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FAMILY BACKGROUND EFFECTS ON READING PERFORMANCE BASED ON SHANGHAI'S PISA 2012

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I declare I have written the master's thesis independently. All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced.

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ABSTRACT

This thesis focused on both the theoretical and statistical analyses of family background effects on reading performance for Shanghai's PISA 2012. PISA is the abbreviation of Programme for International Student Assessment which has three assessments of mathematics, reading and science.

The research problem is whether and how much the family background influences the reading achievement of Shanghai's students in PISA. Both the qualitative and quantitative methods had been used. The qualitative part applied the education production function which includes the three main factors: school resources effects, peer effects and family background effects. For the quantitative method, hierarchical regression and eight models include control variables in both the individual and school level had been used. The regression results revealed a positive correlation between the PISA index of economical, social and cultural status (ESCS) and reading score, this enhanced the qualitative research part.

Keywords: PISA, Shanghai, family background effects, reading performance

INTRODUCTION

Programme for International Student Assessment (PISA) provided a possibility that can measure and compare the student academic achievement in mathematics, reading and science on an international scale since 2000. Shanghai keeps the highest scores in all three subjects since 2009 when it participated PISA, and continually the outperformed in 2012 which caught the world's attention in the last few years. There is a number of studies about western education pattern and the analysis of PISA of different countries. But very few researches concern about Shanghai's PISA, therefore the research gap exists. Moreover, the studies about family background in Shanghai are also scant.

The research problem is whether and how the family background effects the reading performance of Shanghai's students in PISA 2012. In this thesis, both of qualitative method and quantitative method had been used. The importance of family background had been analyzed in the theoretical part. Different studies about school resources effects, peer effects and family background effects which the education production function consisted of had been discussed. The quantitative method applied ordinary linear square method and used the two variables of PISA index of economical, social and cultural status and plausible value of reading assessment in PISA 2012. The results of quantitative method also strengthened the theoretical analysis that the family background has positive effects on student reading performance.

Thus the hypothesis is that the family background has a positive effect on Shanghai's reading performance. The hypothesis leads to the research question that whether family background has effects on Shanghai's students' reading performance in PISA 2012? Therefore the results proved the hypothesis.

Concerning the research objects, the first is, whether various family background has a significant impact on the student reading performance. Second, in the case of Shanghai's PISA 2012, how much did it influence?

In order to figure out the research question and achieve the research objectives, three chapters had been conducted in this thesis.

The first chapter gives a brief introduction to PISA, Shanghai's 2012 PISA results and Shanghai's education reforms during the past four decades. PISA was taken with the purpose of measuring the equity, quality and efficiency of school education through the participated countries and economic entities which includes three assessments: mathematics, reading and science. Furthermore, Shanghai's education reforms were considered as the main reason for Shanghai's success in PISA, therefore the reforms of Shanghai's education system, national curriculum reforms, Shanghai's curriculum reforms, college entrance examination reforms and university admission reforms had been discussed in chapter 1 as well.

The second chapter provided the theoretical background of this thesis which supports by education production function. Education production function includes three main factors which are school resources effects, peer effects and family background effects that may contributes to the student academic achievement. Whether the school resources have effects on student achievement is debatable in the past years. For the factor of peers performance, it seems most of the scientists have agreed that the peer group has a positive relationship with children' academic achievement, and also other behaviors. Since the purpose of this thesis is to figure out the relationship between family background effects and reading performance. The factors of family background such as parental education level, parental occupation level, parental involvement, immigrant background and socioeconomic status (SES) had been discussed more than the other two.

Chapter three introduced the quantitative method to analysis the relationship between the variables of PISA index of economic, social and cultural status (ESCS) and plausible value 1 of reading which stands for the factors of family background and Shanghai's PISA

reading performance in 2012, separately. Variables explanation had been provided in chapter 3 as well which includes such as the mathematical method of ESCS and the introduction of plausible value. Hierarchical regression had been used during the analysis which include eight models and control variables. Furthermore, the result of a statistically significant and positive correlation between family background and reading scores turned to support the qualitative analysis.

Since the variable of ESCS is composed by home possessions (HOMEPOS), the highest parental occupation (HISEI) and the highest parental education recorded as years of schooling (PARED), it cannot reflect all the factors of family background. Therefore, it has its own limitations. However, this thesis still provides another evidence for the positive impacts of family background on reading performance.

1 CASE DESCRIPTION

This thesis concerns family background effects on reading performance based on Shanghai's Programme for International Student Assessment (PISA) results in 2012. PISA provides a measurement of reading, mathematics and science for 15-year-olds students from various countries. Shanghai attracted world's attention since it participated PISA in 2009, for its high scores which were significantly ahead of the average Organisation for Economic Co-operation and Development (OECD) scores and other partner countries. (OECD 2014a)

Chinese education is famous for its intense mathematics exercises training, however, PISA 2009 and 2012 results show that Shanghai has good performance in reading and science as well. Chinese parents do not value social science as important as natural science because a graduate from natural science is much more easier to find a good job than social science. Therefore, even China has the tradition of highlighting the importance of reading, Shanghai's reading achievement of PISA 2009 and 2012 were still surprisingly high.

As well known, China was under the traditional Soviet-style economic system and planned economy before 80s of last century, but changed to which named Socialism with Chinese Characteristics afterward. This implemented through the policy named Reform and Opening up policy which leaded China's blooming economy until nowadays. China leaded altogether eight waves of education reforms since the establishment of new China. These reforms reshaped modern Chinese education significantly different with its traditional way. (Tan 2012)

In addition, Shanghai, as the one of the reform leaders in China, it changed not only its economic operating pattern, but also differentiate its education mode from other areas of China since 1980s. Many Chinese scholars analyzed it and claimed that the most important

success factor of Shanghai's PISA performance is Shanghai's education reforms. (Ding 2010)

In this chapter, at first a brief introduction of PISA will be introduced, followed by the details about the results of Shanghai's PISA 2012, the description about national education reforms and Shanghai's education reforms.

1.1 Introduction of Programme for International Student Assessment

PISA is the abbreviation for Programme for International Student Assessment which sponsored by the Organisation for Economic Co-operation and Development (OECD). The first assessment of PISA was taken in 2000 and repeated every three years. The participants are OECD members, other economic entities and partner countries. In 2012, The total GDP of these participated countries accounts for 90% of the global GDP. All 34 OECD countries and 31 partner countries participated. PISA 2012 included altogether around 510,000 students between the ages of 15 years 3 months and 16 years 2 months which had completed at least six years of formal schooling. (OECD 2014a)

PISA provided assessments of reading, mathematics and sciences for the 15-year-olds students. Each PISA has different domains- the major subject has more detailed questions and take account of nearly two-thirds of the total testing time. The domain was reading in 2000 and 2009, mathematics in 2003 and 2012, and science in 2006. PISA 2012 focused on mathematics, and also included tests of reading, science and collaborate problem-solving. PISA 2012 is also the first time for PISA to include the assessment of financial literacy. Two step sampling had been used. The schools were chosen randomly in the first stage and the students from different schools were chosen randomly in the second stage (OECD 2014a)

Questionnaire for students takes 30-40 minutes to be accomplished, and it concludes the questions about their socioeconomic backgrounds, attitudes toward schools, study strategies, interests and so on. Questionnaire for principals takes 30 minutes to be accomplished, and the questions are about the education resources, schools environment,

teachers quality, etc. Optional questionnaire for parents also had been distributed. It includes questions such as their child' career expectations, their perceptions of involvement, and their support for learning at home, etc. (OECD 2014a)

The purpose of PISA is measuring the equity, quality and efficiency of school education through the participated countries and economic entities. It supposed to reveal not only how well the 15-year-olds students could reproduce the knowledge they already known, but also how much they could use and apply when they meet new tasks in both of in and outside of school. (OECD 2014a)

There are many studies show that a strong relation between the knowledge of 15-year-olds teenagers can mastered and their future career choices, salaries, self-development, etc. (OECD 2014a). PISA provides plenty of information which could reflect the family backgrounds and local education levels among various countries and economic entities. Thus the policy makers and educators can compare and analysis other countries' figures from PISA database and make progress. The teachers can adjust their curriculum and increase the efficiency of teaching based on the results of PISA as well.

This assessment provides mean scores of participated countries and economic entities, however, it is hard to rank them precisely because sometimes the difference is quite small. But the mean scores provided a possibility to compare different countries' performance in a range of rankings.

1.2 Shanghai's Programme for International Student Assessment 2012

Shanghai participated PISA since 2009, and ended up with highest scores in all three assessments: reading, mathematics and science. The results surprised many scholars and named it as "PISA-Shock" and switched the attention from Finland, the previous top performer between 2000 and 2006, to Shanghai and Asia. In PISA 2012, Shanghai was still the best performer in all three assessments and had progresses during the three years. The

other top performers are followed by mostly Asian economic entities such as Hong Kong-China, Taiwan, Singapore, Japan and Korea. (Sellar and Lingard 2013)

Even Shanghai has the highest scores among all three assessments, it cannot prove Shanghai has the best education in the world. Moreover, PISA can just provides a viewpoint to compare Shanghai's education with other areas and countries. In addition, Shanghai can only represent the education level of Shanghai, instead of Mainland China, and some of the top performing countries are not significantly different from each other, therefore the rankings in the following paragraphs and figures are just providing a way to compare these countries.

