	132.391**	54.281
	(51.477)	(35.678)
2018 × *Treated*	115.753**	32.863
	(52.142)	(35.655)
2012	58.180***	58.986***
	(19.043)	(19.540)
2013	259.065***	257.876***
	(18.829)	(19.390)
2014	270.521***	269.537***
	(18.467)	(18.434)
2015	306.928***	308.662***
	(18.206)	(18.642)
2016	581.324***	581.839***
	(18.027)	(18.480)
2017	877.788***	877.267***
	(18.475)	(18.924)
2018	790.482***	791.854***
	(18.427)	(18.885)
Observations	2,189	2,189
R^2	0.969	0.970

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2.8: Event Study Results for "Nine-year Straight Admission"

	Dependent variable: USD per square foot
Treated	79.398***
	(23.294)
$2012 \times Treated$	−43.715
	(33.774)
$2013 \times Treated$	−38.344
	(34.294)
$2015 \times Treated$	112.656***
	(31.617)
$2016 \times Treated$	117.805***
	(32.099)
$2017 \times Treated$	69.362**
	(33.961)
$2018 \times Treated$	75.175**
	(33.388)
2012	−851.771***
	(11.693)
2013	−662.138***
	(11.658)
2014	−654.423***
	(11.591)
2015	−557.140***
	(11.124)
2016	−257.638***
	(11.094)
2017	38.998***
	(11.481)
Pre-reform Admission Rate of Top Middle School	555.972***
	(12.528)
Observations	3,903
R^2	0.790
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 2.9: Quantity of Supply of Housing

Year	2011	2012	2013	2014	2015	2016	2017	2018
# of houses on the list	490	3,504	3,051	3,380	6,856	7,680	3,775	3,651
# of houses sold	547	3,453	3,048	3,378	6,817	7,148	3,425	4,571

CHAPTER 3

Measuing Elite School Effectiveness in China

3.1 Introduction

Parents and students expend significant effort and assets to secure places in what they see as "good" schools, and the valuation of high-quality schools is often reflected in housing prices. A wide range of literature has attempted to estimate the causal relationship between school quality and housing prices. For example, Black (1999) found that parents are willing to pay 2.5% more for a 5% increase in test scores. Similar results were also found in later studies (Figlio and Lucas, 2004; Reback, 2005; Clapp, Nanda and Ross, 2008; Fack and Grenet, 2010), supporting that parents are willing to pay to live in an area with a higher-performing school. In the Chinese context, key schools are considered elite, and parents are willing to pay a premium to allow their children to attend these schools. For example, in the central districts of Beijing, the price of a two-bedroom apartment in a key primary school attendance zone is $84 (dollars in 2007) per square foot higher than similar apartments in the same area but outside the key school district. The annual growth rate of average housing price within key primary school attendance zone is (39%) 1.5 times those which are outside of key school attendance zone (26%). Previous attempts have been made to estimate the housing price differences between key and non-key school zones. For example, Zheng et al. (2016) found that in Beijing, housing units in the attendance zone of a key primary school are associated with a price premium of about 8.1%. Zhang and Chen (2018) also found a housing price premium of about 6.5% for key primary schools in Shanghai.

Given that parents are paying a price premium for what they perceive to be high-quality schools, then the next question is whether the investment into these schools is worth it. Theoretical and empirical literature suggests (Rothstein, 2006; Hastings, Kane and Staiger, 2009; MacLeo and Urquiola, 2009) that differences in students' academic achievements can be a highly misleading guide to the value of a particular school. Moreover, despite the convention of measuring school quality using test scores, there is no standardized test at the primary school level in China. Additionally, to discourage unhealthy competition, no performance statistics are publicly available for the compulsory education stages (i.e., the primary and middle school stages), which results in a lack of measures of academic success for key schools.

Therefore, though the key school system is a well-known concept in China and parents are willing to pay a premium for houses within key school attendance zones, there is very little empirical evidence on the effect of enrollment in key schools on students' academic outcomes. This paper uses a set of newly released data from the China Family Panel Studies (CFPS) to explore the relationship between key school attendance and students' academic performance. We measured school quality using students' performances in mathematics and language tests, which has become an important indicator of school quality in the absence of national standardized tests. The results from the OLS regression show that there is a positive relationship between attending a key primary school and test scores, but the coefficient becomes insignificant after controlling for individual characteristics and family background. Furthermore, we used propensity score matching to alleviate the imbalance of characteristics for students who enrolled in key schools and those who did not. Based on our results, we did not find any evidence supporting that key school enrollment improves children's academic outcomes. Academic achievement among students enrolled in key schools was not significantly different from that of those enrolled in non-key schools.

The rest of the paper is organized as follows. Section 2 describes the background of China's education system and admission rules. Section 3 briefly reviews relevant literature.

Section 4 introduces the data and presents the summary statistics. Section 5 discusses the empirical strategy. Section 6 provides the results, and Section 7 concludes.

3.2 Background

The primary and secondary education system in China is highly centralized and fairly homogeneous. It usually takes twelve years to complete the primary, junior secondary, and senior secondary stages. Under the Law on Nine-Year Compulsory Education, which took effect on July 1, 1986, all children who have reached the age of six must attend school for a minimum of nine years, which typically includes six years of primary school education and three years of junior secondary school education. After this, students may choose to have a standard senior secondary school education or to receive special training from a vocational school. Schools in China are divided into "key" and "non-key" (ordinary) schools. Key schools have a higher academic reputation and are generally allocated more resources by the State. In this section, we introduce the evolution of the key school system.

After the founding of the People's Republic of China (PRC) in 1949, the central government worked on building a new education system. Development of the education system had the dual mission of not only expanding people's right to education but also cultivating talent and producing professionals in the areas of industrialization and national defense. To improve training quality and to ensure the economic demand for skilled workers could be met, the Central Committee of the Communist Party of China proposed the establishment of key schools in 1953, which set up exemplary schools to improve teaching across the education system.

By 1962, all city districts had built at least one key primary school under the orders of the Ministry of Education. The establishment of key schools was adapted to the needs of the time and also reflected the contradiction between "fairness and efficiency" in the development of education. Before the Cultural Revolution (1966–1976), the quality of education differed

very little among key schools and non-key schools. In addition, not all parents chose to send their kids to school, so the competition for admission into key schools was not very intense. During this period, students were admitted to key schools based on test scores.

However, the Cultural Revolution from 1966 to 1976 brought widespread disruption to educational resources. In May 1977, Mao's successor Deng Xiaoping stressed the importance of reforming the key school system as a means of rendering China a modern socialist country. In January 1978, the Ministry of Education compiled a list of key primary and middle schools nationwide. These schools were given priority in the assignment of teachers, equipment, and funds. They were also allowed to recruit the best students for special training to compete for admission to top schools in higher education.

The nine-year compulsory education system has been implemented since 1986 and requires all students to finish at least primary and junior secondary education. Under the law, schools are tuition-free at the compulsory education stage. Due to the expansion of basic education, admission to key schools has become increasingly competitive. Furthermore, in the 1970s, the one-child policy was implemented. During this period, most children born in big cities were the only children in their families, and they reached school age by the 1990s. Families with only one child took more care to cultivate them as that child represented the success of the whole family. Parents paid more attention to the education of their children, increased education expenditures, and pursued high-quality educational resources. Additionally, since the 1980s and the establishment of the socialist economic system, the income gap among Chinese people has widened. Wealthy people hope to obtain better educational resources for their kids. As a result, some key primary and secondary schools started to charge extra admission fees, which harmed opportunities for less advantaged children to pursue education in key schools.

According to Bi's report (1995), which was published in one of the most prestigious newspapers in China, *People's Daily*, the "extra admission fees" in Beijing in the 1995

school year amounted to 28.57 million USD[1]. The phenomenon of hefty school fees is not limited to Beijing. Based on a survey of 94 cities across China (Zhang, 2003), 41.49% of key schools in 2003 charged extra admission fees or other types of costs. Moreover, based on another official report in 2011, the average value of extra admission fees was around $\$20,000$ dollars[2] (Zheng et al., 2016).

Because some local governments have permitted extra admission fees, school selection has become controversial. In 2005, the Ministry of Education explicitly prohibited school selection fees, such as extra admission fees. Subsequently, the State Council and relevant departments of the Ministry of Education issued documents stipulating that public elementary schools must adhere to the principle of nearby school admission. However, the tough administrative orders simply pushed school choice into another stage. Schools still utilized loopholes to continue collecting fees. Students who were out of a school's attendance zone were encouraged to attend a pre-admission exam administered by individual key primary schools; if they did well, they would be selected for a variety of specialized classes such as "artist classes" or "sports classes." The original objective in offering such classes was to find talented students who resided outside a school district's given area. However, due to the limited number of spots in these classes and according to anecdotal evidence from a popular parenting forum[3], students also needed to pay extra fees to take additional classes in after-school tutoring institutions affiliated with key primary schools to obtain the certificate needed to earn a spot.

Certain evidence has revealed that the key school system resulted in education imbalance across districts. According to a national survey of key schools (Yang, 2006), 70% of key middle schools were in cities, 28% in towns, and 2% in rural areas. Another national survey in

[1]The GDP of China in 1995 was 734 billion USD.

[2]For comparison, the average disposable income per capita was around $\$5,000$ in Beijing in 2011. Data source: Beijing Bureau of Statistics.

[3]http://www.jzb.com/bbs/bj/

2010 showed that 60% of students who studied in key schools came from high socioeconomic backgrounds[4]. In general, key schools have higher per capita funding, better teaching quality, and students with more advantaged families (Huang et al., 2020).

To equalize accessibility to key schools, an amendment to the Compulsory Education Law was passed in 2006, officially removing the "key" or "non-key" classifications for primary schools. Furthermore, former key primary schools are no longer allowed to receive additional resources from the local government. Nonetheless, former key primary schools are still considered by most parents to be the best schools, and they continue to exist under other names, such as demonstrative schools or experimental schools (Zheng et al., 2016).

3.3 Literature Review

In the literature, the standards for a "good" school have been heavily debated. In 1966, the Coleman Report on "Equality of Educational Opportunity" was published, fundamentally altering the lens through which scholars, policymakers, and the public at large view and assess schools. Prior to Coleman, a good school was characterized by its inputs — namely per pupil expenditure, school size, and educational resources allocated for students. After Coleman, the measures of a decent school moved to consider outcomes, including students' test scores, admission rates for further education, long-term employment rates, and earnings opportunities. This report stimulated economics research on the relationship between school resources and student academic achievement.

