

**WHAT CAUSES THE COLLEGE ATTENDANCE GAP IN KOREA?
: SHORT-TERM FINANCIAL CONSTRAINT
vs.
LONG-TERM FAMILY BACKGROUND CONSTRAINT**

By

Seung-Eun Lee

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY IN ECONOMIC DEVELOPMENT

2011

**WHAT CAUSES THE COLLEGE ATTENDANCE GAP IN KOREA?
: SHORT-TERM FINANCIAL CONSTRAINT
vs.
LONG-TERM FAMILY BACKGROUND CONSTRAINT**

By

Seung-Eun Lee

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY IN ECONOMIC DEVELOPMENT

2011

Professor Tae Jong KIM

WHAT CAUSES THE COLLEGE ATTENDANCE GAP IN KOREA?
: SHORT-TERM FINANCIAL CONSTRAINT
vs.
LONG-TERM FAMILY BACKGROUND CONSTRAINT

By

Seung-Eun Lee

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

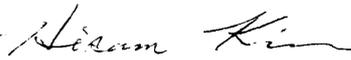
MASTER OF PUBLIC POLICY IN ECONOMIC DEVELOPMENT

Committee in charge:

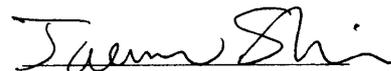
Professor Tae Jong KIM, Supervisor



Professor Hi Sam KIM



Professor Ja Eun SHIN



Approval as of November, 2011

ABSTRACT

WHAT CAUSES THE COLLEGE ATTENDANCE GAP IN KOREA? : SHORT-TERM FINANCIAL CONSTRAINT

vs.

LONG-TERM FAMILY BACKGROUND CONSTRAINT

By

Seung-Eun Lee

This paper aims to investigate which factor would be more important in constraining 4-year college attendance in Korea: short-term unaffordability to pay college tuition fees and the long-term disadvantaged family backgrounds that are crystallized in poor academic achievement. According to the regression results, family income at the college going ages has little effect on 4-year college attendance while family income at earlier ages and academic performance in middle school have significant effect. Also, following the methodology used by Heckman and his collaborators who previously performed similar research on the cause of the U.S.'s higher education gap, I suggest that the more crucial constraint is their academic performance gap caused by long-term family background. This result provides important policy implication to current situation where most policy-setting discussions to alleviate higher education gap focus only on lowering college tuition fees.

Table of Contents

I. Introduction	1
II. Background of Study	6
2.1 Literature Review	6
2.1.1 College Attendance Cost as a Constraint Factor of Tertiary Education Attendance	6
2.1.2 Long-term Constraint as a Major Factor of Disadvantaged Students' Low College Attendance	7
2.1.3 Causes of College Education Gap in Korea	13
2.2 Theoretical Background	15
2.2.1 Theories Based on Sociology	15
2.2.2 Theories Based on Economics	16
III. Hypothesis Development	20
3.1 A Basic Framework of This Study	20
3.2 Hypothesis Development of This Study	22
3.2.1 The Effect of Family Income	23
3.2.2 The Effect of Academic Achievement in Early Adolescent Years	24
3.2.3 The Effect of Family Background	25
3.2.4 Hypothesis Development	26
IV. Methodology	30
4.1 Data	30
4.2 Variables	32
4.2.1 Dependent Variables	32
4.2.2 Independent Variables	32
4.3 Analysis Methodology	37
4.3.1 Multiple Linear Regression	37
4.3.2 HCP Calculation	38
4.4 Descriptive Statistics	41
4.4.1 Descriptive Statistics of the Variables for Multiple Linear Regression	41
4.4.2 Descriptive Statistics for HCP Calculation	42

V. Analysis Result	45
5.1 Results of Multiple Linear Regression	45
5.1.1 Results of MLR on 4-year College Attendance	47
5.1.2 Results of MLR on Top 30 College Attendance	54
5.1.3 Summary of Multiple Linear Regression Results	60
5.2 Results of HCP Calculation	61
5.2.1 HCP Calculation for 4-year College Attendance	61
5.2.2 HCP Calculation for Top 30 College Attendance	65
VI. Conclusion	67
6.1 Summary and Policy Implication	67
6.2. Limitation of the Study and Future Research	72
Reference	74
Appendix	85

List of Tables

[Table 1-1] Higher education attendance rates by income quartiles	3
[Table 3-1] Sample composition ratio according to the type of entered tertiary institutions ..	21
[Table 4-1] Descriptive statistics of variables	41
[Table 4-2] Descriptive statistics of income quartiles	42
[Table 4-3] Descriptive statistics of ranking percentage terciles	42
[Table 4-4] Descriptive statistics of family background index for 4-year college entrance ...	43
[Table 4-5] Descriptive statistics of family background index for top 30 college entrance ...	43
[Table 4-6] Number of observations by income and academic ranking	44
[Table 5-1] Framework of multiple linear regression	46
[Table 5-2] Determinants of 4-year college attendance: the result of OLS regression (Step 1) ..	48
[Table 5-3] Determinants of 4-year college attendance: the result of OLS regression (Step 2) ...	50
[Table 5-4] Determinants of 4-year college attendance: the result of OLS regression (Step 3) ...	52
[Table 5-5] Determinants of top 30 college attendance: the result of OLS regression (Step 1) ...	55
[Table 5-6] Determinants of top 30 college attendance: the result of OLS regression (Step 2) ...	56
[Table 5-7] Determinants of top 30 college attendance: the result of OLS regression (Step 3) ...	58
[Table 5-8] Variables that have significant effect in the regression using all explanatory variables ..	61
[Table 5-9] Gaps in 4-year college attendance relative to highest income quartile	62
[Table 5-10] Weighted Gaps in 4-year college attendance relative to highest income quartile ..	62
[Table 5-11] Coefficients for constructing the family background index (4-year colleges) ...	63
[Table 5-12] Gaps / Weighted Gaps in 4-year college attendance relative to the highest family background index quartile	64
[Table 5-13] Comparison of the HCP calculation result between Korea and the U.S	65
[Table 5-14] Coefficients for constructing the family background index (top 30 colleges) ...	66
[Table 5-15] Gaps / Weighted Gaps in top 30 college attendance relative to the highest family background index quartile	66
[Table A3-1] The list of Top 30 colleges and Top 10 colleges	84
[Table A5-1] Gaps in top 30 college attendance relative to highest income quartile	86
[Table A5-2] Weighted Gaps in top 30 college attendance relative to highest income quartile ...	87

List of Figures

[Figure 1-1] Trend of Gross Higher Education Enrollment Ratio in Korea	2
[Figure 1-2] Trend of Advance rate of high school graduates to higher education in Korea	2
[Figure 2-1] Home investments in children	17
[Figure 3-1] Framework of hypotheses	22
[Figure 4-1] KEEP data used in this study	31
[Figure 4-2] Number of observations by income and academic ranking	44
[Figure 5-1] Framework of multiple linear regression	47

I. Introduction

While education has always been an important issue, the importance of education draws more attention these days as inequality becomes a serious problem both within and across the countries. This is because education is regarded as an instrument that can raise social mobility. This perspective may be true if education guarantees the same opportunity for every student in both qualitative and quantitative aspects. On the other hand, education may act as a means of exacerbating inequity if inequity interferes in the provision process of education.

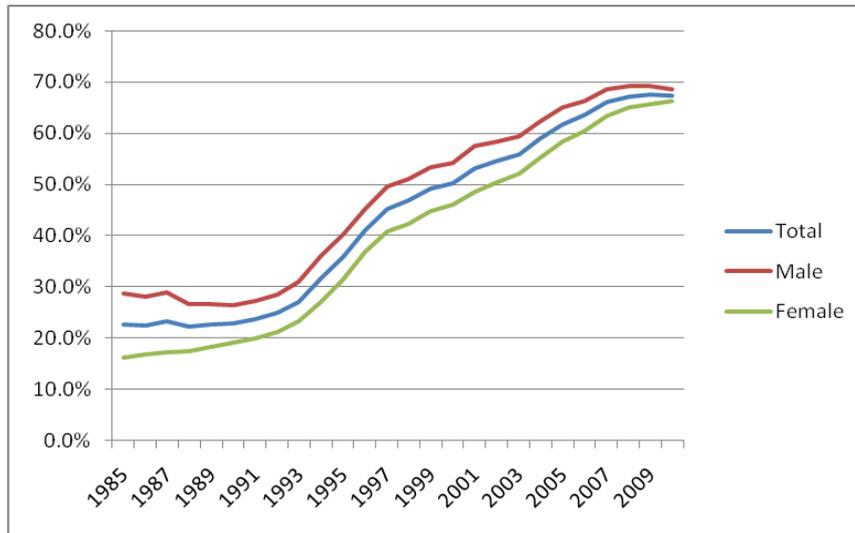
Higher education is a typical example. The situation that employees with higher education degree tend to be paid more than those without the degree is generally accepted in today's society. In particular, those who graduate from prestigious colleges usually receive better treatment in employment than others.¹ These unequal treatments in labor market can be allowed only when students can compete with others for college attendance under the same condition or at least substantial opportunity for the disadvantaged should be provided to help them overcome their circumstance by effort. However, the problem is that inequality of opportunity which is not easy to surmount does exist and its result emerges at higher education explicitly.

According to *Education at a Glance 2010* published by OECD, Korea ranked first in the proportion of people aged 25 to 34 with tertiary education degree (58 percent) in 2008. This is the result of great educational zeal in Korean society, where there are scarce natural resources and therefore human resources play a critical role in the economy. This feature of Korea has caused rapid increase in higher education participation as shown in [Figure 1-1]

¹ For example, Joongang Ilbo and KRIVET(Korea Research Institute for Vocational Education and Training) (February 2nd, 2010) found that people who graduated from three most prestigious colleges (Seoul National University, Korea University, Yonsei University) in 2002 received annual salary more in 2009 by 14.9 percent than those who graduated from the colleges located in Seoul, and by 35 percent than those who graduated from the colleges not located in Seoul.

and [Figure 1-2]. Therefore if we just consider the higher education participation rate and the higher education participation rate by income quantiles, it seems not too bad (see [Table 1-1], colleges (both 4-year and 2-year) attendance rate).

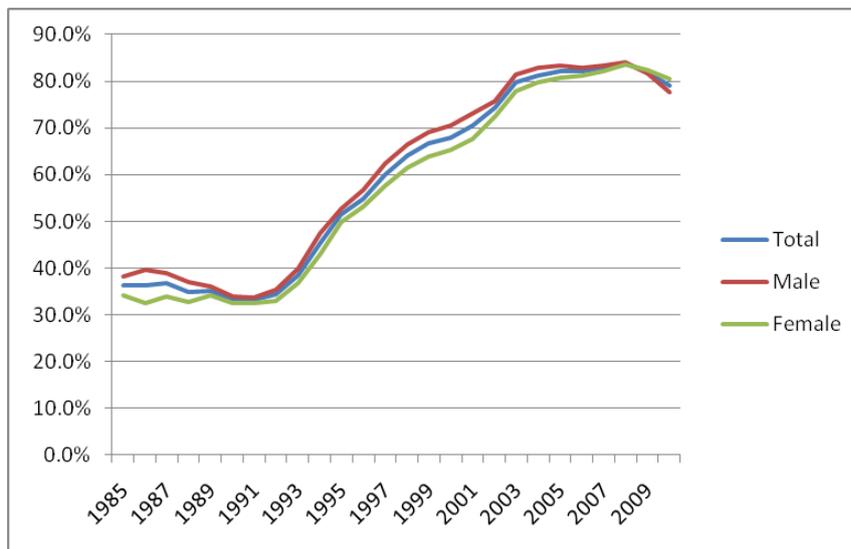
[Figure 1-1] Trend of Gross Higher Education Enrollment Ratio in Korea



Note: gross higher education enrollment ratio = $\frac{\text{number of people aged 18 to 21 who enrolled in higher education}}{\text{number of people aged 18 to 21}}$

Source: Statistics Korea (2011)

[Figure 1-2] Trend of Advance rate of high school graduates to higher education in Korea



Note: advance rate = $\frac{\text{number of high school graduates who enrolled in higher education}}{\text{number of high school graduates}}$

Source: Statistics Korea (2011)

However, when we consider the qualitative aspect of higher education institutions, the situation becomes different. [Table 1-1] shows that the higher education attendance rates by the type of institutions (A1, A2, B, C in [Table 1-1]) increase, as the income level increases except the attendance rate to both 4-year and 2-year colleges (overall higher education institutions). The degree of the relationship between the attendance rate and income level becomes stronger when it regards more prestigious institutions. Moreover, according to Kim et al. (2003)'s study, among the students who were admitted to the College of Social Sciences at Seoul National University, which is regarded as the most prestigious university in Korea, the ratio of students whose fathers were high income earners was 49.5 percent in 2002, while the ratio in 1985 was 15.2 percent.

[Table 1-1] Higher education attendance rates by income quartiles

	Summary of Income Quartiles			Attendance Rate (%)				
	No. of obs	cum. percent	Range of Monthly Income (10,000 KRW)	Colleges (both 4-year and 2- year)	4-year colleges (A1)	4-year colleges (A2)	top 30 colleges (B)	top 10 colleges (C)
1st quartile	318	33.33	0~250	78.3	45	57.4	6.3	1.9
2nd quartile	168	50.94	255~300	82.7	53.6	64.7	6.5	1.8
3rd quartile	234	75.47	306~420	89.3	58.5	65.6	12.4	5.1
4th quartile	234	100.00	430~2500	79.5	61.5	77.4	14.5	6.8
Total	954							

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP). More detailed information regarding this data will be presented in Chapter IV.

Note: 1) The attendance rate of 4-year colleges (A1) refers the gross rate calculated based on both higher education participants and non-participants, while the attendance rate of 4-year colleges (A2) refers the calculated rate considering only higher education participants.

2) Top 30 colleges and Top 10 colleges are selected based on the ranks of Korean colleges which were announced in 2007 by Joongang Ilbo (daily newspaper). More detailed information regarding this evaluation will be presented in Chapter IV.

3) The reason why number of observations belonged to 1st income quartile is very high while those belonged to 2nd income quartile is very low is that there are 81 students whose reported household income is KRW 2.5 million.

As these evidences show, the gap of higher education attendance between different income groups distinctly exists and this leads again to a wage gap between those, which deepens the gap between the rich and the poor by weakening social mobility. Furthermore, these conditions may damage the sustainable economic development and the social stability.

To alleviate the higher education gap, we should grasp the cause of the gap clearly so that we can respond to the problem properly. Today, however, most policy-setting discussions to alleviate higher education gap focus only on lowering college tuition fees. Is reducing college tuition able to relieve the higher education gap indeed?

There was similar argument in the United States. Cameron and Heckman (1998, 1999a, 2001) and Carneiro and Heckman (2002, 2003) divided the higher education constraint factors into two: short-term credit constraint and the long-term credit constraint. Short-term credit constraint refers to incapacity to pay the college tuition fees, while the long-term credit constraint refers to poor academic achievement caused by long-term environmental effect including disadvantaged family background. The result of their study shows that the effect of long-term credit constraint of the college attendance is much bigger than that of short-term credit constraint, presenting that the influence of short-term credit constraint on limiting college education participation is at most 8 percent² (Carneiro and Heckman, 2002). Based on this result, they contended that the early intervention in education gap is far more effective in reducing the higher education gap between different income groups than supporting college tuition fees at the students' college going ages.

This paper tries to figure out whether the Korean situation is similar to that of U.S.'s or not in regard to the cause of higher education gap. Specifically, the research question of this paper is to figure out which factor between two would be more important in constraining higher education attendance: short-term unaffordability to pay college tuition fees and the

² 8 percent was the ratio of short-run credit constraint regarding the completion of 2-year colleges.

long-term disadvantaged family backgrounds that are crystallized in poor academic achievement. To find out the result, this paper will identify which factors affect the higher education gap and then compare the degree of each factor's effect.

The remainder of this paper will proceed as follows. In Chapter II, this paper will introduce related former studies and theories, and in Chapter III, set hypotheses of this study. In Chapter IV, it will introduce the data, variables, and methodologies which will be used in this study and show the descriptive statistics of the variables. Then this paper will present the analysis results in Chapter V. Finally, in Chapter VI, it will conclude by providing policy implications regarding mitigating higher education gap.

II. Background of Study

2.1 Literature Review

According to Duncan and Brooks-Gunn (1997), Western studies on academic attainment were conducted based on the tradition of emphasizing the importance of family background. In the beginning, studies on the effect of parents' socio-economic status (mainly occupational status) and family structure on children's academic achievement were actively performed, and economic studies focusing on the role of family income emerged after 1980s (Koo, 2003).

For example, Coleman (1966) found the most powerful factor in affecting academic achievement was students' family background, while inner school factors such as physical environment of school or quality of teacher had mere effects. Besides, Jencks et al.(1972), Hauser et al.(1971), and Mosteller and Moynihan (1972) showed a positive relation between parents' socio-economic status and children's academic attainment (Kim, 2005).

In this part, I will review previous studies focusing on the cause of college attendance gap as the purpose of this study is to identify a constraint factor of higher education participation.

2.1.1 College Attendance Cost as a Constraint Factor of Tertiary Education Attendance

Many studies have investigated the fundamental reason why students from low-income families participate less in tertiary education than students from upper middle-income or high-income families. Substantial number of those studies argue that low college enrollment of students from disadvantaged families was basically because they lacked capacity to pay tuition costs or their opportunity cost of attending a college was higher than that of other students in the financial aspects (Kane, 1995; Card, 1999, 2001; Deming and Dynarski, 2009; Brown, Scholz, and Seshadri, 2009). In other words, the researchers regarded the tuition costs

or borrowing constraint as a decisive factor that prevented low-income students from participating in college.

For example, Card showed that “IV estimators based on compulsory schooling or school proximity [would] yield estimated returns to schooling” (Card, 2001, p.1156) above the OLS estimates. Then he interpreted this as the evidence of high marginal costs of schooling, since he thought IV estimated the return to schooling “for those induced to change their schooling status by the selected instrument” (Carneiro and Heckman, 2003, p.16).

This kind of contention was a major opinion regarding this issue, and is still supported by many researchers. Deming and Dynarski (2009) reviewed many experimental and quasi-experimental studies on the effect of college costs on college attendance particularly for the students from low-income families, and concluded that a number of evidences verified that interventions of reducing college costs increased college attendance of beneficiaries. Some studies also confirmed that public subsidies for college tuition had enrollment impacts on low-income students (Kane, 1995) and students from the families which “disproportionately” under-invested in education (Brown, Scholz, and Seshadri, 2009).³

2.1.2 Long-term Constraint as a Major Factor of Disadvantaged Students’ Low College Attendance

While college costs were perceived as an important factor that hindered low-income students from entering a college, Cameron, Carneiro and Heckman conducted a set of studies suggesting a different sight on the reason. (Cameron and Heckman, 1998, 1999a, 2001; Carneiro and Heckman, 2002, 2003; Cameron and Taber, 2004). They argue that short-term credit constraint which means the lack of capacity to pay tuition costs plays only a minor role

³ However, Black and Sufi (2002) insisted that individual response to college tuition varies depending on family background. For instance, low-income blacks react to college tuition cost sensitively while blacks from middle or high SES backgrounds do not. Therefore they emphasized that policies in regard of tuition cost should consider these kinds of relations.

in determining disadvantaged students' college enrollment. According to them, rather than income level in late adolescents, accumulated ability gap caused by long-term economic constraint and deprived family background, affects much to the determination.

First, Cameron and Heckman (1998, 1999a, 2001) argued that “long-run family and environmental factors” (Cameron and Heckman, 1999a, p.84) which affect a formation of ability plays a powerful role in determining educational attainments such as schooling completion and college attendance, while response of college attendance to family income in the adolescent years is minor, conditioning on AFQT scores which reflects long-term factors.

