**Master's Thesis in Global Education Cooperation**

# The Widening Achievement Gap in Korea

– Evidence from PISA 2000–2015 –

한국의 교육 불평등: PISA 2000–2015
자료 분석을 통한 학업 격차에 관한 연구

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# The Widening Achievement Gap in Korea
## : Evidence from PISA 2000-2015

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# Abstract

The growing concerns with regard to whether education inequality will continue to increase in Korea are empirically examined in this research. Of several ways of defining and conceptualizing education inequality, this dissertation focuses on the magnitude of relationship between the family socioeconomic status and student's academic achievement. To examine the trends of achievement gap, the international education survey PISA (Program for International Student Assessment) database were analyzed from 2000 to 2015. The PISA data revealed that the achievement gap caused by socioeconomic background has widened during the past fifteen years.

The performances of socioeconomically disadvantaged students and low-performers have been decreased, while the advantaged students and high-performers have been benefited from their background, which were examined with the multidimensional variable of student's socioeconomic status. The alternative analysis employing book possessions as a proxy variable for student's background also presents the same trends that the students at the bottom of the distribution shows the declining results, leading to the expanding gap.

Moreover, variance among schools has been increased with within-school heterogeneity since 2000. The association between the average of school's socioeconomic status and the mean scores of school performances also has been substantially strengthened. Considered that the target population in this analysis attends high school, it may be directly influenced of the emergence of new type high schools such as independent private high school. However, the questions still remains that the reason why the

between-school difference has been decreased as opposed to the hypothesis.

The findings imply that the recent reforms for differentiated education may have led to some undesirable consequences that disadvantaged students have performed worse under the new system, contrary to their intended goals. In order to close the achievement gap, it is necessary that the new approach to help the underprivileged students experience positively in schools. The educational activities that may lack to socioeconomically disadvantaged students should be supplemented in a diverse aspects as possible as earlier stages of schooling.

**Keywords:** education inequality, achievement gap, multilevel analysis

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# Chapter I. Introduction

Increasing class inequality has recently drawn attention from the public and researchers in South Korea. Various social discourse such as the 'silver spoon' discourse and the 'give-up-three generation (*sampo* generation)' reflects widespread social concerns about social inequality. Spoon theory which stems from the well-known English idiom of 'born with a silver spoon' is based on differential opportunity structure. Also, as young generations are frustrated due to their negative and depressing reality, they give up their future with dating, marriage and parenting. It is notable that this phenomenon is a reaction to the closure of social mobility.

Income inequality supports this phenomenon with empirical evidence. According to the National Statistical Office (2017), Gini coefficient to measure income gap has been increased from 0.18-point in 2013 to 35-point which was calculated on the basis of market income in 2016. The difference between the highest and the lowest income bracket households has been increasing 1.73-fold points to 9.32-fold. The economic inequality is influential in the respect that it could expand to other dimensions such as education, labor and marriage inequalities (Shin, 2013), reproducing and persisting the social gap.

On closer inspection, it is education that is the core in inequality discourse, since education has long been seen as a powerful instrument of social mobility in Korean society (Oh, 2000). Even though it is a common that the role of education is regarded as a social ladder to move up, the perception of inequality is more prominent in Korea society comparing to other countries or the past. Moreover, academic achievement such as

particular college diploma (*Hakbul*) has been a crucial factor in determining the opportunity of life in Korea (Lee, 2007).

As survival competition among the class strata has been deepened after economic crisis in 1997, the differential employment opportunities based on diploma from elite universities have been recognized as social discrimination. Therefore, the former governments and the present government have tried to reduce education inequality, making the education issues as the priority of national political agenda. However, most of changes were concentrated on university admission policy, since it is regarded as the critical issues due to the firm hierarchy of college system. Seoul National University, Yensei or Korea Universities are at the top of this ranking, and the universities located in metropolitan area are followed. Next, national universities in the provinces, provincial private universities, industrial universities and two-year colleges are located (Park, 2004).

Since, until the early 2000s, student's test scores CSAT (College Scholastic Ability Test, *suneung*) had worked as a dominant criteria to enter the university, the different treatment based on university label was not regarded as a discrimination, but the reasonable consequence of individual effort and ability. However, as college admission policies have become diverse, new factors instead of the standardized test scores have decided admission to the top universities. Colleges have begun to evaluate students' ability with the performance data listed in the school record. Comparing to the past that all the students should prove their abilities at randomly arranged test sites at the same time, students should fill the documents with their superiority in school conferences, various academic programs and voluntary activities. The changes in this manner in which the experience

records represent students' abilities have led to the criticism of educational inequality. The reason why there are increased possibility to get influenced other factors so as to enter the top-ranked universities.

The news in July 2017 reported that the opportunities to accumulate academic performances in high school are given only to high-ranking students in their grades. (SBS News, July 07. 2017) This situation has been further exacerbated by the strengthening of school accountability policy which evaluates schools with the admission rate of the top-ranking universities. As the teacher working in public high school in that news report stated, "In order to take high ratings in school evaluation, it is the best strategy to invest to students who are more likely to enter the top universities". The low-performers have been restricted their opportunities to participate activities which could be documented in school records by teachers in this reality. Even though shadow education could make up for lack of chances from schools, it is only for the students who can afford to pay tuition fees.

It has been reported that the students who have high grades or the rich have entered the elite universities more than before, as the admission policy has diversified. Deduced from the situation, is it possible to say that increasing education inequality is attributed to the change of university admission policy? However, the diversification in college admission policy was intended to give more opportunities to disadvantaged students. Then, does the actual policy application show the reversed results from the original intention?

The education inequality discourse in Korea is concentrated on the

tertiary education (or the admission system of tertiary education), since college diplomas function as strong capital in Korean society. However, given that the fixation of the elite track starting from the pre-primary education so called English Kindergarten to autonomous private high school (*jasago*) or special-purpose high school (*teugmoggo*), educational inequality may begin not from the tertiary education, but from the more previous stages. It is therefore necessary to examine one step further from focusing the direct phase of entry into hierarchical university system. Moreover, it is also important to analyze how the academic achievement gap has changed over time during the past decade.

### *Research Challenges*

Interestingly, despite the growing criticism of education inequality in Korean society, previous studies have addressed that Korea is a relatively equal society with empirical evidence. The OECD reports which analyzed the PISA results cited Korea as an exemplary case where average test scores is high, while variance is very small, guaranteeing education equity (OECD, 2012). The other studies using educational Gini coefficient also found that Korea shows increasing equality from 1970 to 2000 (Burt & Park, 2008). Ilon (2011) presents the same results that there was a substantial reduction in educational attainment inequality in the last 60 years in Korea, employing the World Bank specification suggested by Thomas, Wang and Fan(2001).

It is questioned that the reason why Korean perceive education inequality is intensifying, notwithstanding Korea is reported as an equal society in terms of equality of opportunity in education. Does the Millennial

generation feel that they are no longer able to climb on the class ladder through school education, unlike their parent's generation, boomers who enjoyed the benefits of standardized education system and have been actively moving up the ladder? Or may it be explained by the law of diminishing marginal utility as inequality widens as fast as the rate of rapid economic growth? Otherwise, those who experienced that disintegrated society within a single generation are more sensitive the inequality, because, after colonial period and the Korea War, the individuals got compensated immediately and definitely according to their efforts in the shuffled-class system.

In this study, I will analyze the education inequality in Korea since 2000 with empirical evidence. The previous studies focused on diagnosing the biased situation in income or wealth structure or identifying people's perceptions on social inequality (e.g. Kim, 2000; Lee & Yoon, 2006; Lee, 2008; Nam, 2015; Lee, Kim & Choi, 2016 etc.) Despite many researches in the sociology of education tried to examine the socioeconomic gap in academic performance, few studies have empirically examined how this gap has changed over time (Byun & Kim, 2010). However, it is important to analyze that the widening gaps in academic achievement have been fixed due to family background at the secondary school level which is not direct preparation stage for college entrance.

***Purpose***

The purpose of this quantitative descriptive research study is to examine education inequality in Korea. This dissertation follows the previous

research which have been observed that persistent advantages of children from affluent families over children from socioeconomically challenged families in education across countries and over time (cf. Boudon, 1974; Blossfeld and Shavit 1993; Muller and Karle, 1993). One of the useful way to assess education inequalities is to examine the magnitude of relationship between students' socioeconomic background and their academic performance (OECD, 2007; Willms, 2003; Willms, 2006). Consequently, this research explores the year variation in the effect of family socioeconomic background on academic achievement, drawing on an international educational survey, PISA (Program for International Student Assessment) database.[①]

The PISA data is useful not only to examine the gap of academic achievement, but also variance among schools, considering time series analysis. However, there are few studies to focus Korean case, employing PISA surveys. Moreover, the reports from KICE (Korea Institute for Curriculum and Evaluation) which is the agency takes in charge of PISA test also shows superficial results, not revealing the implications from the PISA results and the OECD's reports have spotlighted international comparisons. Thus, this dissertation is expected to contribute to the literature of education inequality with careful analysis on Korea.

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① PISA is appropriate for this research, since it does not assess how well the student has performed the curriculum, but it measures the general knowledge and skills in reading, mathematics, science and so on, after finishing compulsory education.

### *Research Questions*

The research questions for this study have derived from a review of the literature. The research study focused on providing the answers to the following research questions:

1. Have education inequality increased in Korea? In other words, has academic achievement gap been widening between socioeconomically advantaged and disadvantaged students or between high- and low-performers?

2. If the empirical evidence supports the Korean's perception on increasing education inequality, which group have contributed to widen the achievement gap among advantaged and disadvantaged students?

### *Hypothesis*

As plausible institutionalized mechanisms, I posit that the role in educational inequality in academic achievement by family origin is to condition the opportunities and incentives for family intervention in the educational process, influencing parental decisions about whether and to what extent to exercise their competitive edge (Uno, 2013). It is related to the most widespread views are that parents from a high social background are likely to invest more and better in human capital (Becker, 1964) and face fewer credit constraints (Becker & Tomes, 1979; Becker & Tomes, 1986).

On the other hand, there is a well-known sociological approach, which is Bourdieu's cultural capital reproduction theory (1977, 1984). Bourdieu

conceptualizes the dimensions of family background in terms of different forms of capital and stresses how the possession of one form of capital may influence the chance of having others. According to him, socioeconomic inequalities in education persist because highly educated parents give their children a better understanding of the dominant culture and an ability to act within it (Martins, & Viega, 2010).

There are various ways that student's background influences to not only opportunities but also academic achievements. I argue that the competitive advantages of higher socioeconomic families have been enhanced, increasing inequality. Since higher returns for educational success intensify the family's investment in child's education. This inequality issue is not a problem of particular country. Even in Korea, which relatively guaranteed equal opportunities for education, the effect of family background have been stronger, restricting class movement to upward.

I pay special attention to Korean case in PISA survey in order to examine these possibilities: 1) achievement gap caused by family background has been widening in Korea, 2) academic performance of disadvantaged students and of low-performers have been declined with increasing achievement gap, and 3) variance among schools has increased over time. I challenge the analysis of the previous studies which insist education equality has been guaranteed in Korean society, by examining PISA database from 2000 to 2015. This research will compare the influence of family background on academic performance over time. It will also be tested whether the academic gap is attributable to the rich or high-performers. This work will contribute to the policy makers, as offering the

empirical evidence on expanding educational inequality[②].

### *Organization of this dissertation*

This dissertation consists of five chapters including this introduction, and the remainder is organized as follows. In the next chapter, Chapter 2, I review the previous researches on education inequality. A brief description of the distinctive features on Korean education and the alterations from recent education reform are also described. In Chapter 3, I introduce the main data source for student performance of this study, PISA 2000 to 2015. The target population, sampling method, and key variables are described. The statistical strategies for this examination are also explained. This serves as introduction to the following chapters, which examines the trends of achievement gap which depends on student's socioeconomic status. Chapter 4 presents the results of analysis, applying the analytic strategy of this dissertation to statistically examine education inequality in Korea from 2000 to 2015. In the concluding chapter, Chapter 5, I summarize the findings from previous chapters and discuss their implications. Also, possible future research directions are suggested.

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[②] It is important to note that this research tried to avoid evaluating educational reforms or specific education policies. This study focused on the observation and analysis of phenomena in terms of inequality. As Molander (2016) insists, the failure of policy application is due to incomplete knowledge of operational mechanisms. Therefore, I would suggest to postpone the evaluation of education policies after accumulating through studies on education inequality.

# Chapter II. Literature Review

The previous research on education inequality are reviewed in this chapter, before analyzing the trends of achievement gap in Korea. The main findings from previous international studies build a case for why student background characteristics have to be taken into account to explain the differences in academic performance. These research argue that socioeconomic status prove essential for understanding the inequality reflected in academic achievement (Carnoy and Marshall, 2001; Fertig, 2003; Willms, 2003; OECD, 2004; Woessmann and Fuchs, 2007). This chapter will explore the historical and current research and publications regarding the impact of socioeconomic status on the academic achievement of students, and institutional changes through education reforms. Attention and analysis will also be given to background information on Korean education system and the most recent major educational system reforms in Korea.

## 1. Education and Inequality

### 1.1. Academic Gap: The Importance of Achievement Differences According to Social Class

Academic gap tends to be used instead of educational inequality in the similar context. This is because both academic gap and educational inequality are the concepts raised from the same problem consciousness. However, in the strict sense, there are differences between the two concepts. Educational inequality is ideological, philosophical, and symbolic, while academic gap is phenomenal, actual, and visible (Kim, 2003). If student's achievement originates in social condition and circumstances, not in the

individual ability, this is linked to the problem of educational inequality. That is, when the differences of academic performance are fixed and unequally distributed according to social strata, this differences lead to social inequality.

The notion of ‘academic gap’ implies that it is not a simple difference of academic achievement but a segmental enlargement of educational inequality based on social class. For instance, it is not an essence of concerns that the difference between the highest and lowest points in the distribution of test scores increases from 50 points to 100 points. Even if the score difference is 100 points, there is a possibility that there is little difference between the lower class students and the upper class students. Or even if the score difference is only 10 points, the difference may reflect all of the differences by class hierarchy. Therefore, it is meaningful to analyze how academic gap has been changed according to the student’s social class.

As the meaning of education equality extends to equality of opportunity, equality of conditions, and ultimately to equality of consequences, the range of academic gap has expanded as well. The efforts to resolve the academic gap initially focused on reducing differences in school enrollment opportunities. The gap between schooling opportunities was largely resolved by expanding ordinary education, thereby reducing differences in educational conditions such as school facilities and the quality of teachers has emerged as a major issue. One step further is the effort to reduce the gaps in achievement outcomes. It is phenomenon that the purpose of education is not just to go to school, but to ensure that everyone reaches a certain level of achievement. In this sense, academic gap can be defined as a comprehensive concept including the gaps of opportunity to access education, the gaps in the process and conditions in which actual

educational activities take place, and the gaps in the results obtained through education (Lee, Kang & Kim, 2004).

The related research on academic gap has mainly been concentrated on the educational achievement, since academic achievement is influential to educational transition. As it is a decisive impact on social status acquisition that a student proceed to what school in the next level, the difference of academic achievement has a dual meaning of the gap of educational outcome and the gap of educational opportunities. Accordingly, the efforts to close the gap of academic achievement is also a preliminary effort to reduce the difference in educational opportunities and circumstances. For this reason, this dissertation focuses on student's academic achievement to analyze the trends in education inequality in Korea.

A key issue that a number of researchers have sought to clarify the cause of academic gap was the question of whether the academic achievement gap is caused by the socioeconomic background of the students or by the school. After that public school systems had closed the gap on school attendance, the focus of gap has shifted to the quality of education, which was being measured by scores on standardized achievement test. The literature have pointed to consistent and persistent socioeconomic-related educational inequality, albeit with significant intercountry differences (cf. Breen & Jonsson, 2005; Erikson & Jonsson, 1996; Shavit & Blossfeld, 1993; Daouli et al., 2010; Rumberger, 2010).

### 1.2. Socioeconomic Status and Academic Achievement

Achievement gaps are associated negatively with measure of educational attainment, employ opportunities, and earnings for certain students, and damage the economic and social fabric of society, undermine civil rights

and social justice for a growing segment of the population, and destroy the right principles of democracy (Murphy, 2010). Furthermore, the capabilities of the future workforce are threatened when sufficient number of students do not achieve at high levels. In this sense, a large body of research continues to explore the effects of inequality on student achievement. Educational research, particularly, has repeatedly fond a correlation between socioeconomic status and student achievement (Schulz, 2005).

The landmark Coleman Report (Coleman et al. 1966) delineated numerous socioeconomic factors that are responsible for substantial portions of the variance in student achievement. The publication of the Coleman Report and the subsequent study by Jencks et al. (1972), which included reanalysis of the data used by the Coleman Report have shocked scholars as well as the public by indicating that difference in family backgrounds is more important to academic achievement than the resource variation across schools. However, the findings of Heyneman and Loxley (1983) have raised concerns about the applicability of Coleman's claim to other context and called for careful consideration of the role of the broader national context to understand the relative importance of family background and school quality in academic achievement. Despite the large quantity of research on this topic, no consensual agreement seems to have been reached among educational researchers. This section concentrates on the previous studies on the list of family background that have been shown to influence academic achievement.

A number of studies have focused on finding proper and adequate ways to examine the factors which are influential to academic achievement, thanks to the increasing availability of data. A good measure of socioeconomic status (SES) and other background characteristics is crucial

because family background factors have been noted as the strongest correlates of student performance (Coleman et al., 1996; White, 1982; Hauser and Sewell, 1986; Baker, Goesling, and LeTendre, 2002; Rothstein, 2004; Sirin, 2005). These research address that the impact of family's socioeconomic status on children's educational outcomes is deterministic and it plays a role in intergenerational transmission of status, through the transmission of financial capital, cultural resources, and social capital from parents to children.

Researchers have sought ways to effectively measure the impact of family background factors on educational success. Some noted that SES is a complex and multidimensional concept and thus a single composite measure of SES could create ambiguity in interpreting research findings (White, 1982; Sirin, 2005). Moreover, since many of the student's background factors are highly correlated and heavily confounded, Sirin (2005) argued that the strength of these variables on achievement depend on which set of family-related variables are included. However, researchers who are mostly interested in the mediating role of SES factors on academic achievement, usually combine parental education, occupation, and income variables in to a single composite measure of socioeconomic status (c.f. Bushmann, 2002).

Socioeconomic status which is measured by the tripartite measures, parental education, parental occupation, and parental income, are highly interconnected. The results of meta-analyses conducted by White (1982) and Sirin (2005) confirm that SES is one of the strongest correlates of successful performance. Parental income is also highly correlated with academic achievement. Poor students living in high-poverty communities, as compared with their counterparts residing in communities with lower rates of poverty, have limited access to jobs and high-quality public and private

services, including child care, schools, and community centers (McLoyd, 1998). Among the tripartite SES factors, Blau and Duncan (1976) address that a father's education and occupational status explain the son's educational attainment and that the father's education, occupation, and income explain the son's occupational status. Sirin (2005) also found that parental education is the most commonly used SES component and important predictor of academic achievement.

Studies were conducted in a range of countries to examine the role of social origins in determining educational and occupational status and mobility (Buchmann, 2002). This research noted that the systematic approach to the measurement of family background factors in the sample of international literature. For instance, occupational status is measured via scales that have been developed to generalize the prestige associated with occupations across a wide range of societies. The International Standard Classification of Education (ISCED) and the Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) categories were used extensively to measure and facilitate comparative research on social stratification and mobility. The importance of including mother's education has received attention, particularly in cases where males are absent from the household, and in many cases, mother's education is used as a measure for parental education. For now, researchers use the higher of the two parents' education levels as a measure of parental education.

Moreover, parents can provide supervision and emotional support as human resources, and be role models affecting children's educational and occupational prospects, social behaviors such as manners and language, as well as daily habits including reading and studying. As cultural and social resource, parents' own knowledge, experiences, and social skills and

connections can be actively utilized and differentially shape how they get involved or guide their children's schooling. Higher SES parents are often to be more aware of how the school system works as well as how their children are doing in school (Baker and Stevenson, 1986; Lareau, 1987, 2002, 2003; Useem, 1992; Teachman, Paasch, and Carver, 1997; McNeal, 1999; Sandefur, Meier, and Campbell, 2006). Dominance of middle-class cultural knowledge and styles in school has also been well-documented (Bourdieu, 1997; Bourdieu and passeron, 1977; DiMaggio, 1982; DeGraaf, 1988). These socioeconomic advantages clearly indicate that differences in resources at home and their application could be a key in accounting for differential achievement across social classes.