Is there really a causal relationship between school resources and student academic achievement? Methodologically, one of the challenges in answering this question is that students choose schools based on unobservable characteristics, and these unobservable characteristics in turn affect academic achievement, leading to endogeneity in estimated results using OLS regressions. In addition to this issue, research on the relationship between school

[4]Here, a high SES family is defined as a family where parents are managers, engineers, or professors.

resources and student achievement is also faced with other biases. Firstly, general educational production functions cannot include all school inputs, and unobservable school input variables may play a considerable role in student academic achievement. Secondly, due to measurement errors, school input variables may not accurately measure differences in educational quality. Lastly, school input is not entirely additive or divisible but rather interacts to influence student academic achievement as a whole. All these problems lead to omitted variable bias and biased estimation results (Hanushek, 1979; Haveman and Wolfe, 1995; Todd and Wolpin, 2007).

To resolve these issues, some scholars use the random assignment of students to different schools as an exogenous change to study whether schools can provide added value to students' academic performances. For example, Cullen, Jacob, and Levitt (2005) used a lottery of school assignments within the Chicago Public Schools (CPS) District to construct an instrument for school admission and explore the impact of school choice on student outcomes. Their results suggested that the observed cross-sectional benefits in "better" schools do not improve students' academic achievement. In contrast, Hastings and Weinstein (2007) used a field experiment in the Charlotte-Mecklenburg Public School District (CMS) and found that attending a higher-scoring school effectively increased academic achievement.

Other scholars have applied regression discontinuity design (RDD) to mitigate endogeneity, but they have provided mixed evidence on elite schools' effects on students' academic performance. For example, in the context of the Romanian secondary school system, Pop-Eleches and Urquiola (2013) found that students who have access to schools with higher average test scores perform better on college entrance examinations. Jackson (2010) constructed instrumental variables based on the discontinuities created by the school assignment mechanism, showing that attending a better primary school positively affects students' academic performance in secondary schools. However, Clark (2009) studied a recent British education reform that allowed public high schools to opt out of local authority control and did not find a significant relationship between students' achievements and school resources.

Similarly, Abdulkadiroğlu, Angrist and Pathak (2014) used Boston and New York City's school data with fuzzy RDD to evaluate the causal effects of peer characteristics. The results showed that attending a high-quality school in Boston or New York did not improve students' academic achievement. Similarly, Dobbie and Fryer's (2014) findings also suggested that elite schools in New York City did not generate significant improvements in long-run student outcomes.

There is also literature that uses Chinese micro-survey data to analyze the relationship between school resources and student academic achievement within the framework of schooling production function. For example, Ma, Peng, and Thomas (2006) studied the effectiveness of ordinary high schools in Baoding, Hebei Province, and found that 60%–80% of the inter-school gap in college entrance examination results is not caused by differences in school education resources. Furthermore, using 2006 Kunming High School survey data and a multilayer linear model, Ding and Xue (2013) investigated the factors influencing senior high school students' academic performance. They found that the most important determinants of students' high school entrance examination performance were students' cognitive ability and knowledge; school variables played a relatively small role in students' performance, and family background and peer characteristics had no significant effect on students' test scores. Similar conclusions were also reached by Du and Hu (2009), Min and Xue (2008), and Hu and Lu (2010).

Though the key school system (KSS) is a very important concept in China, due to data confidentiality, there are limited data sources available. Only a few studies have explored the impact of elite schools on children's academic performance in the Chinese context. Dee and Lan (2015) used an administrative dataset of students who entered the high school from 2006 to 2008 in a large city in Inner Mongolia and applied an RDD using the high school admission requirements. They found that attending a key high school did not significantly improve the academic performance of marginal students. Wang and Sun (2015) also adopted the RDD approach created from the cut-off score in the high school entrance exam, finding that key

high schools have a weak positive impact on student academic achievement. However, both papers limited their research scope to a single city rather than using nationally representative data. Therefore, the results might lack external validity. This study applies a newly released national dataset to contribute to the literature on elite primary schools' impact on students' academic performance and is one of few such studies within the Chinese context.

3.4 Data and Summary Statistics

3.4.1 Data

Our main data source is five panels of the China Family Panel Study (CFPS), which is a nationally representative longitudinal survey of individuals and families. They were launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University and included respondents from 25 provinces [5]. The CFPS was carried out every other year (in 2010, 2012, 2014, 2016, and 2018), and we used all five waves of data. Variables collected include family structure, migration, economic conditions, children's education, and other demographic characteristics. The questionnaires were designed to collect information at the individual and household levels separately. We first searched for children's individual questionnaires and used information from parents' IDs to link parents with their children.

We were granted several privileges to be able to carry out this study. Firstly, administration policy changes eliminated the official classification of key and non-key schools starting in 2006, which makes data collection generally more difficult. However, in the CFPS, parents were asked whether their kids were enrolled in previously key or non-key schools. We used the answer to this question as the indicator for enrollment in key schools. Secondly, as discussed in previous chapters, there are no standardized tests in primary or middle school, which means there are no measurements for school quality during the compulsory education

[5]https://www.isss.pku.edu.cn/cfps/en/index.htm?CSRFT=WH2N-RVV0-RZ5T-L6SF-HRGZ-6H6M-SM1S-L9MZ

stages. In the CFPS, however, all children below 15 years old were tested in word (language) and math skills using standardized multiple-choice questions, which were used as a proxy for the education quality of schools (key or non-key school) they attended.

There are also several drawbacks in the CFPS. Firstly, though the sample covers 16,000 families from 25 provinces in China, there are only around 6,000 children in the annual sample. Furthermore, children's data was tracked poorly. More than half of the sample (3,176 out of 6,014) only appeared once among five waves, and only 87 out of 6,014 observations were tracked in more than three waves. In our analysis, each child only appeared once in the sample, which essentially constructs a cross-sectional dataset, thereby deviating from the panel structure. Secondly, the word and math tests only took place in 2010, 2014, and 2018, which further reduced the sample size of those who had valid test scores. Lastly, using the word and math test scores as measures for key school quality has both pros and cons. In terms of the latter, in contrast with standardized national test scores, these tests may not reflect the genuine academic skills of children in daily school life. However, these tests provide us with a direct quantitative measurement of students' ability.

We restricted the sample using the following criteria: first, we limited the sample to parents aged 18 to 45 because we only focused on the sample of children in primary school. We then restricted the sample to children with valid math and word test scores in at least one of the years of 2010, 2014, or 2018. Finally, we kept the sample that reported whether the children attended a key school or a non-key school. Our final analysis comprised 3,141 observations.

3.4.2 Summary Statistics

We present the summary statistics from three perspectives: children's family background, parents' expected highest education of their children, and children's self-evaluation. To better serve our later analysis, we separated the summary statistics according to whether children were enrolled in key or non-key primary schools.

According to Table 3.1, on average, parents whose kids were enrolled in a key primary school tended to spend RMB 3,467 ($533.85) on children's education annually, which was more than twice what parents spent on kids in a non-key primary school (RMB 1,543; $237.59). Parents with kids enrolled in key primary schools also had higher income compared to the other group. Since self-reported total household income data was unavailable, we used the summation of both parents' income as the measurement for total household income. For families with kids enrolled in key primary schools, total parental income amounted to RMB 30,091.70 ($\$4,633.56$), while families with children in regular schools had an average total income of RMB 24,432.26 ($\$3,762.11$). More details about family income distribution according to school type are provided in Figure 3.7, which reveals a clear pattern wherein key school students are more likely to come from higher socioeconomic backgrounds.

Additionally, families with kids in key primary schools also devote a larger proportion of total income (11.5%) to children's education compared to the other group (6.3%). Lastly, parents with kids enrolled in key schools have a higher average of years of education compared to the other group (for fathers: 8.33 vs. 7.79, $p < 0.05$; for mothers 6.91 vs. 6.43, $p < 0.1$). The distribution of parents' years of schooling is depicted in Figure 3.5 and Figure 3.6.

Information regarding parents' expectations for the highest degree children will complete is provided in Table 3.2. For children enrolled in key primary schools, 78.22% of parents expected their children to obtain a qualification beyond a bachelor's degree, while the proportion of parents of children in non-key primary schools is 75.43%[6].

Lastly, Table 3.3 depicts the test scores and self-evaluation results for students from key and non-key primary schools. Regarding the word test, respondents were tested on literacy using 34 sets of words, with each set counting as one point out of a total of 34. Students from key primary schools obtained higher average scores on the language test (mean = 20.07;

[6]In China, nearly 100% primary school students will be admitted to middle schools; around 50% middle-school students will be admitted to high schools and the admission rate for high school graduates to universities and colleges is approximately $70 - 80\%$ in the recent decade. Data Source: Ministry of Education in China.

st.dev = 6.97) compared to the non-key group (mean = 19.40; st.dev = 6.81). The same pattern also arose in the math test, in which students were asked to complete 24 multiple choices questions on algebra and geometry, with each question worth one point. Students from key primary schools scored an average of 9.35 out of 24 with a standard deviation of 3.46, compared to 8.94 out of 24 in the non-key group with a standard deviation of 3.38. The t-test results show that the difference in math test scores is significant at the 5% level. The distribution of the test scores is depicted in Figures 3.2 and 3.3. Based on Figure 3.2, students enrolled in non-key primary schools tended to perform worse on the math test, with 73% scoring less than 10 out of 24, versus 67% of students in key schools. With regard to the word test results, the score gap is more obvious: 30% of the students in non-key primary schools scored below 15, versus only 22% of students in key primary schools.

The self-evaluation questions consisted of children's personal evaluations of their academic performance, personal characteristics, educational environment, and overall life satisfaction. The questions were answered on a scale of 5. Compared to children from non-key primary schools, kids from key schools were significantly more confident on average ($p < 0.01$) and more satisfied about school ($p < 0.01$) and their academic performance ($p < 0.1$). Conversely, students from non-key primary schools were more likely to rate themselves more highly in regard to "studying hard" (3.11 vs. 2.67, $p < 0.01$) in comparison with the other group.