Then Carneiro and Heckman (2002, 2003) compared the effect of two college attendance constraints – short-term and long-term credit constraints.⁴ Their study showed that only 5.2 percent of white males and 4.2 percent of overall population were short-term credit constrained in regard to enrollment. On the other hand, when they ascertained the influence of family background controlling for family income in the adolescent years, the effect of family background on enrollment still remained. The figure which they called “percentage of population family constrained” (Carneiro and Heckman, 2003, Table 2) from college enrollment was 31.2 percent for white males and 26.2 percent for overall population. Then they concluded that the most important factors which explained educational attainment including college attendance are “family background factors crystallized in ability” (Carneiro and Heckman, 2003, p.22), and emphasized the importance of early intervention as abilities are formed in early life cycle stage. Based on this empirical study, Carneiro and Heckman provided policy implication that policies which focused on cultivating cognitive abilities in early ages can be more effective than tuition or financial aid focusing policies.

⁴ They measured “weighted averages of the differences [in educational attainment] in adjusted rates between the highest income quartiles within each ability tercile averaged over all three ability terciles and over income quartiles within each ability tercile” (Carneiro and Heckman, 2003, p.19). This method will be explained in detail at Chapter IV.

After the introduction of these studies, several studies were conducted to figure out whether Cameron, Heckman, and Carneiro's argument was valid and applicable to other context. (Ellwood and Kane, 2000; Shea, 2000; Keane and Wolpin, 2001; Belley and Lochner, 2008; Vignoles, 2008). Keane and Wolpin (2001) argued through their study that even though borrowing constraints existed, this does not affect students' college attendance as students released the constraint through working. When they relaxed the borrowing constraint in their model, there was no significant increase in college enrollment but decrease in working while in school. Vignoles (2008) conducted a research in the way which was similar to Cameron, Heckman, and Carneiro's to figure out their contention was also valid in the case of the United Kingdom. Her research result showed that most of socio-economic gap in college attendance was due to "differences in the education achievement of children much earlier in the education system, rather than at the point of entry into [college]" (Vignoles, 2008, p.177).

However, Belley and Lochner (2007, 2008) argued that borrowing constraints had become more important than Cameron and Heckman (1998, 2001) and Carneiro and Heckman (2002) suggested. Belley and Lochner conducted a research similar to Cameron, Carneiro, and Heckman but used NLSY97 data, while previous studies used NLSY 79 data.⁵ The result showed that the difference in college attendance rate between the highest and lowest income quartile of NLSY97 data was 16 percent while that of NLSY79 data was 9 percent, controlling for family background factors and AFQT scores. In other words, the importance of family income in determining college attendance has much increased recently.

Substantial effect of long-term constraint leads to the argument that emphasizes the importance of early intervention. For example, after conducting a research on the reason of

⁵ Cameron, Carneiro and Heckman used U.S. data from the 1979 cohort of NLSY79, which included 14-21 years old youth at that time. Therefore, their result reflected the U.S. situation of early 1980s. To figure out whether their argument is still applicable to the current circumstances, Belley and Lochner conducted similar research using NLSY97 as risen tuition costs and stable (or declined) real borrowing limits of student loan program could change the situation. Through these data, they could find out the pattern of early 2000s.

disadvantaged students' low college enrollment rate, Heckman started to study about the importance of early educational intervention for children from low-income families with Cunha, stressing the considerable influence of long-term family background factors on children's education (Cunha and Heckman, 2007; Cunha, Heckman, and Schennach, 2010).

So far, most economic researches on child development regarded development as a single-period activity rather than multi-stage activity. However, to reflect a real phenomenon, Cunha and Heckman (2007) established a new model that explained six characteristics⁶ of children and adolescents' skill development which they found as reviewing many related literatures. In this model, they presented two important concepts – “sensitive periods” and “critical period.” Sensitive periods mean “the stages that are more effective in producing certain skills” (Cunha and Heckman, 2007) and critical period means a stage “if [the] stage alone is effective in producing a skill” (Cunha and Heckman, 2007). These two concepts realize two main features of the model. First one is “self-productivity.” This indicates the characteristic that the skills attained earlier would improve the effectiveness of the skills attained later. Second one is “dynamic complementarity.” This refers to the trait that skills obtained from different stages would reinforce with each other.

Due to these “self-productivity” and “dynamic complementarity,” multiplier effect exists in skill formation. According to Cunha and Heckman, the multiplier effect explains why remediation investment for children from disadvantaged background in early childhood is effective while that in adolescent stage is not that successful. In other words, substitutability

⁶ “First, ability gaps between individuals and across socioeconomic groups open up at early ages [...] Second, ... there is compelling evidence of critical and sensitive periods in the development of the child. ... Third, despite the low returns to interventions targeted toward disadvantaged adolescents, the empirical literature shows high economic returns for remedial investments in young disadvantaged children. ... Fourth, if early investment in disadvantaged children is not followed up by later investment, its effect at later ages is lessened. ... Fifth, the effects of credit constraints on a child's outcomes when the child reaches adulthood depend on the age at which they bind for the child's family. ... Sixth, socioemotional (noncognitive) skills foster cognitive skills ...” (Cunha and Heckman, 2007, p.32-34).

of early investment is low in regard of producing cognitive skills⁷.

Cunha and Heckman also compared three types of policies which are early-only, late-only, and balanced investment policies targeting disadvantaged children and found that the third one was the most effective. Based on these findings, they argued that government should adopt the strategy which invested in the development of disadvantaged children well-proportionally.

Afterward, Cunha, Heckman, and Schennach (2010) set a multistage nonlinear factor model, which could estimate the substitutability between early and late investment in forming skills. According to their model, substitutability for cognitive skills decreased in later stages of childhood,⁸ which meant that later remediation was costly, and thus they suggested on investing relatively more in early stages of life cycle than in later stages.

Besides the studies mentioned above, there are several researches from various backgrounds, which emphasize the importance of early intervention. (Wößmann and Schütz, 2006; Morris, Duncan and Clark-Kaufmann, 2005; Shonokoff and Phillips, 2002; Restuccia and Urrutia, 2004). Wößmann and Schütz (2006) reviewed previous studies about early childhood education, focusing on efficiency aspect and equity aspect. According to them, early childhood education in the U.S. was highly efficient, especially for disadvantaged children. Early childhood education in Europe also showed a positive effect. For example, Feinstein (2003) showed that there was positive and apparent relationship between cognitive achievement in early childhood and educational qualification in mid-20s in U.K. (Wößmann and Schütz, 2006). Wößmann and Schütz (2006) suggested early childhood education was positive in equity aspect, too, and in particular, programs which targeted disadvantaged

⁷ In the case of producing non-cognitive skills, Cunha and Heckman (2007) found that it has higher substitutability of early investment.

⁸ Regarding noncognitive skills, substitutability had no significant difference across the stages. (Cunha, Heckman, and Schennach, 2010).

children had powerful and long-lasting effect on improving equity.

Morris, Duncan, and Clark-Kaufmann (2005) argued that the effects of maternal employment and income policies as part of welfare and antipoverty policies on child development measured by cognitive performance varied according to child age. The results of their study showed that the effect of the policies was significant only to the children who were in transition period. Specifically, policies were positive to cognitive performance of children who were middle childhood (ages 4 and 5) while negative to that of children in early adolescent period (ages 10-11).

Shonokoff and Phillips (2002) argued that the reason for early life experience being important was not because reversing the early damage was impossible but because compensating the damage was so costly as to threaten potentials of children's life. On the other hand, d'Addio (2007) suggested that parental education played the most decisive role in forming children's life chances since parental education was related with income, occupations, and culture and social resources. At the same time, she thought early childhood education could protect children from lack of resources in "parental nest" (p.67). Therefore she provided policy implication that early childhood education with good quality acts essentially in improving intergeneration mobility.

Restuccia and Urrutia (2004) also provided important policy implications. According to them, parental investment in education, particularly in early education, could explain about one-half of the intergenerational persistence of learning. Moreover, their model showed that increase of public investment in early education (pre-college education) by 20 percent of total government expenditures realized 10 percent increase in earning mobility as well as equalization of college enrollment and dropout rate across income groups. On the other hand, increase of investment in college subsidies could not affect earning mobility while it raised

both college enrollment and dropout rate.⁹ Restuccia and Urrutia argued that the greater effect of investment in early education compared to that in college education is explained by the fact that the former one is borrowing constrained more tightly than the latter one.

2.1.3 Causes of College Education Gap in Korea

As this paper mentioned at Chapter I, Korea has experienced a surge of college entrance rate thanks to its rapid economic growth and great educational zeal. Many Korean studies have conducted regarding whether this increase in college entrance rate meant the equalization of education or educational gap still existed. These kinds of studies have been performed in two aspects. The first aspect is about the current situation of education gap and the second aspect is about causes of the gap. In this part, I will review the latter one focusing on the college education.¹⁰

Most studies on the cause of Korean college education gap emphasized the effect of family background. In particular, many studies found that the effect of culture capital was bigger than that of income. Kim (2005) analyzed the determination factors of academic achievement, and he found that gender (female), hours spent studying alone, father's education, father's occupation status, living in metropolitan city and parents' concerns on children's education were directly proportional to the results of the College Scholastic Ability Test. However, family income, private education expenditure, culture capital, and school circumstance had no effect on the results. Bang and Kim (2002) showed that income level had no significant effect on college attendance controlling for social class, and argued the effect of culture capital (father's education and occupation) was much bigger than that of

⁹ Increase of college dropout rate was because investment in college subsidies could not improve disadvantaged students' ability needed for pursuing study in higher education, while it induced them to enter college. (Restuccia and Urrutia, 2004).

¹⁰ This paper summarizes the studies on the current situation of Korean education gap in [Appendix 1].

family's financial capital in status attainment model of Korea. Koo (2003) also reported that the effect of family structure is much bigger compared to the effect of poverty on college attendance, while family structure, family income (average family income during age 15 to age 18), and poverty have a significant effect on college attendance respectively.

Studies on the process of how family background affected educational attainment have been conducted as well. Shin and Lee (2007) argued that parental education and class affected children's high school type that they entered, and the type of the school decisively affected college attendance. Kim and Byeon (2007) showed parental education and family background factors affected college attendance and the type of college they attended by affecting academic achievement.

Recently, studies that identified the change in educational gap from quantitative aspect to qualitative aspect started to be conducted. Bang and Kim (2003) documented educational gap in higher education did not decrease in spite of the expansion of higher education opportunities, and rather it had increased in the aspect of college entering path – 4-year college entrance versus 2-year college entrance. Also, analysis on long-term trend of educational gap showed that qualitative gap became structuralized while quantitative gap decreased.

Nevertheless, studies on the cause of Korean education gap tended not to consider the problem of endogeneity and not to think of the short-term effect and long-term effect of income differently. Also, even though the necessity of early intervention to mitigate education gap and realize education welfare becomes on the rise, studies on the grounds of the argument are still weak. This paper will conduct empirical study and show the need for early intervention, complementing these weaknesses of Korean studies.

2.2 Theoretical Background

Generally, studies which identify the reason of college education gap are based on theories regarding the process of children's educational attainment. In this part, I will examine those theories which are based on sociological perspective as well as economic perspective.

2.2.1 Theories Based on Sociology

In Sociology, there are two models that view the process of children's educational attainment. First one is 'functional model' and the other one is 'conflict model.' Functional model thinks the gap of educational attainment is caused by the gap of achieved skill and motivation. Therefore, it regards the educational attainment gap as a tool that compensates fairly to talented people (i.e. Blau and Duncan's status-attainment model, Wisconsin model). Also, as Boudon (1973) documented that academic attainment of an individual was distributed depending on their ability and not being restricted by family's socio economic background, functional model says schooling can bring gradual equalization of society by improving people's occupational ability (Yeo, 2008). In other words, the model thinks that because of a movement towards a modern society where education opportunity expands and occupation is not determined by hereditary succession, education becomes an important tool for people from low class to improve their social status as education helps them to acquire skills that are needed in industrial society (Yeo, 2008).

In conflict model, on the other hand, education maintains, justifies, and even reproduces existing inequality of society rather than mitigates it. It is because education is performed unfairly according to students' social classes and thus restricts their social mobility. Bowles and Gintis (1976) who were advocates for conflict model argued that social status is determined by family background rather than schooling (Yeo, 2008). They also suggested

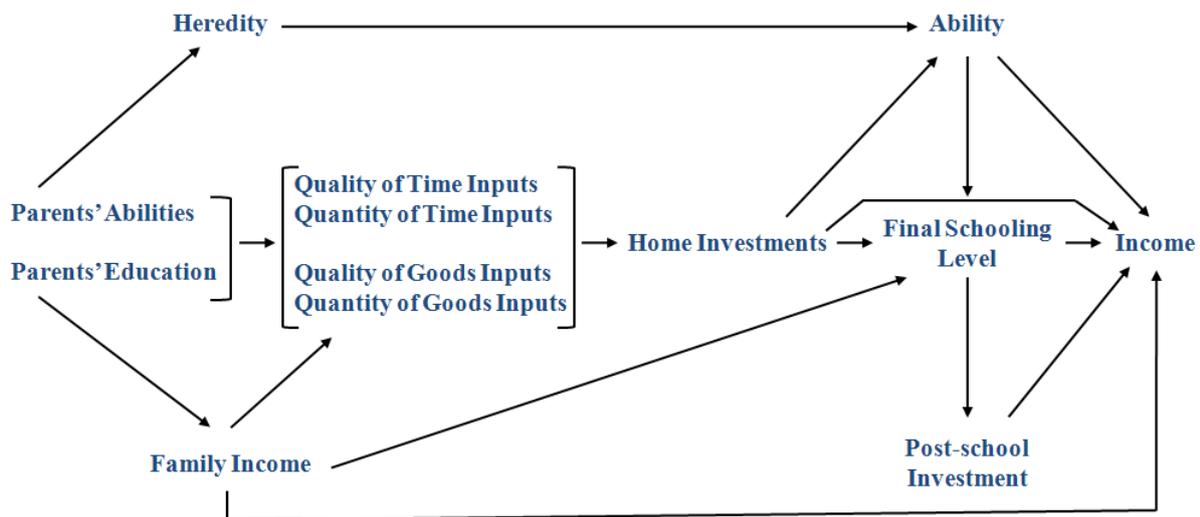
family background affects social status indirectly as well by affecting schooling (Yeo, 2008). Meanwhile, Thurow (1972) argued that ruling class tries to defend their ruling status using differentiated strategies of education by putting more resources on education, when they feel their privileged status get threatened as general education level increases with the expansion of education opportunities (Yeo, 2008). There are two kinds of opinions whether the education gap caused by family background is decreasing or not. Raftery and Hout (1993) argued that education gap between upper classes and lower classes decreased only when “the demand for a given level of education is saturated for the upper classes” (p. 57), and this is called MMI (Maximally Maintained Inequality) model. On the other hand, EMI (Effectively Maintained Inequality) model insisted by Lucas (2001) documented that education gap between classes does not disappear because competition for educational attainment exists in qualitative aspect as well as quantitative aspect. In other words, as upper classes try to obtain advantages wherever the advantages are possible, “if quantitative differences are common, the socioeconomically advantaged will obtain quantitative advantage” (Lucas, 2001, p. 1652).

2.2.2 Theories Based on Economics

According to Haveman and Wolfe (1995), economists approached children’s education attainment with the theory of family behavior from the beginning. They thought that input, output, distribution, and characteristics of family resources affect children’s educational achievement. Besides, some economists added the number of siblings, place of residence, and family structure as the factors that affected children’s attainment. In other words, economists argued that parents invest time as well as financial resources for their children to form a human capital, considering both their benefits and costs. As an opportunity cost of educating children is too high for lower-income parents, they cannot help keeping their investment in child-education low, which in turn lowers their children’s academic achievement (Koo, 2003).

Leibowitz (1974) identified the process of how parents affected children’s educational attainment and their future income. [Figure 2-1] was first introduced by Leibowitz (1974), and then Haveman and Wolfe (1995) adapted it. The figure tells that parents’ genetic traits determine heredity, and parents’ genetic factor and education determine inputs of time and goods for children’s education¹¹. Parents also affect family income, which again affects the inputs. Lastly, children’s final schooling level is affected by stocks of human capital that is composed of family income, home investments, and ability.

[Figure 2-1] Home investments in children



Source: Haveman and Wolfe (1995), Adapted from Leibowitz (1974).

The most well-known research on children’s education attainment which used economic approach is Becker and Tomes (1986)’s study. They thought parents decide the level of investment in their children by utility maximizing behavior between the opportunity of investment and consumption, which is the part of income inequality transference. Also, they thought genetic endowment and cultural endowment affect children’s earning in labor market

¹¹ According to Leibowitz (1974), quality as well as quantity of time inputs to children are positively related with parents’ education.

by affecting the formation of human capital. They expressed their idea through following formulas. Those formulas show that endowment of children is affected by endowment of parents and society, while it is also affected by unsystematic factors. Then the formation of a child's human capital is determined by parental and public expenditures besides the endowment.

$$H_t = \varphi(x_{t-1}, s_{t-1}, E_t), \text{ with } \varphi_j > 0, j = x, s, E.$$

H= child's human capital
 x= parental expenditures
 s= public expenditures

while

$$E_t^i = \alpha_t + hE_{t-1}^i + v_t^i$$

E_t^i = endowment of the i th family in the t th generation
 h= degree of "inheritability" of endowments
 v_t^i = unsystematic components or luck in the transmission process
 α_t = social endowment common to all members of a given cohort in the same society

(Becker and Tomes, 1986)

Haveman and Wolfe (1995) developed this theory further with a broader view. They thought that society, which means government, can affect children's educational attainment indirectly by influencing the level of home investment with such policies as taxing and regulations. Also, children can decide how much effort they would put in by themselves under given circumstances. Therefore, they included the role of society and children as well as that of parents.

This paper will identify the effect of family backgrounds on educational attainment, assuming that genetic endowment, cultural endowment, and parental investment which are all reflected in family background affect children's human capital based on economic theories. In

addition, it will consider the effect of children themselves' efforts similar to Haveman and Wolfe (1995). Also, by focusing on the fact that qualitative differences in college attendance exists apparently, this study will include the research about the effect on prestigious college entrance of family background factors.

III. Hypothesis Development

3.1 A Basic Framework of This Study

The basic framework of this paper is as follows. First, it will identify which factors affect college attendance gap in Korea and in particular examine the effect of family income in right before college-going year and that of other family background factors. As the gap can be occurred in not only quantitative perspective but also qualitative perspective¹², this study will consider both. More specifically, this study will examine the effects of various factors on the two dimensions of college attendance: i) 4-year college attendance, and ii) top 30 college¹³ attendance.

Even though college attendance gap in quantitative perspective can also be described as whether attending either 2-year or 4-year colleges or not, this kind of college enrollment rate has little difference across income groups in the case of Korea (see college (both 4-year and 2-year) attendance rate in Table 1-1) as most students¹⁴ entered either 4-year or 2-year college. Therefore this paper will use whether or not students enter 4-year colleges as a criterion of quantitative college attendance gap.

Qualitative gap in college attendance can also be variously presented such as 4-year college attendance compared to 2-year college attendance, top 10 college attendance, and attendance in college located in the city of Seoul.¹⁵ Our sample compositions according to each criterion mentioned above is as [Table 3-1].

¹² In practice, according to Bang and Kim (2003), qualitative education gap has become systematic, while quantitative education gap keeps decreasing in Korea.

¹³ The way of determining 30 prestigious colleges as well as top 10 colleges will be mentioned in chapter IV.

¹⁴ In our sample, 82.08 percent of students entered either 4-year or 2-year colleges without considering delayed college entrance.