Increasingly, researchers, policymakers, government officials, and educators deepened their discussions of student achievement beyond the context of simple overall nationwide average scores on standardized tests, taking advantage of the recent improvement in large-scale international education surveys with a variety of standardized measurements of academic performance, family background, and school characteristics, such as the Trends in International Mathematics and Science Study (TIMSS) , the Progress in International Reading Literacy Study (PIRLS), as well as the Program for International Student Assessment (PISA) which I use in this dissertation. Existing evidence from recent comparative studies using international surveys are generally consistent with the claim that achievement gap has widen for the impact of SES effects. Students from different family background have different experiences and access different resources. Children from a socio-economically disadvantaged background and environment may find it difficult to acquire basic skills and achieve academically (Egeland & Abery, 1991; Egeland & Kreutzer, 1991). Since a

poor family cannot provide enough educational resources for children and offer necessary assistance for children's cognitive development. Children living in poor families with incomes below the threshold have substantially lower test scores than those of children living in families with income.

On the other hand, compositional effects of school suggest that students' SES may have significant impact on their learning experience at school as well. Specifically, contextual effects refers to collective properties of the student body due to its composition. It is common to capture them by the aggregate of students' background characteristics. They are a reflection of school's intake and it has been argued that the social composition of the student body influences the norms and expectations that students internalize, learning habits, teacher's expectations for students, and the access to social resources, including peers and their families, which in turn significantly affect performance (Coleman 1988; Buchmann & Dalton 2002; Carbonaro 2005; Rumberger & Palardy 2005). Given that the effect reflect the student body, irrespective of their exact mechanisms, either through facilitating differential normative environments or shared learning experiences, they underscore that what students bring into school has a significant impact on their learning experience at school. That is, family SES influences academic performance not only through shaping the kinds and amount of opportunities to be provided at home but also through shaping the learning environment at school. Thus, it is necessary to examine what extent those family SES effects are direct effects taking place at home. I will analyze both contextual and individual SES effects in an attempt to further clarify the association between institutional arrangements and home advantages in learning.

## 2. Education Reforms: Neoliberalism as a school reform strategy

Education has the potential to reduce social stratification, since educational attainment is the primary pathway to social mobility and financial security (Blau & Duncan, 1967). Not all social groups, unfortunately, have equal access to educational opportunities. Research in social stratification examines inequality of educational opportunity to understand how and why stratification persists (Pfeffer 2008, Bar Haim & Shavit 2013, Torche 2005). The previous research revealed that educational opportunities are linked to race, sex, and class (Breen & Jonsson 2005). To eliminate the inequalities of education, initial reforms in the 1950s had tried to equalize educational opportunities by desegregating schools and by providing more resources to impoverished schools.

School reforms aim to weaken or eliminate the link between race, sex, or class and educational opportunity, in hopes of reducing social stratification. However, education inequality persists. Subsequent reforms sought to equalize opportunities by creating uniform standards for all schools. These reforms have varied in their effectiveness, and educational inequalities have persisted (Brathwaite, 2015). Current reforms use a neoliberal strategy to equalize opportunities and weaken the impact of student's socioeconomic status on academic achievement.

This chapter will discuss neoliberalism as a school reform strategy to understand how education reforms impact inequality is critical to improving the life changes of the most disadvantaged populations. I argue that neoliberalism does not target socioeconomic equity, and the series of reforms based on neoliberalism have facilitated the reproduction of inequality. In fact, there are evidence showing that the implementation of

neoliberal reforms may exacerbate inequality in low performing schools (e.g. Booher-Jennings 2005, Jennings & Sohn 2014). A great deal of tax and time has been allocated to the reforms, since reforms require extensive changes surrounding data collection, testing and the overall operation of schools. Nevertheless, the education reforms shaped by a neoliberal ideology have exacerbated inequality, it is necessary to understand whether or not the neoliberal strategy works and for whom.

Neoliberalism is an ideology that currently guides the reform of public services. Philosophy of liberalism developed during the enlightenment era of the late 18th century. This era marks a power shift from hereditary privilege, caste, tradition and religious rule to individual people with the right to own property and to pursue their own personal interests. This individual power is perceived as a civil and moral right of all men and one that government should not minimize or interfere with. Liberalism begets deregulation to promote the individual's right to manage his or her own affairs and a limited role of the state in social transactions.

Neoliberalism is a modern adaptation of liberalism. Neoliberalism is described as a theory and an ideology that maximizes profit relying on free competition in the market and requires nations to implement open market, free trade, and economic liberalization. Neoliberalism promotes small government, which provides minimum social welfare programming and places increased responsibility on individuals. On the basis of Laissez-faire economic policy, neoliberalism considers that the market system appropriately works itself to stimulate free competition in the market, and thus it is unnecessary that governments intervene in order to promote free competition in the market.

The neoliberal argument rest on several underlying assumptions: a strong

faith in the justice and fairness of market, individualism and choice (Apple, 2006). In a free market, people should have the power to choose between several options for all social transactions. According to this logic, competition between public organizations will maximize the quality of public services available. Competition between these options allows for the seemingly natural elimination of businesses or services that are ineffective or inefficient. Organizations and also people should be based own their own merit and effort to survive. This faith in choice and free markets assumes that all individuals are self-interested, and will make rational decisions in their best interest if they have complete information about all of the options available.

Neoliberals believe that free markets are neutral and the use of individual choice will insure that resources that resources and services are distributed equitably to suit the needs of all. They also believe that the state has a duty to regulate the efficiency of public service provider, to achieve the optimal effectiveness (Apple, 2006). In this sense, they argue that the strategy of free market reduce inequality. The rise of test-based accountability systems and school closures are examples of this philosophy at work. The role of state under current reforms is to make sure that schools are optimizing student achievement and attainment and to hold them accountable for this goal. This is supposed to insure over time that all schools are of adequate quality, thus minimizing inequality. The effort to privatize public services redirects attention from funding and systemic issues that can cause inequality to the efficiency of the service provider (Apple, 2006).

The book, Politics, Markets, and American Schools published by Chubb and Moe in 1990 caused a shift in educational reform discourse towards neoliberalism. The authors build on literature finding that private schools

have better performance than public schools (Coleman, Hoffer and Kilgore, 1982), arguing that bureaucracy undermines the potential for public schools to operate effectively. Chubb and Moe (1991) suggested the solution that parents should have the same power over schools that they have in private schools: the power to switch, and they promoted a new type of school. This school has little state involvement and bureaucracy. They can accept and expel anyone they want, there is no tenure for teachers and they are accountable to not the state, but the parents. The authors argue that the quality of public education could be developed by treating the schools as business. This argument reshaped educational discourse so that school reform is now dominated by the use of market logic.

Scholars have argued that reforms using accountability and choice systems are an attempt by the middle class to alter the rules of competition in education so as to provide an advantage for their children in the face of rising economic uncertainty (Feigenbaum & Henig, 1994, Darling-Hammond, 2000). Constantly raising the bar for educational achievement and attainment is a mechanism by which low income and minority students are continually denied access to the potential for social mobility that is afforded by increasing one's attainment (Bourdieu, 1973). Market logic privileges those with higher levels of knowledge and material resources, and helps to maintain inequality (Apple, 2001).

However, the neoliberal ideology has influenced education reform as early as the 1980s. Neoliberal reform was introduced on the heels of the civil rights era when reform policy and federal aid was aimed at improving the opportunities available to the poor and to minorities. The conservative neoliberal ideology promoted individualism and aimed to privatize the distribution of public services and goods such as education and health care.

Neoliberal education reform took full effect during the 1990s and early 2000s. Neoliberal strategies in education focus on high-stakes accountability, increased assessment, and school choice. Under neoliberal reform, schools are mandated to increase the number of assessments they administer and are penalized or rewarded according to student performance. Schools are then classified by this performance, and this classification serves as a measure of school quality for parents when selecting schools.

Neoliberal reforms rely on parents having complete information about schools and their right to choose schools rather than attend a zoned school. Choice is intended to reduce the connection between neighborhood of residence and school quality, so that students living in poor or segregated neighborhoods are not relegated to the worst schools. Furthermore, while the rules surrounding school choice reflect an increase in required knowledge that benefits advantaged students, neoliberal reforms result in a decreased level of skills for disadvantaged students. Under neoliberal reforms, the prevalence of testing reshapes the curriculum in low-performing schools are exposed to a wider variety of knowledge and critical thinking skills (Giroux, 2012). Schools implicitly impart educational skills and ideas that reproduce social inequalities.

Neoliberal reforms are not directly aimed at reducing inequality. Neoliberal policy assumes that choice and competition between schools will lead to reduced inequality. Neoliberal policies do not provide a direct mechanism for reducing inequalities between school outcomes or for reducing segregation. Moreover, Neoliberalism ignores structural inequalities in access and opportunity, and shifts responsibility for high-quality education from the state to the individual. Neoliberal policy creates an illusion of meritocracy, where all students are perceived to have equal

access to a high-quality education. Given this perceived equality of opportunity, poor outcomes are attributed to individual decision making and not the state or any existing racial or socioeconomic inequalities.

## 3. Background on Korean Education

### 3.1. The expansion of educational opportunities in Korea

It has been widely recognized that South Korea (Korea, hereafter) approached its educational system as a crucial basis of economic growth and social development (Green et al., 1999; Jeong & Armer, 1994). Korea shows impressive achievement in educational record comparing to other developing countries with a similar level of income per capita in 1950s. The enrollment rate reached 83 percent in 1954, 96 percent in 1959 (MOE, 1988). Since the Lee Seungman regime (1948-1960) provided universal and uniform basic education in a relatively short period of time as a response to the explosive social demand for basic education (Park S. 2010), primary education became universal in the 1950s. The same level of educational achievement can be found only in those countries with per capita incomes that were three or four times higher (McGinn et al., 1980).

Also, it is notable that the Korean case shows that access and equity can be achieved at the same time. The educational policies have been used as effective tools for social integration and the mobilization of broad societal support (Cheng, 1992; Doner et al., 2005; Green, 1999; 2007). A series of egalitarian educational policies have guaranteed educational opportunities for all. The rapid expansion of education is accounted for synergies of multi-facets. Accordingly, this sector presents the expansion of educational opportunities from the three points of view: education system, educational

policy, and sociocultural factors.

### 3.1.1. Education System: The high level of standardization

Korean educational system is characterized the standardized and uniform structure (Park, 2013), since the central government has had primary responsibility over policies and administration in education system. The Ministry of Education (MOE, or its variants), at the central government level, regulated school operations including enrollment, tuition fees, curriculum, teacher recruitment, school facilities and instruction methods. (Muta, 2000; Kim, 2002; Park, 2007) MOE also has direct jurisdiction over both local education authorities and higher education institutions.

The local government authorities (LEAs) have followed the instructions from the MOE at the provinces and municipalities level. This system made Korean education effective in resource mobilization and allocation at the early stage of educational expansion. The LEAs were the main vehicles through which K-12 educational plans and policies were implemented. Before declaring the Local Education Autonomy Act in 1991, the LEAs had little autonomy over financing, staffing, and setting rules or regulations. (Kim, 2002)

Above all, the high level of educational standardization is exemplified by nationwide college entrance exams and common curricula designed to prepare students for the exams. The students who want to apply for universities take the national college entrance exam called the College Scholastic Ability Test (CSAT) which is nationally standardized test administered by the government once a year. The CSAT score, along with a high school transcript, is the decisive element for admission to all universities. (Park, 2013)

In this highly standardized system, there are no between-school tracking at the level of elementary and middle school, which are comprehensive and compulsory. That is, Korean students in elementary and middle schools were exposed to uniform curricula and a similar pace of instruction both within and between schools, regardless of their ability levels. (Park, 2013) Moreover, Korean students promote to the next grade with their age peers regardless of academic performance, since the grade retention which is students who have not achieved a required level of achievement have to repeat the same grade (Park & Sandefur, 2010) has never been practiced before.

The previous studies analyzing Korean education system show the results of significantly small variation between schools in student performance (Beaton & O'Dwyer, 2002; Marth, Mullis & Gregory et al., 2000; Park, 2010). Consequently, the high degree of homogeneity across schools in terms of school quality and student performance is the most distinctive feature of Korean education. Since 1974, the 'High School Equalization Policy' has been implemented, students are randomly assigned to high schools, regardless of schools are public or private (Park, 2013). All schools have to accept high school entrants assigned by lottery, and students also have to accept the schools assigned by lottery. Although it is possible for students not to comply with the random assignment, non-compliance is very limited (Park, Behrman, & Choi, 2013).

#### 3.1.2. The Educational Policy based on Egalitarianism and Equalization

Since the modern school was first introduced, Korean education system has developed with egalitarianism. From the beginning of the expansion

process the government has tried to ensure equal opportunity for all, regardless of gender, religion, geographic location or socioeconomic status. (Kim, 2002) The Korean developmental state implemented egalitarian educational policies that were primarily geared toward social integration between the late 1960s and the early 1980s. In public policy this egalitarian ideals was expressed as 'uniformity of education'. As the debates over the Education Law illustrated, there was a strong belief in universal education opportunity. This idea stemmed from the spread of egalitarian and democratic ideas that rejected the rigid and largely hereditary class structure. (Seth, 2005)

It is hard to say that Korea education has developed into equalization policy based on egalitarianism. However, the educational policies practiced during Park Chunghee regime (1961-1979) have had a considerable impact on the subsequent policies based on equalization. It is notable that the Park's regime was the military authority, and education was believed to serve a sociopolitical purpose of the nation. The Park regime was very sensitive to the growing social gaps among the general population and greatly concerned about the excessive competition of elite schools (Park S, 2010). Since, severe educational competition made Korean students increasingly selfish, working against the government's efforts to produce 'desirable Koreans' who were supposed to 'love their motherland and cooperate with one another' (Seoul Shinmun, Feb 28. 1973), which could be a hindrance to keeping dictatorship.

In this sense, the educational policies during Park Chunghee regime (1961-1979) underlined the role of education as an important means for social integration (Office of the President, 1969). The implementation of equalization polices was a tool of social integration to maintain political

stability. Accordingly, the equalization policies such as the Middle School Equalization Policy (MSEP) and the High School Equalization Policy (HSEP) were enforced to discipline educational over-competition among the Korean middle classes. During the period of rapid economic development, the fierce competition to enter elite schools or colleges created serious educational and social problems. For example, private tutoring became rampant in Korean society, threatening the normal operation of the formal schooling system. (Park S, 2010)

The Park regime took extraordinary measures in educational reform, which would be almost unthinkable in other societies (Park S, 2010). In 1968, middle school entrance examinations were completely abolished, and students were allocated to middle schools within their school districts through a lottery system, which is called the Middle School Equalization Policy (MSEP). The first-tier elite middles schools which were considered the main source of excessive educational over-competition, were systematically targeted by the state, and then converted to general high schools (MOE, 1998).

The HSEP also purposed to tackle the main source of the problem by breaking down the hierarchy among Korea's high schools. All schools, whether public or private, had to give up their right to select new students and were required to take all students assigned by the Ministry of Education through a district-wide lottery. The difference in the amount of tuition between public and private high schools was leveled by the state, and private schools became in fact quasi-public in terms of financing and governance. Public school teachers were also shuffled around to eliminate between-school differences in teaching quality. The Park regime established a 'School Evaluation Committee' to have oversight the progress in the

implementation of the HSEP in each board of education (MOE, 1988).

The implementation of the equalization policies by the Park regime certainly gave a boost to the educational expansion in Korea in the late 1960s and the 1970s, which again facilitated economic development by providing a capable, mostly literate, labor force that was in great demand at the time (McGinn et al.,1980). Moreover, the Park's educational policies contributed to prevent inequality of education from expanding. Since, although Korea had a relatively low level of economic inequality at the early stage of industrialization in the 1960s, by the mid-1970s income distribution began to deteriorate, enlarging economic gaps between the rich and the poor and increasing a sense of relative deprivation among the working class and the lower middle class citizens (Campos & Root, 1996).

### 3.1.3. Sociocultural Factors

*Education fever: a proof of open society*

Andy Green (1999) emphasized that education were vital for the developmental state's national project, not only for developing skills for economic growth, but first, and equally important, as a means of promoting national unity and social cohesion. Korea's major educational policies often have been heavily charged with sociocultural considerations. The characteristics of Korean society such as a single ethnic composition and Korean's unusual zeal for education also have contributed to the rapid expansion of Korean education system.

As primary education became universal in the 1950s, the social demand for secondary education began to increase rapidly in the 1960s. At this point, Korean's education fever began to be higher by driving the whole nation

into increasing competition for elite schools and private tutoring. The prime cause of this intense educational competition was a well-established ranking system among secondary schools and colleges. Entering one of the first-tier elite middle schools nearly ensure entrance to elite high schools, and eventually success in life in Korean society. Consequently, the preparation for the entrance examinations for elite schools and colleges became a nearly life-and-death matter, driving the whole society into an 'examination hell'. (Park S. 2010)

The national obsession with the attainment of education (Seth, 2002) means that education is seen as the most powerful means to achieve upward social mobility and economic prosperity after the collapse of the traditional class system. This phenomena is similar to the efforts of the transgenerational reproduction by the North American white middle class (Griffith & Smith, 2005). The education fever has reduced the illiteracy rate to almost zero, and it has been a major force in shaping the country's educational development, producing such problems as great financial hardship for millions of Koreans and many anomalies in both the educational system and the general economy (Seth, 2002).

*The distinctive features of Korean society: Homogeneity and Uniformity*

On the other hand, uniformity also has worked as a condition for the equality of education, since uniformity of education meant that the school system had to be more than just open to all, but uniform in content and standard. It came in part from the socialist conceptions on a mass society that greatly influenced Korean intellectuals and writers in the 1920s and 1930s and from the ethnic-racial nationalism derived from Europe and Japan. It colored the concept of nationalism in Korea that emphasized a uniform,

homogeneous nation. Korean nationalists of all political stripes were proud of the long unity and ethnic homogeneity of their nation that gave it a uniqueness and a clearly defined identity. Nationalist rhetoric and even textbooks proudly proclaimed Korea to be ‘united race’, a nation of ‘one-people’, ‘a single blood’ even a ‘single mind’. The two concepts of a social-economic egalitarian society and the ultra-nationalist ideal for a national ethnic-radical and ideological unity together resulted in an intolerance of glaring social inequalities. (Seth, 2005; 2012)

Moreover, Korea as a developmental state has generally been underpinned by exceptionally ‘cohesive’ or ‘disciplined’ society with a high degree of national unity and strong national identity. The orderly societies among the developmental states were not given, but have been achieved or constructed, largely through the work of the state due to ‘the nature of the political project’ that was in essence about ‘national survival and sovereignty’. (Andy Green, 1999) In this sense, the social contract in educational policy making suggests that the Korea was attentive to the issue of social cohesion and unity. (Park S, 2010)

### 3.2. Recent Educational Change based on Neoliberalism

Since the 1990s, there is a shift of the industrial focus from conventional manufacturing sectors based on the industrial learning paradigm toward higher-tech, value-added industrial sectors’ based on a new knowledge creation paradigm in terms of economic structure in the world (Wong, 2004). Korea has taken a critical part in its neoliberal project regarding the role of the state in Korea’s rapid globalization (Park S, 2010). Thurbon and Weiss (2006) may refer it to the post-developmental state’s strategic policymaking, while Pirie (2005) addresses the proactive role that the Korean state has

played in economic globalization is the neoliberal state's rational response to the structural changes in the global economy.

President Kim Youngsam government, which was the first civilian government for three decades (1993-1998), took the initiative to begin neoliberal reforms. As an integral part of reforms, President Kim launched the Presidential Commission on Education Reform (PCER) that later drafted the 'New Education System' or the so-called '5·31 Education Reform Proposal' in the years from 1995 to 1997. The PCER's New Education System was strongly influence by neoliberalism and market-oriented ideas. Ahn Byungyoung who served as the Minister of Education from 1995 to 1997 openly admits that PCER's 5·31 Education Reform Proposal was strongly influenced by globalization and neoliberalism (Ahn, 2007).

### 3.2.1. Education Reform Policy

The main ideas of 5·31 Education Reform are still now operational (Yoon et al., 2002). Reform policies incorporated new terms such as 'open education system', 'orienting toward individual consumer needs/choice', 'diverse and specialized education' and 'basing education on autonomy and accountability' (Presidential Commission on Education Reform, 1996). These terms were the basis of the educational reform policies and are the same as the main discourses of western reforms in education (Whitty, 1998; Apple, 2001). During the reform period, consumer needs and diversity were understood as placing the same value on diverse abilities, and a learner as a subject and the process of teaching and learning were emphasized. Following the Kim Youngsam government, the Kim Daejung government kept developed policies more inclined toward the liberal marketism of broad

national reforms by the International Monetary Fund (IMF) (Sin H, 2003).

After the IMF crisis of 1997-1998, the Kim Daejung government tried to link education policy to market based on productivity. The government changed the name of the department of education from the Ministry of Education (MOE) to the Ministry of Education and Human Resources Development (ME&HRD). The new department has begun to deal with other areas besides education, including training and science (ME&HRD, 2003). The name of the presidential consultative committee was also changed, from the 'Presidential Commission for the New Education Community' to the 'Presidential Commission on Education and Human Resource Policy' (PCEHRP). Since then, the voice of economics has become louder than that of education, stressing product rather than process in education (Jeong, 2003).