In 2012, Shanghai has the highest score in **mathematics** with a mean of 613 points, and the average level of OECD countries is 494. The difference of 119 points is the equivalent of around three years of schooling. The top performing countries are Singapore, Hong Kong-China, Chinese Taipei and Korea which have scores of 573, 561, 560 and 554, separately. The mean scores of OECD countries and other partner countries in mathematics could found in Figure 1. (OECD 2014a)

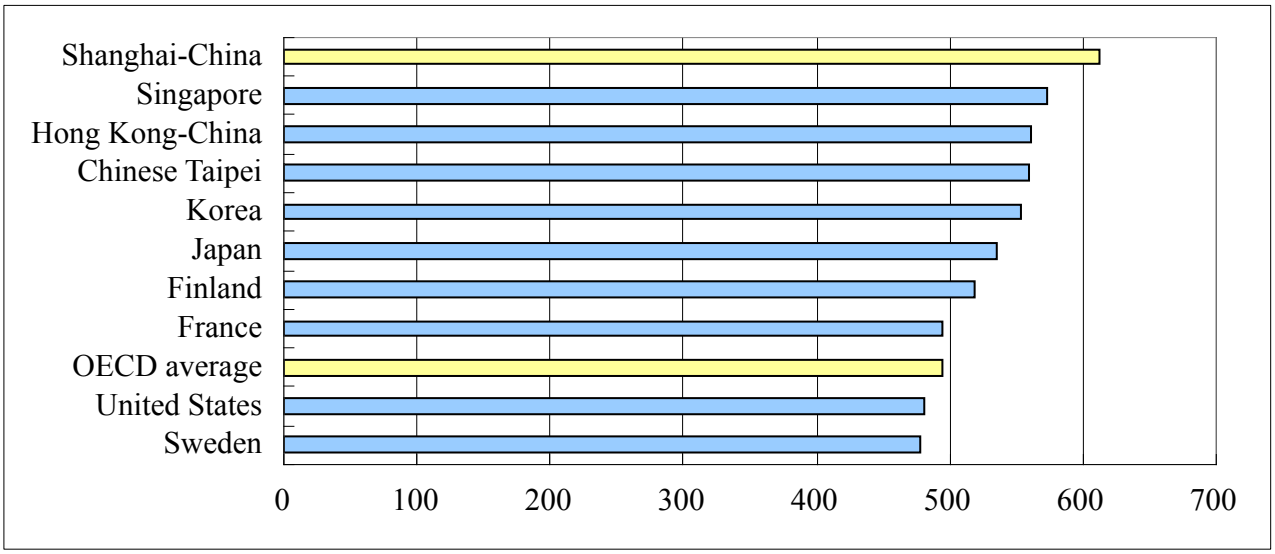

Figure 1. Mean scores of mathematics performance
Source: (OECD, 2013,c)

On average of OECD countries, there are 13% of students belong to the level 5 or 6 which regarded as the group of top performers. This proportion of Shanghai is 55%, and the following countries are Singapore, Chinese Taipei, and Hong Kong-China which are 40%, 37% and 34%, respectively. Moreover, OECD countries on average has 3.3% of students achieved level 6 in mathematics during PISA 2012. Comparably, Shanghai has the largest proportion which is 30.8%. (OECD 2014a)

Moreover, the share of lower achievers which defined as the percentage of students which below level 2 also shows Shanghai's outstanding performance in mathematics. In Shanghai's PISA 2012, the percentage of the share of lower achievers is 3.8%. Among the participated OECD countries, the average level is 23%. The other top performers are more than 8%. (OECD 2014b)

Shanghai also has outstanding scores and performance in **reading** assessment. The average score of OECD countries in reading assessment is 496 points with a standard deviation of 94, and Shanghai has a mean score of 570 points. The difference of 74 points can be comparable of the knowledge obtained during a year-and-a-half of schooling. In addition, the countries following Shanghai are Hong Kong-China, Singapore, Japan and Korea which have scores of 545, 542, 538 and 536 points, respectively. (OECD 2014b)

On the average of OECD countries, 8.4% of students are top performers in reading which defined as level 5 or 6. Meanwhile, Shanghai has the largest percentage of this percentage which is 25.1%. The rest of top performing countries are around 15% or less. (OECD 2014a) Among the OECD countries, around 1% of students are level 6 top performers. More than 3% of students perform at this level for the top performing countries. The corresponding percentage is 5.0% in Singapore, 3.9% in Japan, 3.8% in Shanghai, and 3.0% in New Zealand. (OECD 2014b)

The share of lower achievers of Shanghai in reading assessments is 2.9%. Comparably, the average percentage of OECD participants is 18%. The other Asian top performers are more than 6%, for example 6.8% in Hong Kong and 9.9% in Singapore. (OECD 2014b)

Moreover, the mean scores of reading performance in percentiles for the four top performed countries provided in the Figure 2 below.

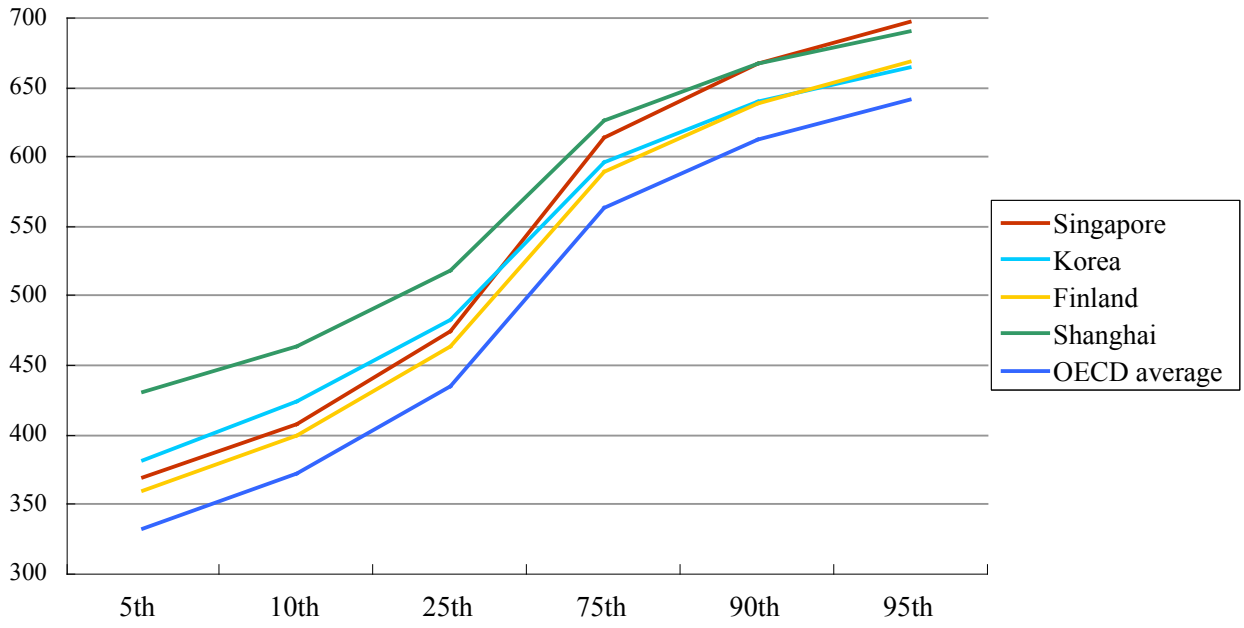

Figure 2. Mean scores of reading performance in percentiles
Source: (OECD, 2013,c)

Girls outperformed boys in reading assessment among all the participated countries and economy entities in both of 2009 and 2012, and the difference gap in 2012 even larger than 2000. Shanghai narrowed the gender difference in reading assessment even Shanghai only participated PISA for two times. The average mean difference on OECD level is 39 and the number in Shanghai is 40 points in 2009. In 2012, the average mean difference among OECD countries is 32 points and Shanghai decreased the gap to 17 points. During the three years, Shanghai decreased the gender gap in reading assessment for 23 points which is significantly progress. (OECD 2012 and OECD 2009)

In PISA 2012, the top five performers in **science** are Shanghai, Hong Kong-China, Singapore, Japan and Finland which have mean scores of 580, 555, 551, 547 and 545, respectively. The average score of OECD countries is 501 points. Shanghai's mean score of 580 points has an equivalent of more than three-quarters of a proficiency level higher than the

OECD average level. (OECD 2014a)

The percentage of top performers belong to level 5 or 6 on OECD average is 8.4 % . This percentage is 27.2% in Shanghai, 22.7% in Singapore, 18.2% in Japan, 17.1% in Finland, and 16.7% in Hong Kong-China. Across OECD countries, an average of 1.1% students perform at Level 6 in science. The percentage of students perform at this level is 5.8% in Singapore, 4.2% in Shanghai, 3.4% in Japan and 3.2% in Finland. (OECD 2014b) The Figure 3 below provides the detailed percentages at each proficiency level in sciences for the top performing countries in 2012.

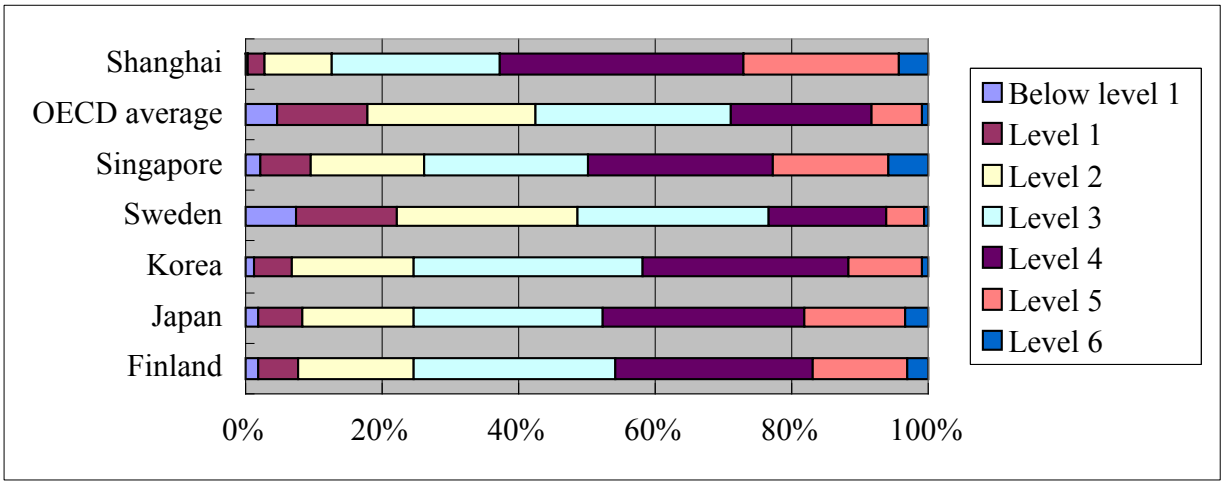

Figure 3. Percentage of students at each proficiency level in science
Source: (OECD, 2013,c)

Among the OECD countries, 16.2% of students are top performers of at least one subjects. Fewer students of top performers found in two subjects: percentage of mathematics and reading, mathematics and science, reading and science is 1.5%, 2.3% and 0.6%, separately. Compare with the percentages of top performers in one or two of the assessments, the percentage of all-rounders, those students who achieve proficiency level 5 or 6 in all three assessments of mathematics, reading and sciences is even lower. (OECD 2014b)

All-rounders are believed to be more versatile, competitive and more capable to solve complex problems in this knowledge-based global economy. On the average level of OECD

countries, the percentage of all-rounders is 4.4% in PISA 2012. The proportions are found larger in the top performed countries such as Shanghai, Singapore, Japan and Hong Kong-China which account for 19.6%, 16.4%, 11.3% and 10.9%, respectively. Moreover, Shanghai increased the percentage of all-rounders during 2009 and 2012 also. This percentage surged from 14.6% in 2009 to 19.6% in 2012 which is a huge progress. (OECD 2012 and OECD 2014b)

The figures of Shanghai's performance show annualized improvement in mean scores of all three assessments. From 2009 to 2012, the mean scores of mathematics, reading and science increased 4.2 points, 4.6 points and 1.8 points separately in Shanghai. The improvements in mathematics and reading scores are more than 3 points which are significant changes. (OECD 2014b)

But the high scores in PISA that Shanghai achieved cannot reflect Shanghai has the best education in the world. In fact, the education in Shanghai had been criticized frequently by the local educators for its own weaknesses. In 2009, Peking University conducted A China Report 2009 shows the students in Shanghai has the second longest study hours per day which is 13.2 hours and the first one is Beijing, which has 14.4 hours (W. Li and Y. Li 2010). In addition, PISA 2012 reported the students in Shanghai spend more than 14 hours per week on homework and more than two hours per week on attending after-school classes (OECD 2013c). Therefore the high study load may also partly explains the reasons of Shanghai's high scores in PISA.