¹⁵ This is possible for Korea as the colleges in Seoul are often aimed to enter for many high-school students because colleges located in Seoul tend to be ranked high in college ranking (see Appendix 3). Some students even want to enter the colleges located in Seoul rather than the higher ranked colleges not located in Seoul, because of the environment near colleges. These symptoms made a term, 'in-Seoul' universities.

[Table 3-1] Sample composition ratio according to the type of entered tertiary institutions

		Percentage
Criteria 1	The ratio of students who entered 4-year colleges compared to students who entered 2-year colleges	65.64
Criteria 2	The ratio of students who entered 30 prestigious colleges compared to all other students	9.85
Criteria 3	The ratio of students who entered top 10 colleges compared to all other students	3.88
Criteria 4	The ratio of students who entered the colleges located in Seoul compared to all other students	7.34

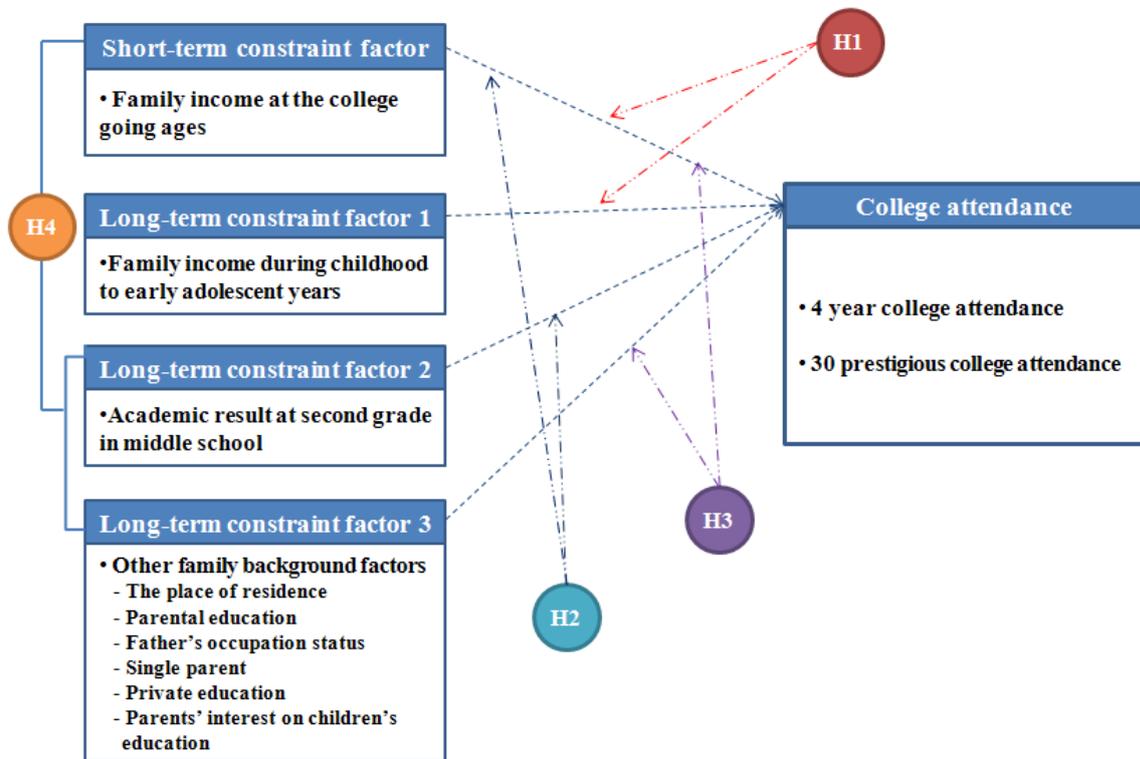
Based on the figures above, this study regarded criteria 2 or 4 were good to use, as about 10 percent participation rate was neither too small nor too big to represent good quality institutions. However, the enrollment decision for college located in Seoul may also be substantially affected by students' place of residence, and therefore this paper set top 30 colleges as high quality institutions.

Second, following just the way which Carneiro and Heckman (2003) did, this paper will compare the constraint effects on 4-year college attendance of family income in 2nd to 3rd grade¹⁶ at high-school and other family background factors that militated for relatively longer period. The method will be explained specifically in Chapter IV.

¹⁶ more precisely, second half of 2nd grade and first half of 3rd grade in high school

3.2 Hypothesis Development of This Study

[Figure 3-1] Framework of hypotheses



As this paper mentioned at Chapter I, the purpose of this study is to compare the effect of short-term financial constraint with that of long-term family background constraint on college attendance. To set hypotheses for solving the research question, this study classifies a short-term constraint factor and long-term constraint factors as follows:

- Short-term constraint factor
 - family income at the college going ages
- Long-term constraint factors
 - family income from childhood to early adolescent years
 - Academic results at second grade in middle school
 - Other family background factors

The details of each factor are documented below.

3.2.1 The Effect of Family Income

The level of family income has been regarded as one of important factors that determine a person's educational attainment. For instance, Haveman and Wolfe (1995) showed that children from low-income families tended to acquire lower educational attainment than children from wealthy families. The study that examined Korean case also reached similar results (Ryu and Kim, 2006).

However, the effect of family income on college attendance can be divided into two factors: the first one is the income in college-entering year that may constrain to pay college costs including tuition fees. The second one is the permanent income or income from childhood to early adolescent years that may have affected students for a longer period by hindering them from receiving sufficient resources such as study materials and private tutoring, which are allegedly helpful for accomplishing good academic result. In this case, family income indirectly affects children's college entrance by influencing cumulative academic achievement. For example, McLoyd (1998) suggested in his study, "Socioeconomic Disadvantage and Child Development," that income level and poverty affect adolescents' academic achievement by threatening their parents' mental stability which leads to the change of the parents' nurturing manner (Koo, 2003). In Korea, Ahn (2005) found that students who achieved outstanding academic outcomes were mostly from high-income families while students with underachievement were chiefly from low-income families. In this sense, family income for long-term can be regarded as one of family background factors, and this study will keep the income in college-going year and the income from childhood to early adolescent years separate.

To be specific, this study will regard the family income level near the college entrance

period as a short-term income factor that may constrain college entrance, affecting capacity to pay college tuition and other related costs. On the other hand, it will regard the family income from childhood to early adolescent years as one of the long-term family background factors. In this study, family income mainly refers to the income in just before college-entering year unless otherwise noted, as the goal of this study is to compare the two constraint factors on college attendance: unaffordability to pay college costs and various factors of disadvantaged family background that are jointly crystallized in academic under-achievement.

3.2.2 The Effect of Academic Achievement in Early Adolescent Years

Many American studies on social phenomena used Armed Forces Qualification Test (AFQT) as one of explanatory variables because the data were included in NLSY. AFQT score is the weighted composite score of Armed Services Vocational Aptitude Battery (ASVAB) which measured “Word Knowledge, Paragraph Comprehension, Arithmetic Reasoning, and Mathematics Knowledge as their measure of general intelligence” (Cawley et al, 1996, p. 6.) in 1980 and were “used by the U.S. military in screening applicants for enlistment” (Rodgers and Spriggs, 1996, p. 14).

AFQT score which presented a cognitive ability measure (Cameron and Taber, 2004) was insisted as a proxy of a few factors. Phillips et al. (1998) suggested that AFQT was a proxy for cognitive gene, while O’Neill (1990) contended that it reflected both the quality of schooling and parental background. On the other hand, Cameron and Heckman (1998, 1999b, 2003) regarded their age-adjusted AFQT score as “the outcome of long-term family and environmental factors produced in part from the long-term permanent income of families” (Cameron and Heckman, 1999b, p. 18).

Taken the studies mentioned above together, AFQT can be a proxy for cognitive gene, quality of schooling or family background. However, considering the studies which

emphasize the greater importance of environmental circumstances especially for family background,¹⁷ AFQT can be told that it substantially reflects long-term family background. In this sense, it may be possible to follow the Cameron and Heckman's idea that AFQT is a factor which family background is crystallized in (1998, 1999b, 2003).

However, as there is no AFQT score in Korean case, we should substitute it with other academic achievement information. The variable responded to AFQT score in our data is "academic result at second grade in middle school,"¹⁸ so this study will use this information. Samples in Cameron and Heckman (1999b)'s study took the AFQT test at 13-16 years of old, and they insisted that this confirmed "there [was] no effect of high school graduation or of college attendance on the test score so that the test score [was] relatively free of endogeneity from schooling" (p. 11). In the case of our study, using the variable of "academic result at second grade in middle school" in place of AFQT score is considered as not a bad option, as the variable also satisfies those two factors¹⁹ and similar to 13-16 years of Cameron and Heckman's study (1999b) because students who are second grade in Korean middle schools age about 14 years. Therefore, this study will conduct research assuming that long-term family background is crystallized in "academic result at second grade in middle school."

3.2.3 The Effect of Family Background

Many studies that conducted research about which factors affect college entrance gap have emphasized the importance of family background, as this paper mentioned at Chapter II. Based on those previous studies, this paper will consider following factors as family

¹⁷ 1. "[T]he nature versus nurture distinction is obsolete" (Cunha and Heckman, 2007, p.32).

2. Expression of gene is administered by environmental circumstances (Rutter, 2006: cited in Cunha and Heckman, 2007).

3. Quality of schooling is substantially affected by place of residence which is one of the major family background factors (Kim and Jang, 2005 for general case; Yoon and Kang, 2008 for Korean case).

¹⁸ The variables and data which this study used will be explained in detail in Chapter IV.

¹⁹ No effect of i) high school graduation or ii) college attendance on the test score

background variables: the place of residence, parental education, father's occupation status, single parent, private education, and parents' interest in children. Main findings of the previous studies in regards of the effect of those variables on college attendance are summarized in [Appendix 2]²⁰. These family background factors have had a cumulative influence on students' college attendance in the long run by affecting their academic achievement from when they were young.

3.2.4 Hypothesis Development

Considering the findings documented above, this study can set hypotheses using following combinations as it aims to compare the effects between short-term financial constraint and long-term family background constraint:

- i) Family income level in just before college-going year versus family income level from childhood to early adolescent years
- ii) Family income level in just before college-going year versus academic result at middle school
- iii) Family income level in just before college-going year versus other family background factors
- iv) Short-term financial constraint versus disadvantaged family background

²⁰ [Appendix 2] also includes the previous studies regarding the effect of control factors (gender, hours spent studying alone, number of siblings, and birth order) on college attendance.

- i) Family income level in just before college-going year versus family income level from childhood to early adolescent years

The first hypothesis to be tested is about the comparison between the effect of family income level in just before college-going year and that of family income level from childhood to early adolescent years on college attendance. As previously mentioned studies, both short-term income factor and long-term income factor may seem to positively affect the probability of college entrance. However, when considering their each causal effect on college attendance with controlling other related factors, the relationships may be changed. In particular, when including two kinds of income factors (short-term and long-term) in a regression model together, overlapped part of each effect on college attendance will be partialled out. Then similar to Cameron and Heckman (1999b)'s argument that which matters in explaining college attendance is "family income at earlier ages and not later ones" (p.34), family income from childhood to early adolescent years is expected to affect more on college entrance than family income in just before college-entering year. Therefore, the hypothesis is as follow.

H1: *The college attendance effect of family income level from childhood to early adolescent years may be greater than that in just before college-going year.*

- ii) Family income level in just before college-going year versus academic result at middle school

The second hypothesis to be tested is in regard to the comparison between the effect of family income level in just before college-going year and that of academic result at middle school on college attendance. This paper identified that academic result at second grade in middle school reflects long-term family background, and it is obviously expected to affect the

college attendance positively, similar to Cameron and Heckman (1998, 1999b, 2003)'s study. Also, according to Cameron and Heckman (1998, 1999b, 2003), including AFQT diminished the effect of family income measured at age 17 in their study, which made them conclude that "long-run family factors crystallized in AFQT scores or in measured family background variables ... are the driving forces behind schooling attainment" (Cameron and Heckman, 1999b, p. 18). Therefore, when we estimate the effect of short-term family income and academic result at middle school jointly, the effect of the income may become insignificant.

H2: *The effect of family income at the college going ages on the college attendance becomes weak when academic result at middle school is controlled for.*

- iii) Family income level in just before college-going year versus other family background factors

The third hypothesis to be tested is regarding the comparison between the effect of family income level in just before college-going year and that of other family background factors. Even though this paper provided some grounds for the reason why academic result at middle school could be a proxy for long-term family background, there still can be a doubt about this. Therefore, the test for this hypothesis will help to compare the effect of short-term financial constraint with that of long-term family background constraint without using academic result at middle school. When we estimate the effect of short-term family income and other family background factors jointly, the effect of income may become insignificant, similar to the case of hypothesis 2.

H3: *The effect of family income at the college going ages on the college attendance becomes weak when other family background factors are controlled for.*

- iv) Short-term financial constraint versus disadvantaged family background (on 4-year college attendance²¹)

As this paper mentioned at a literature review part, long-term credit constraint was far more important in deterring college attendance than short-term credit constraint in the U.S. (Carneiro and Heckman, 2003). The situation may not be different in Korea. Rather, the difference between the effects of two factors may increase, because the level of annual average tuition fee is higher in the U.S. (public institutions: USD 5,943, independent private: USD 21,979, OECD, 2010) than in Korea (public institutions: USD 4,717, independent private: USD 8,519, OECD, 2010), and college attendance gap between income quantiles is also larger in the U.S. than in Korea²². Therefore, hypothesis on this issue in Korea can be demonstrated as follows:

H4: *Disadvantaged family background has a larger effect on 4-year college attendance than short-term financial constraint.*

²¹ It is natural that there's little short-term financial constraint on top 30 college attendance compared to other college attendance as the tuition fees of those colleges are not higher than other colleges. Therefore, this paper applied the comparison between two constraint factors only to 4-year college attendance.

²² According to Haskin and Sawhill, only 34 percent of youths from the families which belong to bottom income quintile entered college, while 79 percent of those from the families which belong to the highest income quintile did so (Rajan, 2010). For the Korean case, refer [Table 1-1].

IV. Methodology

4.1 Data

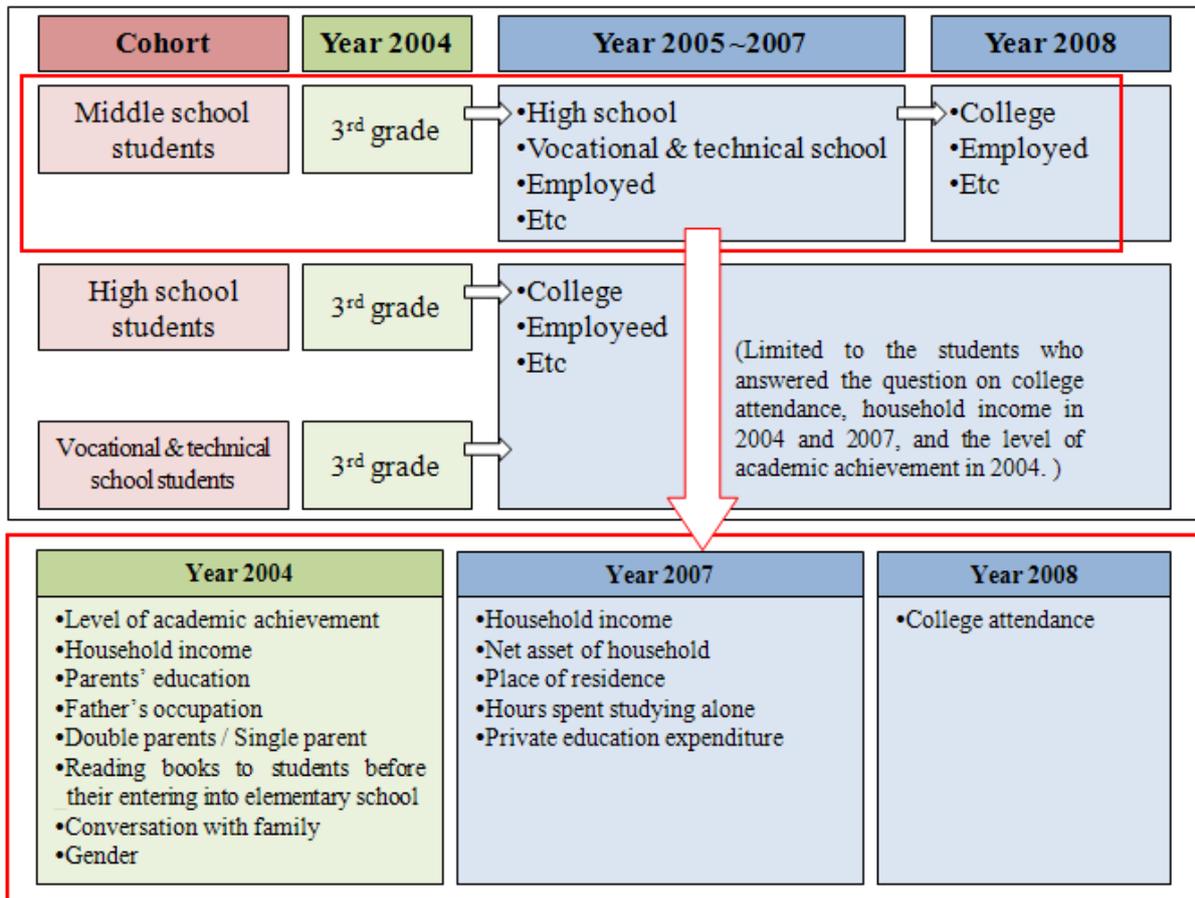
Regarding the data, this paper will use Korean Education and Employment Panel (KEEP, hereafter) produced by KRIVET (Korea Research Institute for Vocational Education and Training) from the year of 2004, as it contains each student's various educational characteristics including academic achievement and hours spent studying alone as well as family background information such as household income, parents' educations, and parents' occupations. The cohort of the panel data consists of third grade students at middle schools, high schools, and vocational & technical schools, which is based on year 2004. Among those three cohorts, this study will use middle school student panel data because the cohort contains data from middle school going stage to college going stage. This makes it possible to figure out the long-term effect of various factors on college attendance, which had affected from when the students were relatively young. In particular, this study will use the year of 2004, 2007, and 2008 data which have information when the students in sample were 3rd graders in middle school, 3rd graders in high school or vocational & technical school, and freshmen in college.

The number of students in each cohort in the year of 2004 (starting observations) was 2,000. KEEP selected its sample through two stages. At first stage, it stratified the whole nation to several areas, and selected schools according to the ratio of number of students in each area at second stage. Finally it selected classes and students among the selected schools.

Among 2,000 students, those selected as sample were limited to the students who answered the question about college attendance, household income in 2004 and 2007, and the level of academic achievement in 2004. Then this study also ruled out the students who had

no data on several variables.²³ The final number of observations in the data of this study is 954.

[Figure 4-1] KEEP data used in this study



- Note. 1) Students who had missing values on several variables that were the place of residence, hours spent studying alone, private tutoring expenditure, parental education, and father's occupation status were also ruled out.
- 2) In 2007, KRIVET added new cohorts who were vocational & technical school students as well as science high school and foreign language high school students in the panel. This study excluded the cohorts as they cannot provide the information during the middle school period.

²³ The variables were the place of residence, hours spent studying alone, private tutoring expenditure, parental education, and father's occupation status.

4.2 Variables

4.2.1 Dependent Variables

Dependent variables of this paper should tell college attendance information of each student to show the effect on college attendance gap of various factors. As mentioned at Chapter III, this study will use i) 4-year college attendance, and ii) top 30 college attendance as dependent variables. Since KEEP data provides the information on whether a student attends a college or not and which college the student attends, this study can use that information. As this paper mentioned at Chapter I, selection of top 30 colleges (and top 10 colleges) was based on the evaluation of Korean colleges conducted by Joongang Ilbo. The evaluation is performed every year, and this study used the evaluation result of 2007 because the year of 2007 was just one year before the college going year of the students whom this paper observed, and therefore the information in that period affected most to those students. See [Appendix 3] to refer to the list of top 30 and top 10 colleges.