After the 5·31 Education Reform, 'education for consumer needs' were shaped as a policy for 'open education'. The term, open education derived from a movement to reform classroom teaching that was begun by private elementary schools and spread to many public school teachers (Lee et al., 1997). Since 'performance assessment' was emphasized in open education, paper and pencil tests for all students in the same grade were officially abolished in elementary schools. Schools also were required by the government to develop diverse non-academic after-school programs such as movies, plays, sports and animation. Information Communication Technology (ICT) education in particular has been pushed as a tool to change the traditional classroom teaching style. (ME&HRD, 2001).

Moreover, for the policy of 'the creation of new school culture' in Kim Daejung government, the entrance exam system for university based on a linear scale from one test has begun to change to the system based on

recommendations without scores form the College Scholastic Ability Test (CSAT) (MOE, 2000). Secondary schools also forced ‘performance assessment’ and graded by absolute criteria rather than comparative grading. That’s because the main ideas of this policy were ‘establishment of school community’, ‘student-centered curriculum’, ‘diverse learning activities in schools and out of schools’ and ‘assessment of diverse student ability’ (ME&HRD, 2001).

The 7th revision of the national curriculum was followed the vision and framework of school reform envisioned by the PCER (Huh, 1998). While ‘open education’ and ‘performance assessment’ focused on the ‘learning process’, the 7th curriculum which began to be applied to schools in 2000 centered on achievement level (Kim, 2002). The major characteristic of 7th curriculum is the grouping of students by achievement level . For instance, among ten subjects in the common curriculum, Mathematics and English are divided into several stages with two sub-stages in each stage. Korean language, social studies, and science consist of three different levels of content in each topic: Basic, In-depth, and Supplementary (MOE, 1997).

The National Scholastic Achievement Assessment has developed out this situation, executing an assessment not over two years but every year. It is important that this was the starting point for a national test system that was intended to be closely linked to ‘accountability’ by schools (Lee, 2002). The movement to establish a school-based accountability system by strengthening autonomy and accountability at the school level had started right after the 5·31 Education Reform. School accountability policy was materialized through school management committee, the invitation of teachers, school accounting system and etc. (Kim & Kim, 2002).

The concept of ‘school choice’ has become a major issue relating directly

to ‘consumer needs’ and ‘diversity’. There were debates about ‘school choice’ such as the ‘abolition of the high school equalization policy’. The new type schools have emerged since 2002 with autonomy in school management including choice of curriculum and texts as well as selection of students. The diversification of school will be discussed in more detail as follows.

### 3.2.2. The Diversification of School Types

The first six-year plan for free compulsory primary education launched in 1954 had completed with an enrollment rate of 95.4 percent (Kim, 2002). The equity of education has expanded at a rapid race. Nowadays, Korea ranks number one among OECD countries with the highest tertiary gross enrollment ratio (UNESCO, 2010). It is important that the process of quantitative expansion was accompanied by qualitative and upward equalization of school education through improvement of school system and standardization of curriculum (Chung, 1995). In other words, the expansion of public education has enlarged the quality of educational opportunities for disadvantaged social class, increasing the possibility of the upward movement of the class (Yeo et al., 2011).

As mentioned before, Korean school system was characterized to the high degree of homogeneity, since the Park regime implemented the MSEP and the HSEP which effectively destroyed an elitist educational system. Moreover, even though one in four high school students attend vocational high schools (KNSO, 2008; Shimahara, 2005), the exclusive focus on homogeneity among primary and middle schools ignores the substantial differentiation among high schools. However, Korean high school system has been hierarchical and tracked student into different types of high schools.

In general, academic high schools are regarded as being more prestigious than vocational high school.

At that time which the MSEP and the HSEP implemented, some educational experts also raised concerns about a possible ‘downward leveling effect’ of the MSEP and the HSEP, suggesting that students’ academic achievements would become poorer once the policies were implemented. Those objections were outright dismissed by the state. However, the Kim’s administration announced that the number of Special Purpose High School (SPHS, hereafter) would be increased to help cultivate and produce the nation’s most talented minds in the sciences, the arts, athletics, and foreign languages, and to attenuate the purported downward leveling effects of the High School Equalization Policy on student’s academic performances (Park S, 2010).

However, there were the SPHS under the equalization policies such as Gyeonggi Science High School and Daewon Foreign Language High School which began as pilot programs in 1982 and 1984, respectively. Those schools also were included in the SPHS program in 1986 and 1992 (Gukjeong Briefing, 19 Oct. 2007; Kim, 2003). By the year 2001, however, the number of SPHS significantly increased due to the transfer of designation certificate from the Minister of MOE to Superintendent of education. According to the analysis by MOE and KEDI (Korean Educational Development Institute) (2001), the number of foreign language high schools which were only 18 in 2001 increased to 33 in 2010. The number of science high schools also increased from 16 in 2001 to 21 in 2010. Along with the expansion of SPHS, academic high schools which was equalized due to the ‘High School Equalization Policy’ have begun to be differentiated.

In 2002, a new type of high school has emerged with the implementation of the Independent Private High School policy. The three independent private schools started piloting, and the other three more schools were added in the next year. Although SPHS made up only a small portion of the schools (less than 7 percent as of 2008), President Lee Myung-Bak's government (2008-2013) had promoted the policy of high school diversification, proposing public boarding school, meister high school, and so on. In this period, high schools were classified into four types: general high school, special purpose high school, specialized high school and autonomous high school. As a result, the number of Independent Private High Schools increased to 51 in 2011, and 46 in 2017, since designating 25 schools in 2009. (MOE, 2009; 2011; 2017)

The emergence and growth of the various types of high school since 2000s have had tremendous ramification. Not surprisingly, the students who attended SPHS or autonomous high schools showed impressive track records in college admissions. Since these schools are allowed to select and education the most 'gifted' students nationwide with their own curricula unlike the general academic high schools. Now, SPHS or Independent Private High Schools are considered 'elite schools' and the fast track for social prestige and success in Korea society. (Park S, 2010)

# Chapter III. Methodology

## 1. Data and Sample

*Data*

For this project I will employ the Korea portion of the Program for International Student Assessment (PISA) data from 2000 to 2015 implemented by the Organization for Economic Cooperation and Development. PISA aims to define each domain not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed in order to meet real-life challenges. That is, students are given assessment tests in reading, mathematics, and science literacy that go beyond the mastery of school-based curriculum and measure the students' ability to apply their knowledge to authentic life situations. This is a unique focus since most assessment studies focus only on school knowledge. In addition to testing the robustness of finding, the analysis based on PISA broadens the outcome of the education process. (OECD, 2001)

In addition to test outcomes, data were collected from a number of other sources. Students answered a background questionnaire providing information about themselves, their homes, and their schools and learning experiences. School principals responded to a questionnaire covering their school system and the learning environment. In some countries, parents responded to an optional questionnaire requesting information about their perceptions of and involvement in their child's school, their support for student learning in the home, and their child's career expectations. It also contributes to a more robust assessment of the different potential determinants of student performance.

*Samples*

PISA's target population are the 15-year-old students in each country, regardless of specific grade they may currently be attending[③]. PISA assesses young people near the end of compulsory schooling to capture the very same age in each country independent of the structure of national school systems. The student population is representative of all 15-year-old pupils attending public and private schools in each country. Participating education systems were required to have a sample of at least 150 schools and 4,500 students.

Data is collected using a stratified sampling procedure that involves two stages. The first stage consists of sampling individual schools that are systematically selected according to the grade levels of the school, type of school, region of the country, population density and minority composition. A minimum of 150 schools were selected in each country. As the schools are sampled, replacement schools are also selected, in case a sampled school is not able to participate for some reason. The second stage of the sampling process involved sampling students within sampled schools. Once schools were selected, a slot of each school's 15-year-old students are prepared. Then thirty-five students are randomly selected between the ages of 15 years, 3 months and 16 years, 2 months. While the number of students sampled per school could differ from 35, there could not be fewer than 20[④].

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③ The other studies using grade-related focus have a possibility to be distorted by differing entry ages and grade-repetition rules in different countries.

④ Countries are permitted to exclude up to 5% of the population by leaving out schools or students. PISA details five exclusion rules for students within schools (OECD, 2012). Students identified as intellectually disabled, functionally disabled, or with limited language experience are eligible for exclusion. Countries are also

I limit the sample to include only students from South Korea. Korean students living abroad are omitted; however, foreign nationals within Korea is present in the data. The final sample includes 4,965 students from 146 schools in 2000, 5,407 students from 149 schools in 2003, 5,076 students from 154 schools in 2006, 4,900 students from 157 schools in 2009, 5,015 students from 156 schools in 2012 and 5,538 students from 168 schools in 2015. Individual-level weights are used to inflate the student sample within each country to be representative of the overall student population.

## 2. Key Indicators and Their Descriptive Statistics

This dissertation focuses on the magnitude of SES effects on student performance as the indicator of educational inequality. Thus, the scores of reading literacy, mathematics literacy, and science literacy and the student's socioeconomic status are the key variables. In this section, I describe these two basic variables in PISA surveys and present the achievement and socioeconomic conditions of students from 2000 to 2015.

### 2.1. Academic Achievement

In this analysis, academic achievement is estimated as a response variable. I examine three dimensions as measures of academic achievement: reading literacy, mathematics literacy, and science literacy. Reading literacy assesses students' competency with locating, interpreting and synthesizing texts. Also, this domain tests students' ability to consider and engage with

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permitted to exclude students with dyslexia, dystrophy and dyscalculic, provided these considerations are previously agreed on (OECD, 2013).

the texts. Mathematics literacy includes six subcategories: formulating situations, employing concepts, facts, procedures, and reasoning, interpreting, change and relationships[⑤], space and shape, quantity and uncertainty. Lastly, the science literacy encompasses sub-categories to measure students' skill with differentiating between scientific and non-scientific questions, describing scientific processes and using scientific evidence.

Standardized achievement scores are developed with Item Response Theory (:IRT) methods. Students' scores in reading, math, and science are created by taking the average of five plausible values in each subject for each student (Levels, Dronkers & Kraaykamp, 2008). Randomly drawn from the posterior distribution of a student's ability, plausible values are appropriate to estimate population parameters such as mean and variance, taking into account the uncertainty associated with the estimates (OECD, 2015; Park, 2013). Test scores are standardized to have a mean of 500 and a standard deviation of 100 to make comparisons across participating countries.

However, in PISA 2000, not all students were assessed in mathematics and science. Moreover, since mathematics items appeared only in five of the nine item booklets, PISA 2000 mathematics scores are available for only about five-ninths of the sampled students. Similarly, science material occurs in five linked booklets, allowing science scores to be reported on a common scale for five-ninths of the sampled students. (OECD, 2002) Therefore, particular caution is needed when interpreting the trends in mathematics and

⑤ The name was Growth and Change in 2000, however it was changed since 2003 assessment.

science performances across the six PISA surveys on the basis of the overall mathematics scores (Park, 2013).

Table 3.2 presents the descriptive statistics about students' performances. The mean and standard deviation are calculated by the authors. All the plausible values (five values in each subject from 2000 to 2012; ten values in 2015) are considered for the computation, and they are matched to the results from the OECD's official reports. For reference, the mean score among OECD countries is 500 points, and the standard deviation is 100 points. The results, even though Korean students have ranked in the top group among participated countries, show a decline in every subjects over time, arousing concern among educators.

Table 3.1. Trends of Academic Achievements in PISA database

| | | Mean Score | | Standard deviation | |
|---|---|---|---|---|---|
| | | Mean | S.E. | S.D. | S.E. |
| **2000** | read | 525 | 2.4 | 70 | 1.6 |
| | math | 547 | 2.8 | 84 | 2 |
| | science | 552 | 2.7 | 81 | 1.8 |
| **2003** | read | 534 | 3.1 | 83 | 2 |
| | math | 542 | 3.2 | 92 | 2.1 |
| | science | 538 | 3.2 | 101 | 2.2 |
| **2006** | read | 556 | 3.8 | 88 | 2.7 |
| | math | 547 | 3.8 | 93 | 3.1 |
| | science | 522 | 3.4 | 90 | 2.4 |
| **2009** | read | 539 | 3.5 | 79 | 2.1 |
| | math | 546 | 4 | 89 | 2.5 |
| | science | 538 | 3.4 | 82 | 2.3 |
| **2012** | read | 536 | 3.9 | 87 | 2 |
| | math | 554 | 4.6 | 99 | 2.1 |
| | science | 538 | 3.7 | 82 | 1.8 |
| **2015** | read | 517 | 3.5 | 97 | 1.7 |
| | math | 524 | 3.7 | 100 | 1.8 |
| | science | 516 | 3.1 | 95 | 1.5 |

### 2.2. Socio-economic Background

In order to understand education careers and to study equity issues within and across countries, family background variables such as socio-economic status have to be taken into account. The distribution of education opportunities and outcomes depending on these background variables shows whether countries succeed in providing equal opportunities. PISA has become famous for its detailed, theory-based assessment of family background and socio-economic status. A lot of effort went into the definition and operationalization of individual student background indicators, finally leading to the establishment of a powerful, integrated indicator for students' economic, social and cultural status (ESCS; Willms, 2006).

The components of this indicator need to be assessed in as stable a way as possible across the PISA cycles. Consequently, I will use ESCS variable as an explanatory variable. The ESCS index used in PISA is derived from three family background variables: the highest level of parental education among two parents (in number of years of education according to the ISCED classification) (PARED), the highest parental occupation among the two parents (HISEI) and the index of home possessions (HOMEPOS) (OECD, 2002). The calculation formula is as follows:

$$ESCS = \frac{\beta_1 HISEI + \beta_2 PARED + \beta_3 HOMEPOS}{\epsilon_j}$$

Missing values for these three variables are imputed and then transformed to an international metric with OECD averages of 0 and OECD standard deviations of 1, so that the values of are directly comparable across

countries. These OECD-standardized variables were used for a principal component analysis in order to obtain ESCS scores applying an OECD population weight giving each OECD country a weight of 1000. (OECD, 2005)

Using these three components for deriving a composite index of socio-economic status reflects the general consensus that this construct is best represented by education, occupational status and economic means. As no direct income measure can be obtained from the PISA context questionnaires, student reports on household items are used as approximate measures of family wealth. (Schulz, 2005)

However, the ESCS index was computed from PISA 2003. Accordingly, it was re-computed for the PISA 2000 data based on occupation, education and home possessions[⑥]. Also, even PISA 2015 keeps measures of socio-economic status and other background variables basically unchanged, some minor changes have become necessary due to extensive development in the ICT sector. These changes are expected not to have any effect on the important trend measures. (OECD, 2016)

Table 3.2 describes SES effects from 2000 to 2015. The influences of student's background on academic achievements are computed by the authors in each PISA assessment year, in order to see the trends of SES effects in Korea. An Ordinary Least Squares (OLS) model is used, and all the plausible values and the proper weighting are considered. Gender variable is employed as a control variable. Figure 3.1 reflects the results of

⑥ There were some deviations as parental education in PISA 2000 had only one combined category for ISCED 5A and 5B.

Table 3.2. As the Table 3.2 and the Figure 3.1 shows, the effect of socioeconomic background on academic performance has been increased gradually. It may implicit that education inequality has become more severe.

Table 3.2. Trends of SES Effects from 2000 to 2015

| | | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 |
|---|---|---|---|---|---|---|---|
| **Reading** literacy | *coef.* | 22.59*** | 31.79*** | 28.33*** | 30.86*** | 33.42*** | 42.84*** |
| | *s.e.* | 2.11 | 2.59 | 3.04 | 2.33 | 2.80 | 3.01 |
| **Math** literach | *coef.* | 31.82*** | 40.29*** | 37.67*** | 38.38*** | 41.85*** | 52.84*** |
| | *s.e.* | 2.55 | 3.18 | 3.68 | 3.14 | 3.26 | 3.20 |
| **Science** literacy | *coef.* | 25.70*** | 38.44*** | 31.62*** | 31.56*** | 28.53*** | 43.92*** |
| | *s.e.* | 2.92 | 3.41 | 3.13 | 2.76 | 2.65 | 2.71 |

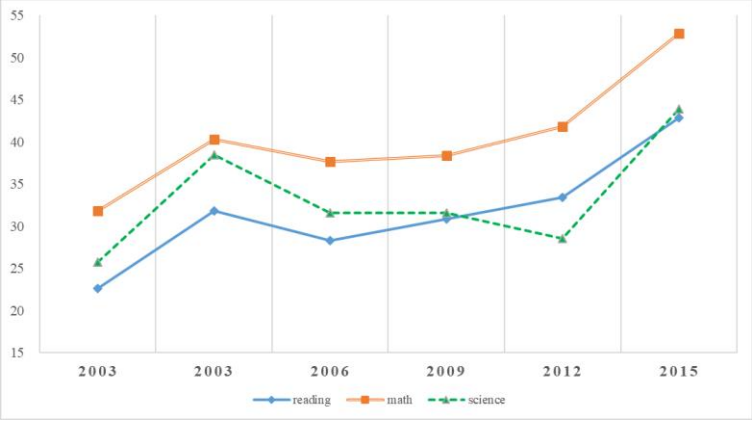


Figure 3.1. Trends of SES Effects from 2000 to 2015

## 3. Statistical Strategies

### 3.1. Plausible Values: Rasch model item response theory

As the three main dimensions PISA assesses are comprehensive areas in education, PISA designed test forms comprised of different combinations of the items from each domain. These test forms are called booklets in PISA

assessments. Each student only responds to one booklet[⑦], and the results are produced as five sets of plausible values which are analyzed by the software program *ConQuest* (Wu, Adams & Wilson, 1998). The five or ten plausible values indicate reading, math, and science proficiency for each student on each dimension. They were randomly drawn from the distribution of ability estimates that could reasonably be assigned to a student, and the mean of the plausible values should be equal to the expected a posterior (EAP) estimator. The plausible values were used to understand the trends of achievement gap. Compared to using the EAP estimator, using plausible values when computing statistics takes into account the sampling error and imputation error (the latter also known as measurement error) (Wu & Adams, 2002), thus producing unbiased estimates (OECD, 2005).

### 3.2. Survey design weights

The sampling variance estimator that is used in the total variance calculation should account for the survey design. In Korea as well as other participant countries, a Balanced Repeated Replication (BRR) design was used: a set of 80 alternative weights are assigned to each student to from alternative samples at country level. To calculate standard errors, a replication method take into account the stratified, two-stage sample design for selection of schools and students within schools. When I do not use

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⑦ In each PISA booklet, the items of each subjects appear in a different order. It is hypothesized that the different order might affect student performance. Therefore, there is a need to monitor and adjust the booklet effects. The rational is that if it is true that some booklets were more difficult than others, then the students who took the more difficult booklets should be compensated through some adjustment to their ability estimates. Similar consideration should be applied to those students who were assigned the easier booklets. (Liu & Wilson, 2009)

plausible values in the estimation, the standard error on any statistic is calculated as the square root of the average squared deviation of the estimates obtained from these alternative weights and the statistic obtained using the original students' weights. In the standard BRR method, schools are paired in pseudo-strata in the order of selection, and within each pseudo-stratum, one school at random is given zero weight and the other receives a double weight.

PISA adopts a particular Fay's variant, with a random school receiving a weight inflated by 1.4 and the other deflated by 0.6 in each pseudo-strata. This approach is used to avoid losing half of the sample, which would make it difficult to estimate parameters on sparse subgroups of the population. As a result, contrary to the standard BRR method, the sum of squared deviation is not divided by 80 but by 80(1-0.6). When plausible values are used, in addition to this sampling variance, the standard errors are corrected by a measurement error variance equal to 1.2 times the variance of the five or ten estimates. (OECD, 2015; Gusio et al., 2008)

## 3.3. Multilevel Analysis

In order to examine the relationship between SES and academic performance, I used a multilevel models (Goldstein, 1995), also known as Hierarchical Linear Models (Bryk & Raudenbush, 1992). In the social sciences, and specifically within educational research, the natural groupings in data structures are hierarchical, which means that students are learners within classes and classes are units within schools. PISA assumes this natural grouping is occurring and refers to it as 'nesting' (OECD, 2010).

Therefore, since it is likely that students participating in PISA test who share the same school have more similar characteristics than learners who are in different schools, it is necessary to use a tool that accounts for this nesting.

Multilevel analysis has gained increasing popularity as the tool most appropriate and effective when variables tend to be nested within other variables (Newman, Newman & Salzman, 2010). This is because multilevel models control for nesting effects and their standard errors are more accurate than other tools. If nesting effects would be ignored, a Type I error could be occurred (Bickel, 2007). Also, HLM controls for variability at different levels. It allows for a school effect in the second level to interact a student effect in the first level, producing appropriate error terms.