Chinese education has always been criticized by its cramming, inefficiency and high-loaded, even by the local educators in China. It is different with the western education pattern in many ways. Chinese education rooted in the influence of Confucian. "The development and characteristics of the system of Chinese education ... have been greatly influenced by this traditional culture" (Wang and Mao 1996). The traditional education way of recitation of Confucian classics also influenced the modern education which is called rote-learning by many scholars.

After the PISA 2009 and 2012 results published, Chinese educators, students and teachers were not satisfied with the results. Many of them criticized the current Chinese education because the cramming education system could not motivate the students to study according to their interests, instead, they study for the college entrance examination, and for their parents. Moreover, the high study load also caused high pressure and deteriorate their study interests so that many of the students do not have the motivation to study anymore in universities after they passed the college entrance examination.

1.3 Education Reforms in Shanghai

China has a long history and tradition which value education highly. The first national exam named Civil Examination system started from 603AD. This exam selected very few officials among a large number of candidates and held only one time every three years. Civil Examination has no limitation for the candidates' family backgrounds and the textbooks are basically named Four Books and Five Classics which are common classic books even for household collection. (OECD, 2010b)

For the reasons of the low costs exam and respectful prospect, success in Civil Examination was the only hope for upwards social and economic mobility for both of the whole family and individual among many poor families. In addition, unlike other cultures which may value economic wealth or military power, success in Civil Examination was regarded as the only respectful success during the ancient time in China. (OECD 2010b) This tradition still has impacts on nowadays Chinese culture. For many Chinese families, the college entrance examination is the most important affair and it is the most respectful choice to enter into a good university for the students.

Nowadays, due to the limited university places, the one-child policy and the tradition of hardworking for study, Chinese children feel the responsibility and obligatory to study for their own future, and mostly for their parents. In a national survey, 77% of the interviewed

one-child family students claimed that the motivation to study hard is “they need to repay their parents” (W. Li and Y. Li 2010).

Since the establishment of People’s Republic of China until 2015, China’s education experienced eight national scale curriculum reforms . The first and second reforms introduced national curriculum and teaching materials based on the Soviet model. The third reform started with “education revolution” in 1958 which mainly promoted socialist and agrarian education until the Ten Years of Turbulence which also known as Cultural Revolution from 1966 to 1976. (Tan 2012) The initial purpose of this revolution was to eliminate all bourgeois influences in the new socialist country which established in 1949 (People’s Republic of China), but finally turned to class struggle which devastated Chinese education for ten years.

However, Chinese national education system changed at the same time when Chinese leader Deng Xiaoping started the economic reform in 1977. This economic reform also named Reform and Opening up policy which changed the traditional soviet-style economic system and planned economy, and allowed the operation of private enterprises. Chinese education changed along with the development of economy which leaded the fifth curriculum reform. Chinese universities began new admissions from 1977 and leaded numerous enrollments because of no admission for the last ten years (OECD 2010a).

The major change is the national entrance examination which is basically 3+X model which means the three compulsory courses of Mathematics, English language and Chinese language. X means the students have to choose Science or Art which requires the exams of Physics, Chemistry and Biology, or Geometry, History and Politics.

In addition, the Law of Compulsory Education enacted in 1986 which ensured every child complete nine years’ education. It include six years of primary school and three years of junior secondary school (OECD 2010a). The Law of Compulsory Education enacted along with the sixth curriculum reform which added more hours for the compulsory courses and other minor changes. The seventh curriculum reform started from 1992 and emphasized the importance of extracurricular activities. The eighth curriculum reform implemented from

1999 until now and leaded plenty of changes. The main purpose was shifting the traditional curriculum towards a more focus on knowledge and skills curriculum for the globalization and the increasing Chinese economy. In addition, "the education reform changed the teacher-centered pedagogy to student autonomy and from knowledge transmission to knowledge construction". (Liu and Fang 2009; Ministry of Education of the People's Republic of China 1993)

The national education reforms had been implemented through decades and leaded huge progress. According to the national census in 2010, the percentage of more than 15 years of schooling increased to 8.9%, and increased 4.5% compare with the figure in 2002. The illiteracy rate decreased from 9.16% in 2002 to 4.08% in 2010. (National Bureau of Statistics of the People's Republic of China 2012)

Shanghai was one of the leader cities in China implemented the nine-year compulsory education policy. As a result, Shanghai has the top enrollment rates and the developed basic education compare with other Chinese cities and provinces. In 2010, Shanghai Municipal Government published the *Shanghai Yearbook 2009* which disclosed the enrollment rate at the age of nine years compulsory education reached 99.9%. The enrollment rate of preschool education was 98% and the rate in senior secondary school was 97%. (Shanghai Municipal Government 2010a) Comparably, the indexes of national scale level were much lower than Shanghai in 2009. The national enrollment rates of primary school, junior secondary school and senior secondary school were 99%, 99.4% and 79.2%, respectively. (Ministry of Education of the People's Republic of China 2009)

As one of the four direct-controlled municipalities of China and with its unique colonial past, Shanghai is famous for its internationalization, openness and finance center (the other three cities are Beijing, Tianjing and Chongqing). Moreover, Shanghai is also one of the educational reform leaders in China.

In 2004, Shanghai launched the new style of nine-year compulsory education that 5 years for primary school and 4 years for junior high school. Most of other parts of China are

using the pattern of 6 years of primary schooling and 3 years of junior high schooling. Moreover, in Shanghai, English is the compulsory course since the first year in primary school. Comparably, most of the other parts of China required English as the compulsory course since the third year in primary school. The initial purpose was provided the students at least nine years English education. This policy leaded many schools in Shanghai began to employ the native speakers of English, design their own teaching materials and send their students to USA, Europe, Australia and so on. (Tan 2012)

Curriculum reforms

In China, most of schools do not have the autonomy about curriculum. Normally the curriculum is the same in one province because they all directed by the same college entrance examination in one province.

The curriculum of Shanghai is also different from other areas of China. After Shanghai participated PISA in 2009, many local experts in China argued that the succeed factor of Shanghai's education is due to the reform of curriculum (Tan 2012).

Shanghai launched two reforms since 1988. The First Curriculum Reform implemented from 1988 to 1997 which directed by the purpose of increasing student quality by combining societal needs, structure of subjects and student development into a new curriculum. The first reform was supposed to allow Shanghai's students choose the select courses according to their personal interests. There are three sections in the curriculum which are compulsory subjects, electives and activity-based subjects. The reform had been implemented incrementally through different levels: primary schools started from 1992, senior high schools started from 1995 and all grades started from 1997. (Ding 2010)

The Second Curriculum Reform in Shanghai was the period from 1998 to 2008. In the document of *Explanation of the Trial Curricular Plan for Ordinary Primary and Secondary Schools in Shanghai*, it states that the reform intended to "meet the demands of a knowledge economy". It encouraged schools to develop their own curriculum according to the students'

needs instead of the national standard curriculum and “shift from the traditional mode of transmitting human cultural knowledge to cultivating an innovative spirit in the students”. The traditional education mode was “exam-oriented education”, and the reform shifted the mode to “quality-oriented exam”. (Shanghai Municipal Education Commission 2004; Ding 2010)

A new curriculum launched during the second curriculum reform which contains eight domains of learning: Mathematics, Language and Literature, Social Sciences, Natural Sciences, Arts, Skills, Sports and Fitness, and Integrated practical learning. The eight domains divided into three types which are Foundational Subjects, Expanded Subjects and Inquiry or Research Subjects. (Shanghai Municipal Education Commission 2004)

The Foundational Subjects are the compulsory courses for all the students. The Expanded Subjects designed for students’ different interests and learning abilities which has two types that Compulsory Expanded Subjects and Elective Expanded Subjects. The Compulsory Expanded Subjects related more to the real life application and the Elective Expanded Subjects are for instance language, sports and fitness and the arts. Moreover, the Inquiry/Research Subjects designed for helping the local students to “learn to learn” and also include two types. For the Type I of Inquiry/Research Subjects, students could choose a specific topic or problem based on their own interests and conducted under the guidance of a teacher. The Type II subjects are more related to the Foundational Subjects which are more based on disciplinary knowledge. (Shanghai Municipal Education Commission 2004)

Table 1 in the following page provides a clear structure of Shanghai’s local curriculum. The difference between Shanghai’s local curriculum and the curriculum in other provinces provides the local students more flexible and efficient education pattern and highly motivated the students’ study.

Table 1. Curriculum in Shanghai

<table>
<tr><td>Domains of learning</td><td colspan="3">Subject category</td></tr>
<tr><td>Mathematics</td><td rowspan="8">Foundational subjects</td><td rowspan="9">Expanded subjects</td><td rowspan="9">Inquiry/Research subjects: type I and type II</td></tr>
<tr><td>Language and literature</td></tr>
<tr><td>Social sciences</td></tr>
<tr><td>Natural sciences</td></tr>
<tr><td>Arts</td></tr>
<tr><td>Skills</td></tr>
<tr><td>Sports and fitness</td></tr>
<tr><td>Integrated practical learning</td><td></td></tr>
</table>

Source: (Shanghai Municipal Education Commission, 2004)

College entrance examination reforms

College entrance examination plays a significant role for all Chinese students. There is a Chinese saying to stress the significance of this exam: “one exam determines the entire life”. Since the college entrance examination resumed in 70s, it had been regarded as the only criteria for the entrance of higher education institutions and universities for a long time. Moreover, this exam only hold once a year and resulted an intensive competition. In China, the college entrance examination regarded almost like the civil examination in the ancient China. Chinese students and parents take the college entrance examination, and entering a good university as their final goals since the students were in their primary school stage.

Shanghai is different from other provinces not only through the curriculum, but also the College Entrance Examination. In most other provinces, the college entrance examination is 3+X model followed the national entrance examination. Chinese language, English language and Mathematics are the three compulsory courses, and X means Physics, Chemistry and Biology, or Geometry, History and Politics which divided students into two groups of Science and Art. But Shanghai changed the mode step by step.