However, there is a limitation in this paper using middle school students cohort of KEEP data. As this study used the KEEP data of from 2004 to 2008, the data could not provide information on the higher education attendance of students who entered college in 2009, not 2008. Considering that there are non-negligible students who enter colleges one year later, some differences may appear in analysis result.

4.2.2 Independent Variables

(i) Family income

KEEP data provides monthly average household income during the previous year annually. This paper will use the information on household income in 3rd grade in

high/vocational and technical school as the family income near the college entrance period and household income in 3rd grade in middle school as the family income during early adolescent years²⁴. The income was measured as monthly average and the unit was ten thousand Korean Won. This study will use those data after conducting log transformation.

(ii) Academic achievement in early adolescent years

As this paper mentioned at Chapter III, it will use “academic result at second grade in middle school” as academic achievement in early adolescent years. KEEP data includes the academic ranking percentage which homeroom teacher reported. The percentage is calculated based on the number of students who were in same school. This is the limitation of this study that the ranking percentage in middle school was computed based on each school level, not national level. However, as middle schools in Korea are standardized, this may not cause serious problem, and this paper will use the academic ranking percentage based on school level as a second-best option.

(iii) Family background

This paper will use most of family background data which were attained in 2004 when the students in the sample were 3rd graders in middle school because this paper intends to identify the long-term effect of family background that have affected students from when they were relatively young. Only two family background factors, place of residence and private tutoring expenditure will be presented by the data measured in 2007. This is because educational environment and private education in 3rd grade of high/vocational & technical school may have more direct effect on college attendance than those in 3rd grade of middle school.

²⁴ Even though this study hoped to use family income from childhood to early adolescent years, there was no information on income before 3rd grade in middle school in KEEP data. Therefore this paper decided to use the information of household income in 3rd grade in middle school, which was the earliest among available data.

a. The place of residence

KEEP data categorizes where students live into four groups: rural areas, (small to medium sized) city, metropolitan city, and the Seoul Metropolis. This paper will use the information when the students were 3rd graders in high school or vocational and technical school as dummy variables. In other words, this study will set rural areas as a reference group, and create each dummy variable.

b. Parental education

This paper will use parents' years of schooling as the index of the level of parental education. Since KEEP data provides parental education information as educational stage, this study will change the stage to years of schooling as follows: ineducation=0, elementary school graduate=6, middle school graduate=9, high school graduate=12, 2-year college graduate=14, 4-year college graduate=16, Master=18, Doctor=21. Also, it will subtract half of corresponding stage's years of schooling when parents have not graduated from the schools at the point of survey. This transformation method is referred from Byeon and Kim (2007).

c. Father's occupation status

Large portion of Korean studies used just father's occupation status instead of parental occupation status as an explanatory variable (Kim, 2005; Bang and Kim, 2002) because mothers' participation in work was relatively low in Korea. Also, mother's occupational status as housewives is hard to categorize, yet they play a powerful role in children's education in Korea. Thus, this study will use only father's occupation status, not mother's, as an explanatory variable. Regarding the usage of occupation status variable, this paper will follow Kim and Jang (2005)'s study. KEEP data provides standard occupation classification

codes of Statistics Korea as well as Korea employment occupation classification codes of Korea Employment Information Service in 2004. Kim and Jang (2005) classified various occupations codes into four categories using standard occupation classification codes of Statistics Korea: upper white collar, lower white collar, upper blue collar, and lower blue collar.²⁵ Then he made dummy variables each, setting the lower blue collar as a reference group. This method will be identically applied to this study, though this paper will add one more dummy variable that stands for missing values of this variable, to minimize the loss of data.

d. Single parent

KEEP data reports who are students' guardians like following categories: father (including stepfather) and mother (including stepmother), father (including stepfather), mother (including stepmother), grandfather (grandmother), brother (sister), and uncle (aunt). This paper classified these categories into three groups: double parents, single parent, and other guardians and created dummy variables that tell whether students' guardian is single parent or others except parents, setting reference group as double parents.

e. Private education

There are data on both private education expenditure as well as hours spent for private education in KEEP, but this study will use private education expenditure as a variable because it may reflect family background better. Also, there are two variables in regard of private education expenditure. One is students' responses and the other is guardians' responses. Considering that students may not know the exact amount of private education expenditure well, this study will use the latter one. Consequently, this paper will include the

²⁵ The classification criterion is presented in [Appendix 4].

monthly average of private tutoring expenditure during the second half year of 2006 and the first half year of 2007. Students in our data were 2nd graders to 3rd graders in high school or in vocational and technical school in that period.

f. Parents' interest in children

There are several questions that are intended to know how much interest parents (guardians) have on their children in KEEP survey, and this paper chose two questions among them to use as variables that reflect parents' or guardians' interest in children. The first one is whether the students had conversation with family or not and the second one is whether their family members had read books to the students before students' entering elementary schools.

Regarding the conversation with family, KEEP data categorizes the answers as follows: scarce, less than 30 minutes a day, 30 minutes to 1 hour a day, 1 hour to 2 hours a day, and more than 2 hours a day. However, this paper will simplify the answers as just 'have conversation' and 'scarce' for a variable. Also, it will use the data in 2004, considering that there may be little conversation between high school student and his/her family due to lack of time, though the family has much interest in the student.

Answers for whether reading books to students or not are also categorized as never, scarce, sometimes, often, and every day, but this study will simplify those as 'yes (sometimes, often, every day)' and 'no (never or scare).'

(iv) Other control variables: Gender, Hours spent studying alone, Number of siblings, and Birth order

To find out and control the effect of gender on college attendance, this paper will include gender as an explanatory variable. Also this study will include hours that students spent for studying alone in a week when they were 3rd grade in high school or vocational and technical school. Regarding the number of siblings and birth order, it will use data as KEEP data provides.

4.3 Analysis Methodology

4.3.1 Multiple Linear Regression

To find out the determining factors of college attendance and confirm the hypothesis 1, 2, and 3, this paper will use OLS multiple regression model as follow.

$$\begin{aligned} \text{College attendance} = & \\ & \beta_0 + \beta_1 \cdot \text{Family income in 2007} + \beta_2 \cdot \text{Family income in 2004} + \beta_3 \cdot \\ & \text{Ranking percentage in 2004} + \beta_4 \cdot \text{Family background factors} + \beta_5 \cdot \\ & \text{Other control variables} + u \end{aligned} \quad (4.1)$$

As there are many factors that affect college attendance, it is necessary to control those variables to identify each effect of core factors such as family income and academic achievement in middle school. Therefore, multiple regression model which can draw *ceteris paribus* conclusions may be an optimal option.

Moreover, this study will use OLS model as it provides the best linear unbiased estimators (BLUEs). However, there are five assumptions that had to be met to use OLS: linear in parameters, random sampling, no perfect collinearity, zero conditional mean, and homoskedasticity. While assuming that the other 4 assumptions are satisfied, the assumption of zero conditional mean should be considered clearly as it is a critical assumption that prevents biases. Fortunately, there is an ‘academic achievement in middle school’ as a variable in the model of this study. Since genetic factor and ability as well as family background may be reflected in the variable, the possibility that the error term in the model would contain a factor which affects both college attendance and explanatory variable should be low.

Referring [Figure 5-1] may be helpful to understand the relationship that the model of this study tries to identify.

4.3.2 HCP Calculation

Carneiro and Heckman (2003) performed a calculation to identify to what extent students were short-term credit constrained and to what extent family constrained²⁶ in their paper “Human Capital Policy.” First, to acquire the degree of short-term credit constraint, they calculated weighted averages of the differences in college attendance rate relative to top income²⁷ quartile within each ability²⁸ tercile. The weight was formed through cross tabulation between income quartiles and ability terciles. They argued these were “measures of the adjusted discrepancy in participation rates by income controlling for long-term factors and [were] an estimate for the importance of short-term credit constraints” (p. 19).

More specifically, they regressed college attendance on family income quartiles and family background variables (south, broken, urban, mother’s education, and father’s education) within each AFQT tercile like following formula:

$$y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + Q_3\beta_3 \quad (4.2)$$

y = college attendance measure

F = vector of family background variables

Q₁, Q₂, Q₃ = dummy for being in each quartile of the family income distribution

(Carneiro and Heckman, 2003)

Then β_1 , β_2 , and β_3 meant the percentage of people short-run credit constrained in each income quartile relative to the top income quartile²⁹. Those betas were acquired separately by AFQT tercile and income quartile, so Carneiro and Heckman calculated weighted averages

²⁶ Carneiro and Heckman (2003) used the expression “family constrained” as the meaning of constrained status due to long-term family background effect.

²⁷ This is family income in adolescent years. Carneiro and Heckman (2003) used “family income at 17.”

²⁸ In their study, this was measured as AFQT score. Regarding AFQT, refer to Chapter III.

²⁹ This method assumes students in the highest income quartile are not short-term credit constrained.

and obtained the ratio of people who were short-term credit constrained. In regard of college attendance, they used various measures such as enrollment, completion of 4-year college, completion of 2-year college, proportion of people not delaying college entry and enrollment in 4-year versus 2-year college.

According to their result, the ratio of short-term credit constrained was 0 to 8 percent (completion of 2-year colleges). In the case of enrollment, the ratio was 4.2 percent. When only considering statistically significant gaps, the ratio became much smaller (0.2 percent for enrollment case).

At the same time, they also calculated the ratio of family constrained. They made a family background index by regressing college attendance on place of residence (south, urban), broken family or not, parental education, and AFQT. This means the family background index is the linear combination of those variables. Then they created quartiles of the index and conducted the regression like following formula:

$$y = \alpha + Q_1\gamma_1 + Q_2\gamma_2 + Q_3\gamma_3 + Inc17\beta \quad (4.3)$$

y = college attendance measure

Q_1, Q_2, Q_3 = dummy for being in each quartile of the family background index

$Inc17$ = family income at age 17

(Carneiro and Heckman, 2003)

Then similar to former formula, γ_1 , γ_2 , and γ_3 meant the percentage of people family constrained relative to the top family background quartile, and by calculating weighted averages, Carneiro and Heckman obtained the result. According to them, the index strongly predicted college attendance, even though they conditioned on family income in the adolescent years. Also most of them were statistically significant.

This paper will call this method of calculation as “HCP (Human Capital Policy) calculation,” and apply the same method to Korean KEEP data to confirm the hypothesis 4. There will be only two differences. First, this paper will use following family background variables: place of residence³⁰ (instead of south and urban), double parents or not (instead of broken), and parental education. Also it will use academic ranking percentage in 2nd grade of middle school instead of AFQT. Regarding family income in adolescent years, it will use monthly average of household income during 2nd half of 2nd grade in high school (or vocational & technical school) and 1st half of 3rd grade in high school (or vocational & technical school). Second, this study will use two kinds of college attendance variable, which are 4-year college attendance and top 30 college attendance. However, because it is meaningless to figure out the ratio of short-term financial constraint regarding the top 30 college attendances as the tuition fees of top 30 college are not higher than other colleges, this paper will only present the ratio of family constraint for the case.

³⁰ The place of residence will be classified into rural areas, small to medium sized cities, metropolitan cities, and Seoul metropolis.

4.4 Descriptive Statistics

4.4.1 Descriptive Statistics of the Variables for Multiple Linear Regression

[Table 4-1] shows the descriptive statistics of variables which will be used in this study.

[Table 4-1] Descriptive statistics of variables

Variable			Mean	Std.Dev.
<Dependent Variables>				
	4-year college attendance	No=0, Yes=1	0.54	0.50
	30 prestigious colleges attendance	No=0, Yes=1	0.10	0.30
<Independent Variables>				
Core variables	Family income in 2007	monthly average household income during last 1 year, natural log value	5.73	0.60
	Family income in 2004	monthly average household income during last 1 year, natural log value	5.58	0.64
	Academic achievement in 2nd grade of middle school	ranking percentage	45.31	26.92
Family background variables	The place of residence in 2007	(Reference group: Rural areas)		
	- Seoul Metropolis		0.19	0.39
	- Metropolitan cities		0.28	0.45
	- Small to medium sized cities		0.29	0.45
	Father's education in 2004	years of schooling	12.44	2.90
	Mother's education in 2004	years of schooling	11.70	2.61
	Father's occupation status in 2004	(Reference group: Lower blue collars)		
	- Upper white collars		0.15	0.35
	- Lower white collars		0.18	0.39
	- Upper blue collars		0.49	0.50
	- Missing		0.05	0.21
	Single parent in 2004	(Reference group: Double parents)		
	- Single parent		0.01	0.07
	- Others except parents		0.01	0.07
Private tutoring expenditure in 2007	monthly average of expenditure during last 1 year, Unit: million KRW	0.25	0.39	
Conversation with family in 2004	Scarce=0, Yes=1	0.93	0.26	
Reading books to students	before their entering into elementary school, Scarce=0, Yes=1	0.72	0.45	
Other control variables	Gender	Male=0, Female=1	0.53	0.50
	Hours spent studying alone	hours that students spent for studying alone in a week in 2007	12.61	14.53
	Number of siblings		2.27	0.68
	Birth order		1.58	0.69

4.4.2 Descriptive Statistics for HCP Calculation

To conduct HCP calculation, this study divided monthly household income of year 2007 into 4 groups. The details of each group are shown in [Table 4-2]. At the same time, this study also divided Academic ranking percentage in 2nd grade at middle school into 3 groups, and the details of each group are presented in [Table 4-3]. [Table 4-4] and [Table 4-5] show the details of family background index quartiles for 4-year college entrance ([Table 4-4]) and top 30 college entrance ([Table 4-5]).

[Table 4-2] Descriptive statistics of income quartiles (Income in 2007)

	Summary of Income Quartiles			
	No. of Obs	Cum. Percent	Mean of Monthly Income (10 thousand KRW)	Range of Monthly Income (10 thousand KRW)
1st quartile	318	33.33	183.48	0~250
2nd quartile	168	50.94	296.01	255~300
3rd quartile	234	75.47	373.00	306~420
4th quartile	234	100.00	632.07	430~2500
Total	954			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP). More detailed information regarding this data was presented in Chapter III.

Note: Due to the existence of same level of income, number of observations of each group is not equal. For the reference, there are 81 students whose reported household income is KRW 2.5 million.

[Table 4-3] Descriptive statistics of ranking percentage terciles (Academic ranking percentage in 2nd grade at middle school)

	Summary of Ranking Percentage Terciles			
	No. of Obs	Cum. Percent	Mean of Ranking Percentage (%)	Range of Ranking Percentage (%)
1st tercile	318	33.33	15.03	0.2~29.9
2nd tercile	318	66.67	44.21	30~58.3
3rd tercile	318	100.00	76.70	58.4~100
Total	954			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP). More detailed information regarding this data was presented in Chapter III.

[Table 4-4] Descriptive statistics of family background index for 4-year college entrance

	Summary of Family Background Index Quartiles			
	No. of Obs	Cum. Percent	Mean	Range
1st quartile (Low)	239	25.05	0.2467	-0.2361~0.3773
2nd quartile	238	50.00	0.4611	0.3777~0.5456
3rd quartile	239	75.05	0.6285	0.5459~0.7160
4th quartile (High)	238	100.00	0.8196	0.7161~1.0354
Total	954			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP). More detailed information regarding this data was presented in Chapter III.

Note: Refer 4.3.2 for the concept of family background index.

[Table 4-5] Descriptive statistics of family background index for top 30 college entrance

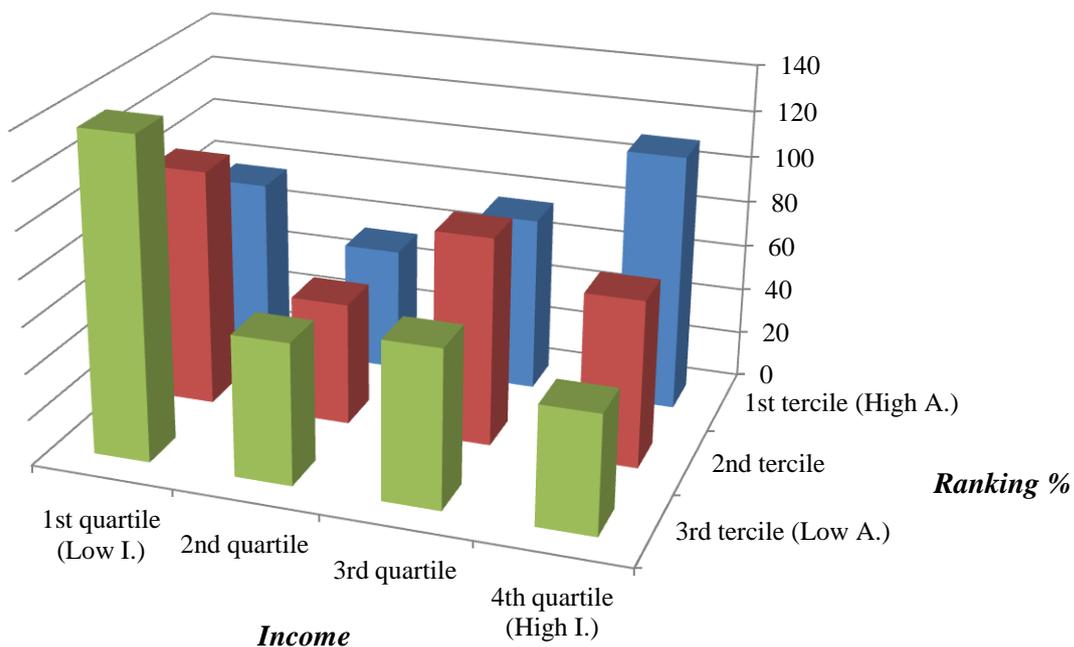
	Summary of Family Background Index Quartiles			
	No. of Obs	Cum. Percent	Mean	Range
1st quartile (Low)	239	25.05	-0.0382	-0.1458~0.0172
2nd quartile	238	50.00	0.0617	0.0178~0.0987
3rd quartile	239	75.05	0.1416	0.0993~0.1811
4th quartile (High)	238	100.00	0.2294	0.1815~0.3118
Total	954			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP). More detailed information regarding this data was presented in Chapter III.

Note: Refer 4.3.2 for the concept of family background index.

[Figure 4-2] was drawn based on cross table [Table 4-6], which presented the joint distribution of two variables that are monthly household income in year 2007 and academic ranking percentage in middle school. The figure clearly shows that students who attained highest academic achievement belong to the highest income quartile group most, while the students who attained lowest academic achievement were most likely to belong to the lowest income quartile group. In other words, apparent academic achievement gap already exists at middle school stage across different income groups.

[Figure 4-2] Number of observations by income and academic ranking



[Table 4-6] Number of observations by income and academic ranking

No. of Obs (Frequency)		Academic Ranking % in 2 nd grade at middle school			
		1 st tertile (Highest)	2 nd tertile	3 rd tertile (Lowest)	Total
Average monthly income in 1 year before the college going age	4 th quartile (Highest)	111	72	51	234
	3 rd quartile	76	90	68	234
	2 nd quartile	54	53	61	168
	1 st quartile (Lowest)	77	103	138	318
	Total	318	318	318	954

V. Analysis Result

5.1 Results of Multiple Linear Regression

The results of multiple linear regression will be presented according to sequential steps. The steps are composed as following framework which is presented in [Table 5-1]. <Step 1> is simply to have a look at the effect of family income at just before the college going age, family income during the second half of 2nd grade and the first half of 3rd grade at middle school, and academic ranking percentage in 2nd grade of middle school. The first one indicates the effect of short-term financial constraint and the other two indicate the effect of long-term family background. For the reference, the variable of net asset at just before the college going age is added. Base regression (refer [Table 5-1]) is to figure out the effect of ranking percentage in middle school alone on college attendance. All the other regressions (No. 1 to No. 5) have their pairs, which add only one variable (ranking percentage in middle school) to the regression.