HLM was chosen over ordinary least squares (OLS) regression to address the nature of nested data in PISA (Raudenbush & Bryk, 2002). First, the base (null) models were specified to look at the trend of the relative sizes of variances existing in student and school levels as follows:

Level 1 model: $Y_{ij} = \beta_{0j} + r_{ij}, r_{ij} \sim N(0, s\ \delta^2)$

Level 2 model: $\beta_{0j} = \gamma_{00} + u_{0j}, u_{0j} \sim N(0, \tau_{00})$

In the equations, $Y_{ij}$ is an individual student's test score for individual i in school j, $\beta_{0j}$ is the mean test score for school j, and $\gamma_{00}$ is the grand mean of test scores for all participating schools. Lastly, $r_{ij}$ and $u_{0j}$ are random coefficients for levels 1 and 2, respectively.

Next, the final full models were specified to estimate the relationship between SES and student achievement. In the full research models, the

school-level predictors (i.e. school sector and school location) were included to examine only school mean differences. The following are the full research models used in the study:

Level 1 model: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (ESCS) $+ \beta_{2j}$ (female) $+ r_{ij}$, $r_{ij} \sim N(0, s\ \delta^2)$

Level 2 model:

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ (public) $+ \gamma_{02}$ (location) $+ \gamma_{03}$(mean(escs)) $+ u_{0j}$ , $u_{0j} \sim N(0, \tau_{00})$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

In the level-1 model, $\beta_{0j}$ is the adjusted mean test score of school j and the $\beta_{1j}$ and the $\beta_{2j}$ are regression coefficients of student-level predictors. The ESCS variable and the female variable were centered on the grand mean. In the level-2 model, $\gamma_{00}$ is the adjusted mean test score for all schools and the $\gamma_{01}$, the $\gamma_{02}$ and the $\gamma_{03}$ are regression coefficients of school-level variables on academic performance differences among schools. All the variables which were public, location and mean (escs) were also centered on the grand mean. The final student weights (2000-2012: w_fstuwt, 2015: w_fstuwt) supplied by PISA were used to correct for design effects after the normalization for each assessment year. This allows the results to be generalized to the target population from 2000 to 2015.

# Chapter IV. Results

## 1. Distribution of Students' performance

In this part, the distributions of test scores for reading literacy, math literacy and science literacy will be presented. For each subject, non-parametric kernel density[⑧] estimates describe the score distribution by PISA assessment cycles.

The average performances and their standard errors for each assessment year are presented in Table 4.1. Figure 4.1 displays the test score distributions for the three subjects that have been tested from 2000 to 2015. The 2000 scores are on average higher than the 2015 scores, which can be seen in the more right position of the distribution and the higher weighted average score. The peak of the 2015 distribution is also clearly to the left of the previous years, which reflects the lower mode of the kernel density estimates. Moreover, there were not only more high-achieved students but especially fewer low and very low performing students in the year of the 2000 than 2015, which has a relatively fat left tail. Over time, a standard deviation of scores also gets higher with the lower average scores. This pattern holds for all three subjects.

The year of 2000 exhibits more desirable characteristics in each test score distribution, namely higher average scores, a higher mode, a lesser spread of test scores and especially fewer very low performing students in all subjects. The question therefore arises that education inequality has been increasing in Korea society. In order to apprehend this trend from the inequality

[⑧] For a description of the employed kernel function, see Appendix A.

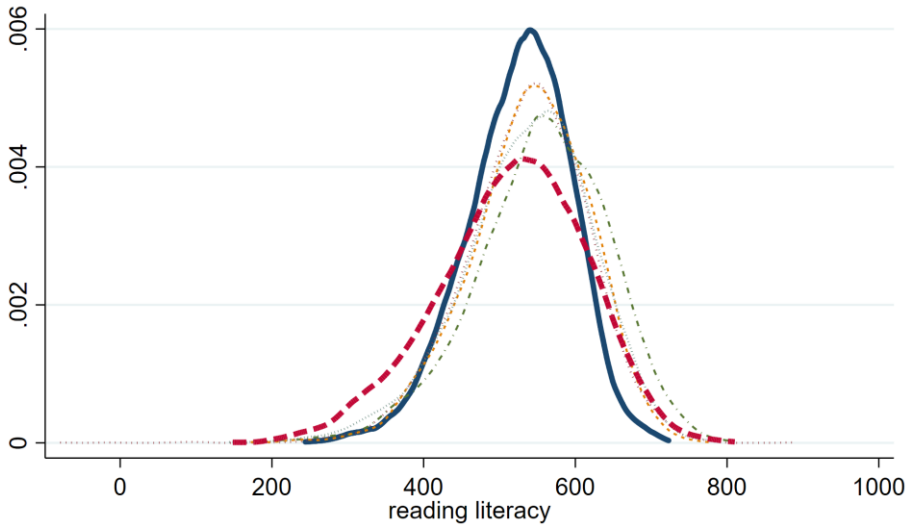
perspective, it is necessary to decompose the academic performance by achievement level and socioeconomic background.

Table 4.1. Student performance in reading, mathematics and science

| | | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 |
|---|---|---|---|---|---|---|---|
| Reading literacy | mean | 524.75 | 534.67 | 556.46 | 539.27 | 536.10 | 518.14 |
| | s.e | 2.42 | 3.08 | 3.82 | 3.46 | 3.92 | 3.46 |
| Math literacy | mean | 546.84 | 542.63 | 547.97 | 546.23 | 554.07 | 524.29 |
| | s.e | 2.76 | 3.22 | 3.80 | 4.02 | 4.56 | 3.70 |
| Science literacy | mean | 552.17 | 538.76 | 522.62 | 537.99 | 537.98 | 516.34 |
| | s.e | 2.69 | 3.52 | 3.39 | 3.44 | 3.64 | 3.11 |
| | obs. | 4982* (2769, 2755) | 5407 | 5076 | 4989 | 5015 | 5538 |

* In 2000, not all participants tested in mathematics and science.

* This result is calculated with all five or ten plausible values for each student using appropriate weights. I used the 'pv' command in the software STATA.



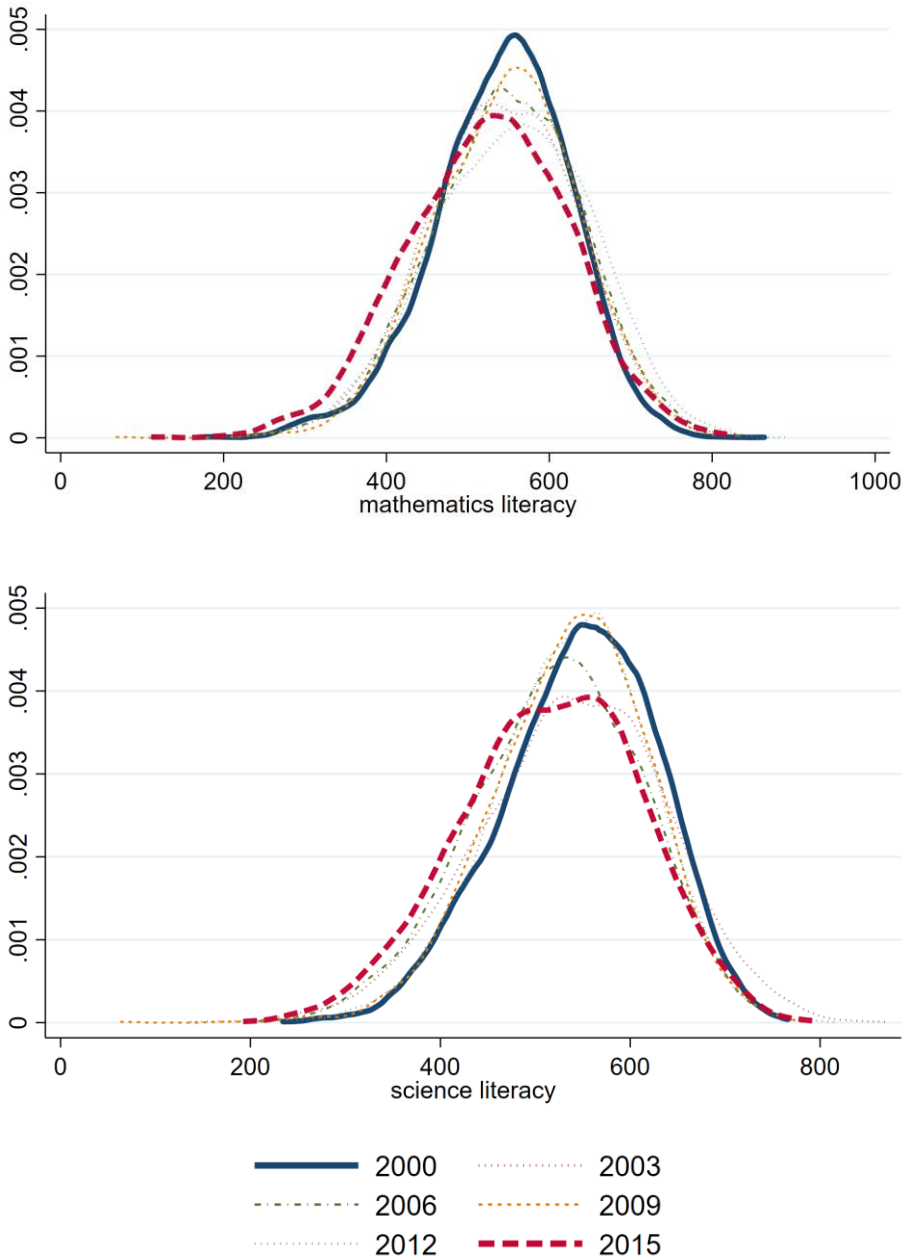



Figure 4.1. Distributions of academic performances

*In calculating the kernel density estimation, it would not be feasible to include five or ten different plausible values in one distribution considering sampling weights. Therefore, the kernel density distribution curves in Figure 4.1 were drawn with only one plausible value in each cycle.

## 2. Trends of Achievement Gap

In order to analyze the trends of academic achievement from 2000 to 2015, one way to measure is that comparing the average scores which are resolved into the students' performance level or socioeconomic background. I begin by dividing all the values into quarters to construct the test score decomposition. Hereafter I refer to the difference between the top 25% and the bottom 25% as achievement gap. I also present the average test score lines of student performances to present the snapshot of the achievement gap. The average test score lines provide comparisons across the years at each quartile divided by test scores and socioeconomic status.

### 2.1. Performance gap between high and low performers

Table 4.2 presents descriptive information about the average scores of each quartile on the basis of the PISA data. In every assessment year, I divide the dataset into four equal-size groups with the three cut points to make quartiles. The test scores are estimated with all five or ten plausible values for each student using appropriate weights. Figure 4.2 illustrates the average of students' performance in reading literacy, mathematics literacy and science literacy. In the figure, the vertical axis indicates the scores on the reading, mathematics and science test and the horizontal axis represents the quantile groups.

Table 4.2. Academic performance at each quartile by scores

| Academic Performance | | 2000 | | | 2003 | | | 2006 | | | 2009 | | | 2012 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie |
| **4th: 75-100%** | ➔ | 600 | 638 | 640 | 623 | 657 | 629 | 656 | 651 | 633 | 630 | 674 | 633 | 634 | 638 | 629 | 625 | 653 | 652 |
| **3rd: 50-75%** | ➔ | 547 | 572 | 578 | 562 | 580 | 556 | 589 | 578 | 569 | 571 | 590 | 568 | 569 | 558 | 551 | 554 | 573 | 573 |
| **2nd: 25-50%** | ➔ | 504 | 520 | 525 | 515 | 520 | 497 | 537 | 524 | 519 | 523 | 524 | 517 | 516 | 497 | 488 | 495 | 512 | 511 |
| **1st: 0-25%** | ➔ | 431 | 436 | 443 | 433 | 432 | 407 | 443 | 443 | 439 | 444 | 428 | 434 | 424 | 401 | 395 | 396 | 426 | 412 |

*The test scores are estimated with multiple plausible values and weighting, standard errors are reported, instead of standard deviation. The full results will be provided, if you ask to the author.

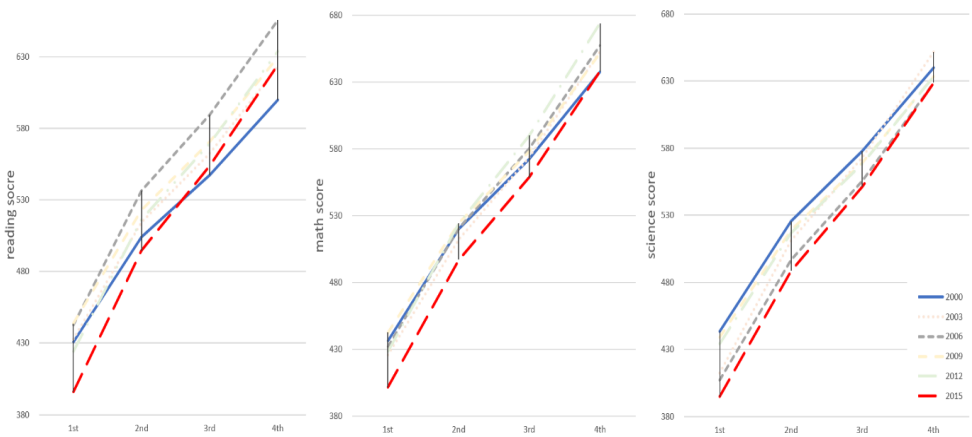



Figure 4.1. Average test scores by performance levels

Comparing to 2000 and 2015, the average scores of the top 25% in 2015 (624.51) has been higher than 2000 (599.85) in reading literacy. However, the bottom 25% shows reversed results. Strikingly, the average scores of the bottom 25% in 2015 (395.86) is the lowest. Even in mathematics and science test, the bottom 25% take the biggest tumble in 15 years (math: 436.24 → 425.59, science: 443.47 → 412.38)⑨. In other words, the academic achievement gap has been widening in the past 15 years as the

⑨ For the detailed results of the difference between the top 25% and the bottom 25%, see Appendix B.

average scores of the low-performed students have declined progressively. Although Korean students show outstanding performance on international achievement test at both high and low ends of the distribution (Park, 2013; OECD, 2013), the consistent downward trends among the bottom 25% as of 2009 reveals that education inequality becomes more severe in Korea.

### 2.2. Performance gap between the rich and the poor

Table 4.3 presents the average scores of each quartile divided by socioeconomic status. Figure 4.3 describes how the achievement gap has been changed from 2000 to 2015. The average score of the poor students who is located in the bottom 25% in the distribution has declined over time. On the contrary, the average score of the rich students who is located in the top 25% has increased consistently, widening achievement gap. This trend is exhibited not only in reading literacy but also mathematics and science literacy test results.

Table 4.3. Academic performance at each quartile by socioeconomic status

| SES | | 2000 | | | 2003 | | | 2006 | | | 2009 | | | 2012 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie |
| **4th: 75-100%** | ➔ | 546 | 617 | 575 | 569 | 586 | 579 | 589 | 590 | 558 | 572 | 587 | 571 | 568 | 595 | 566 | 555 | 570 | 555 |
| **3rd: 50-75%** | ➔ | 524 | 571 | 552 | 542 | 551 | 547 | 560 | 553 | 527 | 550 | 559 | 549 | 547 | 567 | 548 | 529 | 535 | 526 |
| **2nd: 25-50%** | ➔ | 520 | 526 | 544 | 524 | 531 | 528 | 545 | 535 | 510 | 536 | 542 | 535 | 525 | 539 | 527 | 504 | 509 | 502 |
| **1st: 0-25%** | ➔ | 493 | 453 | 514 | 498 | 496 | 494 | 530 | 511 | 492 | 508 | 508 | 505 | 505 | 516 | 512 | 481 | 480 | 480 |

In sum, the average scores of the low-performed and the poor students have been dropped gradually in the last 15 years. That is, the achievement gap between the advantaged and the disadvantaged students is widening in

Korea society. Even though Korean students is well known for excellent results in international large-scale assessment until now, it should be seriously concerned if the low-achieved and the poor students have been neglected while Korean education policy has been revised since 2000.

## 3. Comparisons of SES Effects

The previous results raises the question that why the low ends of the distribution show inferior performance whereas the high ends maintains their outstanding performance or shows even higher than before. Among various potential alternative explanations, SES effects will be particularly examined in this section. To examine the association between student's socioeconomic background and educational achievement, an Ordinary Least Squares (OLS) model is used. The multidimensional aspects of socioeconomic background will be taken into account to estimate the influence of student's socioeconomic background to test scores since 2000.

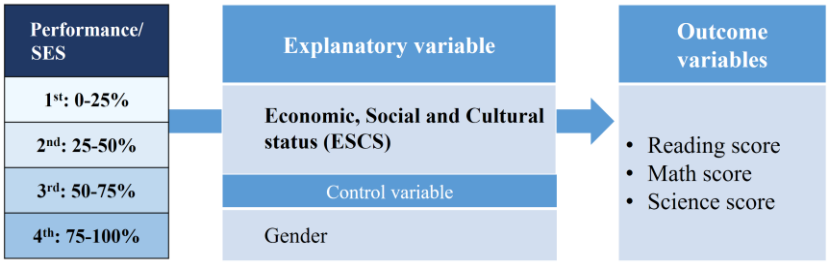



Figure 4.3. Analysis model to estimate SES effects

Considering Korean education system has been differentiated favorable to high-performers, I hypothesis that the reason of widening achievement gap is caused by the high-performed or the rich student are more benefited by a

greater impact of SES. Consequently, in this section, the relationship between socioeconomic status and test scores will be estimated by the separated groups, designating academic performance as the outcome variable. Figure 4.4 presents a schematic representation of the analysis model separated by students' performance level or socioeconomic status. This model will show the magnitude discrepancy in SES effects between each category.

### 3.1. SES difference at different location at distribution

Table 4.4 presents the results of the analysis for the effect of socioeconomic background on student's scores across the assessment years for three different samples: 1) the whole sample of student; 2) the bottom 25 percent of the distribution of performance; 3) the top 25 percent of the distribution of performance. The results in each assessment year pertains to coefficients estimated from regression models simultaneously using all five or ten plausible values for academic performance. The indicator of gender is used as a control variable.

Before looking at the result of quartile groups estimating the relationship between ESCS and test scores, it will be useful to examine the whole sample of students showing the trend of SES effects in each cycle. In the whole sample of students, the results show that the effect of the ESCS index is getting strongly associated with student performance in reading, math, and science literacy. The top 25% students from performance distribution also have followed the increasing tendency. However, on the contrary to the

top, the strength of association has been decreased in the bottom 25% from performance distribution.

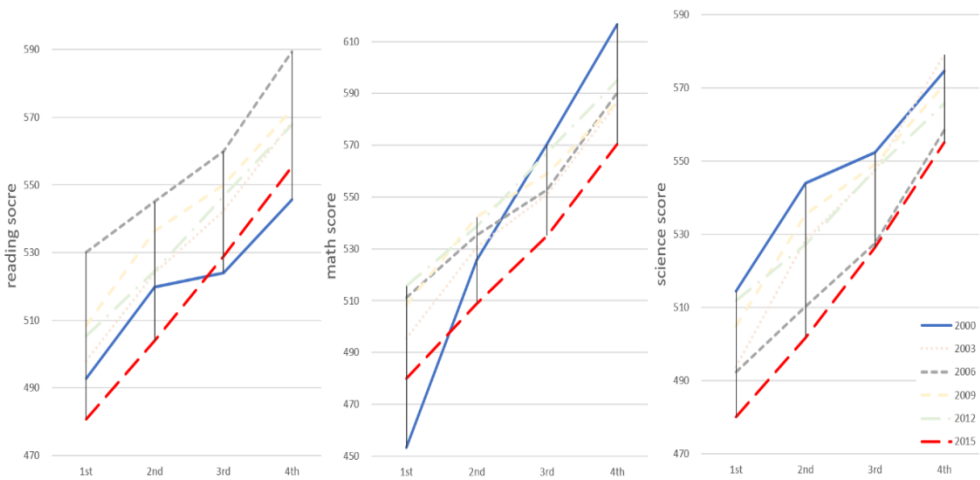



Figure 4.2. Comparisons of SES effects by performance level (bottom 25% vs. top 25%)

To compare the SES effects gap at a glance, figure 4.5 illustrates the difference of influence between the low- and the high-performers in reading, mathematics and science literacy only in 2000 and 2015[⑩]. The top 25% are more advantageous when one unit of ESCS increases comparing to the bottom 25%. This pattern reflects the finding in table 4.4. In other words, the high-performers have been more benefited in their academic performances by socioeconomic background, whereas SES effects have went against the low-performers.

[⑩] Specifically, figure 4.5 is drawn from the estimates in table 4.4 fixing the index of ESCS. High-performers are defined as those with the level of performance to the seventy-fifth percentile of the score distribution, while low-performers are those with performance at the twenty-fifth percentile of the distribution. To illustrate this figure, the same method from Park (2008) is applied.