Shanghai started to have their own college entrance examination since 1985 which means Shanghai has the autonomy about the content of the examination, the curriculum, time schedule of exam and so on. In the beginning, Shanghai allowed the local students choose the

X subjects based on their own interests and not divided them into two groups of Science and Art which highly reduced the study load and pressure of the local students. In addition, since 2012, Shanghai implemented the examination policy of 3+1 which has the same three compulsory subjects, but the students only need to choose one subject instead of three as the national examination requirements. (Shanghai Municipal Government 2014)

Shanghai has the different policies for the vocational schools also. Since the early time of 1980, Shanghai started the new type of vocational schools which does not assign jobs after graduation. This policy differentiate Shanghai from other Chinese provinces which were still in planned economy and mostly guarantee jobs for the graduates at that time. (OECD 2010a)

Moreover, Shanghai organized different entrance examination for the enrollments of vocational schools since 1996. In Chinese, the vocational schools are also named Junior Colleges which normally admitted the students which had lower achievement in College Entrance Examination. Normally it is not possible to transfer from the vocational schools to a university. However, Shanghai Municipal Government enacted new policies for the development of the students in vocational schools as well (L. Li 2009 and R. Li 2008)

Since 2000, for the students who intended to transfer from the vocational schools to the regular undergraduate programmes, they only required to take the exam of 2+X. The 2 exams are English and Computer Technology, and the X refers to the exam of corresponding specialized course. Moreover, Shanghai Municipal Government gave the autonomic admission for the vocational schools also from the year of 2005. These policies provided more choices and increased the probability for the higher education for the local students in Shanghai. (L. Li 2009 and R. Li 2008)

Moreover, the universities in Shanghai shifted their admissions to western pattern as well. In China, the college entrance examination only hold once time a year. Since 2000, Shanghai organized two college entrance examinations for the local students which highly reduced the students' pressure caused by the exam which will "determine the entire life". The additional spring college entrance examination provides one more opportunity for students.

However, during the past decade, it has not successfully implemented. The universities in Shanghai did not actively participated because this additional exam had very few participated students and increased their work load. Therefore the enrollment number of the spring exam reduced continuously since 2000. (People's Daily 2014)

Beijing, Tianjing, Anhui and other cities and provinces also organized the spring examination since 2000, but because of the dramatically declining enrollment number of students, they dropped out after few years. Whereas Shanghai is the only city which still keeping the spring entrance examination and trying to implement a new policy in 2015. This new policy allowed the participated students can get two offers from different universities. 32 universities participated in 2015 admission and increased three times compare with the number of schools in 2014. The new policy enacted and supposed to attract more students in the year of 2015's examination and admission. (People's Daily 2014; Shanghai Municipal Government 2014)

In addition, Shanghai University of Technology was the first university to started their own requirements for admission instead of taking university entrance examination as the only criteria in 1993. Afterwards, Fudan University, Shanghai Jiaotong University and other six vocational higher education institutions organized their own university entrance examinations. (Li 2009)

During the past few years, there were more universities organized their own entrance examinations, allowed recommendations from senior secondary schools and allowed students do self-recommendations. The independent examinations increased the probabilities for the students who has special talents for instance in arts, musics or sports. This importance of this policy is gave the universities autonomy to choose the students and decide the number of students according to their own needs. (Li 2009; OECD 2010a) In 2015, the number of universities organized their own entrance examinations estimated to be more than 90 (Gaokao 2014).

Shanghai Municipal Government published the *Shanghai Medium and Long Term*

Education Plan (2010-2020) in 2010. With the objective of educational equity, the local municipal government set the goals that preschool education enrollment rate increase from 95.5% in 2009 to 99.0% in 2020, compulsory education enrollment rate increase from 99.5% in 2009 to 99.9% in 2020, and senior high school enrollment rate increase from 90.0% in 2009 to 99.0% in 2020. In addition, the proportion of university students among the total population supposed to improve from 4.32% in 2009 to 5.2% in 2020, and the average schooling years of new labor forces planned to arise from 13.8 years to 15 years, respectively. (Shanghai Municipal Government 2010b)

In general, Shanghai had huge progress during the past decades since the implementation of reform and opening up policy in 70s. As a measurement of education outcome, the scores in PISA that Shanghai had achieved in 2009 and 2012 partly proved the improvement of Shanghai's education in the past years.

Moreover, even Shanghai just participated PISA for two times, Shanghai's education had improved in many ways which could be reflected through PISA database which shows the potential of Shanghai's education improvement such as the increased percentage of all-rounded students, the decreased gender gap in reading assessment and increased PISA points in all three assessments. The improvement during the three years proves that Shanghai still has the possibility to make progress in the later assessments.

The success in PISA 2009 and 2012 has many factors for instance the ones discussed in this chapter: curriculum reform, college entrance examination reform and new admission pattern. The national curriculum reforms and Shanghai's local curriculum reforms provided the local students more variety in terms of course choosing. Moreover, the vocational education in Shanghai also reformed step by step in the past decades. These reforms had shaped Shanghai's education significant different from the traditional Chinese education pattern.

Moreover, the college entrance examination reforms and new admission pattern also highly increased the university acceptance rate and reduced the working load for the students

in Shanghai. But there are also many other factors which needed to be considered, such as the Asian culture that highlighting education, the economic development in Shanghai and so on.

But problems in Shanghai's education cannot be ignored also for instance the pressure caused by the high workload and the unequal enrollment requirements and rates for the students from immigrant background. However, even Shanghai's education still has lots of problems needed to be solved, the Shanghai Municipal Government is trying to improve their education continuously.

2 LITERATURE REVIEW

Socialism implemented through the principle of equality which means all citizens have the right to acquire the same education resources regardless their family backgrounds. Shanghai, as the only socialist economic entity among the top performers in PISA 2012, studies about whether its economic system has impacts on family background, therefore whether has influence on students achievement and the fairness of education would be beneficial for the policy makers and educators of other Chinese provinces and countries.

Education production function is the mostly common used during the studies of education. It could be traced to Equality of Education Opportunity which is also named "Coleman Report". This report conducted through half a million students from around three thousand elementary and secondary schools and gave the conclusions about the importance of school resources, family background effects and peer group effects (Coleman et al. 1966).

The inputs of this function are mainly family background effects, school resources effects and peer effects. Each of them has various factors which has effects on the student's achievement. The family background effects include the parental education level, parents' occupations, household annual income and whether from immigrant background, etc. The school resources can be analyzed through the physical facilities, funding, autonomy, etc. Moreover, studies of peer effects concerning about the peers' behaviors, average scores, IQ, etc.

The outputs of education production function are various depend on the researchers. The assessment of educational outcome is difficult to determine. The researchers used the years of schooling in the beginning, but the schooling years can only measure the length of schooling and cannot reflect the quality of education. In recent years, more common used

assessments are the standard test scores for instance the average scores, enrollment rates, dropout rates and so on. (Coleman 1966; Hanushek 1986)

2.1 Introduction of Education Production Function

The importance and meaning of education had been widely accepted and good performance in school directly related to the individual's social performance in the future. In other words, more education can increase the individual productivity during their works, to be better consumers, able to solve new problems and questions, etc., which namely, healthy, wealthy and wise (Hanushek 1986).

Conceptually, the education production function could be simplified by following equation according to Hanushek:

$$A_{it} = f(B_i(t), P_i(t), S_i(t), I_i) \quad (1)$$

Where

A_{it} = student achievement at time t
$B_i(t)$ = vector of family background influences cumulative to time t
$P_i(t)$ = vector of influences of peers cumulative to time t
$S_i(t)$ = vector of school inputs cumulative to time t
I_i = vector of innate abilities and initial level of learning attained by the student prior to entry into the type of schooling in question
(Hanushek 1979)

The education production function (EPF) could be traced to *Equality of Educational Opportunity* which also known as "Coleman Report" which published in 1966. *Equality of Educational Opportunity* was mandated by the Civil Rights Act of 1964 and directly by James Coleman. This report published several conclusions such as the statistical insignificant correlation between the quality differences in schools and students' performance. In addition, this report showed family background is not the only determinant of students' performance, but also the peer students' performance in the same school. In the past decades, this report had been criticized by different studies for its flaws even though it has been cited frequently.

Especially for the educational policy makers. After the publication, the results of Coleman report leaded many researches and school desegregation policy for many years. (Coleman 1966; Hanushek 1986)

In the past, it was popular believing that the best way to improve educational standard is to invest more money. Therefore it had been a long time that the best schools were the ones spend the most money. But Coleman Report directed attention to the student performance instead of only increasing spending on education. (Jaggia and Kelly-Hawke 1999)

Education production function had been applied by many studies relate to education evaluation. In education production function, the inputs could be various for example school resources, teacher quality, and family background factors. Part of the inputs could be controlled by the educational policy makers for instance the characteristics of schools and teachers. School inputs usually include teacher background, school organization and district or community factors. Teacher background are factors such as education level, teaching experience, sex and so on. School organization includes for instance administrative expenditures, facilities and class sizes. District/community factors could be the average expenditure levels. (Hanushek 2008)

There are also part of inputs which are not so controlled by the policy makers for example family background, personal learning capabilities, peers' performance and other innate endowments. For different research objectives, the researchers and scholars may choose different sets of inputs. (Hanushek 1986)

The outcome of this function is student achievement. But the measurement of student achievement is not simple to determinate. The outcome of education is the various individuals with different kinds of abilities and qualities. In the past time, years of schooling was regarded as the measurement of education outcome. But the problem of this measurement is regardless of the quality of schooling which assumed the same schooling years produced same skills and same achievement among various schools, regions and countries. (Hanushek 2008)

The recent studies mostly used standardized test scores such as school attendance rates,

average scores (GPA), college continuation, high school attentions or dropout rates (Hanushek 1986). For reading achievement, there are measurements which could measure the reading outcome which are the reading score, reading attitude and reading motivation. In this thesis, the author used the mean of reading score of PISA 2012 as the measure of quality of Shanghai's reading education.

2.2 School Resources Effects Studies

Among the education production function inputs, the scholars mainly categorize these inputs into school resources, family background and district or community factors. Especially for the factors of school resources and family background, it has been a long debate about the effects of school resources and family background on students' performance. The researches during the past decades show controversial results (Hanushek 2008).

Some of the studies show school resources have positive effects on the students achievement (Krueger 1999; Pritchett and Filmer 1998), whereas there are also studies provided evidences that the effects are insignificant or negative (Hanushek 2008). There are school resources factors studies such as class size (Angrist and Lavy 1999) and family size (Hanushek 1992).

Education production function had been analyzed through considerable studies before 1995. According to the studies of Hanushek, among 90 individual publications contain 377 separate production function estimates, only 14% for teacher-pupil ratios and 9% of estimates for teacher education show a positive and statistically significant relationship between these factors and students' performance. Moreover, only 29% studies provide a positive and statistically significant relationship between teacher experience and student performance which means the rest 71% provide a statistically insignificant or even negative correlation. Moreover, the effect of financial resources show a similar result which means the a higher teacher's salary or general education spending does not improve the students' achievement

accordingly. (Hanushek 2008)

Hanushek provide one viewpoint that there is currently no evidence could prove the positive correlation between education resource and student performance, but it does not show education resource is not important, instead, there are also other studies showed the controversial results with Hanushek. (Krueger 1999; Hanushek 2008; Pritchett and Filmer 1998)

Some researches claimed that there are many other reasons may have deteriorated the outcome of education so that the education resources and student performance do not have a significantly positive relationship, for instance the change of family structures during the past years. More children live with single parent, more live in poverty and more has less access to books compare with the past. (Hedges and Greenwald 1996) However, another point of view that Lankford and Wyckoff (1996) pointed out is the insignificant or negative relationship between school resources and student performance happened because the additional education resources has been allocated to special education students, not the average student.