3.5 Empirical Strategy and Results

To estimate the impact of primary school type on children's academic outcomes, as measured by math and language test scores, we first ran a standard OLS model to illustrate the relationship between school type and children's test scores. The regression has the following

form:

$$Score_i = \alpha + \beta KeySchoolFlag_i + X_i\delta + \epsilon \tag{3.1}$$

where Score is the value from word test results and math test results. "KeySchoolFlag" is defined as a dummy variable, equal to 1 if the student is enrolled in a key primary school and 0 otherwise. X_i is a set of individual characteristics, including family background and self-evaluation measures.

The OLS regression results are presented in Tables 3.4 and 3.5. These tables reveal that the coefficient is large and significant in the naïve regression when we only regress math score and language score for the key school indicator. However, with more control variables, the coefficients decrease sharply and become insignificant. In the case of math scores, the coefficient from the naïve regression is 0.392 and is significant at the 5% level, but it decreases to 0.257 once the self-evaluation measures are controlled for and to 0.362 after controlling for parents' characteristics. The same pattern also appeared for language scores. The coefficient is 0.584 in the naïve regression and is significant at the 10% significance level, decreasing to 0.096 and 0.148 after controlling for self-evaluation measurements and parents' characteristics, respectively. In the full regression controlled for both personal and parental characteristics, the coefficients are insignificant for both the math and language scores. Hence, key school enrollment has an insignificant effect on children's outcomes after controlling for children's and parents' characteristics. The results are robust with various specifications, and the details are provided in Appendix Tables A1 and Table A2.

However, based on evidence from summary statistics in the previous section, children who were enrolled in key primary schools are on average different from those who were not. Therefore, we used propensity score matching (PSM) to explore the treatment effect of enrollment in a key primary school. We estimated the propensity score by running a logit model where the outcome variable was a binary variable indicating treatment status.

To avoid potential omitted variable bias, we also included all the covariates related to both the school type and potential outcomes, including family background and self-evaluation measures. Then, we matched each treated unit (students from key primary schools) to the two observations in the control unit (students from non-key primary schools) with the closest propensity score from students in the same province who took the test in the same year. Finally, we used the OLS model described above to obtain unbiased estimates of the matched data. The kernel propensity densities of the propensity score are depicted in Figure 3.1.

The post-matching summary statistics for both groups are shown in Table 3.6. Compared to the previous summary statistics (Table 3.1 to Table 3.3), the post-matching metrics are insignificantly different across groups. Furthermore, as shown in Appendix Figures A1 to A3, the post-matching distribution for family income and parents' years of schooling are very similar between the key school group and the non-key school group. Therefore, the post-matching OLS coefficient of key school indicator, as the treatment effect of key school enrollment on children's outcomes, is provided in Table 3.7. Though the coefficients are positive in both test score regressions, it is still challenging to draw any conclusions on the effects of key school enrollment because of the insignificance of the results. Furthermore, the R-squared value is also too small to inform a persuasive conclusion regarding the effect of key schools on children's academic outcomes. We also used coarsened exact matching (CEM) as a robustness check. The results are presented in Appendix Table A3 and Table A4, which are consistent with the results from the PSM.

3.6 Conclusion

The effects of key school enrollment on children's outcomes remain murky, but this paper provides valuable insight through the analysis of math and language (word) scores. Though the OLS regression suggests that enrollment in a key primary school is positively correlated with math and language scores, the coefficients become small and insignificant when more

controls are added. We also used propensity score matching (PSM) to mitigate the observable differences between the control and treatment groups, but the results failed to provide a clear conclusion. Therefore, our results did not present evidence of the impact of key school enrollment on children's academic outcomes.

Nevertheless, our study has important implications for parents of school-aged children. We did not find significant differences between the test scores of kids enrolled in key primary schools compared to those of kids who were not. Therefore, parents might reconsider spending a large amount of money to purchase property affiliated with a key primary school. Future studies should use high-quality individual-level data and possibly randomized, controlled trials to draw more decisive conclusions on the effectiveness of key schools.

Table 3.1: Summary Statistics on Parents' Characteristics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
For Non-key School Students							
Yearly Education Expenditure on Children	2,657	1,542.697	2,740.058	0.000	200.000	1,800.000	40,000.000
Mother's age	2,682	40.133	5.231	28	36	43	67
Mother's health status	486	5.864	1.113	1.000	5.000	7.000	7.000
Mother's overall satisfacction with life	2,591	3.542	1.034	1.000	3.000	4.000	5.000
Mother's social status	2,587	2.876	0.921	1.000	2.000	3.000	5.000
Mother's total income last year	2,663	17,212.700	29,289.190	0.000	0.000	24,000.000	840,000.000
Mother's year of schooling	1,335	7.785	4.038	0.000	6.000	9.000	19.000
Father's age	2,682	38.136	4.977	25	34	41	76
Father's health status	539	5.774	1.094	2.000	5.000	7.000	7.000
Father's social status	2,600	2.890	0.979	1.000	2.000	3.000	5.000
Father's total income last year	2,629	7,219.557	15,466.970	0.000	0.000	9,000.000	290,000.000
Father's year of schooling	1,335	6.431	4.418	0.000	0.000	9.000	17.000
For Key School Students							
Yearly Education Expenditure on Children	449	3,467.127	7,247.416	0.000	450.000	3,750.000	112,000.000
Mother's age	459	40.031	5.388	27.000	36.000	43.000	76.000
Mother's health status	167	5.832	1.107	1.000	5.000	7.000	7.000
Mother's overall satisfacction with life	431	3.824	0.975	1.000	3.000	5.000	5.000
Mother's social status	431	3.009	0.976	1.000	3.000	3.000	5.000
Mother's total income last year	457	20,910.010	39,532.940	0.000	0.000	32,000.000	581,000.000
Mother's year of schooling	393	8.331	4.201	0.000	6.000	12.000	19.000
Father's age	459	37.980	5.063	23	35	41	56
Father's health status	176	5.824	1.120	2.000	5.000	7.000	7.000
Father's social status	441	3.048	0.932	1.000	3.000	4.000	5.000
Father's total income last year	441	9,181.690	17,175.380	0.000	0.000	15,000.000	160,000.000
Father's year of schooling	400	6.910	4.728	0.000	3.750	9.000	17.000

Table 3.2: Distribution on Parents' Expectation on Children's highest Education

	Students from Key School		Students from Non-key School	
	N	Percentage	N	Percentage
Primary school	2	0.45	16	0.75
Junior high school	7	1.59	48	2.27
Senior high school	38	8.62	222	10.51
2- or 3-year college	38	8.62	192	9.09
4-year college/Bachelor's degree	153	34.69	919	43.49
Master's degree	156	35.37	466	22.05
Doctoral degree	36	8.16	209	9.89
No need to go to school	11	2.49	41	1.94
Total	441	100	2113	100

Table 3.3: Summary Statistics on Children's Self-evaluation Measurement

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
For Non-key School Students							
word test	2,682	19.403	6.819	0	16	24	34
math score	2,682	8.944	3.380	0	7	11	24
health status	2,681	1.718	0.916	1.000	1.000	2.000	5.000
how excellent of yourself	2,673	3.198	0.913	1.000	3.000	4.000	5.000
number of student in class	2,665	42.681	17.901	2.000	30.000	54.000	120.000
satisfaction with Chinese teacher	2,680	4.286	0.944	1.000	4.000	5.000	5.000
satisfaction with headteacher	2,681	4.307	0.946	1.000	4.000	5.000	5.000
satisfaction with math teacher	2,681	4.225	1.756	1.000	4.000	5.000	5.000
satisfaction with school	2,681	4.054	1.011	1.000	3.000	5.000	5.000
self rate of academic pressure	2,673	2.789	1.156	1.000	2.000	4.000	5.000
self rate of academic performance	2,073	3.395	0.956	1.000	3.000	4.000	5.000
self rate of concetration	2,229	3.179	1.930	1.000	2.000	4.000	5.000
self rate of overburden	922	2.817	0.953	1.000	2.000	3.000	6.000
self rate of studying hard	2,229	3.112	1.892	1.000	2.000	4.000	5.000
For Key School Students							
word test	459	20.070	6.974	0.000	17.500	25.000	34.000
math score	459	9.346	3.463	0.000	7.000	12.000	19.000
health status	459	2.011	0.961	1.000	1.000	3.000	5.000
how excellent of yourself	458	3.319	0.897	1.000	3.000	4.000	5.000
number of student in class	449	52.465	17.226	6.000	42.000	64.000	106.000
satisfaction with Chinese teacher	458	4.358	1.002	1.000	4.000	5.000	5.000
satisfaction with headteacher	458	4.426	0.928	1.000	4.000	5.000	5.000
satisfaction with math teacher	458	4.317	1.030	1.000	4.000	5.000	5.000
satisfaction with school	458	4.317	0.932	1.000	4.000	5.000	5.000
self rate of academic pressure	458	2.806	1.220	1.000	2.000	4.000	5.000
self rate of academic performance	270	3.504	0.912	1.000	3.000	4.000	5.000
self rate of concetration	312	2.571	0.960	1.000	2.000	3.000	5.000
self rate of overburden	177	2.847	0.765	1.000	2.000	3.000	5.000
self rate of studying hard	312	2.612	0.925	1.000	2.000	3.000	5.000