# Table 4.4. Comparisons of SES Effects by performance level

| | | | The Whole Sample of Students | | | | | | Bottom 25% of the Performance Distribution | | | | | | Top 25% of the Performance Distribution | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 |
| **Reading literacy** | escs | coef. | 22.59*** | 31.79*** | 28.33*** | 30.86*** | 33.42*** | 42.84*** | 8.63*** | 10.28*** | 7.42* | 8.73*** | 5.45 | 7.78*** | 2.34 | 8.45*** | 6.58*** | 5.98*** | 7.71*** | 7.71** |
| | | s.e. | 2.11 | 2.59 | 3.04 | 2.33 | 2.8 | 3.01 | 2.53 | 2.6 | 2.97 | 1.9 | 3.32 | 3.02 | 2.05 | 2.72 | 1.82 | 1.83 | 2.15 | 2.88 |
| | gender (female) | coef. | 16.14*** | 22.76*** | 35.62*** | 33.5*** | 25.21*** | 38.05*** | 12.16* | 11.78* | 15.55*** | 20.00*** | 15.00*** | 20.04*** | 4.51 | 8.26 | 10.40*** | 3.22 | 0.58 | 3.75 |
| | | s.e. | 5.31 | 4.56 | 5.19 | 4.89 | 4.82 | 4.73 | 5.5 | 5.02 | 4.94 | 4.77 | 5.03 | 4.5 | 2.62 | 3.91 | 3.2 | 2.98 | 2.84 | 3.97 |
| | | cons. | 537.77 | 528.57 | 538.79 | 528.62 | 523.93 | 508.38 | 438.15 | 434.14 | 439.56 | 438.55 | 421.43 | 393.53 | 599.08 | 616.7 | 647.15 | 626.62 | 630.76 | 621.92 |
| | | obs. | 4976 | 5407 | 5162 | 4900 | 5015 | 5538 | 1244 | 1355 | 1292 | 1247 | 1257 | 1387 | 1244 | 1354 | 1292 | 1245 | 1253 | 1387 |
| **Math literacy** | escs | coef. | 31.82*** | 40.29*** | 37.67*** | 38.38*** | 41.85*** | 52.84*** | 10.65*** | 9.61*** | 9.66*** | 8.40*** | 4.82 | 6.45 | 7.78*** | 12.98*** | 10.81*** | 8.79*** | 9.62* | 13.21*** |
| | | s.e. | 2.55 | 3.18 | 3.68 | 3.14 | 3.26 | 3.2 | 3.33 | 1.52 | 2.81 | 2.1 | 2.53 | 4.03 | 2.1 | 3.62 | 3.42 | 2.79 | 3.13 | 3.12 |
| | gender (female) | coef. | -23.58*** | -21.64*** | -8.51 | -5.86 | -15.40** | 4.02 | 4.44 | 2.33 | 7.82 | 10.29* | 7.02 | 10.84* | -5.09 | -8.45* | -7.10* | -6.93 | -12.77*** | -7.42* |
| | | s.e. | 6.83 | 5.34 | 5.23 | 6.16 | 5.43 | 4.69 | 7.83 | 3.51 | 4.42 | 4.49 | 4.43 | 4.84 | 4.19 | 2.93 | 3.46 | 4.28 | 3.17 | 3.51 |
| | | cons. | 569.84 | 555.34 | 552.07 | 555.58 | 560.74 | 532.79 | 438.15 | 640.51 | 651.02 | 656.39 | 652.33 | 674.97 | 443.06 | 429.64 | 431.23 | 439.02 | 426.4 | 400.74 |
| | | obs. | 2766 | 5407 | 5162 | 4900 | 5015 | 5538 | 1244 | 691 | 1354 | 1292 | 1244 | 1255 | 692 | 1356 | 1293 | 1247 | 1256 | 1385 |
| **Science literacy** | escs | coef. | 25.7*** | 38.44*** | 31.62*** | 31.56*** | 28.53*** | 43.92*** | 7.56* | 9.10*** | 6.26* | 7.66*** | 1.75 | 5.50* | 5.94* | 10.82*** | 7.20 *** | 7.04 *** | 5.11* | 8.08*** |
| | | s.e. | 2.92 | 3.41 | 3.13 | 2.76 | 2.65 | 2.71 | 2.78 | 2.58 | 2.54 | 2.14 | 2.75 | 2.58 | 2.45 | 3.21 | 2.05 | 2.44 | 2.37 | 2.21 |
| | gender (female) | coef. | -16.91* | -16.65* | 2.46 | 0.45 | -1.68 | 6.9 | 6.71 | 4.78 | 7.52* | 6.96 | 8.29* | 10.39* | -1.1 | -7.07 | -3.03 | -6.21 | -7.63* | -6.13 |
| | | s.e. | 6.83 | 5.85 | 4.67 | 5.3 | 4.63 | 4.26 | 6.21 | 4.54 | 3.65 | 5.02 | 3.83 | 3.69 | 3.85 | 3.83 | 3.09 | 3.6 | 3.03 | 3.21 |
| | | cons. | 569.26 | 549.27 | 521.37 | 543.17 | 538.42 | 521.70 | 446.3 | 414.58 | 405.83 | 437.57 | 431.13 | 393.4 | 641.26 | 650.87 | 627.85 | 634.94 | 635.07 | 630.69 |
| | | obs. | 2755 | 5407 | 5162 | 4900 | 5015 | 5538 | 689 | 1355 | 1292 | 1246 | 1257 | 1385 | 688 | 1354 | 1291 | 1244 | 1253 | 1384 |

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

### 3.2. The difference of SES effects between 2000 and 2015

In this section, the effect of socioeconomic background on students' academic performance is examined according to students' background distribution. In other words, it is the analysis on the year effects to each different groups divided by socioeconomic status. I choose only two assessment years so as to better understand the difference of SES effects between 2000 and 2015. For this analysis, the data from 2000 and 2015 were merged into one dataset for each subject since the samples of mathematics and science are not the same in 2000. The new dummy variable was added to measure the year effects (year dummy: 0=2000/1=2015). In order to analyze interaction between each quartile group divided by socioeconomic background and the year effects, I could not utilize all five plausible values in 2000 and ten values in 2015. Accordingly, one plausible value in each subject was employed as outcome variables. Since not all plausible values were used, there is no need to use the eighty replicated weightings. The final student weighting was considered in this analysis. Table 4.5 presents the SES effects by each ESCS quartile in merged dataset. The students who are located in bottom 25% in ESCS distribution are set as a reference group.

Table 4.3. Comparisons of SES effects (2000 vs. 2015)

| | | Reading literacy | Math literacy | Science literacy |
|---|---|---|---|---|
| escs: 26-50% | coef. | 29.90*** | 3.89*** | 32.32*** |
| | s.e. | 3.17 | 7.63 | 3.81 |
| escs: 51-75% | coef. | 34.24*** | 39.99*** | 37.94*** |
| | s.e. | 3.14 | 3.83 | 3.74 |
| escs: 76-100% | coef. | 55.59*** | 69.24*** | 60.67*** |
| | s.e. | 3.11 | 3.80 | 3.69 |
| year2015 (vs. 2000) | coef. | -18.52*** | -31.71*** | -39.37*** |
| | s.e. | 3.18 | 3.88 | 3.79 |
| escs:26-50%* year2015 | coef. | -5.61 | -0.75 | -9.45 |
| | s.e. | 4.47 | 5.48 | 5.33 |
| escs:26-50%* year2015 | coef. | 18.58*** | 17.02** | 9.99 |
| | s.e. | 4.44 | 5.44 | 5.28 |
| escs:26-50%* year2015 | coef. | 23.50*** | 23.16*** | 15.37** |
| | s.e. | 4.42 | 5.41 | 5.23 |
| gender(female vs.male) | coef. | 26.44*** | -10.43*** | -4.36* |
| | s.e. | 1.57 | 1.92 | 1.86 |
| | cons. | 482.46 | 516.40 | 520.50 |
| | obs. | 10,524 | 8,314 | 8,303 |

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

The results supports the idea that education inequality has intensified in Korea over the past fifteen years. This is because the performances of students who are located in the upper level of ESCS distribution are clearly higher in 2015 than in 2000 in all three subjects, and it is statistically significant. To have an interpretation conveniently, the students who are in the bottom 25% from ESCS distribution are called ‘the poor’, while those who are in the top 25% are called ‘the rich’. In reading literacy, the difference of test scores between the poor and the rich was 55.59 points in 2000. However, in 2015, the gap increased by 23.50 points to a difference of 79.09 points. In the case of mathematics, the difference was 69.24 points in 2000, but increased by 23.16 points to 92.39 points in 2015. The results of science literacy shows the same pattern. The difference in 2000 was 60.67 points, but it was increased by 15.36 points. The rich was 76.04 points

higher than the poor in 2015. Besides, all the results are statistically significant.

## 4. Alternative analysis: book possessions and academic performances

Before closing this section, I have to deal with another indicator for the socioeconomic background. I used the term of 'the poor' mixed with the students who are located in the lower end in the ESCS distribution. To define 'poor' or 'rich' students across countries is not straightforward since life conditions of students can be relative within countries (Park, 2013). Furthermore, PISA do not have information on household income which is the common indicator used to measure poverty. Even though PISA has developed several variables to measure students' socioeconomic background such as the multidimensional indicator ESCS, which is the main indicator in this research, it is not the exactly same variable in every assessment year.

Accordingly, I will try to replace ESCS variable to the number of books as an alternative measures, comparing to the previous results. Comparative studies of educational stratification have paid attention to the number of books available at home as an indicator of home literacy environments that affect children's educational attainment and academic performance (Park, 2008; Evans et al, 2010; Park, 2013). Besides, the number of books has been found to be a strong predictor of student's performance according to Wöbmann (2003). First, I examine descriptive statistics on book possessions since 2000.

### 4.1. Descriptive Statistics on book possessions

The participating students reported the number of books available at home by selecting one of the seven (2000) or six ordered categories (2003-2015)[11]. However, I re-scaled the the categories to four for comparability across the assessment years: 0-10 books, 11-100 books, 101-500 books, and more than 500 books. In order to understand the trends of socioeconomic circumstances measuring book possessions, this section presents descriptive statistics for the number of books across PISA surveys.

Table 4.6 presents the number of students in each category divided by the number of books from 2000 to 2015. For instance, in 2012, there were only 231 students who have more than 500 books. This table shows the trends that the number of students possessing less than 100 books have been increasing. On the contrary, the students who possess more than 101 books have been decreasing. Even though this trend would be interpreted by the spread of electronic books, it may act as a signal of general decline in academic achievement considering the previous researches addressing that the number of books at home is associated with student's performance.

Table 4.6. The number of students by book possessions

| # of books | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 |
|---|---|---|---|---|---|---|
| **500+** | 449 | 335 | 258 | 239 | 231 | 255 |
| **101-500** | 2,066 | 2,418 | 2,162 | 1,922 | 1,761 | 1,877 |
| **11-100** | 2,114 | 2,309 | 2,263 | 2,274 | 2,448 | 2,722 |
| **0-10** | 336 | 345 | 393 | 465 | 575 | 684 |
| total obs. | 4,965 | 5,407 | 5,076 | 4,900 | 5,015 | 5,538 |

[11] For the specific categories from the questionnaires, see Appendix B.

As expected from the trend of book possessions, Table 4.7 and Figure 4.5 provide evidence for declining of test scores. Table 4.7 shows the average test scores in reading literacy, mathematics, and science in each separated group by the number of books at home. Figure 4.6 illustrates how the average test scores has been changed from 2000 to 2015 according to book possessions. It is clear that the students who have lesser books shows steeper drop in their academic performance in every subjects.

Table 4.7. Average test scores by book possessions

| # of books | 2000 | | | 2003 | | | 2006 | | | 2009 | | | 2012 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie |
| **500+ ➔** | 554 | 585 | 589 | 577 | 614 | 605 | 604 | 614 | 572 | 581 | 602 | 584 | 582 | 614 | 579 | 553 | 570 | 556 |
| **101-500 ➔** | 537 | 563 | 564 | 556 | 568 | 563 | 574 | 568 | 543 | 557 | 567 | 556 | 548 | 569 | 549 | 534 | 541 | 532 |
| **11-100 ➔** | 511 | 530 | 535 | 516 | 517 | 516 | 539 | 525 | 502 | 525 | 527 | 521 | 515 | 525 | 517 | 491 | 493 | 488 |
| **0-10 ➔** | 463 | 470 | 483 | 461 | 455 | 447 | 469 | 447 | 433 | 469 | 462 | 466 | 463 | 474 | 476 | 441 | 441 | 442 |

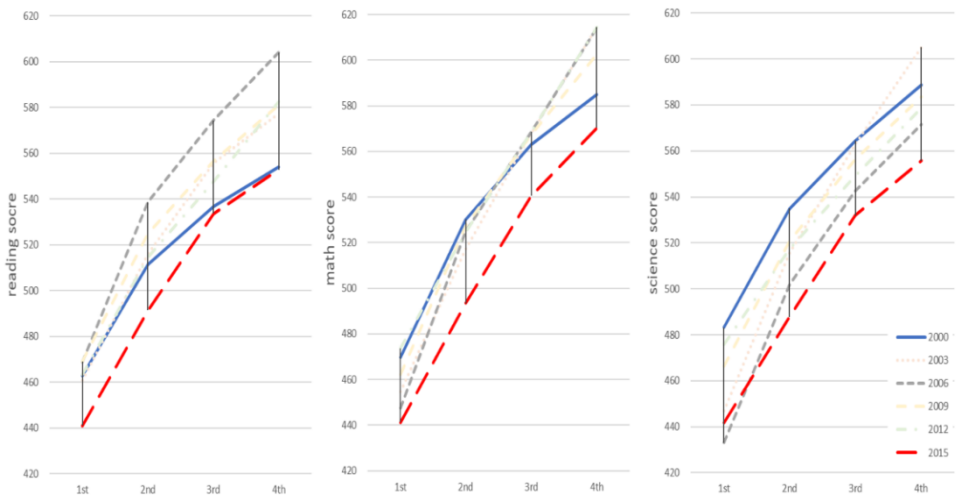



Figure 4.5. Average test scores by book possessions

Next, Table 4.8 presents book possessions in each subject's performance level. The performance level was measured as a categorical variable using the average value of five or ten plausible values. This result is only to show the tendency of relationship between test scores and the number of books at home. Accordingly, it gives the insight that high performers have more books than low performers.

Table 4.8. Book possessions by performance level

| Performance level | 2000 | | | 2003 | | | 2006 | | | 2009 | | | 2012 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie |
| 76-100% ➔ | 2.77 | 2.75 | 2.77 | 2.83 | 2.89 | 2.84 | 2.84 | 2.93 | 2.88 | 2.89 | 2.95 | 2.90 | 3.14 | 3.19 | 3.10 | 2.99 | 3.04 | 3.01 |
| 51-75% ➔ | 2.59 | 2.73 | 2.72 | 2.57 | 2.56 | 2.58 | 2.64 | 2.61 | 2.63 | 2.69 | 2.68 | 2.70 | 2.65 | 2.67 | 2.65 | 2.78 | 2.77 | 2.76 |
| 26-50% ➔ | 2.40 | 2.54 | 2.57 | 2.43 | 2.37 | 2.39 | 2.50 | 2.46 | 2.48 | 2.55 | 2.54 | 2.54 | 2.20 | 2.16 | 2.20 | 2.60 | 2.59 | 2.60 |
| 0-25% ➔ | 2.13 | 2.22 | 2.84 | 2.14 | 2.15 | 2.16 | 2.23 | 2.20 | 2.23 | 2.27 | 2.23 | 2.26 | 1.67 | 1.65 | 1.70 | 2.41 | 2.37 | 2.40 |

## 4.2. Trends of the relationship between book possessions and academic performances

In this section, the effect of book possessions on student's test scores is analyzed since 2000. To better take into account the relationship between the number of books as a proxy for student's socioeconomic status and test scores in three subjects, OLS models is employed based on all five or ten plausible values. I hypothesis that the student who possesses more books shows higher performance comparing to the student who possesses less books, considering the previous analysis about the relationship between the ESCS and test scores and the descriptive statistics from Section 4.1.

### 4.2.1. Performance gap between a large number of book holders and few book holders

The relationship between book possessions and academic performance was analyzed at two different samples: 1) the students who reported that 0-10 books possessed); 2) the students reported that more than 500 books possessed. The gender variable is used as a control variable. Table 4.4 presents the results of analysis for the effect of book possessions on student's test scores from 2000 to 2015. Looking at the changes of academic performance in the whole sample of the students, the correlation between book possessions and academic performance has been stronger over time, confirming the hypothesis. The distinguishing feature comparing to the previous analysis using the ESCS variable is that the sample of the students who have more than 500 books shows the clearly positive impact from book possessions, while that association in the students who have less than 10 books have been steadily weakening or not statistically significant. Figure 4.6 illustrates the difference of influence between the students who possess less than 10 books and more than 500 books in reading, mathematics and science literacy only in 2000 and 2015 to see the achievement gap[⑫].

[⑫] Figure 4.6 is drawn from the estimates in table 4.4 fixing the index of book possessions. In each figure, 1st are defined as those with 0 to 10 books possessors, and 4th are those with more than 500 books possessors.

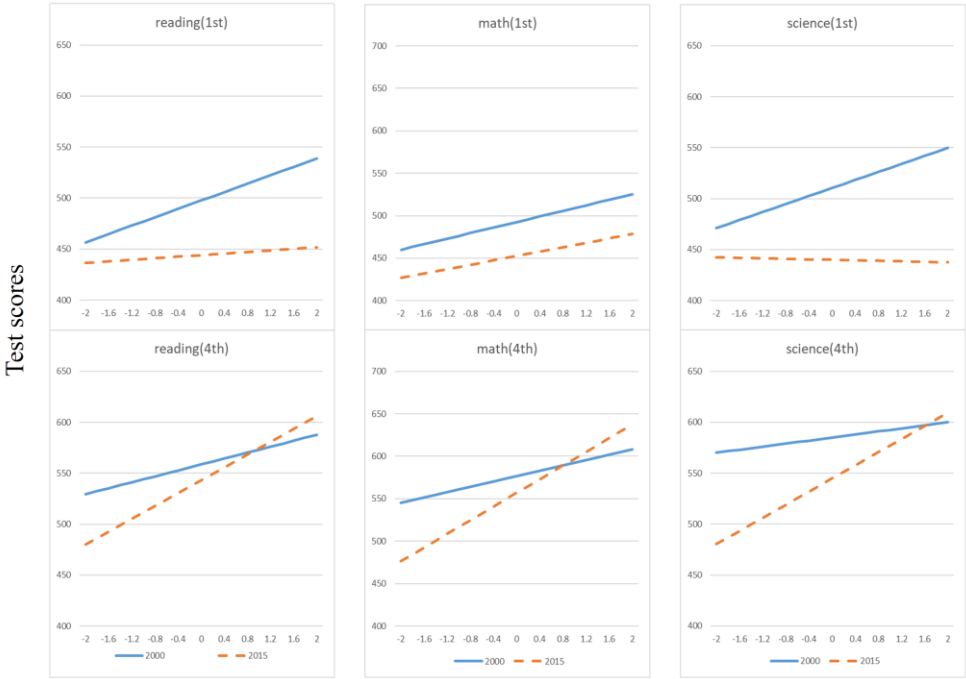



Figure 4.6. Comparisons of SES effects by book possession level (0-10 vs. 500+)