2.3 Peer Effects Studies

The importance of peer effects on students' academic achievement and behaviors had been widely accepted. But the influence of their peer group is difficult to measure. First is because it is not easy to define the peer group. The second is students often select those with whom they associate. Therefore many researches focused on the freshman' roommates/ floormates/hallmates which could be easily defined and randomly assigned in universities. (Han and Li 2009; Siegfried and Gleason 2006)

There are many studies discussed the peer effects from different aspects and used various methods. The most famous study is still the Coleman Report which covered half a million students from around three thousand elementary and secondary schools. The key findings of this report were the insignificant difference of students' achievement caused by the

difference of school resources, and the aspirations of peers in the same school and the family background strongly related to the pupil's academic achievement. (Coleman et al. 1966)

Another survey which conducted by Henderson, Mieszkowski, and Sauvageau (1978) included around seven thousand students between the first and third grades in Montreal, Canada, which also provides a cogent evidence for the importance of peer effects. This study revealed the nonlinear relationship between student achievement and the average classroom IQ score. Therefore McPherson and Schapiro (1990) suggested that mixing the students may generate higher learning outcome than separating the students according to their abilities. Moreover, many other studies provided evidences for the impact of peer abilities during recent years (Kang 2006; Foster and Frijters, 2010; Han and Li 2009).

Kang (2006) conducted the peer group study through the South Korean middle school students also proved the positive correlation between the mean score of peer group and the student's academic achievement. The compelling evidence Kang (2006) provided that the weak students interact more with other weak students than with the strong students in their group, therefore their learning could be even weaken. However, the strong perform students associate more closely with other strong students so that their academic ability can be improved by their better performing peers.

2.4 Family Background Effects Studies

The reading skills development could be influenced by parents significantly. However, what particular family background factors have significant correlations with a 15-year-olds child reading performance are vital to be analyzed for parents and teachers. The factor of family background is characterized by socio-demographic characteristics for instance parental education background, household income, parents' possessions and family size. Many studies had been conducted through different aspects of family background based on various countries' data.

Parents' education

There are many evidences showed the strong positive correlation between parents' education and children' performance. According to Akinsanya, Ajayi, and Salomi (2014), the parents' qualification has the most significant correlation with students' mathematics achievement compare with other factors such as parents' occupation and the children' academic motivation. The similar researches had been conducted by for instance Grissmer (2003), Musgrave (2000) and Taiwo (1993). Musgrave claimed that the educated parents who have more than minimum education level could more probably have a positive attitude toward the children' education and more capable to provide the materials which their children needed. Musgrave also analyzed that well educated parents are more likely have the activities at home for example reading newspapers, magazines and journals which could encourage their children to do the same. It is also more likely for the children to follow their parents' step on career (2000).

Table 2. Percentages of Maternal ISCED levels in Shanghai's PISA 2012

	ISCED category	Proportions (%)
1	ISCED level 3A	39.59
2	ISCED level 3C	17.62
3	ISCED level 2	32.23
4	ISCED level 1	6.23
5	She did not complete ISCED level 1	3.58
m	missing or invalid category	0.75

(Source: OECD, 2012, b)

The significance of parental education also could be reflected through the database that PISA provided in 2012. The Table 2 above contains the percentages of different maternal education levels in Shanghai's PISA 2012 which shows that most of the mothers in Shanghai have the education of at least ISCED level 1 which equals to the primary education. 1 to 5 states for ISCED level 3A, ISCED level 3C, ISCED level 2, ISCED level 1 and she did not

complete ISCED level 1, separately. “m” is the missing or invalid response category.

The mean scores of reading, mathematics and sciences according to 6 levels of mother’s highest schooling in Shanghai’s PISA 2012. The difference between the group of ISCED level 3A and the mothers who did not finish the basic education reached 100 points in reading. The difference in Mathematics performance even larger than 100 points and in sciences the gap is 88 points.

Figure 4 below demonstrates the positive relationship between mother’s education level and students’ academic achievement in all three subjects. It is clear from the graph that the group 1 of ISCED level 3A has the highest scores and the group 5 which the mother did not complete ISCED level 1 has the lowest scores. The same results could be found in paternal education level also. In addition, the significant differences could be found not only in Shanghai, but also in other countries as well, for instance Canada, Germany, Finland, the United States, Switzerland and so on (OECD 2012b).

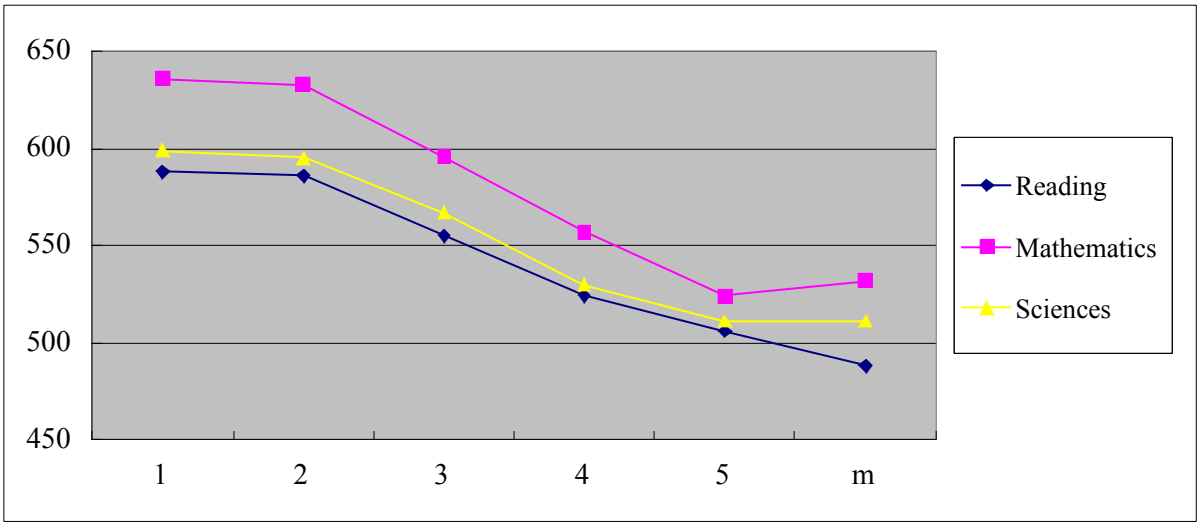

Figure 4. Maternal education levels and mean scores of Shanghai’s PISA in 2012
Source: (OECD, 2012, b)

Parents' occupations

Many researchers have disagreement about the importance of income measures, instead, the researchers concluded that a family's financial capital is more vital for the children' development (Wong 1998; Conley 1999). Family possessions and structural characteristics of the home often regarded as measurements of family wealth which is the better reflections of earnings and purchasing power during the child's development. Moreover, the household income only can reflect the family's economic environment in a specific time and the measurement of income may not be a good index for the socialism entities since the distribution of income may equalized and influence the results. (Wong 1998)

PISA collected the household possessions information in 2012 since the household income information is difficult to be collected for some cultures, for example it is not valid for Shanghai. The questionnaire asked about the parents' occupations and divided the occupations into four categories which are elementary occupations, plant and machine operators, professionals, and managers. The occupation classification defined as "Managers are considered the most highly-skilled, followed by professionals; technicians and associate professionals; clerical support workers; service and sales workers; skilled agricultural, forestry and fishery workers; craft and related trades workers; plant and machine operators and assemblers; and workers in elementary occupations". (OECD 2014c)

The report named *Do Parents' Occupations have an Impact on Student Performance?* generalized the parental occupation information and the mathematics performance, and get the conclusion that in most of countries, the students whose parents are professionals have the averagely better performance in mathematics. The exceptions are Colombia, Indonesia, Italy, Mexico, Peru and Sweden. In these six countries, the managers' children have the highest scores in mathematics. But the relationships between student performance and parents' occupations are varies across different countries. For example, the children of cleaners in Shanghai were performed better than the children of professionals in the United States in the mathematics assessment of PISA 2012. (OECD 2014c)

Moreover, the children whose parents are elementary occupations and plant and machine operators perform worse than the children whose parents are professionals and managers. Mostly the students whose parents are plant and machine operators perform better than the ones whose parents belong to the elementary occupations. (OECD 2014c)

Moreover, PISA also provided data about parental working status and students achievement. The Figure 5 below is the relationship between the paternal working status and students PISA achievement in Shanghai. It shows that the group of full-time working father has a positive impacts on the students' performance in all three assessments. It is the same case for mother's working status that the group of children whose mother working full-time has the highest mean scores in all three assessments.

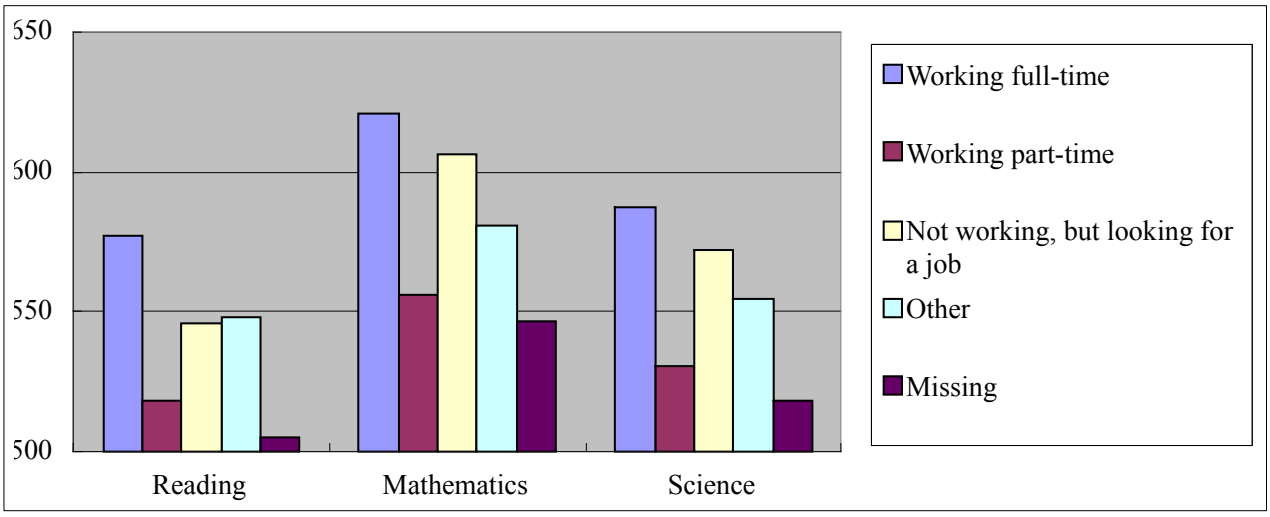

Figure 5. Paternal working status and mean scores of Shanghai's PISA in 2012
Source: (OECD, 2012, b)

Parental Involvement

For the children' development, it is far not enough to have higher education level and better jobs for the parents. Parental involvement is sometimes more important compare with other factors. It requires parents spend more time to do the activities with their children which may help the children' academic life. Parental academic involvement can be defined as parents' efforts on the activities which associated with schools and their children to benefit

their children' academic achievement and future development (Hill and Taylor 2004).