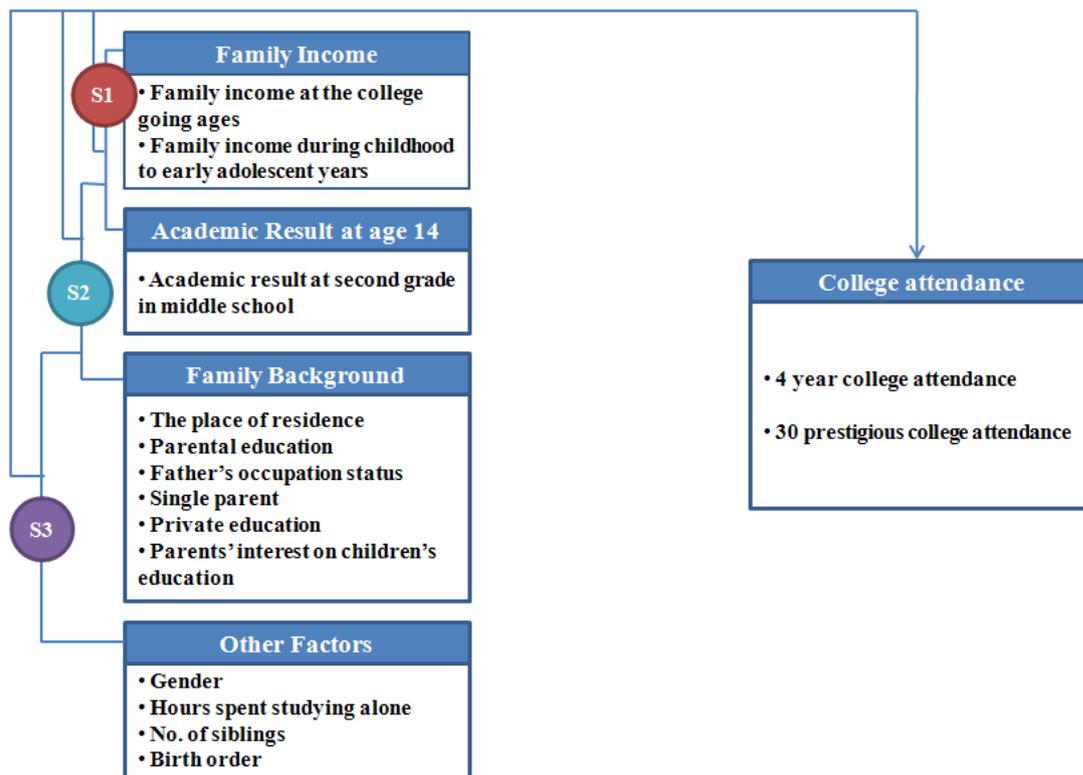
Additional family background variables are added in <Step 2>. Regression [1-1] is to find out the effect of additional family background variables except the variable of parents' interest in children on college attendance, and [1-2] included the parent's interest variable. The other regressions put income variables and family background variables together into the models, and they also have pairs similar to <Step 1>.

Other control variables such as gender, hours spent studying alone, number of siblings, and birth order are added in <Step 3>. Base regression is to find out the effect of hours spent studying alone on college attendance, conditioning on income and family background variables. The other regressions mixed income variables and family background variables, using other control variables to find out their joint effect, and they have pairs similar to <Step 1>, too.

[Table 5-1] Framework of multiple linear regression

<Step 1>											
Explanatory variables	[base]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]	[5-1]	[5-2]
ln(income in 2007)		o	o			o	o	o	o	o	o
ln(income in 2004)				o	o			o	o	o	o
ln(net asset in 2007)						o	o			o	o
Ranking % in middle School	o		o		o		o		o		o
<Step 2>											
Explanatory variables		[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]		
ln(income in 2007)				o	o			o	o		
ln(income in 2004)						o	o	o	o		
Ranking % in middle School					o		o		o		
Place of residence		o	o	o	o	o	o	o	o		
Father's years of schooling		o	o	o	o	o	o	o	o		
Mother's years of schooling		o	o	o	o	o	o	o	o		
Father's occupational status		o	o	o	o	o	o	o	o		
Double parents or not		o	o	o	o	o	o	o	o		
Private tutoring expenditure		o	o	o	o	o	o	o	o		
Conversation with family			o	o	o	o	o	o	o		
Reading books to students			o	o	o	o	o	o	o		
<Step 3>											
Explanatory variables		[base-1]	[base-2]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]		
ln(income in 2007)		o	o	o	o			o	o		
ln(income in 2004)						o	o	o	o		
Ranking % in middle School			o		o		o		o		
Place of residence		o	o	o	o	o	o	o	o		
Father's years of schooling		o	o	o	o	o	o	o	o		
Mother's years of schooling		o	o	o	o	o	o	o	o		
Father's occupational status		o	o	o	o	o	o	o	o		
Double parents or not		o	o	o	o	o	o	o	o		
Private tutoring expenditure		o	o	o	o	o	o	o	o		
Conversation with family		o	o	o	o	o	o	o	o		
Reading books to students		o	o	o	o	o	o	o	o		
Gender (0=Male, 1=Female)				o	o	o	o	o	o		
Hours spent studying alone in 2007		o	o	o	o	o	o	o	o		
No. of siblings				o	o	o	o	o	o		
Birth order				o	o	o	o	o	o		

[Figure 5-1] Framework of multiple linear regression



5.1.1 Results of MLR on 4-year College Attendance

[Table 5-2] shows the result of OLS regression on 4-year college attendance when using household income in 2004 and 2007, net asset in 2007 and students' academic ranking percentage in middle school as explanatory variables (<Step 1>). Ranking percentage in 2nd grade of middle school positively affects 4-year college attendance, and the effect is strongly significant. When the ranking percentage rises by 10, the possibility of attending 4-year colleges increases by 7 percent. This effect does not decrease even when controlling for income in 2004 and in 2007.

Income in the year just before the college entrance (2007) alone seems to positively affect the 4-year college attendance, even though the degree of the effect is not that substantial. However, we can find out that the income loses the significance of its effect,

conditioning on academic ranking in middle school. Also, the income in middle school alone as one of family background factors positively affects the 4-year college attendance. However, the effect of the income decreases when the ranking in middle school variable is included in the regression. When including both income in 2007 and that in 2004, income in 2007 loses its significance. Adding ranking percentage in middle school variable more to the model leads to the decrease in the effect of income in 2004. When model [1-1] includes the variable of net asset in 2007 ([3-1]), the effect of the net asset is not significant while the effect of the income in 2007 decreases.

[Table 5-2] Determinants of 4-year college attendance: the result of OLS regression (Step 1)

	[base]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]	[5-1]	[5-2]
ln(income in 2007)		0.093*** (0.027)	0.030 (0.025)			0.069** (0.033)	0.029 (0.031)	0.045 (0.029)	-0.003 (0.027)	0.018 (0.035)	-0.014 (0.033)
ln(income in 2004)				0.125*** (0.025)	0.077*** (0.024)			0.107*** (0.028)	0.079*** (0.026)	0.133*** (0.032)	0.114*** (0.030)
ln(net asset in 2007)						0.015 (0.011)	-0.002 (0.010)			0.009 (0.011)	-0.006 (0.010)
Ranking % in middle S.	0.007*** (0.001)		0.007*** (0.001)		0.007*** (0.001)		0.007*** (0.001)		0.007*** (0.001)		0.007*** (0.001)
Constant	0.868*** (0.029)	0.006 (0.154)	0.687*** (0.152)	-0.156 (0.141)	0.423*** (0.138)	0.025 (0.181)	0.718*** (0.180)	-0.316* (0.174)	0.435** (0.172)	-0.365* (0.202)	0.367* (0.201)
R ²	0.15	0.01	0.16	0.03	0.16	0.01	0.15	0.03	0.16	0.04	0.17
N	954	954	954	954	954	704	704	954	954	704	704

Note. 1) *p<0.1, **p<0.05, ***p<0.01

2) Standard error in parentheses

[Table 5-3] shows the regression result of <Step 2>. Among newly added family background variables, only living in Seoul metropolis and father's education have significant effects. Students who live in Seoul show less 4-year college attendance rate than students who live in rural areas, holding other things equal. Also, one more year of father's year of schooling leads to the rise in the possibility of 4-year college entrance by 4.4 percent. On the contrary to many studies, conversation with family and reading books to student before schooling do not have significant effect on 4-year college attendance, when other things are

equal. Maybe this is because the effects of those factors are already reflected to other family background variables.

When including income in 2007 to the model, the effect of the income on 4-year college attendance is insignificant while the effects of other factors remain almost the same. However, when adding ranking percentage in middle school, the coefficients of living in Seoul and father's years of schooling decrease. The effect of ranking percentage also decreases a little compared with the effect when regress the ranking percentage alone on the 4-year college attendance. When including income in 2004 rather than that in 2007, income in 2004 is significant under the 5 percent significance level, but shows smaller coefficient than the coefficient from its simple regression on 4-year college attendance. When including income in both 2007 and 2004 with other family background variables, the result is similar to the model which adds just income in 2004 to other family background variables.

[Table 5-3] Determinants of 4-year college attendance: the result of OLS regression (Step 2)

	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]	
ln(income in 2007)			0.004 (0.031)	-0.012 (0.029)			-0.012 (0.031)	-0.028 (0.029)	
ln(income in 2004)					0.067** (0.029)	0.064** (0.027)	0.069** (0.030)	0.069** (0.028)	
Ranking % in middle School				0.006*** (0.001)		0.006*** (0.001)		0.006*** (0.001)	
Other family background variables	Place of residence - S to M sized city	-0.070 (0.045)	-0.069 (0.045)	-0.069 (0.045)	-0.035 (0.043)	-0.070 (0.045)	-0.037 (0.043)	-0.070 (0.045)	-0.036 (0.043)
	Place of residence - Metropolitan city	0.028 (0.045)	0.030 (0.045)	0.030 (0.045)	0.045 (0.043)	0.033 (0.045)	0.047 (0.043)	0.033 (0.045)	0.049 (0.043)
	Place of residence - Seoul Metropolis	-0.233*** (0.052)	-0.232*** (0.052)	-0.231*** (0.053)	-0.186*** (0.050)	-0.235*** (0.052)	-0.188*** (0.049)	-0.236*** (0.052)	-0.191*** (0.049)
	Father's years of schooling	0.044*** (0.008)	0.043*** (0.008)	0.043*** (0.008)	0.037*** (0.008)	0.041*** (0.008)	0.034*** (0.008)	0.041*** (0.008)	0.035*** (0.008)
	Mother's years of schooling	-0.006 (0.009)	-0.006 (0.009)	-0.007 (0.009)	-0.010 (0.008)	-0.008 (0.009)	-0.012 (0.008)	-0.008 (0.009)	-0.011 (0.008)
	Father's job - Higher Blue Collars	-0.043 (0.051)	-0.052 (0.051)	-0.052 (0.052)	-0.042 (0.048)	-0.066 (0.052)	-0.057 (0.049)	-0.065 (0.052)	-0.054 (0.049)
	Father's job - Lower White Collars	0.070 (0.061)	0.059 (0.062)	0.058 (0.062)	0.039 (0.059)	0.039 (0.062)	0.018 (0.059)	0.041 (0.063)	0.022 (0.059)
	Father's job - Higher White Collars	-0.009 (0.069)	-0.023 (0.070)	-0.024 (0.070)	-0.053 (0.066)	-0.051 (0.071)	-0.082 (0.066)	-0.049 (0.071)	-0.077 (0.066)
	Father's job - Missing Value	-0.113 (0.084)	-0.119 (0.084)	-0.119 (0.084)	-0.084 (0.079)	-0.087 (0.085)	-0.053 (0.080)	-0.086 (0.085)	-0.051 (0.080)
	Guardian - Single parent	-0.343 (0.215)	-0.331 (0.215)	-0.331 (0.215)	-0.255 (0.202)	-0.308 (0.215)	-0.231 (0.202)	-0.309 (0.215)	-0.233 (0.202)
	Guardian - Others except parents	0.139 (0.218)	0.147 (0.218)	0.149 (0.219)	0.147 (0.206)	0.170 (0.218)	0.175 (0.205)	0.166 (0.219)	0.164 (0.205)
	Private tutoring expenditure (Unit: M KRW)	0.057 (0.046)	0.055 (0.046)	0.053 (0.048)	0.008 (0.045)	0.036 (0.046)	-0.016 (0.044)	0.042 (0.048)	-0.003 (0.046)
	Conversation with family		0.052 (0.061)	0.051 (0.061)	0.027 (0.057)	0.050 (0.060)	0.024 (0.057)	0.052 (0.061)	0.028 (0.057)
	Reading books to students		0.040 (0.036)	0.040 (0.036)	0.004 (0.034)	0.038 (0.036)	0.003 (0.034)	0.039 (0.036)	0.003 (0.034)
Constant	0.111 (0.086)	0.065 (0.099)	0.047 (0.174)	0.584*** (0.171)	-0.239 (0.166)	0.235 (0.161)	-0.195 (0.203)	0.341* (0.196)	
R ²	0.10	0.10	0.10	0.21	0.11	0.21	0.11	0.22	
N	954	954	954	954	954	954	954	954	

Note. 1) * p<0.1, ** p<0.05, *** p<0.01

2) Standard error in parentheses

[Table 5-4] presents the OLS regression result on college attendance which includes all variables that were mentioned in Chapter IV (<Step 3>). The regression of [base-1] shows that the number of hours spent studying alone has substantial and strongly significant effect on 4-year college attendance. More specifically, ten more hours spent studying alone a week leads to increase in the possibility of attending 4-year colleges by 6 percent. When an ranking percentage in middle school being more controlled, the effect of hours spent studying alone decreases by half. The reason of this strong effect is that nothing can be achieved without student's effort even if all resources and circumstances needed to acquire good educational attainment are available. Income in the one year before college going age is still insignificant in the model. In the model that includes all control variables ([1-1]), 'living in small to medium sized city', 'living in Seoul', and 'being born later' have negative effects on 4-year college attendance. Not including delayed college entrance may partly be the reason why living in Seoul negatively affects the 4-year college attendance. When birth order is late, the possibility of attending 4-year colleges decreases by about 5 percent. No effect of number of siblings and negative effect of birth order is similar to Koo (2003)'s finding. On the other hand, father's year of schooling has positive effects. Having father who went to school one year more increases the possibility to attend 4-year colleges by about 4 percent. However, private tutoring expenditure has no significant effect on 4-year college attendance. When ranking percentage in middle school is added, living in small to medium sized city loses its significance and the coefficients of significant variables decrease. This is similar when including income in 2004 rather than income in 2007, but the effect of income in 2004 is significant. Income in 2004 may affect 4-year college attendance through influencing the type of high school students entered. In other words, students whose household income in 2004 was low were more likely to enter vocational & technical school compared to other students, and this may lead to low 4-year college attendance.

[Table 5-4] Determinants of 4-year college attendance: the result of OLS regression (Step 3)

	[base-1]	[base-2]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	
ln(income in 2007)	-0.005 (0.030)	-0.015 (0.029)	0.003 (0.030)	-0.008 (0.029)			-0.010 (0.031)	-0.023 (0.029)	
ln(income in 2004)					0.057** (0.029)	0.062** (0.028)	0.059** (0.030)	0.066** (0.028)	
Ranking % in middle School		0.006*** (0.001)		0.006*** (0.001)		0.006*** (0.001)		0.006*** (0.001)	
Other family background variables	Place of residence - S to M sized city	-0.071 (0.045)	-0.038 (0.043)	-0.082* (0.046)	-0.047 (0.044)	-0.083* (0.045)	-0.048 (0.043)	-0.082* (0.045)	-0.046 (0.043)
	Place of residence - Metropolitan city	0.008 (0.045)	0.034 (0.043)	-0.005 (0.046)	0.027 (0.044)	-0.001 (0.046)	0.030 (0.044)	-0.000 (0.046)	0.032 (0.044)
	Place of residence - Seoul Metropolis	-0.276*** (0.052)	-0.210*** (0.050)	-0.281*** (0.053)	-0.214*** (0.051)	-0.281*** (0.053)	-0.213*** (0.051)	-0.282*** (0.053)	-0.215*** (0.051)
	Father's years of schooling	0.039*** (0.008)	0.035*** (0.008)	0.039*** (0.008)	0.035*** (0.008)	0.038*** (0.008)	0.033*** (0.008)	0.038*** (0.008)	0.034*** (0.008)
	Mother's years of schooling	-0.005 (0.009)	-0.009 (0.008)	-0.008 (0.009)	-0.011 (0.008)	-0.010 (0.009)	-0.013 (0.008)	-0.009 (0.009)	-0.013 (0.008)
	Father's job - Higher Blue Collars	-0.036 (0.051)	-0.036 (0.048)	-0.045 (0.051)	-0.041 (0.049)	-0.057 (0.051)	-0.056 (0.049)	-0.056 (0.051)	-0.053 (0.049)
	Father's job - Lower White Collars	0.065 (0.061)	0.043 (0.058)	0.058 (0.061)	0.039 (0.058)	0.042 (0.061)	0.019 (0.058)	0.044 (0.062)	0.022 (0.059)
	Father's job - Higher White Collars	-0.011 (0.069)	-0.045 (0.066)	-0.013 (0.069)	-0.045 (0.066)	-0.036 (0.069)	-0.072 (0.066)	-0.034 (0.070)	-0.069 (0.066)
	Father's job - Missing Value	-0.094 (0.083)	-0.076 (0.079)	-0.095 (0.083)	-0.075 (0.079)	-0.068 (0.084)	-0.045 (0.080)	-0.067 (0.084)	-0.044 (0.080)
	Guardian - Single parent	-0.301 (0.212)	-0.248 (0.202)	-0.333 (0.213)	-0.266 (0.203)	-0.315 (0.212)	-0.245 (0.202)	-0.315 (0.212)	-0.245 (0.202)
	Guardian - Others except parents	0.124 (0.215)	0.136 (0.205)	0.073 (0.216)	0.102 (0.206)	0.091 (0.216)	0.126 (0.206)	0.088 (0.216)	0.120 (0.206)
	Private tutoring expenditure (Unit: M KRW)	0.041 (0.047)	0.006 (0.045)	0.027 (0.048)	-0.004 (0.046)	0.012 (0.046)	-0.026 (0.044)	0.017 (0.048)	-0.016 (0.046)
	Conversation with family	0.035 (0.060)	0.022 (0.057)	0.032 (0.060)	0.019 (0.057)	0.031 (0.059)	0.017 (0.057)	0.032 (0.060)	0.020 (0.057)
	Reading books to students	0.025 (0.036)	0.000 (0.034)	0.014 (0.036)	-0.008 (0.035)	0.012 (0.036)	-0.010 (0.035)	0.013 (0.036)	-0.010 (0.035)
Control variables	Gender (0=Male, 1=Female)			0.015 (0.032)	-0.006 (0.030)	0.019 (0.032)	-0.002 (0.030)	0.020 (0.032)	-0.001 (0.030)
	Hours spent studying alone in 2007	0.006*** (0.001)	0.003** (0.001)	0.006*** (0.001)	0.003*** (0.001)	0.006*** (0.001)	0.003** (0.001)	0.006*** (0.001)	0.003** (0.001)
	No. of siblings			-0.008 (0.027)	0.006 (0.026)	-0.006 (0.027)	0.008 (0.026)	-0.005 (0.027)	0.009 (0.026)
	Birth order			-0.053** (0.026)	-0.050** (0.025)	-0.056** (0.026)	-0.055** (0.025)	-0.056** (0.026)	-0.053** (0.025)
Constant	0.087 (0.171)	0.560*** (0.170)	0.195 (0.183)	0.634*** (0.181)	-0.053 (0.182)	0.318* (0.178)	-0.017 (0.212)	0.398* (0.206)	
R ²	0.14	0.22	0.14	0.22	0.14	0.22	0.14	0.22	
N	954	954	954	954	954	954	954	954	

Note. 1) *p<0.1, **p<0.05, ***p<0.01,

2) Standard error in parentheses

<Confirmation of Hypothesis>

Followings are the summary of the regression results on 4-year college attendance. First, even though family income in 2007 may seem to affect 4-year college attendance positively ([1-1] of Step 1), the effect loses its statistical significance when the variable of family income in 2004 is added. However, the effect of the income in 2004 still remains. This shows that income from childhood to early adolescent years³¹ as one of family background variables exerts more meaningful effect on 4-year college attendance than family income in just before college-going year.