Table 3.4: OLS Regression Results for Math Score

	Dependent variable:			
	Math Score			
	(1)	(2)	(3)	(4)
key school flag	0.392**	0.257	0.362*	0.389
	(0.169)	(0.207)	(0.198)	(0.256)
number of students in class		0.014***		0.010*
		(0.004)		(0.006)
self rate of academic pressure		−0.177***		−0.305***
		(0.057)		(0.088)
how excellent of yourself		0.285***		0.202*
		(0.073)		(0.120)
self rate of studying hard		0.077**		0.125
		(0.038)		(0.145)
self rate of concentration		0.075**		0.239*
		(0.037)		(0.130)
satisfaction with school		−0.145*		−0.042
		(0.076)		(0.114)
satisfaction with headteacher		0.115		0.022
		(0.101)		(0.150)
satisfaction with Chinese teacher		−0.022		−0.065
		(0.097)		(0.139)
satisfaction with math teacher		0.052		0.007
		(0.039)		(0.041)
health status		0.144*		0.148
		(0.075)		(0.104)
yearly education expenditure on child			0.036	0.009
			(0.051)	(0.069)
Father's age			0.040	0.019
			(0.027)	(0.032)
Father's years of schooling			0.078***	0.121***
			(0.026)	(0.032)
Father's total income last year (log)			0.017	0.006
			(0.017)	(0.022)
Mother's age			0.048*	0.063*
			(0.028)	(0.033)
Mother's years of schooling			0.086***	0.049
			(0.025)	(0.032)
Mother's total income last year (log)			0.039*	0.043*
			(0.020)	(0.025)
Constant	11.003***	8.966***	5.767***	5.141***
	(0.024)	(1.113)	(1.365)	(1.835)
Province Fixed Effect	Y	Y	Y	Y
Observations	3,141	2,540	1,545	1,038
R^2	0.049	0.070	0.106	0.139
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.5: OLS Regression Results for Word Score

	Dependent variable:			
	child_wordtest			
	(1)	(2)	(3)	(4)
key school flag	0.584*	0.096	0.148	0.244
	(0.336)	(0.410)	(0.381)	(0.486)
number of student in class		0.032***		0.009
		(0.008)		(0.012)
self rate of academic pressure		−0.323***		−0.359**
		(0.113)		(0.168)
how excellent of yourself		0.494***		0.118
		(0.144)		(0.230)
self rate of studying hard		0.189**		1.025***
		(0.074)		(0.278)
self rate of concentration		0.157**		0.044
		(0.073)		(0.250)
satisfaction with school		−0.236		0.059
		(0.150)		(0.219)
satisfaction with headteacher		0.311		−0.267
		(0.200)		(0.287)
satisfaction with Chinese teacher		0.108		0.159
		(0.192)		(0.268)
satisfaction with math teacher		0.121		0.112
		(0.077)		(0.079)
health status		0.207		0.252
		(0.148)		(0.200)
yearly education expenditure on child (log)			0.270***	0.322**
			(0.098)	(0.133)
Father's age			0.132**	0.110*
			(0.051)	(0.061)
Father's years of schooling			0.192***	0.170***
			(0.050)	(0.062)
Father's total income last year (log)			0.049	0.014
			(0.033)	(0.041)
Mother's age			0.038	0.031
			(0.053)	(0.063)
Mother's years of schooling			0.235***	0.182***
			(0.049)	(0.061)
Mother's total income last year (log)			0.031	0.018
			(0.038)	(0.049)
Constant	24.237***	19.390***	9.274***	7.481**
	(1.837)	(2.202)	(2.728)	(3.633)
Province Fixed Effect	Y	Y	Y	Y
Observations	3,141	2,540	1,545	1,038
R^2	0.075	0.109	0.129	0.160
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.6: Key school vs. Non-key school Post-matching Summary Statistics

	metric	non-key school	key-school
1	Number of Observations	686.00	339.00
2	Number of Children	676.00	339.00
3	Father's age	40.21	39.81
4	Father's year of schooling	8.11	8.28
5	Father's total income last year	19428.97	21090.75
6	Mother's age	38.22	37.87
7	Mother's year of schooling	6.79	7.07
8	Mother's total income last year	8272.08	9334.51
9	Number of students in class	48.91	51.28
10	Self rate of academic performance	3.52	3.41
11	Self rate of academic pressure	2.77	2.78
12	How excellent of yourself	3.22	3.30
13	Self rate of studying hard	2.55	2.50
14	Self rate of concetration	2.45	2.45
15	Satisfaction with school	4.20	4.29
16	Satisfaction with headteacher	4.42	4.42
17	Satisfaction with Chinese teacher	4.36	4.37
18	Satisfaction with math teacher	4.42	4.28

Table 3.7: OLS Regression Results (post-matching)

	Dependent variable:	
	Math Score	Word Score
	(1)	(2)
key school flag	0.276	0.285
	(0.213)	(0.429)
Constant	9.278***	19.987***
	(0.122)	(0.247)
Observations	1,025	1,025
R^2	0.02	0.04
Note:	*p<0.1; **p<0.05; ***p<0.01	

Figure 3.1: Kernal Density of Propensity Score Between the Treated and Control Group