Parental involvement plays an important role during a child's development and it starts at birth and never stop. The importance of parental involvement had been analyzed by many studies which show the significant relationship (Houtenville and Conway 2008; OECD 2012a).

For the researches about elementary school students, the important parent involvement activities are for instance the contact and communication between parents and teachers, volunteering at school, the quality of parents and teachers' relationships and involvement in academic-related activities at home . For the adolescents in middle school and high school, the discussions between the parents and teachers about school and plans for their plan are more essential for the adolescents' academic development when concerns about parents' academic involvement factor. (Hill and Taylor 2004) The strong relations between parents' involvement and academic achievement had been proved by many other studies as well (Epstein and Sanders 2002; Yonezawa 2000).

In 2009, PISA focused on reading section and took numerous questionnaires regards the parental involvement and reading habits, parental education and household environment. "PISA asked parents whether they read books to their child at that age, told stories, sang songs, played with alphabet toys, talked about things the parent had done, talked about things the parent had read, played word games, wrote letters or words, or read aloud signs and labels" (OECD 2012a).

The participated countries of the questionnaires are Denmark, Germany, Hungary, Italy, Korea, New Zealand and Portugal which are OECD member countries and in Croatia, Hong Kong-China, Lithuania, Macao-China, Panama and Qatar which are partner countries (OECD 2012a).

Results from PISA show that the children with more parental involvement have better reading performance than the children without parental involvement. These involvements reflect the parents value reading which can encourage their children to read and help children

familiar with the new tasks in school. The results reveal the strong relation between reading performance and parental involvement. Among the countries listed above, except Lithuania, children whose parents read books to them in the first year of primary school are more likely to have better reading scores in PISA. (OECD 2012a)

New Zealand and Germany have the most significant difference between the children whose parents read to them in the early primary school years and the children whose parents were not, which are 63 and 51 points. In PISA, 39 points is the equivalent of one school year which means in New Zealand and Germany, the students whose parents read to them have the reading ability of at least one year higher than the children whose parents were not. This relationship between reading performance and whether parents read to the children is strong even regardless the level of family income. (OECD 2012a)

Moreover, not only the parental involvement related to reading during children' early age influence the reading achievement, but also the factors for instance whether the parents discuss the social or political issues with the adolescents. The students which discuss social or political issues with their parents tend to enjoy reading than the students who do not. This relationship is strong especially in Germany, Italy, Korea, Lithuania and New Zealand. (OECD 2012a)

Therefore for children' development, parents may have lots of responsibilities and many family factors could influence their children' academic achievement. The positive roles that parental education levels, and parental occupation levels and types are widely accepted by many cultures. Moreover, the important role that parental involvement should not be denied as well.

Students with immigrant backgrounds

Whether a student emigrated from another country and the duration lived in the current country also have influence on their PISA performance. The study shows in most OECD countries, newly arrived 15-year-old immigrant students (defined as arrived at age 12

or older) performed poorer than the immigrant students who arrived in the new country during their early age (defined as arrived at age 5 or earlier). The results show that there is no significant difference between the students who arrived before 5 and the ones arrived between 6 and 11. Moreover, the immigrant students from countries with similar levels of development and the same language do not suffer any late-arrival penalty at all. (OECD 2013a)

The reason of the immigrant family background factor is needed to be considered in Shanghai's case is because Shanghai has a large number of internal immigrant workers. They come from other provinces of China and speak various dialects which may totally different with Mandarin and Shanghai dialect. The children of immigrant workers may face different kinds of challenges when they start their new life in Shanghai. (Chen, X. et al. 2015)

Immigrant workers in Shanghai bloomed since the reform and opening up policy implemented and the number reached 8.98 billion which account for around 39% of the total population of Shanghai in 2010 (Shanghai Municipal Bureau of Statistics 2011).

There are two types of immigrants which are official registered and non-official registered. The latter type could not have the same rights as the official one and the local. In Shanghai, there are different schools for children of local residences and non-official registered immigrant workers which are state schools and private schools/ migrant schools and these schools funded by different levels of local government. (OECD 2013b) For the reasons of many barriers in both of social life and education, the students with a immigrant background could probably have poorer reading performance compare with their peers.

The studies concern about the group of immigrant workers are scant and the studies about the studies about the immigrant children are even less. Because of the residence permit limitation for the immigrant workers and their children, the immigrant children can only enroll the immigrant schools which mostly are privately funded. (Song, Z. et al. 2014) The study conducted in Zhejiang province shows that the students from immigrant schools performed poorer than the students from public schools. This research shows that the main reason of the poor performance of the immigrant children is because of the different quality

between immigrant schools and private schools. (Chen, X. et al. 2015)

The local government of Shanghai took the policy that ensure 70% of the immigrant students could attend state schools since 2011. However, due to the large number of immigrant students and scarce school resources, there are still many immigrant students attend private or immigrant schools which have much lower quality compare with the state schools. (Feng and Chen 2012) This disadvantages of immigrant students may also influence their reading performance in PISA.

Measurement of SES

Socioeconomic status (SES) has been widely used in different researches in the past decades. Numerous studies had been conducted about the relationships between socioeconomic status and children' health, psychological well-being, academic achievement and so on. However, the definition of socioeconomic status is still ambiguous. Researchers used socioeconomic status through different combinations of variables and sometimes use the SES and social class interchangeably (Sirin 2005).

The studies about the relations between SES and children' development are conducted through the belief that a higher SES family is more capable to provide their children services, materials, social connections which a lower SES family may not able to support, and these resources are essential factors which will influence their children' educational development and future (Brooks-Gunn and Duncan 1977). However, according to Mueller & Parcel, SES could be defined as an individual's or a family's hierarchically ranking based on access or control over the combination of valued commodities such as wealth, power and prestige (Mueller and Parcel 1981). While there is disagreement with the definition of SES, the three main indicators of SES had been accepted by many studies which are parental education, parental income and parental occupation (Gottfried 1985; Hauser 1994).

Parental income could reflects the potential of social and economic resources that the parents could provide for the children during their development. But it is usually indexed by

occupational status. Income is considered a volatile indicator of financial capital and many studies suggested that a combination of income and occupational status could provides a better index than use income or occupational status alone. (Bradley and Corwyn 2002)

Parental education is a factor that strongly correlated with parents' income in many cultures. The correlation between parental education and student academic achievement could be reflected through the PISA database also which revealed that in most countries that the parental education level has a positive correlation with the student performance in reading, mathematics and science. Moreover, the relation between paternal education level and PISA achievement is also positive which is enhanced the importance of parental education level. (OCED 2012b)

Moreover, parental occupation is also an important factor which could influence the children' academic achievement. Researches show that occupation and one's social network have strong relations, therefore occupational status could reflect partially social capital's indicators (Bradley and Corwyn 2002). PISA 2012 data also show that in Shanghai, the group of children whose mother and father are working full time for pay has the highest mean scores in reading, mathematics and science compare with other groups that working for part time, not working but looking for a job and others (OECD 2012b).

During the research about the relationship between parental occupations and mathematics performance conducted by OECD in 2014, in most countries, the students whose parents are professionals performed better than the ones whose parents are managers, and followed by plant and machine operators, and elementary occupations. But the results are not comparable among countries which means the children of professionals in Germany had higher achievement than the ones in Finland, and the children of cleaners in Shanghai had higher scores than the children of professionals in the United States. (OECD 2014c; Sirin 2005)

Moreover, OECD also provided the socio-economic index which includes the factors such as "parental education and occupation, income levels, (...), and the educational resources

available at home. A student's socio-economic status is also closely related with other student characteristics like immigrant background, the language spoken at home, and place of residence." (OECD 2014e) The socio-economic index of average OECD level is zero so that a positive socioeconomic index stands for relatively advantaged and a negative index reveals relatively disadvantaged. Figure 6 shows the relationship between the mean scores of mathematics and socio-economic index. It is easy to observe the fact that the socio-economic index has a positive relation with mathematics performance.

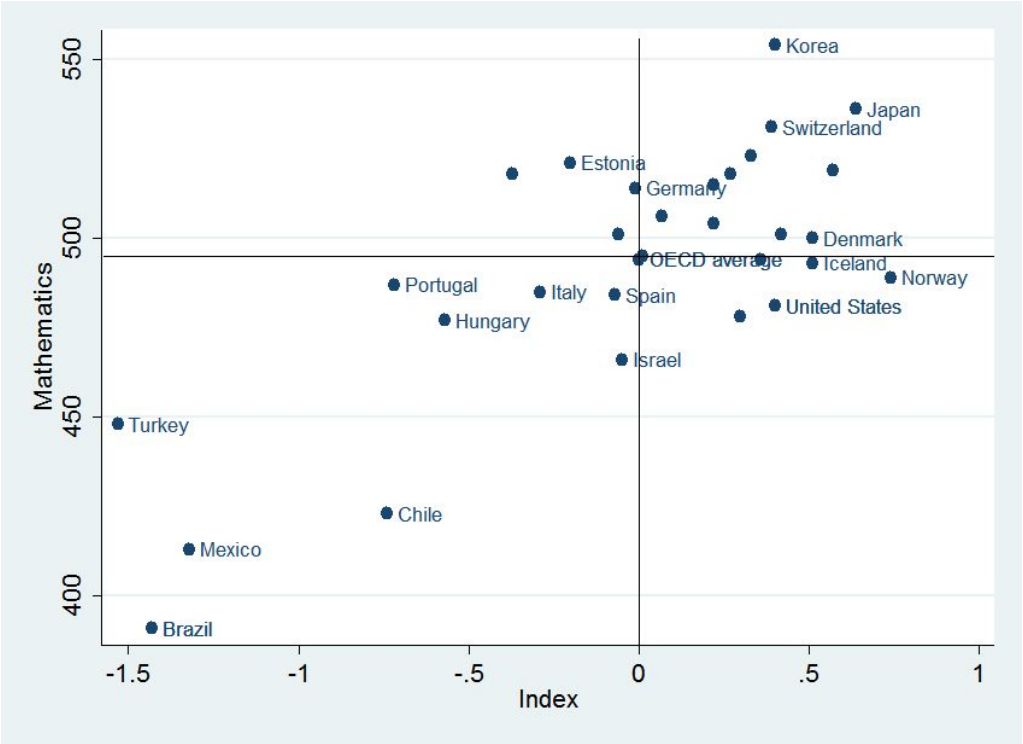

Figure 6. Socio-economic indicators and the relationship with performance in mathematics
Source: (OECD, 2013,c)

Education Production Function had been widely used during the past decades for the education related studies. The output is the outcome of education which is sometimes difficult to define. But in recent years, scholars used mainly standard scores to describe the education outcome for instance the average scores of PISA, GPA and dropout rates. Education

Production Function captured most of the variables which may influence a student's achievement which divided them into four main categories: school resources effects, peer effects, family background effects and students' innate factors.