H1: *The college attendance effect of family income level from childhood to early adolescent years may be greater than that in just before college-going year.* → Accepted.

Second, ranking percentage in middle school which cumulatively reflects long-term family background always affects 4-year college attendance strongly. On the other hand, the effect of income in just before college-going year loses its statistical significance when the academic result in middle school is controlled for. This is similar when other family background variables are controlled instead of the ranking percentage. Again, results show more meaningful effect of long-term family background compared to that of short-term financial status on 4-year college attendance.

H2: *The effect of family income at the college going ages on the college attendance becomes weak when academic result at middle school is controlled for.* → Accepted.

³¹ This paper used the information of family income in 3rd grade in middle school as a variable that showed the family income from childhood to early adolescent years because it was the earliest one among available family income data. However, this is a limitation of my study as I could not include the information about family income of earlier stage.

H3: *The effect of family income at the college going ages on the college attendance becomes weak when other family background factors are controlled for.* → Accepted.

5.1.2 Results of MLR on Top 30 College Attendance

It is natural that there is little short-term financial constraint in top 30 college attendance because the level of top 30 colleges' tuition fees is not that higher than that of other colleges'. In other words, there will be only small number of students³² who enter other colleges due to financial constraint, even though they can get an admission from top 30 colleges. The result of this paper also shows the situation. For example, [Table 5-5] and [Table 5-6] show that income in 2007 loses its significance, when controlling for ranking percentage in middle school or family background factors. The reason why the income in 2007 alone has significant effect on the top 30 college attendance is that the income partially reflects family background before controlling for the family background variables. Therefore, this study analyzes the result of multiple linear regressions on top 30 college attendance focusing on family background variables.

Compare to the result of <Step 1> on 4-year college attendance ([Table 5-2]), the coefficients of significant variables in [Table 5-5] (<Step 1> on top 30 college attendance) are about a half. In regard of academic ranking in middle school, the possibility of attending top 30 colleges increases by 4 percent when the ranking percentage rises by 10.

³² The small number of students may choose to enter other colleges rather than top 30 colleges to get scholarships.

[Table 5-5] Determinants of top 30 college attendance: the result of OLS regression (Step 1)

	[base]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]	[5-1]	[5-2]
ln(income in 2007)		0.050*** (0.016)	0.019 (0.015)			0.054** (0.021)	0.033 (0.020)	0.030* (0.018)	0.005 (0.017)	0.034 (0.022)	0.016 (0.021)
ln(income in 2004)				0.057*** (0.015)	0.033** (0.014)			0.045*** (0.017)	0.031** (0.016)	0.053** (0.020)	0.043** (0.019)
ln(net asset in 2007)						0.005 (0.007)	-0.004 (0.007)			0.003 (0.007)	-0.006 (0.007)
Ranking % in middle S.	0.004*** (0.000)		0.004*** (0.000)		0.004*** (0.000)		0.004*** (0.000)		0.004*** (0.000)		0.004*** (0.000)
Constant	0.264*** (0.018)	-0.186** (0.092)	0.154* (0.093)	-0.219*** (0.085)	0.074 (0.085)	-0.247** (0.115)	0.128 (0.117)	-0.323*** (0.105)	0.054 (0.106)	-0.401*** (0.129)	-0.003 (0.131)
R ²	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.11	0.02	0.12
N	954	954	954	954	954	704	704	954	954	704	704

Note. 1) * p<0.1, ** p<0.05, *** p<0.01

2) Standard error in parentheses

As shown in [Table 5-6] (<Step 2>), the effects of income in 2007 as well as income in 2004 become insignificant when controlling for family background variables. When regressing top 30 college attendance on only family background variables, nothing is significant. However, the effects of academic ranking in middle school and living in metropolitan cities become significant when adding income variables and ranking percentage in middle school variable to the model.

[Table 5-6] Determinants of top 30 college attendance: the result of OLS regression (Step 2)

	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	[4-1]	[4-2]	
ln(income in 2007)			0.004 (0.019)	-0.005 (0.018)			-0.001 (0.019)	-0.009 (0.019)	
ln(income in 2004)					0.020 (0.018)	0.019 (0.017)	0.020 (0.018)	0.021 (0.018)	
Ranking % in middle School				0.003*** (0.000)		0.003*** (0.000)		0.003*** (0.000)	
Other family background variables	Place of residence - S to M sized city	-0.017 (0.028)	-0.017 (0.028)	-0.017 (0.028)	0.001 (0.027)	-0.017 (0.028)	0.000 (0.027)	-0.017 (0.028)	0.000 (0.027)
	Place of residence - Metropolitan city	0.042 (0.028)	0.042 (0.028)	0.041 (0.028)	0.049* (0.027)	0.042 (0.028)	0.050* (0.027)	0.042 (0.028)	0.050* (0.027)
	Place of residence - Seoul Metropolis	0.012 (0.032)	0.012 (0.032)	0.013 (0.032)	0.036 (0.031)	0.011 (0.032)	0.036 (0.031)	0.011 (0.032)	0.034 (0.031)
	Father's years of schooling	0.005 (0.005)	0.005 (0.005)	0.005 (0.005)	0.002 (0.005)	0.004 (0.005)	0.001 (0.005)	0.004 (0.005)	0.001 (0.005)
	Mother's years of schooling	0.005 (0.005)	0.004 (0.005)	0.004 (0.005)	0.003 (0.005)	0.004 (0.005)	0.002 (0.005)	0.004 (0.005)	0.002 (0.005)
	Father's job - Higher Blue Collars	-0.018 (0.031)	-0.021 (0.032)	-0.021 (0.032)	-0.016 (0.031)	-0.025 (0.032)	-0.021 (0.031)	-0.025 (0.032)	-0.020 (0.031)
	Father's job - Lower White Collars	0.028 (0.038)	0.025 (0.038)	0.024 (0.038)	0.014 (0.037)	0.019 (0.039)	0.008 (0.037)	0.019 (0.039)	0.009 (0.037)
	Father's job - Higher White Collars	0.064 (0.043)	0.060 (0.043)	0.059 (0.043)	0.044 (0.041)	0.052 (0.044)	0.036 (0.042)	0.052 (0.044)	0.037 (0.042)
	Father's job - Missing Value	-0.009 (0.052)	-0.010 (0.052)	-0.010 (0.052)	0.008 (0.050)	-0.000 (0.053)	0.017 (0.050)	-0.000 (0.053)	0.018 (0.050)
	Guardian - Single parent	-0.058 (0.133)	-0.054 (0.133)	-0.054 (0.133)	-0.014 (0.127)	-0.047 (0.133)	-0.007 (0.127)	-0.047 (0.133)	-0.008 (0.127)
	Guardian - Others except parents	-0.023 (0.135)	-0.021 (0.135)	-0.019 (0.135)	-0.020 (0.129)	-0.014 (0.135)	-0.011 (0.129)	-0.014 (0.135)	-0.015 (0.129)
	Private tutoring expenditure (Unit: M KRW)	0.045 (0.028)	0.045 (0.028)	0.043 (0.030)	0.020 (0.029)	0.039 (0.029)	0.012 (0.028)	0.040 (0.030)	0.016 (0.029)
	Conversation with family		-0.001 (0.037)	-0.002 (0.038)	-0.014 (0.036)	-0.002 (0.037)	-0.015 (0.036)	-0.001 (0.038)	-0.014 (0.036)
	Reading books to students		0.025 (0.022)	0.025 (0.023)	0.006 (0.022)	0.025 (0.022)	0.006 (0.022)	0.025 (0.023)	0.006 (0.022)
	Constant	-0.054 (0.053)	-0.055 (0.061)	-0.072 (0.108)	0.206* (0.107)	-0.147 (0.102)	0.098 (0.102)	-0.143 (0.125)	0.134 (0.124)
R ²	0.04	0.05	0.05	0.13	0.05	0.13	0.05	0.13	
N	954	954	954	954	954	954	954	954	

Note. 1) * p<0.1, ** p<0.05, *** p<0.01

2) Standard error in parentheses

When adding other control variables (<Step 3>), income variables are still insignificant and the effects of ranking percentage in middle school and living in metropolitan city remain almost the same. Similar to the case of 4-year college attendance, hours spent studying alone has positive effect on top 30 college attendance even though the effect is vanished when controlling for the academic ranking in middle school. This means that large portion of students' effort and aspiration for study crystallized in hours spent studying alone is already reflected in academic ranking in middle school³³. In other words, students who achieved good academic result during 2nd grade of middle school tend to spend more time in studying alone during 3rd grade in high school. On the other hand, disappearance of statistical significance of hours spent studying alone, which is different from 4-year college attendance case, may mean that the gap in academic ability which is needed for entering prestigious colleges and formed earlier is difficult to overcome by student's own effort. Unlike 4-year college attendance, father's years of schooling loses its significance. However, if father's schooling quality being considered instead of mere schooling year, the result may be changed. When academic ranking in middle school being controlled, living in metropolitan city positively affects top 30 college attendance. Also, female students have about 5 percent higher possibility to attend 30 prestigious colleges than male students. The coefficient decreases to about 4 percent, conditioning on academic ranking in middle school. This shows the vanishment of females' inferior status in qualitative college education aspect, while finding of Statistics Korea (2011) that advance rate of female graduates to tertiary education even exceeded that of male graduates from 2009, shows the disappearance of quantitative college education gap between different genders. Lastly, private tutoring expenditure and birth order have no significant effect on top 30 college attendance.

³³ The correlation between two variables is 0.365.

[Table 5-7] Determinants of top 30 college attendance: the result of OLS regression (Step 3)

	[base-1]	[base-2]	[1-1]	[1-2]	[2-1]	[2-2]	[3-1]	[3-2]	
ln(income in 2007)	0.000 (0.019)	-0.005 (0.018)	-0.002 (0.019)	-0.008 (0.018)			-0.007 (0.019)	-0.013 (0.019)	
ln(income in 2004)					0.018 (0.018)	0.021 (0.017)	0.020 (0.018)	0.024 (0.018)	
Ranking % in middle School		0.003*** (0.000)		0.003*** (0.000)		0.003*** (0.000)		0.003*** (0.000)	
Other family background variables	Place of residence - S to M sized city	-0.018 (0.028)	0.000 (0.027)	-0.011 (0.028)	0.008 (0.027)	-0.012 (0.028)	0.008 (0.027)	-0.011 (0.028)	0.008 (0.027)
	Place of residence - Metropolitan city	0.034 (0.028)	0.048* (0.027)	0.036 (0.029)	0.054* (0.028)	0.037 (0.029)	0.054** (0.028)	0.038 (0.029)	0.056** (0.028)
	Place of residence - Seoul Metropolis	-0.003 (0.033)	0.034 (0.032)	0.009 (0.033)	0.046 (0.032)	0.009 (0.033)	0.047 (0.032)	0.008 (0.033)	0.045 (0.032)
	Father's years of schooling	0.003 (0.005)	0.001 (0.005)	0.004 (0.005)	0.002 (0.005)	0.004 (0.005)	0.001 (0.005)	0.004 (0.005)	0.001 (0.005)
	Mother's years of schooling	0.005 (0.005)	0.003 (0.005)	0.005 (0.005)	0.004 (0.005)	0.005 (0.005)	0.003 (0.005)	0.005 (0.005)	0.003 (0.005)
	Father's job - Higher Blue Collars	-0.016 (0.032)	-0.015 (0.031)	-0.015 (0.032)	-0.013 (0.031)	-0.020 (0.032)	-0.019 (0.031)	-0.019 (0.032)	-0.018 (0.031)
	Father's job - Lower White Collars	0.027 (0.038)	0.015 (0.037)	0.029 (0.038)	0.018 (0.037)	0.023 (0.038)	0.010 (0.037)	0.024 (0.038)	0.012 (0.037)
	Father's job - Higher White Collars	0.064 (0.043)	0.045 (0.042)	0.063 (0.043)	0.045 (0.042)	0.055 (0.043)	0.035 (0.042)	0.056 (0.044)	0.037 (0.042)
	Father's job - Missing Value	-0.001 (0.052)	0.009 (0.050)	-0.002 (0.052)	0.009 (0.050)	0.007 (0.052)	0.019 (0.050)	0.007 (0.052)	0.020 (0.050)
	Guardian - Single parent	-0.043 (0.132)	-0.014 (0.127)	-0.045 (0.133)	-0.008 (0.128)	-0.039 (0.133)	-0.000 (0.128)	-0.039 (0.133)	-0.000 (0.128)
	Guardian - Others except parents	-0.028 (0.134)	-0.021 (0.129)	-0.027 (0.135)	-0.010 (0.130)	-0.019 (0.135)	-0.000 (0.130)	-0.021 (0.135)	-0.004 (0.130)
	Private tutoring expenditure (Unit: M KRW)	0.039 (0.030)	0.020 (0.029)	0.037 (0.030)	0.020 (0.029)	0.031 (0.029)	0.010 (0.028)	0.034 (0.030)	0.016 (0.029)
	Conversation with family	-0.007 (0.037)	-0.015 (0.036)	-0.010 (0.037)	-0.016 (0.036)	-0.011 (0.037)	-0.018 (0.036)	-0.010 (0.037)	-0.016 (0.036)
	Reading books to students	0.020 (0.022)	0.006 (0.022)	0.016 (0.023)	0.004 (0.022)	0.015 (0.023)	0.003 (0.022)	0.015 (0.023)	0.003 (0.022)
Control variables	Gender (0=Male, 1=Female)			0.052*** (0.020)	0.040** (0.019)	0.053*** (0.020)	0.041** (0.019)	0.053*** (0.020)	0.042** (0.019)
	Hours spent studying alone in 2007	0.002*** (0.001)	0.000 (0.001)	0.002*** (0.001)	0.000 (0.001)	0.002*** (0.001)	0.000 (0.001)	0.002*** (0.001)	0.000 (0.001)
	No. of siblings			-0.001 (0.017)	0.006 (0.016)	-0.000 (0.017)	0.007 (0.016)	-0.000 (0.017)	0.007 (0.016)
	Birth order			0.005 (0.016)	0.007 (0.016)	0.004 (0.016)	0.005 (0.016)	0.004 (0.016)	0.006 (0.016)
Constant	-0.058 (0.107)	0.204* (0.108)	-0.089 (0.114)	0.153 (0.114)	-0.183 (0.114)	0.022 (0.112)	-0.160 (0.132)	0.069 (0.130)	
R ²	0.06	0.13	0.06	0.13	0.06	0.13	0.06	0.13	
N	954	954	954	954	954	954	954	954	

Note. 1) * p<0.1, ** p<0.05, *** p<0.01

2) Standard error in parentheses

<Confirmation of Hypothesis>

Summary of regression results on top 30 college attendance is as follows. First, family income in just before college-going year and that from childhood to early adolescent years seem to have a positive effect on top 30 college attendance ([1-1] and [2-1] of Step 1) and the effect of family income in just before college-going year weakly remains when including family income from childhood to early adolescent years³⁴ in the regression model ([4-1] of Step 1). However, the statistical significance of those two incomes vanishes when ranking percentage in middle school and other family background variables are controlled for. The disappearance of the significant effect of family income from childhood to early adolescent years is the difference from 4-year college attendance case.

H1: *The college attendance effect of family income level from childhood to early adolescent years may be greater than that in just before college-going year.* → Hard to be accepted.

Second, academic ranking in middle school has significant effect on top 30 college attendance. Similar to the case of 4-year college attendance, the effect of income in just before college-going year does not have significant effect on top 30 college attendance when ranking percentage in middle school or other family background variables are controlled for.

H2: *The effect of family income at the college going ages on the college attendance becomes weak when academic result at middle school is controlled for.* → Accepted.

³⁴ This paper used the information of family income in 3rd grade in middle school as a variable that showed the family income from childhood to early adolescent years because it was the earliest one among available family income data. However, this is a limitation of my study as I could not include the information about family income of earlier stage (Same to the case of 4-year college attendance).

H3: *The effect of family income at the college going ages on the college attendance becomes weak when other family background factors are controlled for.* → Accepted.

5.1.3 Summary of Multiple Linear Regression Results

To sum up the regression results so far, household income in one year before the college going age (Income in 2007) has no significant effect on college attendance, when controlling for academic ranking in 2nd grade of middle school or other family background variables. On the other hand, academic ranking in middle school 2nd grade that reflects long-term family background does not lose its strong significance in any cases. From these results, we can find out that there is little effect of short-term financial constraint on college attendance, while long-term family background has significant and strong effect, which is crystallized in academic achievement during early adolescent years. Besides the academic ranking in middle school, other family background factors such as income in 2004, place of residence and father's years of schooling also affect the college attendance.³⁵ Therefore, we can make an inference that the effect of family background that lasts for long-term is larger than the effect of short-term financial constraint. The HCP calculation presented in next section will confirm this inference.

[Table 5-8] shows the variables that have significant effect in the regression using all explanatory variables.

³⁵ Income in 2004 and father's years of schooling have significant effect only on 4-year college attendance.

[Table 5-8] Variables that have significant effect in the regression using all explanatory variables

Variables	4-year college attendance		Top 30 college attendance	
	[3-1]	[3-2]	[3-1]	[3-2]
ln(income in 2004)	0.059** (0.030)	0.066** (0.028)	0.020 (0.018)	0.024 (0.018)
Ranking % in middle School		-0.006*** (0.001)		-0.003*** (0.000)
Place of residence (S to M sized city)	-0.082* (0.045)	-0.046 (0.043)	-0.011 (0.028)	0.008 (0.027)
Place of residence (Metropolitan city)	-0.000 (0.046)	0.032 (0.044)	0.038 (0.029)	0.056** (0.028)
Place of residence (Seoul Metropolis)	-0.282*** (0.053)	-0.215*** (0.051)	0.008 (0.033)	0.045 (0.032)
Father's years of schooling	0.038*** (0.008)	0.034*** (0.008)	0.004 (0.005)	0.001 (0.005)
Gender (0=Male, 1=Female)	0.020 (0.032)	-0.001 (0.030)	0.053*** (0.020)	0.042** (0.019)
Hours spent studying alone in 2007	0.006*** (0.001)	0.003** (0.001)	0.002*** (0.001)	0.000 (0.001)
Birth order	-0.056** (0.026)	-0.053** (0.025)	0.004 (0.016)	0.006 (0.016)
R ²	0.14	0.22	0.06	0.13
N	954	954	954	954

Note. 1) *p<0.1, **p<0.05, ***p<0.01

2) Standard error in parentheses

5.2 Results of HCP Calculation

This study followed the method of Carneiro and Heckman (2003) to compare the constraint effect on college attendance between family income in adolescent years and long-term family background. In this section, this paper will present the result with the calculation process sequentially. Refer 4.3.2 for the methodology of HCP calculation.