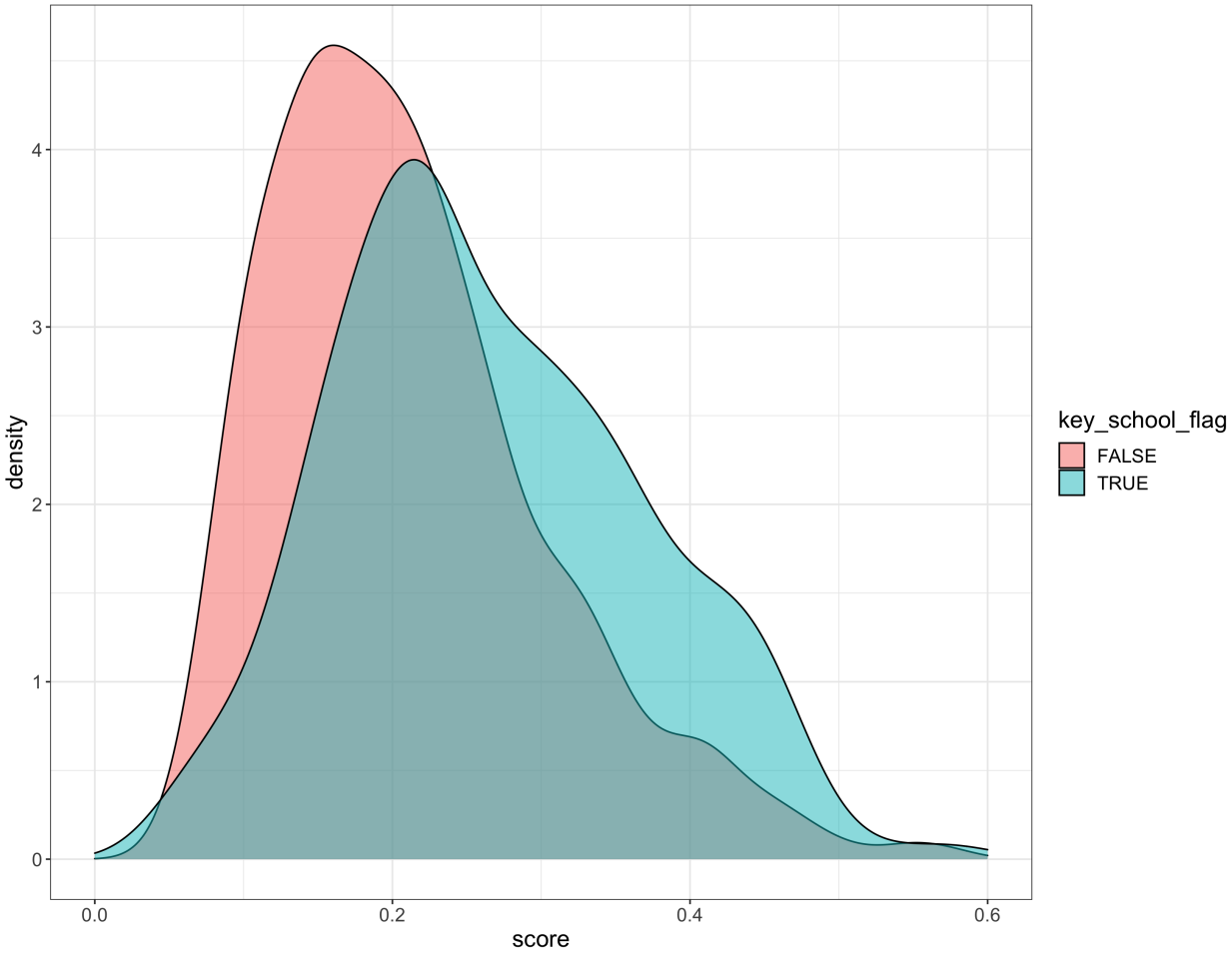


Figure 3.2: Math Score Distribution by School Type

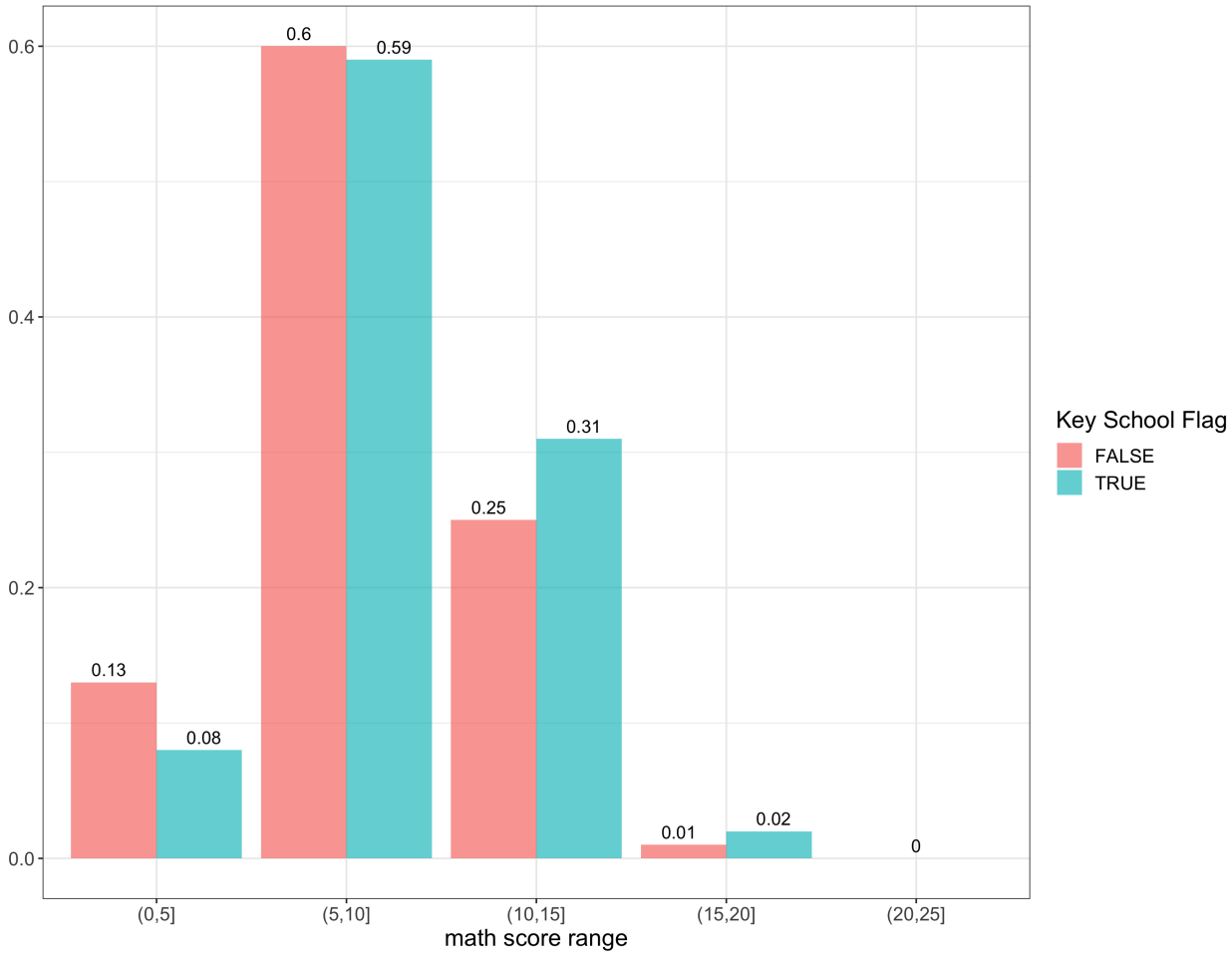


Figure 3.3: Word Score Distribution by School Type

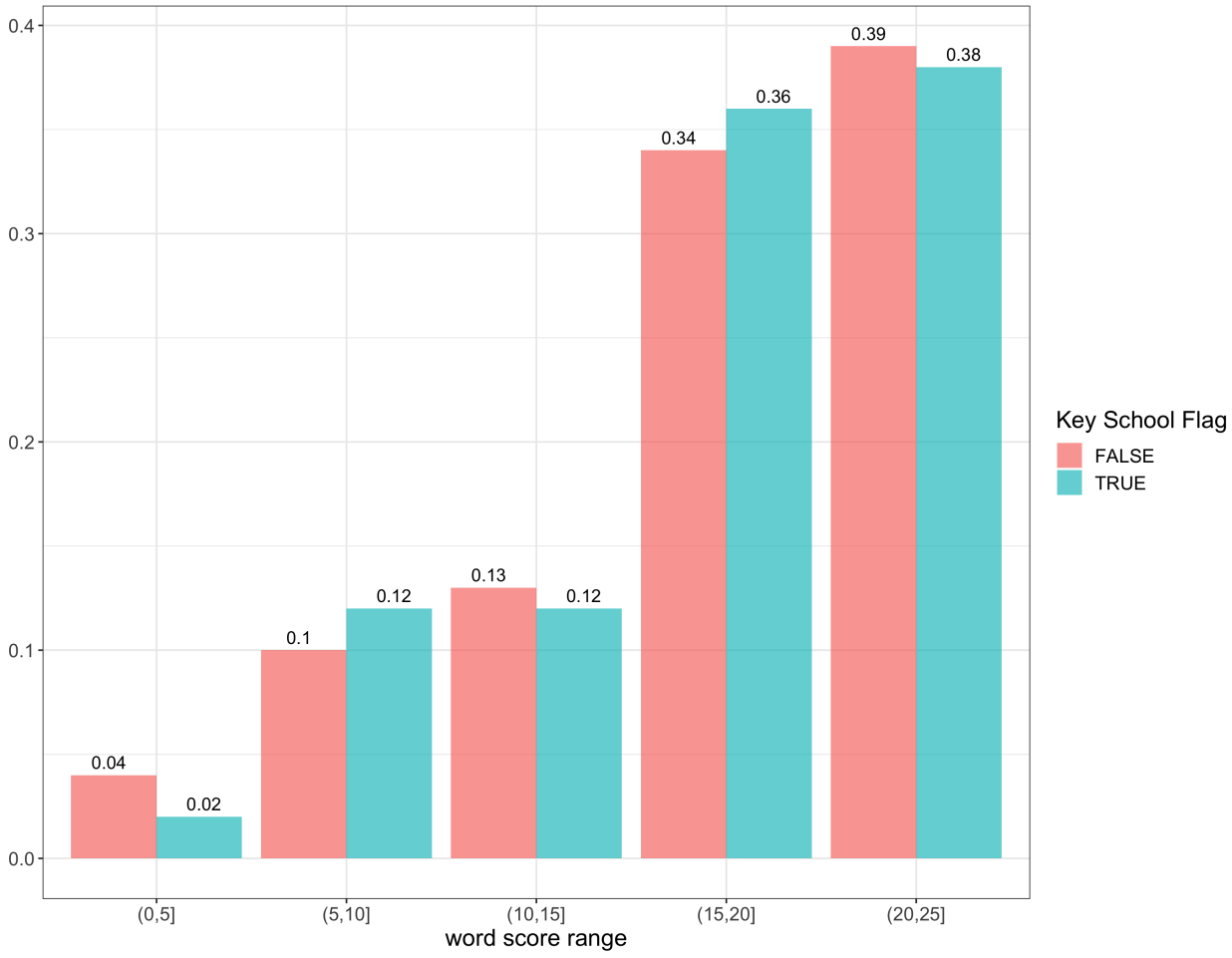


Figure 3.4: Family Income Distribution by School Type

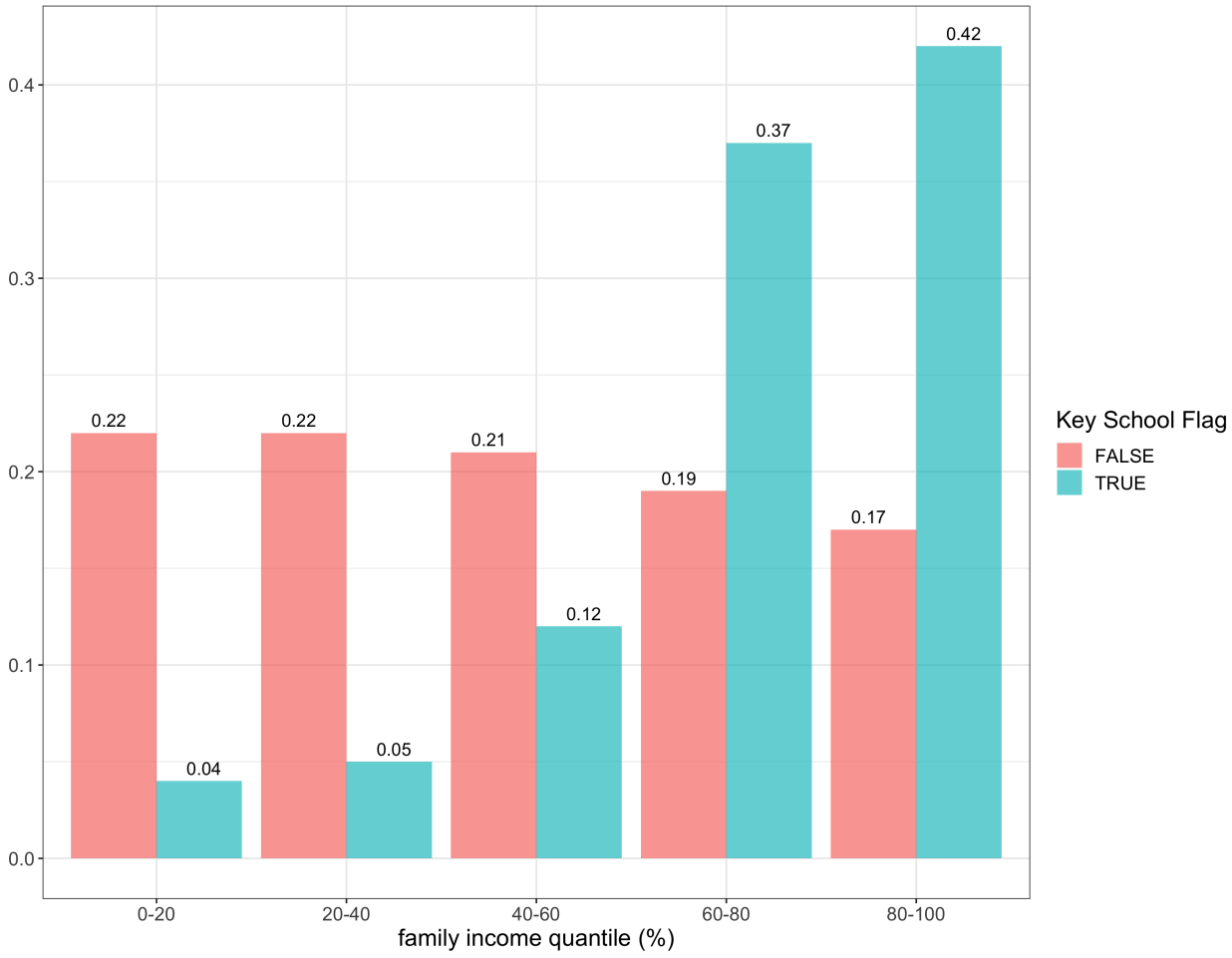


Figure 3.5: Father's Years of Schooling Distribution by School Type

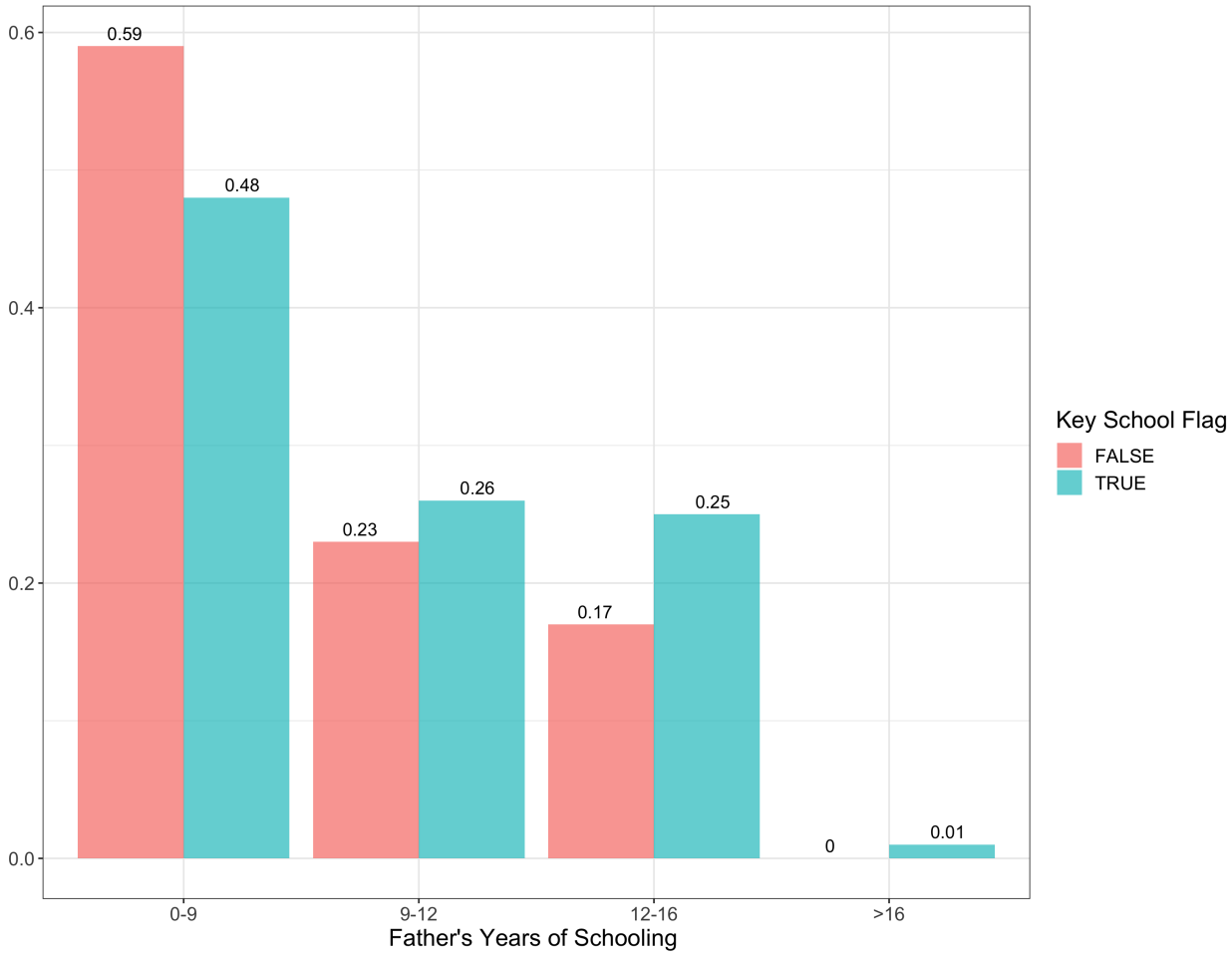


Figure 3.6: Mother's Years of Schooling Distribution by School Type

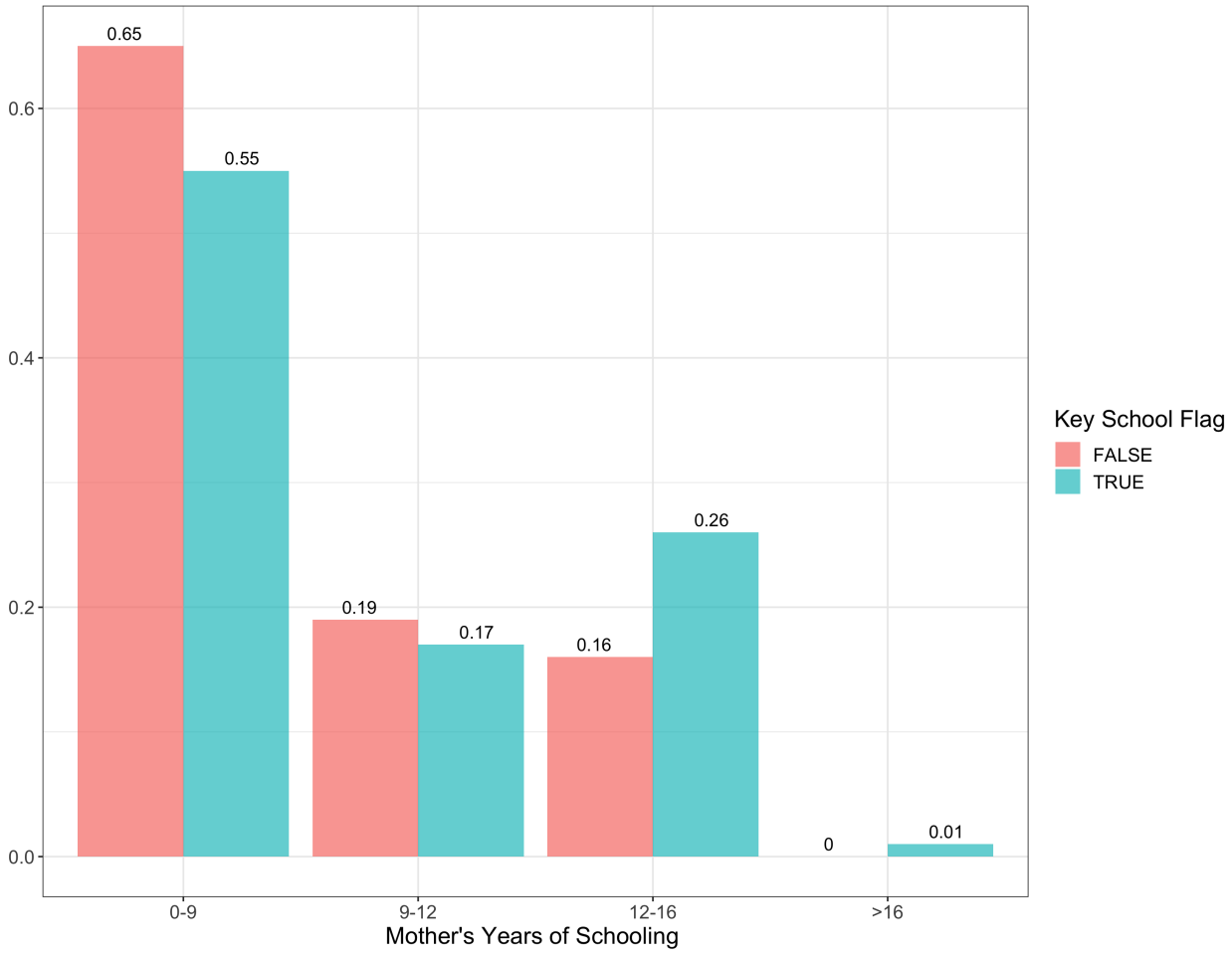


Figure 3.7: Family Income Distribution by School Type

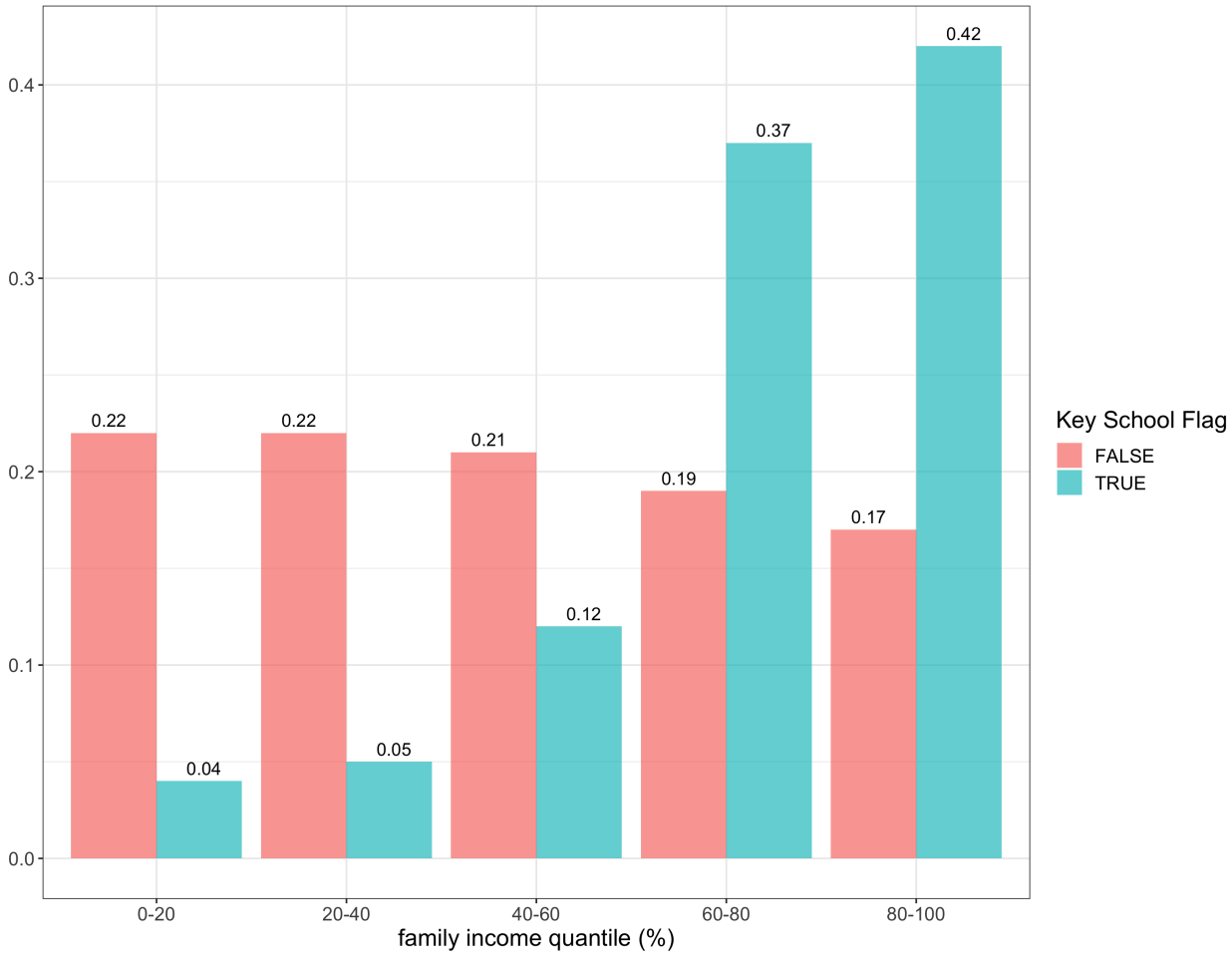


Table A1: Additional OLS Regression Results for Math Score

	Dependent variable:				
	Math Score				
	(1)	(2)	(3)	(4)	(5)
key school flag	0.402**	0.392**	0.219	0.144	0.303
	(0.171)	(0.169)	(0.223)	(0.306)	(0.772)
number of student in class			0.015***		−0.010
			(0.004)		(0.021)
self rate of academic pressure			−0.174***		0.284
			(0.059)		(0.321)
how excellent of yourself			0.252***		0.283
			(0.082)		(0.479)
self rate of studying hard			0.064*		0.433
			(0.038)		(0.506)
self rate of concentration			0.046		0.961*
			(0.038)		(0.537)
satisfaction with school			−0.167**		−0.036
			(0.078)		(0.404)
satisfaction with headteacher			0.156		−0.238
			(0.106)		(0.535)
satisfaction with Chinese teacher			−0.076		−0.102
			(0.101)		(0.505)
satisfaction with math teacher			0.052		0.058
			(0.039)		(0.394)
health status			0.071		−0.149
			(0.078)		(0.429)
yearly education expenditure on child				0.00005*	0.00002
				(0.00003)	(0.00004)
Father's age				0.131***	0.177*
				(0.046)	(0.105)
Father's years of schooling				0.042	0.138
				(0.042)	(0.101)
Father's total income last year				0.00000	0.00002
				(0.00000)	(0.00001)
Father's social status				−0.002	0.089
				(0.147)	(0.405)
Father's health status				−0.014	−0.154
				(0.161)	(0.387)
Father's overall satisfaction with life				−0.047	0.365
				(0.147)	(0.333)
Mother's age				−0.059	0.0001
				(0.047)	(0.105)
Mother's years of schooling				0.071*	0.011
				(0.042)	(0.113)
Mother's total income last year				0.00001	0.00001
				(0.00001)	(0.00002)
Mother's social status				−0.239*	−0.578*
				(0.131)	(0.334)
Mother's health status				0.030	0.329
				(0.165)	(0.435)
Constant	8.944***	11.003***	9.644***	7.330**	−3.566
	(0.065)	(0.924)	(1.168)	(3.563)	(5.599)
Province Fixed Effect	N	Y	Y	Y	Y
Observations	3,141	3,141	2,353	521	115