Intuitively, each of them could be divided into more detailed factors. School resources includes the factors for example curriculum, autonomy of schools, teachers and so on. Peer group effects can conclude the relations between a student's academic achievement and the peer group's socioeconomic status, academic mean scores, average IQ, etc. However, because this thesis concerns about the family background effects on reading performance, this theoretical background introduction focused more on the family background and cited many studies based on PISA results by OECD.

Among the family background effects, the factors that may influence a student's achievement could be parental education level, parents' income, parents' occupations, immigrant background, parental involvement and so on. There are lots of studies provided cogent evidences that the parental education level, parents' income and parental involvement have significant relations with a student's achievement. Moreover, the studies also show that the impacts of parents' occupations and their immigrant background, such as in all the participated countries of PISA, the children of professionals have much higher mean scores than the cleaners' children, and the students with a short immigrant background history averagely performed worse than the local students.

In addition, socioeconomic status (SES) had been widely used by researches also. SES concerns the three dimensions that parental education level, parents' income and parents' occupations. A high socioeconomic status family is believed to be more able to provide materials, social connections and supports for the children' development.

It is difficult to measure all the factors which could influence the student achievement in Shanghai. For the analyses of family background effects on reading performance, it is also not possible to include all the family background factors. The variables chosen, data analysis and findings in this thesis will be introduced in the next chapter.

3 DATA ANALYSIS AND FINDINGS

This chapter concludes variables explanations, models explanation, regression results, findings and results interpretation.

The model used during this thesis is Ordinary Least Squares (OLS). OLS is a relatively easy method during the quantitative analysis. It could directly reveal the relation between the independent variable and dependent variable. Whereas the hierarchical regression applied during the analysis which includes eight models altogether. In addition, the standard errors had clustered by school id which considered as independently variable.

PISA index of economic, social and cultural status (ESCS) used as independent variable and log(plausible value in reading) used as dependent variable that could partly present the family background factors and the reading performance of Shanghai's PISA 2012. ESCS is a composite variable which could obtained from the OECD database. It comprised the family background factors such as home possessions, highest parental occupation and highest parental education which all have strong impacts on student achievement which had been discussed in the theoretical part already. The control variables are in both of individual and school level which are gender, books at home, preschool enrollment, and getting along with teachers, ownership, competition and percentage of government funding.

Furthermore, the regression results also show that a positive relation between the family background effects and student reading performance which enhanced the theoretical analysis. But the control variables in school level are not statistically significant.

3.1 Variables Explanation

PISA collected data based on two-stage sampling which is different with simple random sampling. Firstly schools are first sampled and then students are sampled in the participated schools. This sampling design increases the standard errors of any population estimates. In addition, PISA applied imputation methods therefore the plausible values used to present student performance. Since the analysis only concerns Shanghai's PISA 2012, the structure of the data is cross-sectional data set. The PISA index of economic, social and cultural status is the independent variable and plausible value 1 in reading is the dependent variable.

Index of economic, social and cultural status

OECD measures students' socio-economic backgrounds by using a continuous scale-PISA index of economic, social and cultural status (ESCS) which consists three components: home possessions (HOMEPOS) which comprised all items on the WEALTH, CULTPOS and HEDRES scales, such as books in the home which recorded in four categories (fewer than or equal to 25 books, 26-100 books, 101-500 books, more than 500 books); the highest parental occupation (HISEI); and the highest parental education recorded as years of schooling (PARED) (OECD 2014d).

Missing values for students for only one variable were calculated with predicted values plus a random component based on regression on the other two variables. If there are missing data for more than one variables, ESCS was not computed and a missing value was assigned (OECD 2014d).

For the OECD countries, the ESCS scores were calculated as component scores for the first principal component with zero being the score of an average OECD students and one being the standard deviation across equally weighted OECD countries. For partner countries and economics, such as Shanghai, the formula used as

$$ESCS = \frac{\beta_1 HISEI' + \beta_2 PARED' + \beta_3 HOMEPOS'}{\varepsilon_i} \quad (2)$$

Where
β_1, β_2, β_3 = OECD factor loadings
HISEI', PARED', HOMEPOS' = "OECD-standardised" variables
ε_i = eigenvalue of the first principal component
(OECD, 2014, d)

The value of this index had been standardized to have a mean of zero and a standard deviation of one across the OECD countries. Therefore a positive score stand for a student is more advantaged and a negative score indicates a more disadvantaged student. The frequency and distribution of Shanghai students' ESCS could be show from the figure below which demonstrate Shanghai is relatively disadvantaged on average compare with the average OECD countries. The mean value of ESCS is -0.38 and the index value in Shanghai ranges from the -3.63 to 2.22.

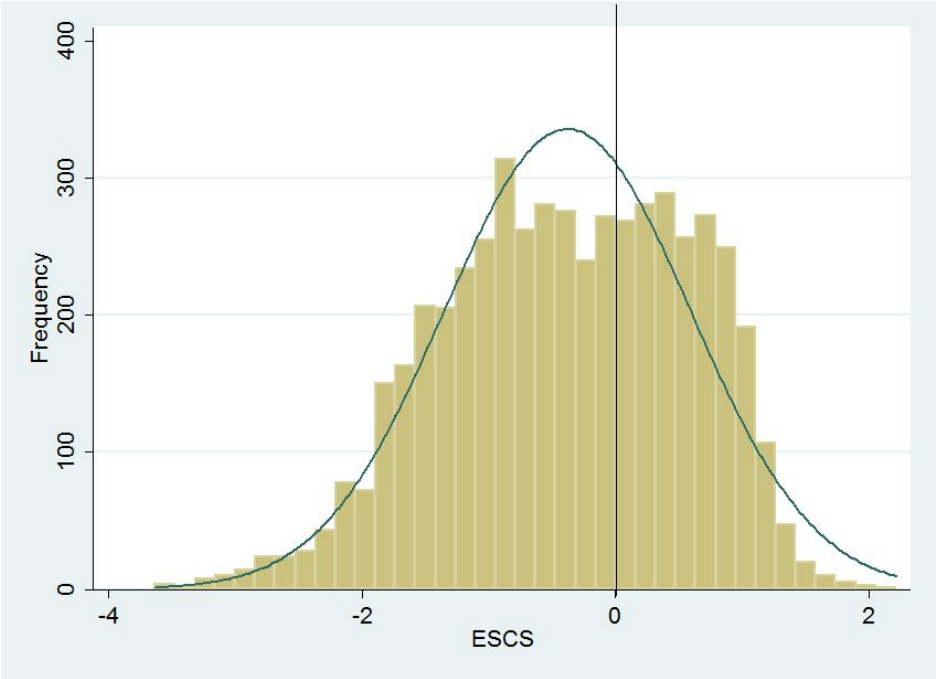

Figure 7. Frequency and distribution of ESCS in Shanghai

Plausible values

Plausible values had been commonly used in large-scale assessment which is a multiple imputation approach. The plausible value approached was developed by Mislevy and Sheehan (1989) which based on the imputation theory of Rubin (1987).

Since the Third International Mathematics and Science Survey (TIMSS) conducted by the IEA in 1995, student proficiency estimates are collected through plausible values. "The simplest way to describe plausible values is to say that plausible values are a representation of the range of abilities that a student might reasonably have. (…). Instead of directly estimating a student's ability θ, a probability distribution for a student's θ, is estimated. That is, instead of obtaining a point estimate for θ, (like a WLE), a range of possible values for a student's θ, with an associated probability for each of these values is estimated. Plausible values are random draws from this (estimated) distribution for a student's θ." (Wu and Adams 2002)

In PISA, the plausible values generation assumes a flat linear regression with all students' background variables. Moreover, homoscedasticity and normality of conditional variance are assumed as most linear models as well. Plausible values are not test scores for the individuals, instead, they are random numbers that drawn from the distribution of scores that could be possibly assigned to each student that is from the marginal posterior distribution. These plausible values contain random error variance components and not optimal scores for the individuals. The plausible values data set is more suitable to depict the performance of the population than set of scores that are optimal at the individual student level. (OECD 2014d)

During PISA 2012, OECD provided five plausible values for both of reading and science assessment and more for mathematics because of mathematics is the domain in PISA 2012. For mathematics in 2012, OECD provided subscale plausible values in such as quantity, employ, formulate, interpret, etc.

Theoretically, if an analysis with plausible values were to be carried out, then it would be taken five times with each relevant plausible values variables. The results could be averaged, and significance tests adjusting for variation between the five sets of results

computed. But for the large number of samples, chosen only one plausible value does not have big difference with use five plausible values. (OECD 2014d) In the case of Shanghai, the number of observations is more than 5,000 so that the difference between the two methods is very insignificant. Therefore, only plausible value 1 had been used during the regression analysis.

Figure 8 shows the student attainment in reading assessment. The reading scores has a mean of 567 with a standard deviation of 80 and range from 53.63 to 836.81 PISA points.

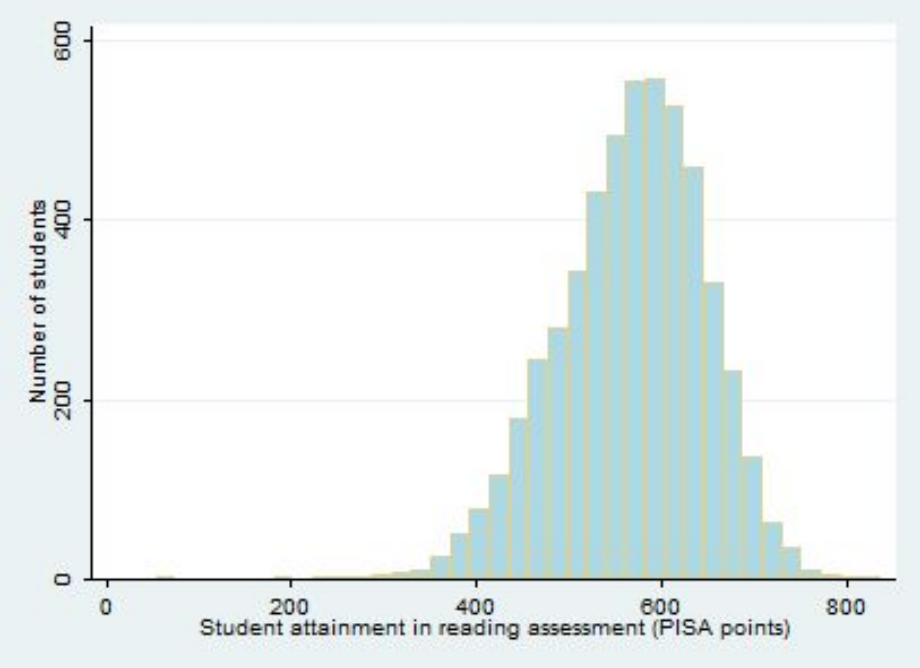

Figure 8. Student attainment in reading assessment

Control variables

The theoretical analysis demonstrate that many factors many contribute to the students' academic achievement. The statistical analysis applied control variables to examine the effects of ESCS on reading performance. The control variables include both of individual and school level variables. The control variables in individual level are gender, books at home, preschool enrollment and getting along with teachers. The control variables in school level are ownership, competition and percentage of government funding. The table 3 in the next page

provides more information about the dependent, independent and control variables.