5.2.1 HCP Calculation for 4-year College Attendance

(i) Obtaining the ratio of short-term financial constraint

First, this study regressed 4-year college attendance on income quartiles and family background variables (refer formula (4.2)) and then obtained the gaps between each income quartile and top income quartile as [Table 5-9]. A beta with “minus” sign indicates that there is a college attendance gap relative to the highest income quartile. Last three columns of the

table show the result of not conditioning on ranking percentage in middle school. Among the betas in the table, only -0.0800 (q1-q4 of not conditioning on ranking percentage) is significant under the level of 10 percent. For the reference, at the regression for ranking percentage tercile 2, the variable of double parents was omitted due to the collinearity. In other words, every student in ranking percentage tercile 2 group has double parents.

[Table 5-9] Gaps in 4-year college attendance relative to highest income quartile

	Ranking % Tercile 1 (Highest)			Ranking % Tercile 2			Ranking % Tercile 3 (Lowest)			Not conditioning on Ranking %		
	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat
q1-q4	0.0855	0.0725	1.18	-0.0772	0.0774	-1.00	-0.0734	0.0782	-0.94	-0.0800	0.0451	-1.77
q2-q4	0.0313	0.0743	0.42	0.0095	0.0879	0.11	-0.0543	0.0875	-0.62	-0.0375	0.0499	-0.75
q3-q4	0.0775	0.0662	1.17	-0.1126	0.0761	-1.48	0.0965	0.0833	1.16	-0.0043	0.0449	-0.10

Note) 1) q1-q4 = gap in 4-year college attendance between quartile 4 and 1

2) q2-q4 = gap in 4-year college attendance between quartile 4 and 2

3) q3-q4 = gap in 4-year college attendance between quartile 4 and 3

Then, this study calculated the weighted average of the gaps by applying the weight (percent of students in cell) shown in [Table 4-6]. The result is shown in [Table 5-10]. Overall weighted gap is -0.0108, and we can say only 1 percent of students experience short-term financial constraint. When only significant figures are considered, there is nothing that verifies the existence of the short-term constraint. Therefore, we can conclude that the ratio of short-term financial constraint on 4-year college attendance is at most 1 percent, conditioning on family background and academic ranking percentage in 2nd grade of middle school.

[Table 5-10] Weighted Gaps in 4-year college attendance relative to highest income quartile

	Ranking % Tercile 1 (Highest)	Ranking % Tercile 2	Ranking % Tercile 3 (Lowest)	Total
	Beta	Beta	Beta	
q1-q4	0.0069	-0.0083	-0.0106	-0.0121
q2-q4	0.0018	0.0005	-0.0035	-0.0012
q3-q4	0.0062	-0.0106	0.0069	0.0024
Total				-0.0108

Note) 1) q1-q4 = gap in 4-year college attendance between quartile 4 and 1

2) q2-q4 = gap in 4-year college attendance between quartile 4 and 2

3) q3-q4 = gap in 4-year college attendance between quartile 4 and 3

(ii) Obtaining the ratio of family constraint

First, this study regressed 4-year college attendance on family background variables and ranking percentage in 2nd grade of middle school and obtained family background index which was the linear combination of those variables. The coefficients for the construction of the index are as [Table 5-11].

[Table 5-11] Coefficients for constructing the family background index (4-year colleges)

Variable	Coef.	Std. Err.
Place of residence (city)	-0.0373	0.0408
Place of residence (metropolitan city)	0.0359	0.0408
Place of residence (Seoul metropolis)	-0.1970	0.0460
Double parents	0.0599	0.1441
Father's education	0.0372	0.0071
Mother's education	-0.0107	0.0079
Ranking % at middle school	-0.0065	0.0006
Constant	0.4747	0.1570

Then this study obtained the 4-year college attendance gaps between each family background index quartile and top family background index quartile by regressing 4-year college attendance on family background index quartiles and family income in year 2007 (refer formula (4.3)). After that, it calculated the weighted gaps using the number of observation in each quartile presented in [Table 4-6]. [Table 5-12] shows the result. Contrary to the gaps of short-run financial constraint, all gaps of family constraint are strongly significant. According to the result, overall weighted gap is 26.62 percent. In other words, about 27 percent of students experience family constraint when they enter the 4-year college, even conditioning on family income in just before college going year. This is contrasting to the fact that there are few students who experience short-term financial constraint in the same situation. These two results definitely show the necessity of early intervention that can mitigate the long-term effect of disadvantaged family background.

[Table 5-12] Gaps / Weighted Gaps in 4-year college attendance relative to the highest family background index quartile

	4-year college attendance			
	Coefficient	Std. Err.	t-stat	Weighted Gaps
q1-q4	-0.5902	0.0419	-14.09	-0.1479
q2-q4	-0.3255	0.0415	-7.84	-0.0812
q3-q4	-0.1483	0.0412	-3.60	-0.0372
Total				-0.2662

Note) 1) q1-q4 = gap in 4-year college attendance between quartile 4 and 1
 2) q2-q4 = gap in 4-year college attendance between quartile 4 and 2
 3) q3-q4 = gap in 4-year college attendance between quartile 4 and 3

<Confirmation of Hypothesis>

H5: *The effect of disadvantaged family background that affects for a long term has larger effect on 4-year college attendance than the effect of short-term financial constraint.*

→ Accepted.

For the reference, [Table 5-13] provides HCP calculation result of the U.S. together, which was performed by Carneiro and Heckman (2003). Even though there is a difference between Korean and the U.S. results that Korean result is obtained in regard to 4-year college attendance and the U.S. result is obtained regarding i) not only 4-year but also 2-year college attendance or ii) attendance in 4-year colleges compared to 2-year colleges, rough comparison between two countries' situations is possible through [Table 5-13]. The effect of short-term financial constraint on college attendance is weaker in Korea (1 percent) than in the U.S. (4.2 percent or 5.9 percent) while the effect of long-term family constraint is similar or stronger in Korea (26.6 percent) than in the U.S. (26.2 percent or 11.6 percent).

[Table 5-13] Comparison of the HCP calculation result between Korea and the U.S

	Korea	U.S.
A. Percentage of population short-term financial constrained		
Attendance	-0.0108	-0.0419
Attendance in 4-year vs. 2-year college		-0.0587
B. Percentage of Population short-term financial constrained – Only statistically significant gaps		
Attendance	0	-0.0018
Attendance in 4-year vs. 2-year college		-0.0391
C. Percentage of population long-term family constrained		
Attendance	-0.2662	-0.2623
Attendance in 4-year vs. 2-year college		-0.1155
D. Percentage of population long-term family constrained – Only statistically significant gaps		
Attendance	-0.2662	-0.2623
Attendance in 4-year vs. 2-year college		-0.1155

Note) Carneiro and Heckman (2003) used the term ‘enrollment’ instead of ‘attendance.’
 Source) HCP calculation result of U.S. is from Carneiro and Heckman (2003).

5.2.2 HCP Calculation for Top 30 College Attendance (Obtaining the ratio of family constraint)

As this paper mentioned at the methodology part, this study will only present the percentage of family constraint regarding the top 30 college attendance.³⁶ Similar to HCP calculation for 4-year college attendance, this study obtained the family background index first. [Table 5-13] shows the coefficients for constructing the index.

³⁶ For the reference, this paper provides the HCP calculation result on the ratio of short-term financial constraint for entering top 30 colleges in [Appendix 5]. The result naturally shows that there’s no short-term financial constraint relative to the highest income quartile.

[Table 5-14] Coefficients for constructing the family background index (top 30 colleges)

Variable	Coef.	Std. Err.
Place of residence (city)	0.0004	0.0256
Place of residence (metropolitan city)	0.0500	0.0256
Place of residence (Seoul metropolis)	0.0436	0.0289
Double parents	-0.0002	0.0906
Father's education	0.0037	0.0045
Mother's education	0.0043	0.0049
Ranking % at middle school	-0.0034	0.0004
Constant	0.1349	0.0987

Then this study regressed top 30 college attendance on the family background index quartiles and family income in 2007 to identify the attendance gaps of each family background index quartile relative to the highest family background index quartile (refer formula (4.3)). Finally, using the weights shown in [Table 4-6] (No. of Observations), this study calculated the weighted gaps. [Table 5-14] shows the result in regard of top 30 college attendance. These gaps are all strongly significant, and the overall weighted gap is 19.1 percent. Even though the degree is weaker than that on the 4-year college attendance, there is also substantial family constraint on top 30 college attendance as about 19 percent of students experience family constraint when they try to enter top 30 colleges even conditioning on family income.

[Table 5-15] Gaps / Weighted Gaps in top 30 college attendance relative to the highest family background index quartile

	Top 30 college attendance			
	Coefficient	Std. Err.	t-stat	Weighted Gaps
q1-q4	-0.2808	0.0261	-10.75	-0.0704
q2-q4	-0.2474	0.0258	-9.60	-0.0617
q3-q4	-0.2351	0.0256	-9.18	-0.0589
Total				-0.1910

Note) 1) q1q4= gap in top 30 college attendance between quartile 4 and 1
 2) q2-q4= gap in top 30 college attendance between quartile 4 and 2
 3) q3-q4 = gap in top 30 college attendance between quartile 4 and 3

VI. Conclusion

6.1 Summary and Policy Implication

This study found out the existence of the gap in 4-year college attendance rate between different income groups and identified the reasons of this phenomenon. In particular, this study focused on figuring out which of two caused low-income students' low 4-year college attendance rate: lack of capacity to pay college tuition fees or lack of decent academic result needed to enter 4-year colleges which was affected by disadvantaged family background.

First, this paper performed multiple linear regression. At the regression, this study included two kinds of family income level, which are family income level during the second half of 2nd grade and the first half of 3rd grade in middle school (early adolescent years) and that in high school. It regarded the former one as one of family background factors and the latter one as a constraint factor to pay tuition fees. In addition, this study used the academic ranking percentage in 2nd grade of middle school as one of core variables. As mentioned earlier, academic result in middle school was affected by family background, innate ability, effort of students themselves, and quality of schooling. Innate ability cannot be revealed without adequate family support and schooling quality is also substantially affected by place of residence which is one of main family background factors (see Chapter III). Moreover, people's early-formed ability encourages their motivation and effort (Joongang Sunday, January 31st, 2010). In this perspective, childhood family background should be reflected in the academic result of 2nd grade of middle school. In addition, this paper included other family background factors, gender, hours spent studying alone, number of siblings and birth order as variables in the analysis.

According to the result of the analysis, family income during the second half of 2nd grade and the first half of 3rd grade in high school which affected the capacity to pay tuition

fees had no significant effect on 4-year college attendance rate, while that in middle school had significant effect. When the academic ranking percentage in middle school increased by 10, the possibility of attending 4-year colleges increased by 6 to 7 percent. Hours spent studying alone had significant effect on 4-year college attendance as well. When studying alone 10 hours more a week, the possibility of 4-year college attendance increased by 3 to 6 percent. Besides, this study performed same analysis on top 30 college attendance rate to figure out the effect of family background on prestigious college attendance. The result showed that when the academic ranking percentage in middle school increased by 10, the possibility of attending top 30 college increased by 3 to 4 percent.

Moreover, this paper applied a calculation method which was used in Carneiro and Heckman (2003)'s study, "Human Capital Policy," to compare each effect of family income in just before the college going year and family background more apparently. According to the result, the percentage was 1 percent that lower income group students attended college less than highest income group students due to incapacity to pay tuition fees. On the other hand, the percentage was 26.7 percent that students from lower family background index group attended college less than students from highest family background index group. The percentage that family background constrained the attendance of top 30 colleges was 19.1 percent.

Through these two analyses (multiple linear regression and HCP calculation), this study concluded that there was little short-term financial constraint in 4-year college attendance, while the effect of long-term family background constraint apparently existed in 4-year college attendance and top 30 college attendance in Korea. This result is coherent with OECD (2008)'s opinion regarding the reason why students from disadvantaged background accessed tertiary education less than others. It argued that not having "qualifications needed for entry into tertiary education" (p.60) played a greater role than "the inability ... to afford tertiary

education” (p.60). This kind of result provides important policy implication to current situation where policymakers try to find out the solution for college education gap across income groups from simply reducing tuition fees.

Actually, there are studies that argue cognitive ability formed earlier than middle school years consistently affect educational attainment and occupational ability even after becoming an adult. For example, Heckman (2008) argued that most of ability gaps shown in 18-year-old people already existed at the age of 5.

The fundamental reason of this phenomenon is that its remediation is impossible or very hard as previous studies mentioned at Chapter II, when a person could not acquire relevant cognitive abilities at “critical period” or “sensitive periods.” Also, when a skill that should be formed earlier has not been formed, the formation of following skills cannot be performed effectively as skills formed earlier support the formation of following skill. Therefore, early intervention is effective for the development of cognitive skills of children from disadvantaged family backgrounds. Intervening for grown-ups to mitigate education gap may also be possible, but this is not easy and apparently costly. Also, the effectiveness of lowering tuition fees for mitigating college education gap is questionable under the analysis result that the effect of capacity to pay tuition fees on college attendance is insignificant (refer Kean and Wolpin (2001) mentioned at Chapter II).

How and where to use public resources efficiently is a very important issue as government has budget limitation just like individuals. Therefore, it may be desirable to focus on early intervention first that secures both efficiency and effectiveness. First of all, early intervention is helpful for students from disadvantaged background. The students can keep their motivation as early intervention can support their study before the cognitive development falls behind that of other students’. Also, they do not need to put much more effort in study than others as early intervention is not a remediation program conducted after

missing adequate development stage.

In long-term perspective, positive effects of early intervention to students from disadvantaged background are more than mentioned above. Nowadays in Korea, there are many youths who are in difficult situation that they can hardly get a job even after graduating from colleges. Among them, there are also many youth who have got a loan to pay tuition fees. Like this situation, obtaining decent return compared to the costs from college attendance is not easy when the college is not recognized well in the society. At the same time, long-term family background constraint does exist in the attendance of prestigious colleges as this study showed. This means a large portion of students who acquire low return compared to cost from college education participation are from disadvantaged backgrounds. They enter even less prestigious colleges with paying high tuition fees because college graduation has become a social norm in Korea. Therefore early intervention for children from low-income families is desirable so that their starting point does not fall behind others and their prestigious college attendance rate as well as 4-year college attendance rate increase through fair competition. This may be a fundamental solution that can reduce college attendance gap and increase social mobility.

Furthermore, early intervention is desirable for national finance as well. It is because ROI (Return on Investment) of early intervention for low-income children is much higher than other social policies such as tuition support, adult literacy program, and mentoring program (Cunha and Heckman, 2007). Therefore, early intervention is the policy which can achieve both reducing inequality and raising productivity. For the reference, intervention balanced through life cycle is more effective than early intervention, while early intervention is better than later intervention (Cunha and Heckman, 2007). However, considering current

Korean situation of insufficient early intervention policies³⁷, government needs to focus more on early intervention.

Specific policies for the early intervention can be followings: First, government needs to provide fruitful study programs for children from low-income families so that their learning ability does not fall behind from the beginning stage. This kind of study program is needed both before and after entering schools. According to Entwisle, Alexander, and Olsen (1997), even though there is a learning gap before entering school due to prerequisite learning, the gap expands after school entrance as well because some students get supplementary learning during summer vacation while others do not (Rajan, 2010). Therefore, government needs to provide supplementary study programs after school or during vacation even after school entrance. If government has a difficulty in offering programs that help students' learning effectively at firsthand, government can provide vouchers for participating private educational institutes.

Secondly, just providing study programs may be insufficient to make children and youth, in particular students from disadvantaged background, concentrate on study. If providing mentoring programs by matching students who participate in program and college students through 1:1 relationship, the effectiveness of study program can be improved. Mentors can provide learning support as well as counseling, show concerns, and encourage students to be motivated.

Third, drawing a family support for children is needed because development and academic achievement of children are substantially affected by family background and there is a limitation to overcome negative effects of risky family background by the simple effort by government or children themselves. Government can offer parents program that reminds

³⁷ 'Westart Program,' 'Dream Start Program,' and 'Seesaw and Swing Program' are the examples of early intervention programs being performed in Korea.

the importance of children education, gives counseling in regards of parents' troubles, and supports parents to overcome their problems. Also, government can provide incentives to make parents participate in parents program and show their concern to their children. For instance, Mexico made poor parents pay attention to their children successfully "by making welfare payments conditional on parents meeting certain milestones" (Rajan, 2010, p. 186).

Fourth, policies of early intervention should be planned and performed from a long-term perspective as their effects are not revealed in a short period. At the same time, it is necessary to provide an opportunity to move upward and encourage disadvantaged students' motivation by opening doors of colleges including prestigious colleges through admission policies which care disadvantaged students. This may be implemented temporarily until early intervention policies achieve their desired results.

Lastly, after the period when cognitive skill is malleable, programs to develop non-cognitive skills such as endurance and social skills can be provided to disadvantaged students so that they can consistently develop their potential successfully.

6.2. Limitation of the Study and Future Research

This study has some limitations. First, the variable of academic ranking percentage in middle school used in multiple linear regression is based at school level, not at national level as mentioned at Chapter IV. Second, as this paper used data which has information until 2008, it could not consider delayed college entrance after studying one or two years more. Third, even though this study set a hypothesis using the factor of family income from childhood to early adolescent years, there was no information on income before 3rd grade in middle school in KEEP data. Therefore, this paper used the information of household income in 3rd grade in middle school, which was the earliest among available data, as a variable that showed the family income from childhood to early adolescent years. Fourth, this study did not consider

non-cognitive skills even though not only cognitive skills but non-cognitive skills such as social or emotional ability also affect college attendance significantly. Fifth, this paper only contemplates the effect of tuition fees on college attendance gap, not on enrolled college students' welfare.

Future research may think of non-cognitive ability which becomes more important these days. In other words, it may find out how family background affects the formation of non-cognitive skills and how disadvantaged family background deteriorates college attendance by constraining the sound formation of non-cognitive as well as cognitive skills. In addition, how family income in just before college-going year affects GPA in college instead of college attendance may also be interesting topic for future studies.

Reference

- Ahn, B. (2005), "The evaluation on the inequality of academic result according to socio-economic background," *Proceedings for the first KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- Bang, H. and Kim, K. (2002), "Opportunity and Inequality: the analysis on inequality between social classes in higher education opportunity", *Korean Sociology*, Vol. 36, No. 4, pp. 193-222. [in Korean]
- Bang, H. and Kim, K. (2003), "Educational stratification in Korea," *Proceedings for the fourth KLIPS conference*, Seoul: Korea Labor Institute. [in Korean]
- Becker, G. and Tomes, N. (1986), "Human Capital and the Rise and Fall of Families," *Journal of Labor Economics*, Vol. 4, No. 3, Part 2, pp. S1-39.
- Belley, P. and Lochner, L. (2007), "The Changing Role of Family Income and Ability in Determining Educational Achievement," *Journal of Human Capital*, University of Chicago Press, Vol.1(1), pp. 37-89.
- Belley, P. and Lochner, L. (2008), "Educational Attainment by Parental Income: A Canada-U.S. Comparison."
- Black, S. and Sufi, A. (2002), "Who Goes to College? Differential College Enrollment by Face and Family Background," NBER Working Paper 9310, National Bureau of Economic Research.
- Brown, M., Scholz, J. and Seshadri, A. (2009), "A New Test of Borrowing Constraints for Education," NBER Working Paper No. 14879, National Bureau of Economic Research.
- Byeon, S. and Kim, K. (2007), "The effect of culture capital on the education result in Korean society," *Proceedings for the third KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- Cameron, S. and Heckman, J. (1998), "Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males," *Journal of Political Economy*, 106(2):262-333.
- Cameron, S. and Heckman, J. (1999a), "Can Tuition Policy Combat Rising Wage Inequality?" in M. Koster, ed., *Financing College Tuition: Government Policies and Educational Priorities*. Washington, D.C.: American Enterprise Institute Press.