R^2	0.002	0.049	0.071	0.155	0.496

Note: *p<0.1; **p<0.05; ***p<0.01

Table A2: OLS Regression Results for Word Score

	Dependent variable:				
	Word Score				
	(1)	(2)	(3)	(4)	(5)
key school flag	0.666*	0.584*	0.096	0.214	0.847
	(0.346)	(0.336)	(0.410)	(0.590)	(1.569)
number of students in class			0.032***		0.035
			(0.008)		(0.042)
self rate of academic pressure			−0.323***		0.162
			(0.113)		(0.652)
how excellent of yourself			0.494***		1.941*
			(0.144)		(0.974)
self rate of studying hard			0.189**		−0.416
			(0.074)		(1.028)
self rate of concetration			0.157**		2.370**
			(0.073)		(1.093)
satisfaction with school			−0.236		−0.388
			(0.150)		(0.821)
satisfaction with headteacher			0.311		0.497
			(0.200)		(1.087)
satisfaction with Chinese teacher			0.108		−1.251
			(0.192)		(1.027)
satisfaction with math teacher			0.121		0.197
			(0.077)		(0.802)
child's health status			0.207		0.979
			(0.148)		(0.873)
yearly education expenditure on child				0.00002	0.00004
				(0.00005)	(0.0001)
Father's age				0.236***	0.165
				(0.089)	(0.213)
Father's years of schooling				0.366***	0.269
				(0.082)	(0.205)
Father's total income last year				0.00000	0.00001
				(0.00001)	(0.00003)
Father's social status				−0.207	0.436
				(0.285)	(0.824)
Father's health status				−0.413	−0.475
				(0.311)	(0.788)
Father's overall satisfaction with life				0.404	0.170
				(0.285)	(0.676)
Mother's age				−0.110	−0.035
				(0.091)	(0.214)
Mother's years of schooling				0.050	−0.266
				(0.080)	(0.230)
Mother's total income last year				0.00002*	0.00005
				(0.00001)	(0.00003)
Mother's social status				−0.416	−0.919
				(0.253)	(0.679)
Mother's health status				0.187	−1.057
				(0.319)	(0.884)
Constant	19.403***	24.237***	19.390***	12.629*	13.574
	(0.132)	(1.837)	(2.202)	(6.881)	(11.384)
Province Fixed Effect	N	Y	Y	Y	Y
Observations	3,141	3,141	2,540	521	115
R^2	0.001	0.075	0.109	0.155	0.404

Note: *p<0.1; **p<0.05; ***p<0.01

Table A3: CEM: Average Treatment Effect on Math Score

	Dependent variable:			
	Math Score			
	(1)	(2)	(3)	(4)
key school flag	0.833***	0.512	0.350	0.016
	(0.315)	(0.403)	(0.373)	(0.562)
number of students in class		0.016**		0.018
		(0.007)		(0.016)
self rate of academic pressure		−0.195*		−0.361*
		(0.108)		(0.200)
how excellent of yourself		0.484***		1.065***
		(0.145)		(0.311)
self rate of studying hard		−0.053		0.196
		(0.139)		(0.340)
self rate of concentration		0.030		0.244
		(0.043)		(0.286)
satisfaction with school		−0.120		0.209