## Table 4.9. The relationship between book possessions and academic performance

| | | | The Whole Sample of Students | | | | | | Students who possess 0-10 books | | | | | | Students who possess more than 500 books | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 |
| **Reading literacy** | escs | coef. | 22.59*** | 31.79*** | 28.65*** | 30.86*** | 33.42*** | 42.84*** | 20.56*** | 20.91* | 1.13 | 17.67* | -5.65 | 3.9 | 14.57* | 26.60*** | 25.34*** | 23.49*** | 24.04*** | 31.38*** |
| | | s.e. | 2.11 | 2.59 | 3.04 | 2.33 | 2.8 | 3.01 | 5.55 | 7.57 | 7.73 | 6.33 | 9.63 | 9.27 | 5.75 | 7.34 | 8.06 | 6.2 | 6.95 | 8.37 |
| | gender (female) | coef. | 16.14*** | 22.76*** | 35.39*** | 33.50*** | 25.21*** | 38.05*** | 20.34 | 34.13* | 43.60*** | 56.29*** | 48.94*** | 57.07*** | 19.26* | 25.43* | 26.42* | 12.86 | 17.82* | 37.69*** |
| | | s.e. | 5.31 | 4.56 | 5.2 | 4.89 | 4.82 | 4.73 | 10.43 | 12.14 | 14.4 | 15.42 | 15.5 | 12.74 | 7.77 | 9.48 | 9.86 | 8.38 | 7.79 | 9.57 |
| | | cons. | 537.77 | 528.57 | 539.3 | 528.62 | 523.93 | 508.38 | 487.51 | 467.66 | 451.09 | 458.14 | 436.53 | 415.51 | 548.97 | 547.43 | 570.31 | 559.93 | 560.85 | 524.28 |
| | | obs. | 4976 | 5407 | 5076 | 4900 | 5015 | 5538 | 449 | 335 | 262 | 239 | 231 | 255 | 336 | 345 | 411 | 465 | 575 | 684 |
| **Math literacy** | escs | coef. | 31.82*** | 40.29*** | 38.01*** | 38.38*** | 41.85*** | 52.84*** | 16.32* | 19.24* | 7.45 | 20.81* | -6.52 | 12.92 | 15.66 | 38.31*** | 38.88*** | 31.92*** | 28.30*** | 40.26*** |
| | | s.e. | 2.55 | 3.18 | 3.7 | 3.14 | 3.26 | 3.2 | 6.65 | 6.71 | 6.74 | 8.28 | 9.63 | 11.2 | 8.86 | 9.16 | 9.3 | 9.14 | 7.96 | 8.7 |
| | gender (female) | coef. | -23.58*** | -21.64*** | -8.81 | -5.86 | -15.40* | 4.02 | -14.15 | -16.38 | 2.98 | 20.5 | 9.54 | 25.94* | -23.48 | -28.81*** | -20.11* | -24.84 | -25.56*** | 7.16 |
| | | s.e. | 6.83 | 5.34 | 5.3 | 6.16 | 5.43 | 4.69 | 14.23 | 10.76 | 13.11 | 14.43 | 16.73 | 12.27 | 14.73 | 8.92 | 8.89 | 12.24 | 8.64 | 9.79 |
| | | cons. | 569.84 | 555.34 | 552.7 | 555.58 | 560.74 | 532.79 | 499.73 | 480.8 | 454.43 | 468.15 | 464.39 | 439.66 | 588.34 | 596.06 | 593 | 594.51 | 608.63 | 553.3 |
| | | obs. | 2766 | 5407 | 5076 | 4900 | 5015 | 5538 | 271 | 335 | 262 | 239 | 231 | 255 | 189 | 345 | 411 | 465 | 575 | 684 |
| **Science literacy** | escs | coef. | 25.70*** | 38.44*** | 31.89*** | 31.56*** | 28.53 *** | 43.92*** | 19.7 | 16.58 | 4.02 | 14.86* | -10.97 | -1.24 | 7.47 | 35.12*** | 27.17*** | 26.65*** | 17.66* | 32.25*** |
| | | s.e. | 2.92 | 3.41 | 3.14 | 2.76 | 2.65 | 2.71 | 9.61 | 8.43 | 7.31 | 6.85 | 8.96 | 10 | 9.32 | 9.9 | 7.35 | 7.87 | 6.97 | 8.25 |
| | gender (female) | coef. | -16.91* | -16.65* | 2.28 | 0.45 | -1.68 | 6.9 | -7.45 | -8.54 | 8.88 | 20.24 | 18.68 | 25.25* | -22.22 | -15.47 | -2.16 | -25.20* | -6.68 | 11.9 |
| | | s.e. | 6.83 | 5.85 | 4.71 | 5.3 | 4.63 | 4.26 | 13.8 | 11.45 | 11.99 | 15.86 | 14.49 | 10.35 | 13.67 | 9.69 | 8.77 | 11.39 | 7.43 | 9.45 |
| | | cons. | 569.26 | 549.27 | 521.81 | 543.17 | 538.42 | 521.7 | 514.19 | 466.87 | 434.43 | 468.85 | 458.66 | 427.38 | 596.17 | 583.98 | 550.06 | 579.3 | 571.04 | 538.94 |
| | | obs. | 2755 | 5407 | 5076 | 4900 | 5015 | 5538 | 238 | 335 | 262 | 239 | 231 | 255 | 188 | 345 | 411 | 465 | 575 | 684 |

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

### 4.2.2. The difference of book possession effects between 2000 and 2015

In order to examine the effect of socioeconomic background on student's test score using the alternative variable, the number of books at home, the analysis on the year effects to each different groups divided by book possession levels was examined. As same as the section 3.2 which measures the difference of SES effects, two assessment years were chosen for this analysis: 2000 and 2015. First, the data from 2000 and 2015 were merged into one dataset for each subject since the number of samples are not matched. The new dummy variable was added to measure the year effects (year dummy: 0=2000/1=2015). The most important part, comparing the year effects, is to make interaction variables with the categorical variable of book possessions and the year variable. Consequently, one plausible values out of five or ten values was utilized as outcome variables so as to examine the interaction effects. The final student weighting was considered. Table 4.10 presents the SES effects measuring by the number of books at home between 2000 and 2015. The students who have less than 10 books are set as a reference group.

The results show the similar trends with the results using ESCS variable, supporting the hypothesis. That is, the alternative variable also substantiate the argument that the gap of academic achievement has been widening since 2000 because of disadvantaged students. In all three subjects, the students who have more books get much higher scores in 2015, and they are statistically significant. For instance, the difference of reading performances between the students who have less than 10 books and the students who have more than 500 books was 92.79 points in 2000. However, this gap increased by 27.17 points to a difference of 119.09 points. Even in

mathematics and science, the difference of test scores between 2000 and 2015 was widened.

Table 4.10. Comparisons of book possession effects by socioeconomic background (2000 vs. 2015)

| | | Reading literacy | Math literacy | Science literacy |
|---|---|---|---|---|
| book: 11-100 | coef. | 52.23*** | 65.18*** | 57.36*** |
| | s.e. | 4.17 | 4.95 | 5.06 |
| book: 101-500 | coef. | 77.61*** | 98.29*** | 83.85*** |
| | s.e. | 4.15 | 4.93 | 5.03 |
| book: 500+ | coef. | 92.79*** | 116.32*** | 103.3*** |
| | s.e. | 5.5 | 6.6 | 6.59 |
| year2015 (vs. 2000) | coef. | -30.43*** | -28.56*** | -41.71*** |
| | s.e. | 6.47 | 7.84 | 7.74 |
| book:11-100*year2015 | coef. | 2.53 | -13.66 | -12 |
| | s.e. | 6.95 | 8.44 | 8.31 |
| book:101-500*year2015 | coef. | 21.23** | 1.24 | 3.86 |
| | s.e. | 6.85 | 8.33 | 8.19 |
| book:500+*year2015 | coef. | 27.17** | 16.78 | 13.02 |
| | s.e. | 8.2 | 9.97 | 9.76 |
| gender(female vs. male) | coef. | 27.86*** | -8.20*** | -3.11 |
| | s.e. | 1.55 | 1.91 | 1.84 |
| | cons. | 450.86 | 474 | 486.17 |
| | obs. | 10,503 | 8,297 | 8,286 |

## 5. Variance among schools

The previous studies revealed that the most distinctive feature of Korean schools is the high degree of homogeneity across schools in terms of school quality and student performance (cf. Beaton & O'Dwyer, 2002; Martin, Mullis, Gregory et al. 2000; Cave, 2007; LeTendre, 2000; Lewis, 1995; Whitman, 2000). Despite of the typical view that Korean schools are highly homogeneous and standardized, school policies and practices have dramatically changed in the last twenty years. Therefore, it is necessary to analyze the extent to Korean schools differ in students' performance over time. Given that primary and middle schools are compulsory and comprehensive in Korea, between-school differences in students' performance might not have significantly increased at these levels of education, particularly in comparison to the level of high schools in which more radical policy measures toward increased school choices and differentiation have been implemented. Using data from 2000 to 2015 PISA, I examine and compare between-school and within-school components of total variance across years in middle and high schools participating PISA surveys[⑬].

Before analyzing the specified characteristics of schools in Korea, it is necessary to compare how total variance in student test scores is decomposed into between- and within-school variation. The analysis provides the proportion of total variance in student performance between schools by dividing between-school variance by total variance (Park, 2013).

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⑬ I used the statistical software, STATA for most of this research. However, in this section, I used the other software, HLM which has a capacity to run five or ten plausible values simultaneously (Park, 2013). For the weighting, I employed the final student weighting variable in student level.

Using school level data with student level, Table 4.11 presents basic descriptive statistics of between- and within-school variance in reading, mathematics and science scores. Based on the results of table 4.11, figure 4.7 demonstrates variance in each test score between and within schools as well as the percentage of total variance that lies between schools.

**Table 4.11. Two-level HLM models of achievement (base model)**

| | | School Mean Achievement | | % of variance in school mean achievement | Sample size | |
|---|---|---|---|---|---|---|
| | | Intercept, γ00 | s.e | | Student | School |
| **2000** | read | 522.97*** | 3.86 | 36.74% | 4976 | 146 |
| | math | 545.18*** | 5.15 | 40.39% | 2766 | 146 |
| | scie | 549.66*** | 4.84 | 38.75% | 2755 | 146 |
| **2003** | read | 532.35*** | 4.25 | 35.60% | 5372 | 148 |
| | math | 540.55*** | 5.07 | 41.61% | 5372 | 148 |
| | scie | 536.33*** | 5.29 | 37.72% | 5372 | 148 |
| **2006** | read | 554.16*** | 4.68 | 39.81% | 5076 | 154 |
| | math | 545.85*** | 4.87 | 40.07% | 5076 | 154 |
| | scie | 520.83*** | 4.43 | 34.42% | 5076 | 154 |
| **2009** | read | 535.54*** | 4.54 | 35.47% | 4900 | 157 |
| | math | 541.42*** | 5.38 | 40.18% | 4900 | 157 |
| | scie | 534.91*** | 4.50 | 34.06% | 4900 | 157 |
| **2012** | read | 515.65*** | 4.35 | 27.29% | 5015 | 156 |
| | math | 550.84*** | 5.21 | 39.17% | 5015 | 156 |
| | scie | 535.52*** | 4.09 | 35.71% | 5015 | 156 |
| **2015** | read | 515.65*** | 4.35 | 27.29% | 5538 | 168 |
| | math | 522.33*** | 4.55 | 27.98% | 5538 | 168 |
| | scie | 514.47*** | 3.97 | 24.99% | 5538 | 168 |

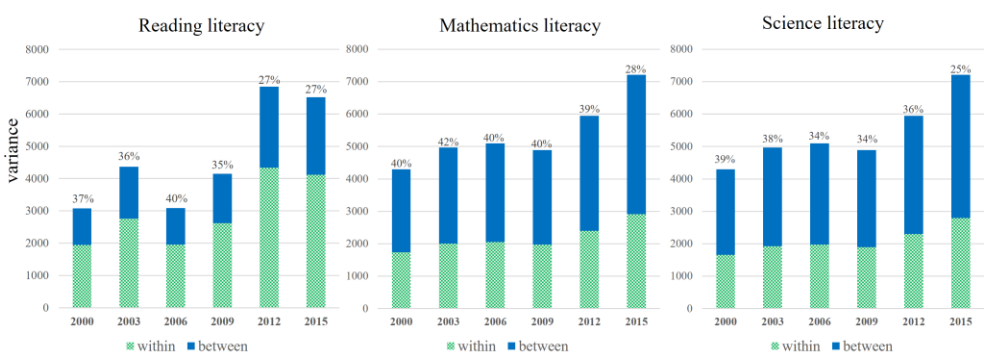


Figure 4.7. Between- and within-school variance in test scores across the years
*Between-school variance is noted on the top of the bar*

Although the magnitude seems different according to the subjects, figure 4.6 shows the overall trend that total variance has been increased over time. In reading literacy, total variance was only 3,073 in 2000 and 6,515 in 2015. The same patterns are found in mathematics literacy (4,295 in 2000 and 7,214 in 2015) and science literacy (4,029 in 2000 and 6,776 in 2015). This increase in total variance was driven by an increase in within-school variance. The results are the contrary to what the previous literatures have found, addressing that Korea are considerably homogeneous in student performance. Since school variance reflects a high degree of educational standardization (e.g. OECD 2004). However, it is clear that the total variance has increased since 2000, and within-school variance has also increased as a share of total variance. The results from Table 4.10 present that the percentage of between-school variance actually decreased. For instance, the between-school variance in reading literacy actually decreased from 36.74% in 2000 to 27.29% in both 2012 and 2015. This trend does not seem consistent with the description of increase of school diversification in the literature review.

To further analyze features of between-school differences, the relationship between school mean achievement and school mean SES (:ESCS) is examined. By averaging the values of the ESCS index of all students within schools, school mean SES that indicates the overall level of socioeconomic composition of students within schools was created as a school-level variable[⑭]. However, the female variable which was used as a control variable was excluded in the school-level, since this research is not

[⑭] I used the statistical software, SPSS so as to make school-level variables. Moreover, even though HLM supports the data format from STATA, the combination of SPSS and HLM is better to use without errors.

concerned with the gender effects. In other words, it is hypothesized that the gender effects are the same in all assessment years.

Table 4.11 presents the results for two-level hierarchical linear models of reading, mathematics and science scores. The school mean SES is associated with an increased school mean score in every assessment years. While not as strong as in 2000, the relationship between schools mean SES and school mean score is comparably substantial in 2015. That is, a 1 standard deviation increase in school mean SES is associated with about 54.38-point in 2000, but 92.08-point in 2015 in reading literacy. Mathematics (77.87-point in 2000 but 101.28-point in 2015) and science literacy (70.08-point in 2000 but 92.71-point in 2015) also show a strong effect of school mean SES on school mean achievement.

## Table 4.11. Two-level hierarchical linear models of academic achievement on the PISA test (analysis model)

| | 2000 | | | 2003 | | | 2006 | | | 2009 | | | 2012 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fixed Effects** | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie | read | math | scie |
| **School Mean Achievement** | | | | | | | | | | | | | | | | | | |
| Intercept, γ00 | 520.78 | 542.42 | 547.36 | 532.65 | 540.24 | 536.19 | 554.14 | 545.25 | 520.46 | 538.55 | 544.4 | 537.32 | 533.95 | 551.22 | 535.77 | 516.05 | 521.81 | 514.14 |
| Public (vs. private), γ01 | -7.47 | -3.64 | -0.57 | 6.65 | 7.56 | 6.65 | -10.58 | -6.89 | -4.8 | -12.9* | -14.21 | -9.88 | -12.98* | -16.58* | -12.24* | -6.6 | -1.44 | -4.89 |
| s.e. | 6.31 | 6.98 | 7.12 | 7.48 | 6.47 | 7.48 | 6.75 | 6.61 | 6.3 | 5.22 | 7.19 | 5.81 | 6.2 | 7.16 | 6.09 | 5.97 | 6 | 5.67 |
| location, γ02 | -1.68 | -2.81 | -1.9 | -3.44 | -4.27 | -4.5 | -2.35 | -6.82 | -6.86 | -0.57 | 0.63 | -0.87 | -0.6 | -1.17 | -1.3 | -3.01 | -0.6 | -2.77 |
| s.e. | 3.1 | 3.84 | 3.23 | 3.6 | 4.04 | 4.69 | 5.08 | 4.51 | 4.73 | 3.46 | 4.24 | 3.61 | 2.93 | 3.22 | 2.81 | 3.57 | 3.53 | 3.27 |
| School mean ESCS, γ03 | 54.38*** | 77.87*** | 70.08*** | 73.97*** | 93.45*** | 93.22*** | 82.21*** | 93.25*** | 84.17*** | 66.38*** | 81.73*** | 71.44*** | 89.19*** | 108.4*** | 84.11*** | 92.08*** | 101.28*** | 92.71*** |
| | 8.87 | 9.3 | 9.28 | 7.4 | 8.62 | 9.77 | 10.94 | 11.46 | 11.09 | 6.01 | 8.47 | 7.2 | 8.73 | 10.73 | 8.94 | 8.95 | 8.89 | 8.31 |
| **ESCS differentiation, γ10** | 6.45*** | 8.45*** | 4.03 | 11.21*** | 13.37*** | 11.21*** | 5.39** | 12.29*** | 9.06*** | 12.24*** | 15.49*** | 11.37*** | 11.54*** | 14.97*** | 7.85*** | 21.74*** | 29.79*** | 22.68*** |
| s.e. | 1.37 | 2.18 | 2.13 | 1.89 | 1.75 | 1.89 | 1.85 | 1.82 | 1.9 | 1.49 | 1.89 | 1.64 | 1.9 | 2.06 | 1.71 | 2.42 | 2.32 | 2.15 |
| **Female (vs. male), γ20** | 20.88*** | -18.85*** | -11.58** | 26.92*** | -16.68*** | -10.43*** | 33.98*** | -10.98** | 0.41 | 31.27*** | -11.9** | -2.39 | 30.54*** | -10.19** | 1.06 | 34.24*** | 0.77 | 2.98 |
| s.e. | 2.66 | 4.35 | 4.02 | 2.93 | 3.11 | 3.82 | 3.37 | 3.65 | 3.44 | 3.31 | 3.66 | 3.51 | 3.28 | 3.5 | 3.02 | 3.97 | 3.56 | 3.27 |
| **% of variance in school mean achievement explained by school mean SES** | 22.55% | 19.94% | 22.44% | 17.50% | 19.26% | 19.79% | 25.00% | 23.20% | 19.98% | 16.86% | 22.64% | 17.90% | 21.54% | 22.25% | 22.36% | 11.81% | 11.64% | 10.85% |
| **Sample size** | | | | | | | | | | | | | | | | | | |
| Student | 4976 | 2766 | 2755 | 5372 | 5372 | 5372 | 5076 | 5076 | 5076 | 4900 | 4900 | 4900 | 5015 | 5015 | 5015 | 5538 | 5538 | 5538 |
| School | 146 | 146 | 146 | 148 | 148 | 148 | 154 | 154 | 154 | 157 | 157 | 157 | 156 | 156 | 156 | 168 | 168 | 168 |

# Chapter V. Conclusion

This dissertation has examined how the performance gap between socioeconomically advantaged and disadvantaged students has changed over time in the midst of changes of educational systems in Korea, using the student- and school-level data of Korean 15-year-old students. I have focused on educational inequality related to academic achievement, as academic performance is a crucial factor determining student's subsequent educational transitions and ultimate attainment, and systematic disparity. This topic is timely and important given the recent rise of economic inequality. Furthermore, I have also tried to effectively marshal data from different years of PISA from 2000 to 2015, since PISA data are not easy to be dealt with due to their complicated sampling design and academic performance measures.

Chapter 2 has reviewed the literature related to achievement gap caused by student's socioeconomic background, and education reforms using neoliberal strategy. It also clearly presents the education system in Korea with recent changes. In Chapter 3 to 4, I have attempted to account for the recent rise of education inequality in Korea using the PISA index of economic, social and cultural status to measure student's family background. In order to see how the results are robust depending on different measure of family background, I also employs an alternative measure, the number of books available at home which is well documented by previous international studies to be a fairly strong predictor of student's academic performance. The findings of the study show the rise of achievement gap between students at the top and bottom of socioeconomic status across PISA surveys. Particularly significant is the decline in academic performance among

students from low-performers and disadvantaged family background.

*Findings*

Even though Korean students consistently rank high on international measures of reading, mathematics and science literacies, there was a sharp decline of national averages in 2015. Most of related analyses were focused on not differential performance rates between stronger and weaker students or rich and poor students, but the decline of scores itself. However, it is important to assess the achievement gap decomposed by performance level or socioeconomic status in order to resolve the problem of education inequality. The results have indicated that the degree of SES effects has dramatically increased since 2000. The disadvantages of lower SES students and low-performers are apparent. Moreover, the performances of students who are located in the upper level of SES distribution are clearly higher in 2015 than in 2000. That is, the high-performers and rich students have been more benefited in their academic achievement by socioeconomic background, while the achievement of low-performers and poor students have been gradually dropped. The alternative analysis using book possessions as a proxy variable for student's background also show the same trends.

Concerning the variance among schools, I have hypothesized that both between-school variance and within-school variance have been increased. However, on the contrary to the hypothesis, the results reveals that between-school variance has decreased as of 2012, whereas the total variance has increased with within-school variance. To investigate the implication of a

decline of between-school variance, I compared the variance among schools to OECD countries. Especially, in mathematics literacy among OECD countries, between-school variance was 34% in 2003 and slightly increased to 36% in 2012, while within-school variance was 67% to 53%, respectively. However, the results of Korean case showed the reversed trends. Between-school variance decreased from 42% to 39%, but within-school variance increased from 58% to 61% between 2003 and 2012. In Korea, a tracking system separates students into academic schools and vocational schools at upper secondary level. To reflect the specificity of Korean education system and to find out the clue which could help to understand the cause of the decrease in between-school variance, I also tried to examine variance only among academic high schools⑮. Interestingly, the samples of academic high schools showed the same pattern with OECD countries. Between-school variance among academic schools in 2003 was 29% and increased to 32% in 2012.[16]

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⑮ In 2003 data, school stratum is composed by nine categories: metropolitan general, metropolitan vocational, urban general, urban vocational, urban general and vocational, rural general, rural vocational, rural general and vocational, moderately small schools. The three categories, metropolitan vocational, urban vocational, and rural vocational, are grouped to 'vocational schools'. The remainders are all included to 'general schools'. In 2006 data, all schools were high schools except for give middles schools which were excluded from the analysis. The other eight schools took academic programs but some took vocational programs were treated as academic high schools. In 2012 and 2015 data, school stratum concludes three categories: lower secondary and general, upper secondary and general, upper secondary and vocational. Only upper secondary and general schools are included in the analysis. Table 5.3 summarizes the information of school sampling.