- Cameron, S. and Heckman, J. (1999b), "The Dynamics of Educational Attainment for Blacks, Hispanics, and Whites," NBER Working Paper No. 7249, National Bureau of Economic Research.
- Cameron, S. and Heckman, J. (2001), "The Dynamics of Educational Attainment for Black, Hispanic, and White Males," *Journal of Political Economy*, 109:455-499.
- Cameron, S. and Taber, C. (2004), "Estimation of Educational Borrowing Constraints Using Returns to Schooling," *Journal of Political Economy*, 112(1):132-82.
- Card, D. (1999), "The Causal Effect of Education on Earnings" in Ashenfelter, O. and Card, D. eds., *Handbook of Labor Economics*, Vol. 3A, Amsterdam: Elsevier Science, North-Holland, 1801-63.
- Card, D. (2001), "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," *Econometrica*, 69(5):1127-60.
- Carneiro, P. and Heckman, J. (2002), "The Evidence on Credit Constraints in Post-Secondary Schooling," *The Economic Journal*, 112: 705–734. doi: 10.1111/1468-0297.00075.
- Carneiro, P. and Heckman, J. (2003), "Human Capital Policy," NBER Working Paper No. 9495, National Bureau of Economic Research.
- Cawley, J., Conneely, K., Heckman, J., and Vytlačil, E. (1996), "Measuring the Effects of Cognitive Ability," NBER Working Paper No. 5645, National Bureau of Economic Research.
- Cha, J. (1992), "The Structure and Process of Social Class," Hwang, I. ed. *Inequality and Equity in Korean Society*, Seoul: Nanam. pp. 71-140. [in Korean]
- Choi, G., Kim, S., and Min, B. (2008), *Analysis on the Current Situation of Education Gap Among Classes*, Korean Educational Development Institute. [in Korean]
- Choi, H. (2008), "The effect of private education on college entrance," *International Economy Study*, Vol. 14, No. 1, pp. 73-111. [in Korean]
- Choy, S. (2001), "Students Whose Parents did not go to College: Postsecondary Access, Persistence, and Attainment," *The Condition of Education 2001*, pp. 18-43.
- Cunha, F. and Heckman, J. (2007), "The Technology of Skill Formation," *The American Economic Review*, Vol. 97, No. 2, pp. 31-47.
- Cunha, F., Heckman, J. and Schennach, S. (2010), "Estimating the Technology of Cognitive and Noncognitive Skill Formation," *Econometrica*, 78: 883–931. doi: 10.3982/ECTA6551.

- D'Addio, A. (2007), "Intergenerational Transmission of Disadvantage: Mobility of Immobility across Generations? A Review of the Evidence for OECD Countries," *OECD Social Employment and Migration Working Papers*, No.52, OECD.
- Deming, D. and Dynarski, S. (2009), "Into College, Out of Poverty? Policies to Increase the Postsecondary Attainment of the Poor," NBER Working Paper No. 15387, National Bureau of Economic Research.
- Ellwood, D. and Kane, T. (2000), "Who is Getting a College Education?: Family Background and the Growing Gaps in Enrollment," in S. Danziger and J. Waldfogel, eds., *Securing the Future: Investing in Children from Birth to College*. New York: Russell Sage Foundation.
- Garner, C. and Raudenbush, S. (1991), "Neighborhood Effects on Educational Attainment: A Multilevel Analysis," *Sociology of Education*, Vol. 64 (October), pp. 251-262.
- Haveman, R. and Wolfe, B. (1995), "The Determinants of Children's Attainments: A Review of Methods and Findings," *Journal of Economic Literature*, Vol. 33, No. 4, pp. 1829-1878.
- Jang, S. (2006), "The Opportunity for Higher Education of Females: Who and Why Sent Daughters to College?" *Korean Sociology*, Vol. 40, No. 1, pp. 127-156. [in Korean]
- Kane, T. (1995), "Rising Public College Tuition and College Entry: How Well Do Public Subsidies Promote Access to College?" NBER Working Paper No. 5164, National Bureau of Economic Research.
- Keane, M. and Wolpin, K. (2001), "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment," *International Economic Review*, 42(4):1051-1103.
- Kim, H. (2010), *Analysis of the Effects of Private Education on Academic Achievement and Labor Market Performance*, Research Paper 2010-05, Korea Development Institute. [in Korean]
- Kim, K. (2005), "The Actual Condition and Cause of Education Gap in Korean Society," *Proceedings for the first KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- Kim, K. and Bang, H. (2005), "Social Class and Gender Differentials in Korean and Japanese Higher Education – A Comparative Study," *Korean Sociology*, Vol. 39, No. 5, pp. 119-151. [in Korean]
- Kim, K. and Byeon, S. (2007), "Trends and Differentials in Educational Stratification in Korea," *Proceedings for the third KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]

- Kim, K. and Jang, H. (2005), "Characteristics of families which moved their place of residence for educational reason," *Proceedings for the first KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- Kim, K., Kim, D., Seo, Y., and Lee, C. (2003), *The Change of Entrance System: Who Enter into Seoul National University?* Korean Social Science, Vol. 25, No. 1-2, Seoul: The Center for Social Sciences in SNU, pp. 3-187. [in Korean]
- Kim, H. and Lee, B. (2007), "The Effect of Family Background, Social Capital, and Cultural Capital on Children's Academic Achievement," *Korean Demography*, Vol. 30, No. 1, pp. 125-148. [in Korean]
- Koh, H. (2005), *Study on the way of Resolving Education Gap*, Policy study 2005-designation-62, Korean Educational Development Institute. [in Korean]
- Koo, I. (2003), "The Effect of Family Background on Youth's Academic Achievement: the Effect of Family Structure, Family Income, and Poverty," *Social Welfare Studies*, Vol. 22, Korea Association for Social Welfare Studies, pp. 5-32. [in Korean]
- Leibowitz, A. (1974), "Home Investments in Children," *Journal of Political Economy*, Vol. 82, No. 2, Part 2: Marriage, Family Human Capital, and Fertility (Mar. – Apr.), pp. S111-131.
- Lucas, S. (2001), "Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects," *American Journal of Sociology*, Vol. 106, No. 6 (May 2001), pp. 1642-1690.
- Morris, P., Duncan, G. and Clark-Kaufman, E. (2005), "Child Well-Being in an Era of Welfare Reform: The Sensitivity of Transitions in Development to Policy Change," *Developmental Psychology*, 41(6): 919-32.
- OECD (2008), *Tertiary Education for the Knowledge Society*.
- OECD (2010), *Education at a Glance 2010*.
- Oh, H. (2006), "Income bracket and academic achievement," *Proceedings for the second KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- O'Neill, J. (1990), "The Role of Human Capital in Earnings Differences Between Black and White Men," *Journal of Economic Perspectives*, pp. 25-45.
- Phillips, M., Brooks-Gunn, J., Duncan, G., Klebanov, P., and Crane, J. (1998), "Family Background, Parenting Practices, and the Black-White Test Score Gap," in Jencks, C. and

- Phillips, M. eds., *The Black-White Test Score Gap*, Washington: The Brookings Institution, pp. 103-145.
- Raftery, A. and Hout, M. (1993), "Maximally Maintained Inequality: Expansion, Reform, and Opportunity in Irish Education, 1921-75," *Sociology of Education*, Vol. 66, No. 1 (Jan., 1993), pp. 41-62.
- Rajan, R. (2010), *Fault Lines*, Princeton: Princeton University Press.
- Restuccia, D. and Urrutia, C. (2004), "Intergenerational Persistence of Earnings: The Role of Early and College Education", *American Economic Review*, 94 (5).
- Rodgers, W. and Spriggs, W. (1996), "What Does the AFQT Really Measure: Race, Wages, Schooling and the AFQT Score," *Review of Black Political Economy*, Spring 1996; 24, 4, pp. 13-46.
- Ryu, B., and Kim, S. (2006), *Education Gap: The Analysis on the Effect of Family Background and Schooling*, RP 2006-7-2. Seoul: Korean Educational Development Institute. [in Korean]
- Sewell, W. (1971), "Inequality of Opportunity for Higher Education," *American Sociological Review*, Vol. 36 (October), pp. 793-809.
- Shea, J. (2000), "Does Parent's Money Matter?" *Journal of Public Economics*, 77(2):155-84.
- Shin, K. and Lee, B. (2007), "Social class and college entrance," *Proceedings for the third KEEP symposium*, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]
- Shonokoff, J. and Phillips, D. eds. (2000), *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington D.C.: National Academy Press.
- Statistics Korea (2011), Social Indicator of Korea. [in Korean]
- Vignoles, A. (2008), "State intervention in higher education," in *Social Mobility and Education*, Carnegie Corporation of New York.
- Wößmann, L. and Schütz, G. (2006), "Efficiency and Equity in European Education and Training Systems", Analytical Report for the European Commission prepared by the European Expert Network on Economics of Education.
- Yeo, Y. (2008), "A Study of the Influence of Education on Social Mobility," *Health and Social Study*, Vol. 28, No. 2, Korea Institute for Health and Social Affairs, pp. 53-80. [in Korean]

Yoo, H. (2006), *Social Class and Education Gap*, Policy study 2006-14, Seoul: Korea Research Institute for Vocational Education & Training. [in Korean]

Yoon, H. and Kang, M. (2008), "The effect of place residence of the entrance rate of prestigious colleges," *Seoul City Study*, Vol. 9, No. 4, Seoul Development Institute. [in Korean]

Joongang Ilbo, February 2nd, 2010.

Joongang Sunday, January 31st, 2010.

APPENDICES

[Appendix 1] Previous Studies on the Current Situation of Korean Education Gap

Previous studies	
Ryu and Kim (2006)	There is substantial gap between social classes and regions in family's educational support, students' school experience, and academic achievement. This kind of gap comes out from elementary school level, and the biggest gap exists in family's education support. Also, the gap is largest in high-school level while it is smallest in elementary school level. Family background affects college entrance as well as academic achievement. There are positive relations between prestigious college entrance and parents' occupational status, parental education, and parents' income level.
Yoo (2006)	Students' academic achievement levels are higher in cities than rural areas, using the National Academic Achievement Test results of elementary school students, middle school students, and high school students. Students who have high parental SES (Social Economic Status) show better results. However, this gap between socio-economic backgrounds is smaller compared to foreign cases.
Koh (2005)	There is the existence of the gap in educational opportunity, educational process (parental support, cultural activities, private education, school resources), and educational output (cognitive and non-cognitive achievement) between social classes and regions.
Choi, Kim, and Min (2008)	Education gap is intensified at high school level, and the gap is the product of accumulated gap from early childhood. To mitigate the accumulation of educational gap, intervention should be focused on the compensation of cultural and learning experiences when children are young, while it should be focused on academic program when children become middle or high school students.

[Appendix 2] Previous Studies on Family Background Factors and Control Factors

	Factor	Related previous studies	
Family background	Place of residence	Garner and Raudenbush (1991)	Students who live in backward area tend to achieve low educational attainment, controlling for pupil ability, schooling, and other family background.
		Ryu and Kim (2006)	In Korea, students who live in rural areas show less 4-year college participation than average.
		Yoon and Kang (2008)	Even in same city (Seoul, in their study), students' high-ranked college entrance rate of each district (gu) differs according to education circumstances of the districts.
		Kim (2005)	As parents who live in affluent area keep investing in educational circumstances, their children can study in more favorable conditions than others. Moreover, only well-to-do families can move to such areas as housing costs of the areas are high, which exacerbates the situation.
	Parental education	Choy (2001)	Having parents who did not go to college negatively affects college access.
		Cha (1992)	In Korea, father's education is the most important factor that determined educational attainment.
		Oh (2006)	Mother's education (and place of residence) significantly affected the college scholastic ability test (CSAT) score.
		Bang and Kim (2002)	There is positive effect of parental education on children's college entrance.
	Parental occupation	Sewell (1971)	Parental occupation caused substantial differences in the opportunity of higher education.
	Single parent	McLanahan (1997)	Children from single parent family showed lower cognitive and socio-emotional development than children from both-parents family, because of deficient economic resources and social capital as well as single parent' emotional instability caused by family dissolution (Koo, 2003).
		Koo (2003)	In Korea, students who were from single-parent family reported low level of academic result, and its negative effect on college entrance was bigger than that of poverty.
Private education	Choi (2008)	When private education expenditure increased by 10 percent, probability of entering 31 of high-ranked colleges or medical colleges increased by 0.6~0.37 percent, while that of entering 4-year colleges increased by 0.8 percent.	

		Kim (2010)	The effect of private education on educational attainment was faint controlling for ability, and hours spent studying alone rather than private education affect more significantly on academic achievement.
	Parents' interest in children	Furstenberg and Hughes (1995)	Social capital in family such as communications among family members, parents' help for children's homework or study, and parents' monitoring on children's education is related with children's high-school completion and college attendance (Kim and Lee, 2007).
		Coleman (1987)	Parents' human capital as well as economic capital can affect children's academic achievement only when with social capital (Kim and Lee, 2007).
		Kim (2005)	In Korea, there is positive effect of parents' interest in children's education and their will for supporting their children on the children's educational attainment. (measures of parents' interest: parents' expectation on children's ultimate education level, their interest in education policy, and social capital)
		Kim and Lee (2007)	Parents' interest toward children still exerts important effect on children's academic achievement independently, while the effect of other social and cultural capitals tend to be absorbed into that of parents' socio-economic resources.
Other factors for control	Gender	Kim and Bang (2005)	Female students tend to receive less higher education than male students. The gap between genders becomes more significant when it measures the entrance rate of high-ranked colleges.
		Jang (2006)	The gap of receiving higher education between genders enormously decreased.
	Hours spent studying alone	Kim (2005)	Hours spent studying alone which shows the endeavor of students themselves, has a positive effect on academic attainment.
		Kim (2010)	The effect of hours spent studying alone is strong.
		Kim (2008)	The degree of putting effort into studying has a positive relationship with students' family background.
	Number of siblings and Birth order	Koo (2003)	Being born first has a positive effect on college entrance while number of siblings doesn't have any significant effect.

[Appendix 3] The List of Top 30 Colleges and Top 10 Colleges

This ranking is based on the evaluation of Korean colleges by Joongang Ilbo in 2007. The evaluation considered various factors of colleges such as education condition, financial status, research performance of faculty, globalization, and reputation.

[Table A3-1] The list of Top 30 colleges and Top 10 colleges

No.	Rank	Name of Institution	Located in Seoul or not
1	1	Pohang University of Science and Technology (Postech)	
2	2	Korea Advanced Institute of Science and Technology (KAIST)	
3	3	Seoul National University	Seoul
4	4	Yonsei University	Seoul
5	4	Korea University	Seoul
6	6	Sungkyunkwan University	Seoul
7	7	Hanyang University	Seoul
8	8	Sogang University	Seoul
9	9	Ewha Womans University	Seoul
10	10	Inha University	
11	10	Hankuk University of Foreign Studies	Seoul
12	12	Kyunghee University	Seoul
13	13	Chungang University	Seoul
14	13	Pusan National University	
15	13	Konkuk University	Seoul
16	16	Kyungpook National University	
17	16	Ajou University	
18	18	Handong Global University	
19	19	University of Seoul	Seoul
20	19	The Catholic University of Korea	Seoul
21	19	Hongik University	Seoul
22	19	Chonnam National University	
23	23	University of Ulsan	
24	24	Chungnam Naional University	
25	24	Korea University of Technology and Education	
26	24	Sookmyung Women's University	Seoul
27	24	Hallym University	
28	28	Inje University	
29	28	Dongguk University	Seoul
30	28	Korea Aerospace University	

Note: As there are two colleges that are ranked in 10th, this study will use 11 colleges including both of two 10th colleges as top 10 colleges.

[Appendix 4] Classification of Occupation Codes

Classification				
upper white collar	01	member of assembly, executives	14	health expert
	02	administration manager	15	education expert
	03	general manager	16	administration expert
	11	scientific expert	17	law, social service, and religion expert
	12	computer expert	18	culture, art, and broadcasting expert
	13	engineering expert		
lower white collar	21	associate expert on science	27	associate expert on social service and religion
	22	associate expert on computer	28	associate expert on culture, entertainment, and event
	23	associate expert on engineering	29	other associate expert
	24	associate expert on health	31	general office worker
	25	associate expert on education	32	office worker for customer service
	26	associate expert on administration		
upper blue collar	41	service employee	72	technician on metal or machine
	42	catering employee	73	mechanic
	43	travel and transportation employee	74	technician on precision instrument or craftsmanship
	44	security service employee	75	other technician
	51	wholesale-retail sales employee	81	system operator
	52	mail-order business employee	82	machine operator
	53	public relations employee	83	assembly employee
	71	construction technician	84	driver
lower blue collar	61	farm worker	92	general labor for farming, forestry, and fishing
	62	forestry worker	93	general labor for manufacturing
	63	fishing worker	94	general labor for mining industry, construction, and transportation
	91	general labor for service		

[Appendix 5] Ratio of Short-term Financial Constraint for Top 30 College Attendance

Similar to the case of 4-year college attendance, this study regressed top 30 college attendance on income quartiles and family background variables (refer formula (4.2)) and then obtained the gaps between each income quartile and top income quartile as [Table A5-1]. Among the betas in the table, 0.1364 (q4-q3 of ranking percentage tercile 1) is significant under the level of 5 percent, and -0.0368 (q4-q1 of ranking percentage tercile 3) and -0.0402(q4-q2 of ranking percentage tercile 3) are significant under the level of 10 percent.

[Table A5-1] Gaps in top 30 college attendance relative to highest income quartile

	Ranking % Tercile 1 (Highest)			Ranking % Tercile 2			Ranking % Tercile 3 (Lowest)			Not conditioning on Ranking %		
	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat	Beta	Std. Err.	t-stat
q4-q1	0.0362	0.0692	0.52	0.0191	0.0350	0.55	-0.0368	0.0194	-1.90	-0.0368	0.0278	-1.32
q4-q2	-0.0288	0.0710	-0.41	-0.0145	0.0397	-0.36	-0.0402	0.0217	-1.86	-0.0509	0.0308	-1.66
q4-q3	0.1364	0.0632	2.16	-0.0331	0.0344	-0.96	-0.0115	0.0206	-0.56	-0.0031	0.0277	-0.11

Note) 1) q4-q1 = gap in 4-year college attendance between quartile 4 and 1
 2) q4-q2 = gap in 4-year college attendance between quartile 4 and 2
 3) q4-q3 = gap in 4-year college attendance between quartile 4 and 3

Then, this study calculated the weighted average of the gaps by applying the weight (percent of students in cell) shown in [Table 4-6]. The result is shown in [Table A5-2]. Overall weighted gap is 0.0069, and as the sign of the number is “plus,” we can say there’s no short-term financial constraint relative to the highest income quartile. When consider only significant figures, the weighted gap is 0.0030 which also shows the “plus” sign. Therefore, we can conclude that there is no significant short-term financial constraint on top 30 college attendance, conditioning on family background and academic ranking percentage in 2nd grade of middle school.

[Table A5-2] Weighted Gaps in top 30 college attendance relative to highest income quartile

	Ranking % Tercile 1 (Highest)	Ranking % Tercile 2	Ranking % Tercile 3 (Lowest)	Total
	Beta	Beta	Beta	
q4-q1	0.0029	0.0021	-0.0053	-0.0003
q4-q2	-0.0016	-0.0008	-0.0026	-0.0050
q4-q3	0.0109	-0.0031	-0.0008	0.0069
Total				0.0016

Note) 1) q4-q1 = gap in 4-year college attendance between quartile 4 and 1
 2) q4-q2 = gap in 4-year college attendance between quartile 4 and 2
 3) q4-q3 = gap in 4-year college attendance between quartile 4 and 3