		(0.146)		(0.295)
satisfaction with headteacher		−0.121		−0.618
		(0.197)		(0.379)
satisfaction with Chinese teacher		0.090		0.342
		(0.186)		(0.311)
satisfaction with math teacher		0.229		−0.081
		(0.143)		(0.284)
health status		0.329**		0.159
		(0.164)		(0.265)
yearly education expenditure on child (log)			0.030	0.006
			(0.115)	(0.204)
Father's age			0.055	0.041
			(0.062)	(0.081)
Father's years of schooling			0.033	0.046
			(0.058)	(0.080)
Father's total income last year (log)			0.257	0.370
			(0.255)	(0.400)
Mother's age			0.083	0.152
			(0.066)	(0.093)
Mother's years of schooling			0.024	0.009
			(0.058)	(0.084)
Mother's total income last year (log)			0.116	−0.164
			(0.182)	(0.242)
Constant	10.905***	7.309***	1.047	−3.543
	(1.260)	(1.816)	(3.991)	(6.184)
Province Fixed Effect	Y	Y	Y	Y
Observations	911	748	370	209
R^2	0.095	0.123	0.149	0.279

Note: *p<0.1; **p<0.05; ***p<0.01

Table A4: CEM: Average Treatment Effect on Word Test Score

	Dependent variable:			
	Word Test Score			
	(1)	(2)	(3)	(4)
key school flag	1.389**	0.423	0.507	−0.474
	(0.611)	(0.781)	(0.693)	(1.040)
number of students in class		0.027*		−0.001
		(0.014)		(0.029)
self rate of academic pressure		−0.050		0.135
		(0.209)		(0.369)
how excellent of yourself		1.059***		1.573***
		(0.282)		(0.575)
self rate of studying hard		0.283		0.553
		(0.269)		(0.629)
self rate of concentration		0.033		0.003
		(0.083)		(0.529)
satisfaction with school		−0.232		0.004
		(0.283)		(0.546)
satisfaction with headteacher		0.308		−1.377*
		(0.383)		(0.701)
satisfaction with Chinese teacher		0.026		1.038*
		(0.361)		(0.576)
satisfaction with math teacher		0.313		0.097
		(0.277)		(0.526)
health status		0.454		0.625
		(0.318)		(0.490)
yearly education expenditure on child (log)			0.232	0.171
			(0.213)	(0.378)
Father's age			0.078	0.157
			(0.114)	(0.151)
Father's years of schooling			0.071	0.044
			(0.107)	(0.149)
Father's total income last year (log)			0.299	0.014
			(0.474)	(0.739)
Mother's age			0.194	0.078
			(0.122)	(0.171)
Mother's years of schooling			0.249**	0.426***
			(0.107)	(0.156)
Mother's total income last year (log)			0.297	−0.421
			(0.337)	(0.449)
Constant	24.032***	14.497***	0.787	2.610
	(2.444)	(3.519)	(7.407)	(11.441)
Province Fixed Effect	Y	Y	Y	Y
Observations	911	748	370	209
R^2	0.144	0.176	0.189	0.296
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure A1: Post-Matching Father's Years of Schooling Distribution by School Type