[16] There is no trends difference in reading literacy and science literacy among OECD countries, including Korea. Between-school variance has decreased over time. Specifically comparing between the two core assessment years- reading literacy was compared between 2000 and 2009, and science literacy was compared between 2006 and 2015, even the samples of academic high schools indicate the declining trends.

*Discussions*

There are a number of other possible explanations for the evident trends in the widening achievement gap. The dynamics behind the rising academic performance gap are likely complex and interconnected. The more research to find out the causes of increasing inequality trends is necessary in Korea. Equally important thing, however, is the research to understand the consequences of these patterns. The student's background has become more predictive of academic achievement among recent cohorts. As students who do better in PISA surveys are more likely to go to universities, and those who are more likely to earn more income (Schleicher, 2010; Fischback, Keller, Preckel, & Brunner, 2013). Thus, if we should not try to reduce the achievement gap, we risk producing an even more unequal and economically polarized society (Reardon, 2013).

As one of the plausible explanations to explore the reason why educational inequality has deepened in Korea, this dissertation tries to focus on a series of education reforms. Education reforms with neoliberal strategy mark a symbolic return to equity using the language of achievement gaps, but they do not directly address inequality. These reforms are intended to indirectly reduce inequalities through accountability and choice. Neoliberal reforms assume that if all students are given the opportunity to choose their schools and they are given adequate knowledge on the quality of the schools available, that they will all have improved access to high quality schools. This does not seem to be the case in Korea. The findings of this research indicate that education reforms do not seem to benefit the disadvantaged students.

The diversification of education with the abundant literature questioning the growing capacity of the education system as a useful solution for equalization of educational opportunities (Raftery and Hout, 1993; Shavit and Blossfeld, 1993; Lucas, 2001). In this sense, this study supports the possibility that the more diversified education may create more incentives for higher SES families, since affluent families are attracted to invest in children's school success to secure their access to more prestigious degrees as those qualification become more and more common among the public.

The caution against blind faith in educational reform is requested of attention with the sight of local context which can help to understand for the meaning and effects of neoliberal strategy. As Park (2013) points out, Korean students under the high level of educational standardization showed a higher average level of test scores not only in reading, mathematics, and science literacies but also in critical thinking and creativity. Notwithstanding a record of Korean student's achievement which we can be proud, education reforms had implemented based on a myth of typical criticisms relying on the uniform curriculum and instruction which are tightly linked to national entrance exams. As a results, education inequality has exacerbated over time in Korean society which has marginalized low-performers and socioeconomically disadvantaged students.

In Korea, there has been a 'dragon from streams', which refers to a successful person or self-made man who succeeds in spite of a humble background. Particularly, those of poor family background who made it to prestigious universities usually have been considered the dragons in Korean society. It was considered that the education system has helped the society could produce a number of 'dragons from streams'. However, it is

deplorable it is hard to find such a dragon these days. Now, education has been recognized as playing a role in reproducing class conditions rather than promoting social mobility in contemporary Korean society (Byun & Kim, 2010).

*Limitations and Suggestions for Future Studies*

The following question arises as to why the Korean government are pursuing such changes through education reforms nevertheless the benefits of the pre-reform standardized system. This question should be discussed beyond quantitative results. A theoretical discussion, for instance, about the potential influence of the 'neoliberal turn' in Korea's economy and society would have provided a larger context for the new educational policies. The recent education reforms were partly based on the desire to develop specialized skills that are tailored to the demands of the new information economy, but does not interrogate further how this discourse of the new economy may have justified the shift to differentiated education.

The recent education reforms from the egalitarian approach to the market-oriented approach may lead to higher educational inequality unless other policy interventions are also considered. However, as this study concentrated on analyzing the phenomenon, it could not reveal the causes of the increase in education inequality since 2000 in Korea. I postpone the evaluation of the recent education policies, but I expect more research on the achievement gap focusing on Korean case will be accumulated so as to identify the reason why the achievements of low-performers and disadvantaged students has been decreased recently. Molander (2016)

addresses that the failure policy application is due to incomplete knowledge of operational mechanisms. I believe that I believe that future analyses will overcome the limitation using the results of this analysis which observed how the achievement gap has changed over time empirically using nationally representative data.

In fact, there was a policy effort to reduce the achievement gap. As converting the National Achievement Evaluation and Assessment from sampling test to census test in 2008, the Korean government set the policy goal to make zero students who are under basic academic achievement. Considering the results that the achievements of low-performers has continuously declined, I cannot but questioning the effectiveness of the policy. On the contrary, the similar policy NCLB (No child Left Behind) in the United States has indeed helped improve education outcomes for low-performers and disadvantaged students, nevertheless the criticism that the NCLB Act has worked in a cost-efficient manner.

Furthermore, discussion of educational inequality often implicitly assumes the delivery of educational effectiveness as a prerequisite, and equalization of educational opportunities seems to be unwanted if it were at the expense of effectiveness. However, contrary to such concerns about possible trade-offs between effectiveness and equality attributable to institutional practices rather few national-level factors have shown significant effects on both academic productivity and inequality. Thus, the further research should corroborate that change in institutional context, building empirical evidence which will be consistent with the claim of previous studies (Van de Werfhorst & Mijs 2010).

*Implications for Educational Policy*

A growing body of cross-national research of student achievement has shown that institutional and policy arrangements matter in the process of educational stratification and inequality (e.g. Bushmann & Parrado, 2006; Park, 2008; Pong, Dronkers & Hampden-Thomson, 2003; Xu, 2008), offering evidence in support of institutional theory arguments. In this sense, this study has important policy implications for the reduction of educational inequality in Korean society as well as other countries. The recent education reforms for differentiated education pursued by the Korean governments that are motivated by the criticisms that standardized curriculums for their inability to meet the needs of both high-performing and underachieving students. However, contrary to the intended goals, the reforms have led to some undesirable consequences: low-performers and poor students are performing worse under the new system but not students at the top of the distribution, which then is leading to widening achievement gap.

If the reforms are producing these negative consequences, it is the time that we should rethink the direction of education reforms. It is difficult to elucidate the implications of educational policy to reduce achievement gap, since it is strongly related to individual student's background. Considered the results of this study, the recent increasing achievement gap is more likely to be transferred from social inequality rather than being made by school. In this sense, the most obvious way to alleviate achievement gap is to reduce socioeconomic disparity. However, the solution through social reform is not realistic.

Therefore, it is important to explore the possibility to resolve the widening

achievement gap through school education. The high heterogeneity within a school could be interpreted as a large difference in school experience of each individual student. Although the different school experience caused by different class is a factor for increasing academic gap, at the same time, it also has the potential to reduce the gap in that school experience can affect academic achievement independently of socioeconomic background.

The key to prevent widening the current gap in education is to look for the ways that how more of the underprivileged students can have positive experiences in school and how the school experience can be more meaningful to them. In other words, if we can change the differentiated school experience according to the class into an equal level, it is possible to close the gap caused by family background. Since nothing can be more apparently a class ladder to move up than a school and meaningful school experiences help to establish important life attitudes for future life, I think that the strengthening school education is important to reduce education and social inequality.

Therefore, firstly, school should supplement the educational activities that may lack to socioeconomically disadvantaged students. The supports should take place in the earlier level of schooling. As the influence of student's background and the achievement gap increase as the level of the school increases, the possibility to relive education inequality through school experience is gradually lowered at higher school level. Therefore, policy support and efforts should apply from the initial stage before the educational gap is fixed.

In addition, it is necessary to support disadvantaged students to have

diverse educational experiences in school. Considering that the academic achievement measure by PISA surveys is not a simple results of curriculum acquisition but rather a discipline in terms of citizens' ability to participate fully in society, there is a need to break from approaching academic achievement only to limited areas such as standardized test scores, not to make disadvantaged students be alienated again in the process of seeking jobs. Thus, school should encourage all students to find their strength and overcome the difficulties from their background conditions.

The point to be made in this dissertation is not to assess education reforms but to analyze education inequality with empirical evidence. I have tried to identify the direction of policy changes so as to measure the plausible influence of the education reforms, and cautiously underline the negative consequences of the recent education reforms. An important feature in Korea after the education reforms was the relatively weak performance of students at the lower end of the distribution, widening the disparity in academic achievement between students at the top and bottom of the distribution. It is time to turn our interest that is directed at upper-level students or PISA rankings to make new efforts for low-performers and socioeconomically disadvantaged students.

# References


Ammermueller, A. (2007). Poor background or low returns? Why immigrant students in Germany perform so poorly in the program for international student assessment. Education Economics, 15(2), 215-230.

Apple, M. W. (2001). Comparing neo-liberal projects and inequality in education. Comparative education, 37(4), 409-423.

Apple, M. W. (2006). Educating the" right" way: Markets, standards, God, and inequality. Taylor & Francis.

Apple, M.W. (2001) Educating the ‘Right Way’: market, standards, God, and inequality. New York and London: Routledge Falmer.

Baker, D. P., & Stevenson, D. L. (1986). Mothers' strategies for children's school achievement: Managing the transition to high school. Sociology of education, 156-166.

Baker, D. P., Goesling, B., & LeTendre, G. K. (2002). Socioeconomic status, school quality, and national economic development: A cross-national analysis of the “Heyneman-Loxley effect” on mathematics and science achievement. Comparative education review, 46(3), 291-312.

Barro, R. J. (2000). Inequality and Growth in a Panel of Countries. Journal of economic growth, 5(1), 5-32.

Barro, R. J., & Lee, J. W. (2001). International data on educational attainment: updates and implications. oxford Economic papers, 53(3), 541-563.

Basu, K., & Foster, J. E. (1998). On measuring literacy. The Economic Journal, 108(451), 1733-1749.

Beaton, A., & O’Dwyer, L. (2002). Separating school, classroom, and student variances and their relationship to socio-economic status. Secondary analysis of the TIMSS data, 211-231.

Becker, G. S., & Tomes, N. (1979). An equilibrium theory of the distribution of income and intergenerational mobility. The Journal of Political Economy, 1153-1189.

Becker, G. S., & Tomes, N. (1979). An equilibrium theory of the distribution of income and intergenerational mobility. Journal of political Economy, 87(6), 1153-1189.

Becker, G. S., & Tomes, N. (1986). Human capital and the rise and fall of families. Journal of labor economics, 4(3, Part 2), S1-S39.

Becker, G. S., & Tomes, N. (1986). VHuman capital and the rise and fall of familiesV. Journal of Labor Economics, 4(3), S1qS39.

Becker, W. C. (1964). Consequences of different kinds of parental discipline. Review of child development research, 1, 169-208.

Becker, W. C. (1964). Consequences of different kinds of parental discipline. Review of child development research, 1(4), 169-208.

Bickel, R. (2007). Multilevel analysis for applied research: it's just regression!. Guilford Press.

Birdsall, N. and Haggard, S. (2000) After the Crisis: The Social Contract and the Middle Class in East Asia, Washington, DC: Carnegie Endowment for International Peace.

Blau, Peter M. and Otis Dudley Duncan 1967 The American Occupational Structure. New York: Wiley.

Booher-Jennings, J. (2005). Below the bubble:"Educational triage" and the Texas accountability system. American educational research journal, 42(2), 231-268.

Boudon, R. (1974). Education, opportunity, and social inequality: Changing prospects in western society.

Bourdieu, P. (1973). The three forms of theoretical knowledge. Information (International Social Science Council), 12(1), 53-80.

Bourdieu, P. (1977). Outline of a Theory of Practice (Vol. 16). Cambridge university press.

Bourdieu, P. (1984). Distinction: A social critique of the judgement of taste. Harvard University Press.

Bourdieu, P. (1984). Distinction: A social critique of the judgement of taste. Harvard university press.

Bourdieu, P. (1997). Capital cultural, escuela y espacio social. Siglo xxi.

Bourdieu, P. (2011). The forms of capital.(1986). Cultural theory: An anthology, 81-93.

Bourdieu, P., & Passeron, J. C. (1977). Reproduction in education, culture and society.

Bourdieu, P., & Passeron, J. C. (1977). Reproduction in education, culture and society.

Brathwaite, J. R. (2015). Unequal opportunities: Graduation rates in New York City under neoliberal reform. Temple University.

Breen, R., & Jonsson, J. O. (2005). Inequality of opportunity in comparative perspective: Recent research on educational attainment and social mobility. Annual review of sociology, 223-243.

Breen, R., & Jonsson, J. O. (2005). Inequality of opportunity in comparative perspective: Recent research on educational attainment and social mobility. Annu. Rev. Sociol., 31, 223-243.

Bryk, A. S., & Raudenbush, S. W. (1992). Hierarchical linear models for social and behavioral research: Applications and data analysis methods.

Buchmann, C. (2002). Measuring family background in international studies of education: Conceptual issues and methodological challenges. Methodological advances in cross-national surveys of educational achievement, 150-197.

Buchmann, C., & Dalton, B. (2002). Interpersonal influences and educational aspirations in 12 countries: The importance of institutional context. Sociology of education, 99-122.

Buchmann, C., & Parrado, A. E. (2006). Educational achievement of immigrant-origin and native students: A comparative analysis informed by institutional theory. International Perspectives on Education and Society, 7, 345–377.

Buchmann, C., & Parrado, E. A. (2006). Educational achievement of immigrant-origin and

native students: A comparative analysis informed by institutional theory. In The impact of comparative education research on institutional theory (pp. 335-366). Emerald Group Publishing Limited.

Burt, M. E., & Namgi, P. (2008). Education inequality in the Republic of Korea: Measurement and causes. In Inequality in Education (pp. 261-289). Springer, Dordrecht.

Byun, S. Y., & Kim, K. K. (2010). Educational inequality in South Korea: The widening socioeconomic gap in student achievement. In Globalization, changing demographics, and educational challenges in East Asia (pp. 155-182). Emerald Group Publishing Limited.

Campos, J. E., & Root, H. (1996). The key to the Asian miracle. Washington, DC: The Brookings Institution.

Campos, J. E., and Root, H. L. (1996) The Key to the Asian Miracle: Making Shared Growth Credible, Washington, DC: The Brookings Institution.

Carbonaro, W. (2005). Tracking, students' effort, and academic achievement. Sociology of Education, 78(1), 27-49.

Carnoy, M., & Marshall, J. H. (2001). Explaining Differences in Primary School Student Achievement in Latin America: A Simulation Approach. Mimeo, Stanford University.

Cave, P. (2007). Primary school in Japan: Self, individuality and learning in elementary education. Routledge.

Center for Education Statistics. (2008) 2008 Ganchurin Gyoyuk Tonggye [2008 Selected Education Statistics], Seoul: Korean Educational Development Institute.

Cheng, T.J. (1992–3) ‘Dilemmas and choices in educational policies: the case of South Korea and Taiwan’, Studies in Comparative International Development 27(4): 54–79.

Chubb, J. E., & Moe, T. M. (1991). Politics, markets and America's schools.

Coleman, J. S. (1966). Equality of educational opportunity.

Coleman, J. S. (1988). Social capital in the creation of human capital. American journal of sociology, S95-S120.

Coleman, J. S. (1988). Social capital in the creation of human capital. American journal of sociology, 94, S95-S120.

Coleman, J. S., Hoffer, T., & Kilgore, S. (1982). High school achievement: Public, Catholic, and private schools compared. New York: Basic Books.

Daouli, J., Demoussis, M., & Giannakopoulos, N. (2010). Mothers, fathers and daughters: Intergenerational transmission of education in Greece. Economics of Education Review, 29(1), 83-93.

Daouli, J., Demoussis, M., & Giannakopoulos, N. (2010). Mothers, fathers and daughters: Intergenerational transmission of education in Greece. Economics of Education Review, 29(1), 83-93.

Darling-Hammond, L. (2000). Teacher quality and student achievement. Education policy analysis archives, 8, 1.

De Graaf, N. D., & Flap, H. D. (1988). “With a little help from my friends”: Social resources as an explanation of occupational status and income in West Germany, The Netherlands, and the United States. Social forces, 67(2), 452-472.

DiMaggio, P. (1982). Cultural capital and school success: The impact of status culture participation on the grades of US high school students. American sociological review, 189-201.

Doner, R.F., Bryan, K. R. and Slater, D. (2005) ‘Systemic vulnerability and the origins of developmental states: Northeast and Southeast Asia in comparative perspective’, International Organization 59(2): 327–361.

Egeland, B., & Abery, B. (1991). A Longitudinal Study of High-Risk Children: Educational Outcomes. International Journal of Disability, Development and Education, 38(3), 271-287.

Egeland, B., & Kreutzer, T. (1991). A longitudinal study of the effects of maternal stress and protective factors on the development of high risk children. Life-span developmental psychology: Perspectives on stress and coping, 61-85.

Erikson, R., & Jonsson, J. O. (Eds.). (1996). Can education be equalized?: The Swedish case in comparative perspective. Westview Press.

Evans, M. D., Kelley, J., Sikora, J., & Treiman, D. J. (2010). Family scholarly culture and educational success: Books and schooling in 27 nations. Research in social stratification and mobility, 28(2), 171-197.

Fagerlind, C. E., & Saha, K. E. (1997). Public Expenditure and human development in Nigeria.

Feigenbaum, H. B., & Henig, J. R. (1994). The political underpinnings of privatization: A typology. World Politics, 46(2), 185-208.

Fertig, M. (2003). Who's to blame? The determinants of German students' achievement in the PISA 2000 study.

Fischbach, A., Keller, U., Preckel, F., & Brunner, M. (2013). PISA proficiency scores predict educational outcomes. Learning and Individual Differences, 24, 63-72.

Fuchs, T., & Woessmann, L. (2007). pWhat Accounts for International Differences in Student Performance. A Re'Examination Using PISA DataqEmpirical Eco.

Giroux, H. A. (2012). Education and the crisis of public values. New York: Peter Lang.

Goldstein, H. (1995). Hierarchical data modeling in the social sciences. Journal of Educational and Behavioral Statistics, 20(2), 201-204.

Green, A. (1999) ‘East Asian skill formation system and the challenge of globalisation’, Journal of Education and Work 12(3): 253–79.

Green, A. (2007) ‘Globalization and the changing nature of the state in East Asia’,Globalisation, Societies, and Education 5(1): 22–38.

Green, F., James, D., Ashton, D. and Sung, J. (1999) ‘Post-school education and training policy in developmental sates: the cases of Taiwan and South Korea’, Journal of Educational Policy 14(3): 301–15.

Griffith, A. I. & Smith, D. E. 2005. Mothering for schooling. New York: Routledge/Taylor Francis.

Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and math. SCIENCE-NEW YORK THEN WASHINGTON-, 320(5880), 1164.

Gukjeong Briefing. (2007) 'Woegukeogo, Ipsigyoyukui Sasangah' [Foreign language high schools, an illegitimate child of exam-oriented education], 19 October.

Haim, E. B., & Shavit, Y. (2013). Expansion and inequality of educational opportunity: A comparative study. Research in Social Stratification and Mobility, 31, 22-31.

Hauser, R. M., & Sewell, W. H. (1986). Family effects in simple models of education, occupational status, and earnings: Findings from the Wisconsin and Kalamazoo studies. Journal of Labor Economics, 4(3, Part 2), S83-S115.

Heyneman, S. P., & Loxley, W. A. (1983). The effect of primary-school quality on academic achievement across twenty-nine high-and low-income countries. American Journal of sociology, 88(6), 1162-1194.

Ilon, L. (2011). Can education equality trickle-down to economic growth? The case of Korea. Asia Pacific Education Review, 12(4), 653-663.

Jencks, C. (1972). Inequality: A reassessment of the effect of family and schooling in America.

Jennings, J., & Sohn, H. (2014). Measure for measure: How proficiency-based accountability systems affect inequality in academic achievement. Sociology of Education, 87(2), 125-141.

Jeong, G.O. (2003) Starting of the Department of Ministry of Education & Human Resources Development, in KEDI (Ed.) 2002 Korea Education Review, pp. 33-48. Seoul: Korean Educational Development Institute.

Jeong, I. and Armer, J. M. (1994) 'State, class, and expansion of education in South Korea: a general model', Comparative Education Review 38(4): 531–45.

Kim, Byung-jo. (2000). Characteristics and Determinants of Korean Subjective Consciousness. Korean Sociology, 34, 241-268.

Kim, G. J. (2002). Education policies and reform in South Korea. Secondary education in Africa: Strategies for renewal, 29-39.

Kim, J. H., & Kim, S. (2002). School Accountability System and School Ranking for Korean Schools: The Investigation on School Effects based on Educational Production Function and Hierarchical Linear Model.

Kim, Young Chul. (2003) 'Teuksumokjeokhyeong Godeuhakkyo Cheje Yeongu I' [A study on high school system pursuing special purposes], Seoul: The Korean Educational Development Institute.

Lareau, A. (1987). Social class differences in family-school relationships: The importance of cultural capital. Sociology of education, 73-85.

Lareau, A. (2002). Invisible inequality: Social class and childrearing in black families and white families. American sociological review, 747-776.