The data set contains information on 5,167 students' plausible values of reading and their ESCS indexes for the year 2012 which collected from 155 schools in Shanghai. These data were obtained from OECD database directly. In this sample, the average plausible value 1 in reading is 567.43 points with the smallest and largest being 53.63 and 836.81 points, respectively. The mean value of ESCS is -0.38 which shows a relatively disadvantage on the average compare with OECD participants. The index value in Shanghai ranges from the -3.63 to 2.22.

Table 3:Descriptive Statistics

	Shanghai				
	# obs	Mean	Stad. Dev.	Min	Max
Dependent variable:					
Average PISA score	5177	567.43	79.92	53.63	836.81
Individual level independent variable:					
ESCS	5167	-0.38	0.97	-3.63	2.22
Individual level control variables:					
Gender(Male=1)	5177	0.49	0.50	0	1
Books at home [a]	5163	2.98	1.23	1	6
Preschool enrollment [b]	5170	1.83	0.46	0	2
Getting along with teachers [c]	3450	1.28	0.61	-1	2
School level control variables:					
Ownership(Private=1)	5177	0.89	0.28	0	1
Competition [d]	5177	1.73	0.44	1	2
Government fund (% of total)	5075	83.50	27.66	0	100

[a]: 1=0-10 books, 2=11-25 books, 3=26-100 books, 4=101-200 books, 5=201-500 books, 6=more than 500 books

[b]: 2=more than a years, 1=less than a year, 0=no

[c]: 2=strong agree, 1=agree, 0=disagree, -1=strong disagree

[d]: 2=school is competing with 2 or more schools over students, 1=school is competing less than one school

3.2 Model and Results Interpretation

The model specification is the following:

$$A_i = \beta ESCS + \sum_{i=1}^{N} I_{is} + \sum_{s=1}^{n} S_s + \mu \quad (3)$$

Where

A_i=student reading score
ESCS=PISA index of economical, social and cultural status
I_{is}= Individual level control variables
S_s=School level control variables

The equation includes the independent variable ESCS, individual level control variables and school level control variables. The analysis applied hierarchical multiple regression model and it includes eight models. Model 1 examined the correlation between log(plausible value) and the ESCS. In order to measure whether the other individual level control variables have impacts on both of the plausible value and the ESCS, Model 2, Model 3, Model 4 and Model 5 include the variables of gender, books at home, preschool enrollment and attitude towards teachers had ran separately. Moreover, Model 6, Model 7 and Model 8 include the control variables in school level which are ownership, competition and percentage of government funding. In addition, clustered standard error had used based on the variable of school identity code because the schools were chosen randomly during the test.

The PISA index of economic, social and cultural status could not reflect all the family background factors. The ESCS only captured the family possessions, highest parental occupation and highest parental education factors. The factors such as parental involvement, immigrant background discussed in the chapter 2 are not included in this variable.

Table 4: Regression results

	(1) log(PV_1) b/se/ar2	(2) log(PV_1) b/se/ar2	(3) log(PV_1) b/se/ar2	(4) log(PV_1) b/se/ar2	(5) log(PV_1) b/se/ar2	(6) log(PV_1) b/se/ar2	(7) log(PV_1) b/se/ar2	(8) log(PV_1) b/se/ar2
ESCS	0.060***	0.059***	0.044***	0.036***	0.036***	0.035***	0.034***	0.035***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Control variables (individual level)								
Gender (Male=1)		-0.043***	-0.041***	-0.038***	-0.042***	-0.042***	-0.042***	-0.043***
		(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Books at home [a]			0.023***	0.022***	0.020***	0.020***	0.019***	0.019***
			(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Preschool enrollment [b]				0.059***	0.060***	0.060***	0.059***	0.059***
				(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Getting along with teachers [c]					0.016***	0.016***	0.016***	0.016***
					(0.004)	(0.004)	(0.004)	(0.005)
Control variables (school level)								
Ownership (Private=1)						0.024	0.021	0.026
						(0.020)	(0.020)	(0.044)
Competition [d]							0.019	0.015
							(0.013)	(0.013)
Government funding (% of total)								0.000
								(0.000)
constant	6.354***	6.375***	6.300***	6.189***	6.175***	6.174***	6.144***	6.146***
	(0.006)	(0.006)	(0.009)	(0.013)	(0.014)	(0.014)	(0.028)	(0.051)
N	5167	5167	5160	5159	3441	3441	3441	3372
adj. R-sq	0.155	0.176	0.201	0.232	0.233	0.235	0.238	0.243

Note: Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

[a]: 1=0-10 books, 2=11-25 books, 3=26-100 books, 4=101-200 books, 5=201-500 books, 6=more than 500 books

[b]: 2=more than a years, 1=less than a year, 0=no

[c]: 2=strong agree, 1=agree, 0=disagree, -1=strong disagree

[d]: 2=school is competing with 2 or more schools over students, 1=school is competing less than one school

The regression results show in the table above. Whereas the result in Model 1 produced a positive correlation between ESCS and student reading achievement in Shanghai's PISA 2012. The Model 1 regression result shows that the ESCS index explains 15.5% of the variation in log(plausible value 1). Moreover, plausible value in reading increases by 6% for

every unit of ESCS changes. By adding control variable of gender in Model 2, R-square increases from 0.155 to 0.176 which means gender can explain around 2% of the variance. The negative coefficient demonstrates the fact that girls outperformed than boys in reading assessment in all participated countries.

In Model 3, the R-square increases from 0.176 to 0.201 by adding the variable of number of books at home. This variable increases 2.5% of R^2, and produces a positive coefficient of 0.023. The preschool enrollment has a statistically and positive correlation of 0.059 with the log(plausible value) and increases R^2 by 3.1%. plausible value in reading increases by 5.9% for every unit of preschool enrollment changes. However, the use of variable of getting along with teachers dropped 1,718 observations because of missing and invalid data. The results from Model 6, 7, 8 all show the statistically insignificant correlation between the three school level variables which are ownership, competition and percentage of government funding.

The figure 9 is residual-versus-fitted plot which shows the symmetrically distributed residuals and clustered towards the middle of the plot around the y-axis. It indicates that it is not clear pattern therefore model chosen is suitable for Shanghai's data.

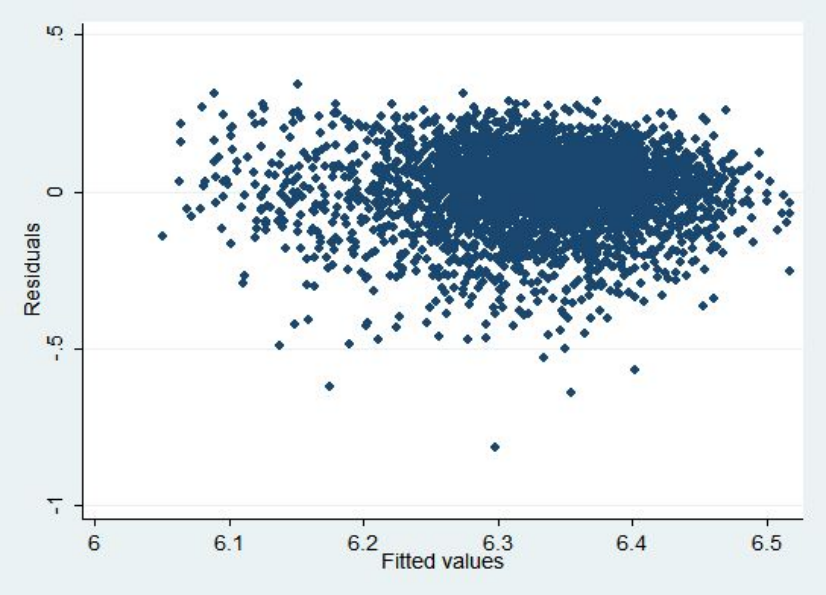

Figure 9. Residual-versus-fitted plot

The results obtained from the statistical analysis strengthened the theoretical study in chapter two that the family background has significant impact on reading performance. The purpose of education equity is to provide every student education with the same opportunity and quality. Therefore in the case of Shanghai, the regression shows that the PISA index of economical, social and culture status does not influence the local student in a high level which is 6% for every unit of ESCS changes. In addition, the control variables in school level applied in the thesis also did not show a statistically significant result and indicate the insignificant impacts on student reading performance.

CONCLUSIONS

The research objectives are whether various family background has significant impact on the student reading performance and how much it influenced in the case of Shanghai's PISA 2012?

Education production function had been the main theoretical support in chapter two. In education production function, the three main factors which influence a student's academic achievement most are the school resources effects, peer effects and family background effects. Since the research problem is concerning about family background effects, the theoretical parts of school resources effects and peer effects are more short than family background effects.

During the part of family background effects, various studies had been cited and discussed for example the parental education level, parental occupation status, immigrant background, parental involvement and socioeconomic status (SES). Among these variables, most of them have positive influences on children' academic development such as parental education level, parental occupation and parental involvement. It is easy to understand that the immigrant background will deteriorate a student's academic performance since the child may meet challenges of language and culture.

In chapter 3, quantitative research method had been used. The hierarchical regression had been applied and the two variables are the PISA index of economical, social and cultural status (ESCS) and plausible value 1 in reading. Altogether eight models had been used during the analysis. ESCS is an composed index which provided by PISA database. It consists three components that based on the following variables: home possessions (HOMEPOS), the highest parental occupation (HISEI), and the highest parental education recorded as years of

schooling (PARED). The variables could only reflect parts of the family background and reading performance of Shanghai's students. Moreover, control variables in both of individual and school level applied as well. The number of books at home, preschool enrollment, attitude towards teachers which are individual level variables have statistically significant correlations with reading scores. Whereas the school level control variables are all statistically insignificant. In addition, The coefficient between the log(reading scores) and ESCS is positive and the ESCS explained 15.5% of the variation in log(reading scores) which strongly supported the hypothesis.

By conclusion, both of the theoretical and statistical analysis had proved the hypothesis of positive correlation of family background on reading performance in Shanghai's PISA 2012. The coefficient between the PISA index of economical, social and cultural status (ESCS) and log(reading scores) is only 0.06. But the ESCS index explains 15.5% of the variation in log(reading scores). The results of statistically significant correlation between reading scores and individual level variables such as books at home and preschool enrollment indicate the importance of family background.

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