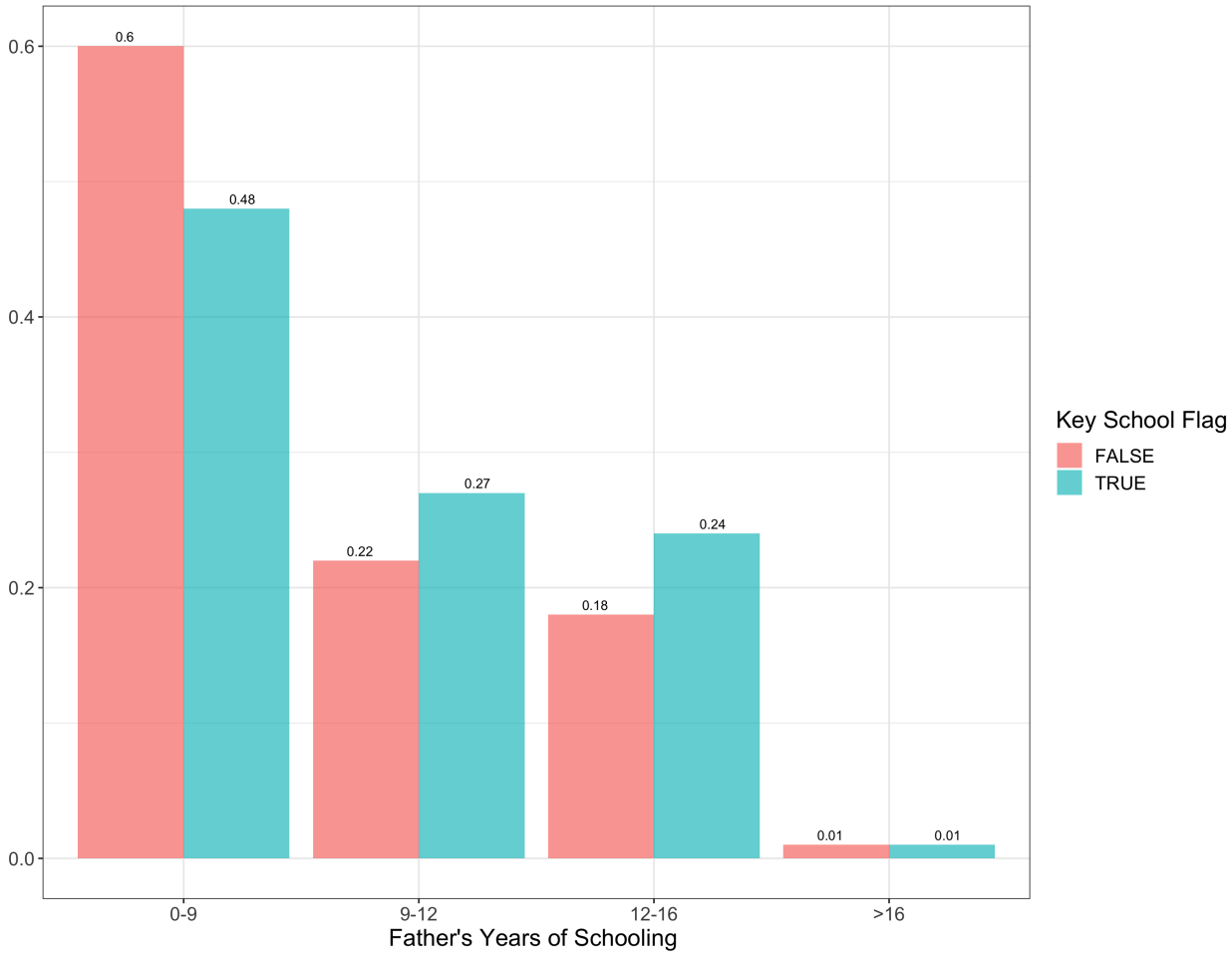


Figure A2: Post-Matching Mother's Years of Schooling Distribution by School Type

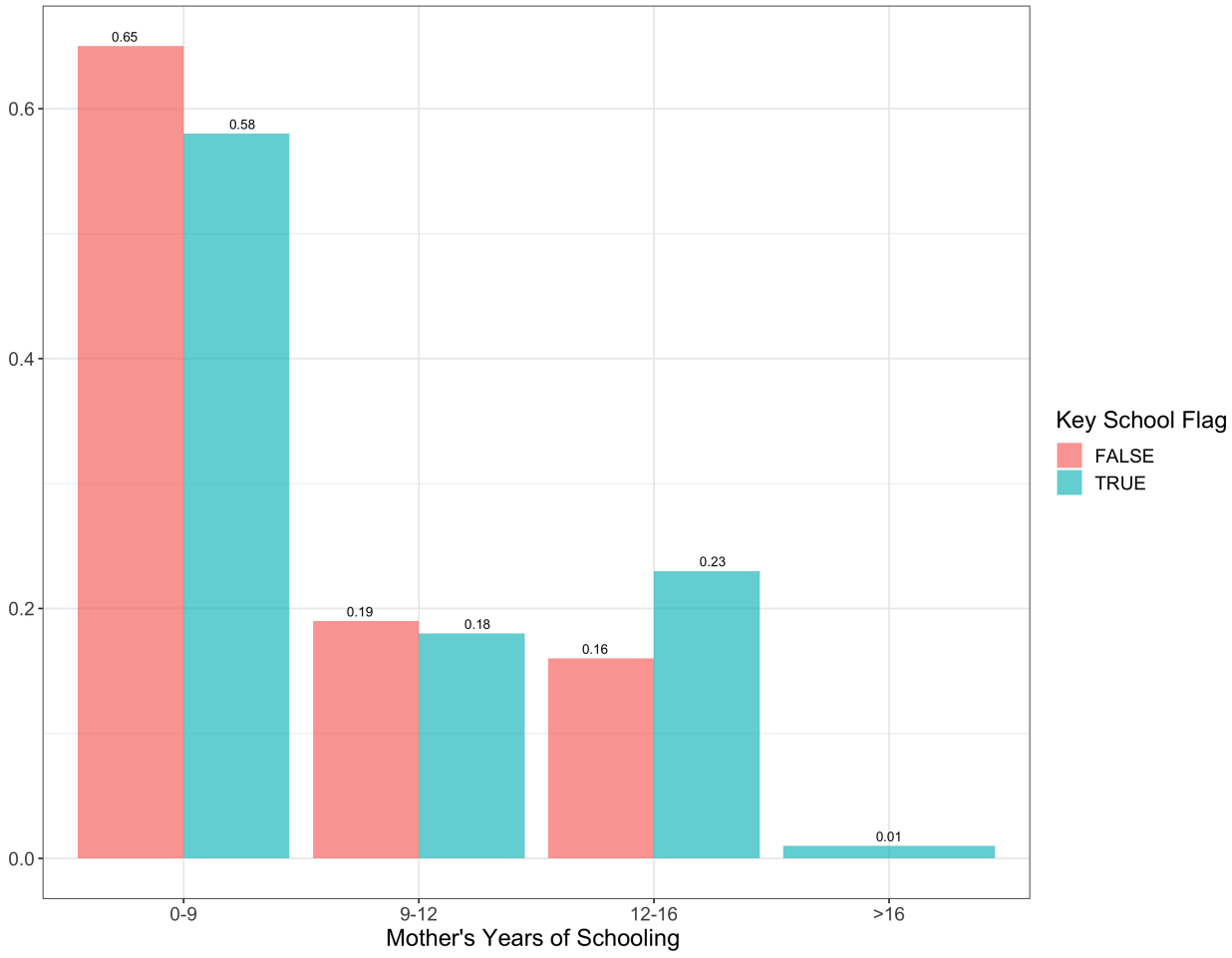
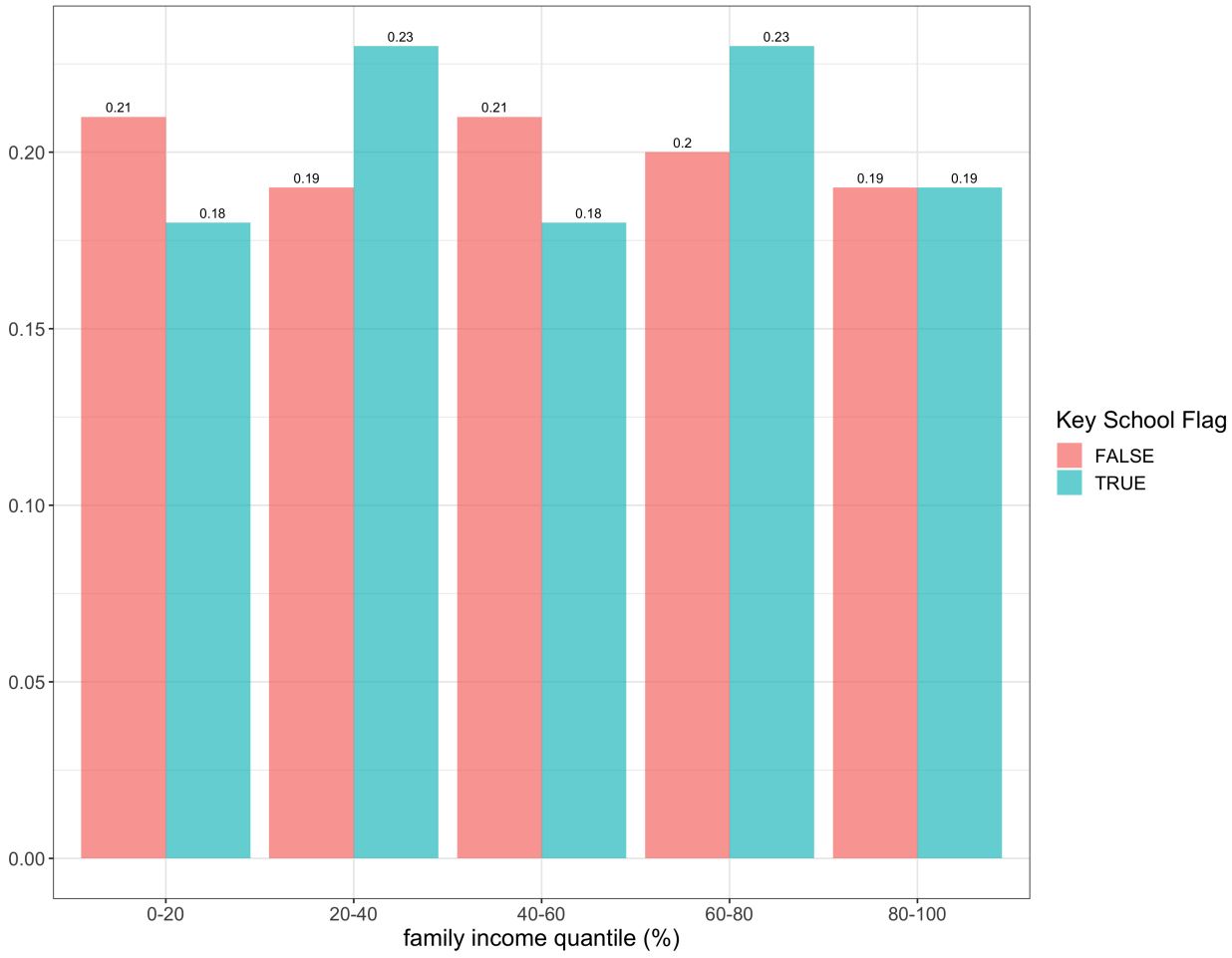


Figure A3: Post-Matching Family Income Distribution by School Type



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