Lareau, A., & Weininger, E. B. (2003). Cultural capital in educational research: A critical assessment. Theory and society, 32(5), 567-606.

Lee, Byung-hoon, & Yun, Jung-hyang. (2006). A Study on the Variation of Social Class Consciousness. Economics and Society, 70, 111-140.

Lee, Gun-man. (2007). Academicism and Class Conflict in Korean Society-Toward the Theory of Academic Capital. Studies in Educational Sociology, 17, 63-85.

Lee, I., Lee, N.M., Howang, H.J., Kim, Y.B., Kim, J.W. & Yoo, Y.S. (1997) Action Research on Curriculum Reconstruction and Teaching & Learning Methods for Implementing Open Education. Seoul: Korean Educational Development Institute.

Lee, M.H. (2002) A Plan for the Establishment of Educational Achievement System for the Improvement of School Education Quality, paper presented at National Scholastic Achievement Assessment: is this to improve school education quality or to make school hierarchy, Citizen Movement for Educational Reform, Seoul.

Lee, Sung-Kyun. (2008). Household Income Components: After the Economic Crisis and Profit Inequality Effects. Labor Policy Research, 8 (4), 119-146.

Lee, Wang-Won, Kim, Moon-Jo, & Choi, Yul. (2016). The hierarchical attribution of Korean society and change of consciousness of upward movement. Korean Sociology, 50 (5), 247-284.

LeTendre, G. K. (2000). Learning to be adolescent: Growing up in US and Japanese middle schools. Yale University Press.

Levels, M., Dronkers, J., & Kraaykamp, G. (2008). Immigrant children's educational achievement in western countries: origin, destination, and community effects on mathematical performance. American Sociological Review, 73(5), 835-853.

Lewis, D. A., & Nakagawa, K. (1995). Race and educational reform in the American metropolis: A study of school decentralization. SUNY Press.

Liu, O. L., & Wilson, M. (2009). Gender differences in large-scale math assessments: PISA trend 2000 and 2003. Applied Measurement in Education, 22(2), 164-184.

Liu, O. L., & Wilson, M. (2009). Gender differences in large-scale math assessments: PISA trend 2000 and 2003. Applied Measurement in Education, 22(2), 164-184.

Lucas, S. R. (2001). Effectively maintained inequality: Education transitions, track mobility, and social background effects. American journal of sociology, 106(6), 1642-1690.

Maasoumi, E. (1986). The measurement and decomposition of multi-dimensional inequality. Econometrica: Journal of the Econometric Society, 991-997.

Martin, M. O., Mullis, I., Gonzalez, E., O'Connor, Chrostowski, S., Gregory, K., Smith, T., & Garden, R. (2000) TIMSS 1999: International science report. Chestnut Hill, MA: Boston College.

Martins, L., & Veiga, P. (2010). Do inequalities in parents' education play an important role in PISA students' mathematics achievement test score disparities?. Economics of Education Review, 29(6), 1016-1033.

McGinn, N. F. (1980). Education and development in Korea(Vol. 90). Harvard University

Press.

McGinn, N. F., Snodgrass, D. R., Kim, Y. B., Kim, S.-B. and Kim, Q.-Y. (1980) Education and Development in Korea. Cambridge, MA: Council on East Asian Studies, Harvard University Press.

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. American psychologist, 53(2), 185.

McNeal Jr, R. B. (1999). Parental involvement as social capital: Differential effectiveness on science achievement, truancy, and dropping out. Social forces, 78(1), 117-144.

ME&HRD (Ministry of Education & Human Resources Development) (2001) Handbook of the Major Works of ME&HRD. Unpublished.

Ministry of Education (1997) Elementary and Secondary School Curriculum: Common National Curriculum. Seoul: Ministry of Education.

Ministry of Education. (1988) Mungyo 40yon Sa [The 40 Years of the Ministry of Education of Korea], Korea: Ministry of Education of Korea.

Ministry of Education. (1998) Gyoyuk 50yon Sa: 1948–1988 [The 50 Years of Education History in Korea], Korea: Ministry of Education of Korea.

Molander, P. (2016). The Anatomy of Inequality: Its Social and Economic Origins-and Solutions. Melville House.

Müller, W., & Karle, W. (1993). Social selection in educational systems in Europe. European sociological review, 9(1), 1-23.

Mullis, I. V., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades. TIMSS & PIRLS International Study Center. Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467.

Murphy, S. (2010). The pull of PISA: Uncertainty, influence, and ignorance. Inter-American Journal of Education for Democracy, 3(1), 27-44.

Muta, H. (2000). Deregulation and decentralization of education in Japan. Journal of Educational Administration, 38(5), 455-467.

Nam, Sang-Ho. (2015). Characteristics of Household Income and Asset Distribution in Korea. Health & Welfare Issue & Focus, 277, 1-8.

National Statistical Office. (2017). Social indicators of Korea. Daejeon: National Statistical Office.

Newman, D., Newman, I., & Salzman, J. (2010). Comparing OLS and HLM models and the questions they answer: Potential concerns for type VI errors. Multiple Linear Regression Viewpoints, 36(1), 1-8.

OECD (2001), Knowledge and Skills for Life: First Results from PISA 2000, OECD Publishing, Paris.

OECD (2004), Learning for Tomorrow's World: First Results from PISA 2003, OECD

Publishing, Paris.

OECD (2007), PISA 2006: Science Competencies for Tomorrow's World: Volume 1: Analysis, OECD Publishing, Paris.

OECD (2010), PISA 2009 Results: What Students Know and Can Do: Student Performance in Reading, Mathematics and Science (Volume I), OECD Publishing, Paris.

OECD (2014), PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science, OECD Publishing, Paris.

OECD (2016), PISA 2015 Results (Volume I): Excellence and Equity in Education, OECD Publishing, Paris.

OECD. (2002). PISA Programme for international student assessment (PISA) PISA 2000 technical report: PISA 2000 technical report. OECD Publishing, Paris.

OECD. (2005). PISA 2003 Data Analysis Manual: spss users, OECD Publishing, Paris.

Oh, Wook-Hwan. (2000). The fever of education in Korean society: origins and deepening. History of Education Science.

Park, Geo-Yong. (2005). The reality of Korean universities: criticism of new liberal education policy. History of Cultural Science.

Park, H. (2008). Home literacy environments and children's reading performance: A comparative study of 25 countries. Educational Research and Evaluation, 14(6), 489-505.

Park, H. (2008). The varied educational effects of parent-child communication: A comparative study of fourteen countries. Comparative Education Review, 52, 219–243.

Park, H. (2013). Re-evaluating education in Japan and Korea. Routledge.

Park, H., & Sandefur, G. (2010). Educational gaps between immigrant and native students in Europe: The role of grade. In Quality and inequality of education (pp. 113-136). Springer Netherlands.

Park, H., Behrman, J. R., & Choi, J. (2013). Causal effects of single-sex schools on college entrance exams and college attendance: Random assignment in Seoul high schools. Demography, 50(2), 447-469.

Park, S. Y. (2010). Crafting and dismantling the egalitarian social contract: The changing state-society relations in globalizing Korea. The Pacific Review, 23(5), 579-601.

Petrakis, P. E., & Stamatakis, D. (2002). Growth and educational levels: a comparative analysis. Economics of Education Review, 21(5), 513-521.

Pfeffer, F. T. (2008). Persistent inequality in educational attainment and its institutional context. European Sociological Review, 24(5), 543-565.

Pirie, I. (2005) ‘The new Korean state’, New Political Economy 10(1): 25–42.

Pong, S. L., Dronkers, J., & Hampden-Thompson, G. (2003). Family policies and children's school achievement in single-versus two-parent families. Journal of marriage and family, 65(3), 681-699.

Pong, S., Dronkers, J., & Hampden-Thompson, G. (2003). Family policies and children's school achievement in single- versus two-parent families. Journal of Marriage and Family, 65, 681–699.

Presidential Commission on Education Reform (1996) Education Reform Report for New Education System. Seoul: Presidential Commission on Education Reform.

Raftery, A. E., & Hout, M. (1993). Maximally maintained inequality: Expansion, reform, and opportunity in Irish education, 1921-75. Sociology of education, 41-62.

Raudenbush, S. W., & Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods (Vol. 1). Sage.

Reardon, S. F. (2011). The widening academic achievement gap between the rich and the poor: New evidence and possible explanations. Whither opportunity, 91-116.

Reardon, S. F. (2013). The widening income achievement gap. Educational Leadership, 70(8), 10-16.

Rothstein, R. (2004). Class and schools. Teachers College, Columbia University.

Rumberger, R. W. (2010). Education and the reproduction of economic inequality in the United States: An empirical investigation. Economics of Education Review, 29(2), 246-254.

Rumberger, R. W. (2010). Education and the reproduction of economic inequality in the United States: An empirical investigation. Economics of Education Review, 29(2), 246-254.

Rumberger, R. W., & Palardy, G. J. (2005). Does segregation still matter? The impact of student composition on academic achievement in high school. Teachers college record, 107(9), 1999.

Saigal, S., & Doyle, L. W. (2008). An overview of mortality and sequelae of preterm birth from infancy to adulthood. The Lancet, 371(9608), 261-269.

Saint-Paul, G., & Verdier, T. (1993). Education, democracy and growth. Journal of development Economics, 42(2), 399-407.

Sandefur, G. D., Meier, A. M., & Campbell, M. E. (2006). Family resources, social capital, and college attendance. Social science research, 35(2), 525-553.

SBS News, July 07. 2017.

Schleicher, A. (2010). Assessing literacy across a changing world. Science, 328(5977), 433-434.

Schoon, I., & Parsons, S. (2002). Teenage aspirations for future careers and occupational outcomes. Journal of Vocational Behavior, 60(2), 262-288.

Schulz, W. (2005). Measuring the Socio-Economic Background of Students and Its Effect on Achievement on PISA 2000 and PISA 2003. Online Submission.

Schulz, W. (2005). Measuring the Socio-Economic Background of Students and Its Effect on Achievement on PISA 2000 and PISA 2003. Online Submission.

Seoul Shinmun (1973) 'Mungyobu Jangkwan Damwha' [Announcement by Minister of Education], 28 February.

Seth, M. (2012). Education zeal, state control and citizenship in South Korea. Citizenship studies, 16(1), 13-28.

Seth, M. J. (2002) Education Fever: Society, Politics, and the Pursuit of Schooling in South Korea, Honolulu: University of Hawaii Press.

Seth, M. J. (2005). Popular demand and education in South Korea: An historical overview. In conference "Profits and challenges of education in Korea," by the Korea Argentina Study Center, University of Buenos Aires. Retrieved January(Vol. 11, p. 2007).

Shavit, Y., & Blossfeld, H. P. (1993). Persistent Inequality: Changing Educational Attainment in Thirteen Countries. Social Inequality Series. Westview Press, 5500 Central Avenue, Boulder, CO 80301-2847.

Shavit, Y., & Blossfeld, H. P. (1993). Persistent Inequality: Changing Educational Attainment in Thirteen Countries. Social Inequality Series. Westview Press, 5500 Central Avenue, Boulder, CO 80301-2847.

Shavit, Y., & Blossfeld, H. P. (1993). Persistent Inequality: Changing Educational Attainment in Thirteen Countries. Social Inequality Series. Westview Press, 5500 Central Avenue, Boulder, CO 80301-2847.

Shavit, Y., & Blossfeld, H. P. (1993). Persistent Inequality: Changing Educational Attainment in Thirteen Countries. Social Inequality Series. Westview Press, 5500 Central Avenue, Boulder, CO 80301-2847.

Shin, Kwang-young. (2013). Social Inequality Research. Humanitas.

Sin, H.S. (2003) A General Review about Policy Making and Enforcement Process, in KEDI Ed.) 2002 Korea Education Review, pp.7-32. Seoul: Korean Educational Development nstitute.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. Review of educational research, 75(3), 417-453.

Teachman, J. D., Paasch, K., & Carver, K. (1997). Social capital and the generation of human capital. Social forces, 75(4), 1343-1359.

Thomas, V., Wang, Y., & Fan, X. (2001). Measuring education inequality: Gini coefficients of education (Vol. 2525). World Bank Publications.

Thurbon, E. and Weiss, L. (2006) 'Investing in openness: the evolution of FDI strategy in South Korea and Taiwan', New Political Economy 11(1): 1–22.

Torche, F. (2005). Privatization reform and inequality of educational opportunity: The case of Chile. Sociology of education, 78(4), 316-343.

UNESCO. (2010). EFA global monitoring report.

Uno, M. (2013). National institutional context and educational inequality: a multilevel analysis of variation in family SES effects on academic achievement across OECD countries.

Useem, E. L. (1992). Middle schools and math groups: Parents' involvement in children's placement. Sociology of education, 263-279.

Van de Werfhorst, H. G., & Mijs, J. J. (2010). Achievement inequality and the institutional structure of educational systems: A comparative perspective. Annual review of sociology, 36, 407-428.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. Psychological bulletin, 91(3), 461.

Whitty, G. (1998) Marketization, the State, and the Re-Formation of the Teaching Profession, in A.H. Halsey, H. Lauder, P. Brown & A.S. Wells (Eds) Education: culture, economy, society, pp. 299-310. Oxford: Oxford University Press.

Willms, J. D. (2003). Ten Hypotheses about Socioeconomic Gradients and Community Differences in Children's Developmental Outcomes. Final Report. Human Resources Development Canada. Service Canada, Ottawa, ON K1A 0J9, Canada.

Willms, J. D. (2006). Variation in socioeconomic gradients among cantons in French-and Italian-speaking Switzerland: Findings from the OECD PISA. Educational Research and Evaluation, 12(02), 129-154.

Wong, J. (2004) 'From learning to creating: biotechnology and postindustrial developmental state in Korea', Journal of East Asian Studies 4(3): 491–517.

Wößmann, L. (2003). Schooling resources, educational institutions and student performance: the international evidence. Oxford bulletin of economics and statistics, 65(2), 117-170.

Wu, M. L., Adams, R. J., & Wilson, M. (1998). ACER ConQuest: Generalised item reponse modelling software. Acer Press.

Wu, M., & Adams, R. (2002). PISA 2000 technical report.

Xu, H. (2010). Sample average approximation methods for a class of stochastic variational inequality problems. Asia-Pacific Journal of Operational Research, 27(01), 103-119.

Xu, J. (2008). Sibship size and educational achievement: The role of welfare regimes cross nationally. Comparative Education Review, 52(3), 414–436.

Yoon, Jong-Hyeok, Kim, Y. C., Kim, J. N., and Han, Y. K. (2003) 'Gogyo pyeongjunhwa jeongchakui jeokhapseong yeongu (I)' [On the relevancy of High School Equalization Policy I], Seoul: Korean Educational Development Institute.

Ahn, B.-y. (2007) 'Ahn Byung-young jeon gyoyuk bu chongri yonseidae toeim gobyeol gangyeon' [Professor Byung-young Ahn, a former Education Minister and Deputy Prime Minister, made a farewell speech at Yonsei University], Shindonga 568: 198–221.

김병성. (2003). 우등생과 열등생 차이, 그 오래된 의문점: 교육격차의 의미. 배경. 인과론. 교육개발, 30(3), 20-25.

이혜영, 강태중, 김수영. (2004). 교육복지투자우선지역과 타 지역 학교의 교육격차 분석 연구. 서울: 한국교육개발원.

# Appendix A. Kernel Function

A kernel function is a weighting function that produces smoothed estimates of the density at a certain score by basing the density estimate on the frequency of scores in the neighborhood. A large weight is assigned to scores in the near neighborhood and a smaller weight to scores that are further away. The weighted values of the kernel function *K* are summed in the following function:

(1) $$F_K = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - X_i}{h}\right).$$

The population size is *n*, *x* is the score for which I want to estimate the kernel, and *h* the bandwidth. The variable *Xi* represents the other scores in the neighborhood of *x*. The bandwidth *h* is determined by Silverman's (1986) rule of thumb, which shall obviate the under- or over-smoothing of the data that would allow the variance or the bias to dominate asymptotically, respectively.

The Epanechnikov kernel function *K(z)*, $z = \left(\frac{x - X_i}{h}\right)$. For $|z| < \sqrt{5}$ which is the most efficient in minimizing the mean integrated squared error, is used to estimate the density values

(2) $$K(z) = \frac{3}{4}\left(1 - \frac{1}{5}z^2\right)/\sqrt{5}, \quad K(z) = 0 \text{, otherwise.}$$

# Appendix B. How to measure the book possessions

In section 4 in Chapter IV, the alternative indicator was employed instead of the multidimensional indicator ESCS. The detailed information is explained with the questionnaires in each assessment year.

- PISA 2000 (ST37Q01)

**Q 37 How many books are there in your home?**

*There are usually about 40 books per yard of shelving. Do not include magazines.*

*Please fill in only **one** oval.*

None ..... Ⓐ

1-10 books ..... Ⓑ

11-50 books ..... Ⓒ

51-100 books ..... Ⓓ

101-250 books ..... Ⓔ

251-500 books ..... Ⓕ

More than 500 books ..... Ⓖ

- PISA 2003 (ST19Q01)

**Q19 How many books are there in your home?**

*There are usually about <40 books per metre> of shelving. Do not include magazines, newspapers, or your schoolbooks.*

*(Please <tick> only one box.)*

0-10 books ..... ☐1

11-25 books ..... ☐2

26-100 books ..... ☐3

101-200 books ..... ☐4

201-500 books ..... ☐5

More than 500 books ..... ☐6

- PISA 2006 (ST15Q01)

**Q15 How many books are there in your home?**

*There are usually about 40 books per metre of shelving. Do not include magazines, newspapers, or your schoolbooks.*

*(Please fill only one circle.)*

0-10 books ..... ①

11-25 books ..... ②

26-100 books ..... ③

101-200 books ..... ④

201-500 books ..... ⑤

More than 500 books ..... ⑥

- PISA 2009 (ST22Q01)

**Books in the home**

**Q22 How many books are there in your home?**

*There are usually about 40 books per metre of shelving. Do not include magazines, newspapers, or your schoolbooks.*

*(Please tick only one box)*

0-10 books ☐1

11-25 books ☐2

26-100 books ☐3

101-200 books ☐4

201-500 books ☐5

More than 500 books ☐6

- PISA 2012 (ST28Q01)

| Q25 (ST28) | **How many books are there in your home?**<br>*There are usually about 40 books per metre of shelving. Do not include magazines, newspapers, or your schoolbooks.*<br>*(Please tick only one box.)* | |
|---|---|---|
| | 0-10 books | ☐ 1 |
| | 11-25 books | ☐ 2 |
| | 26-100 books | ☐ 3 |
| | 101-200 books | ☐ 4 |
| | 201-500 books | ☐ 5 |
| | More than 500 books | ☐ 6 |

- PISA 2015 (ST013Q01TA)

| ST013 ST013Q01TA | **How many books are there in your home?**<br>*There are usually about 40 books per metre of shelving. Do not include magazines, newspapers or your schoolbooks.*<br>*(Please select one response.)* | |
|---|---|---|
| | 0-10 books | ☐ 1 |
| | 11-25 books | ☐ 2 |
| | 26-100 books | ☐ 3 |
| | 101-200 books | ☐ 4 |
| | 201-500 books | ☐ 5 |
| | More than 500 books | ☐ 6 |

# 국문 초록

본 연구는 국제 학업성취도 비교 평가인 **PISA** 자료를 이용하여 한국에서 교육 불평등이 심화되어 온 양상을 분석하였다. **2000**년에서 **2015**년에 이르기까지 부모의 사회경제적 배경이 자녀의 학업성취에 미치는 영향력이 어떻게 달라지는 지를 측정하여 우리 사회에서 점차 심화되어 가고 있는 불평등 정도를 실증적으로 파악하고자 하였다. 분석 결과, 학생들의 전반적인 학업 성취 수준은 점차 하락하는 추세를 보였으며 동시에 교육 불평등은 심화되는 것으로 나타났다. 특히, 학업 성취 수준 및 사회경제적 수준이 낮은 학생일수록 최근 들어 더욱 낮은 학업 성취를 보였다. 학생의 배경을 다면적으로 측정한 변수가 아닌 학생들이 가정에서 보유하고 있는 책의 권수를 이용하여 분석하는 경우에도 마찬가지로 저소득층과 성적 하위권 학생들의 성취도 하락으로 인해 학업 격차가 확대되는 경향성을 발견할 수 있었다. 뿐만 아니라, 한 학교를 다니는 학생들 간의 이질성이 증가하면서 전체 학교 간 차이가 **2000**년 이후 점차 증가하였으며, **2000**년에 비해 **2015**년에는 학교 평균 사회경제적 수준이 학교 평균 성적에 미치는 영향력이 상당히 확대되었다. 이러한 결과는 한국 사회에서 계층 상승 이동을 가능하게 했던 교육에서 조차 양극화가 진행되고 있음을 보여주고 있다.

주제어: 교육 불평등, 학업 격차, **PISA**, 다층 모형