What causes the college entrance gap in Korea?
: short-term financial constraint vs. long-term family background constraint*

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요 약

본 연구는 저소득층의 4년제 대학 진학을 제약하는 두 가지 요인, 즉 등록금 납부 여력이 부족하다는 단기적, 금전적 요인과 불우한 가정배경의 누적적인 영향으로 학업성취 수준이 떨어진다는 장기적 요인 중 어느 요인이 더 큰 영향을 끼치는지를 살펴보았다.

회귀분석 결과, 대학 진학 시기의 가구소득은 4년제 대학 진학에 거의 영향을 주지 못하는 반면, 중학교 시기의 학업성취와 몇 가지 가정배경 변수들은 유의한 영향을 미치고 있었다. 또한, 헤크만과 그의 동료 연구자들이 미국 고등교육 격차의 원인을 규명하기 위해 수행한 연구방법을 한국 상황에 적용해본 결과, 가정배경을 누적적으로 반영하고 있는 학업성취의 격차가 등록금 납부 여력의 격차보다 4년제 대학 진학 여부에 더 중요한 영향을 미치고 있는 것으로 나타났다.

이러한 연구결과는 고등교육 격차 문제 해결의 초점을 단순히 등록금 인하에만 맞추고 있는 현 상황에 중요한 시사점을 제공한다.

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.[2]

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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]. 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) entrance rate).
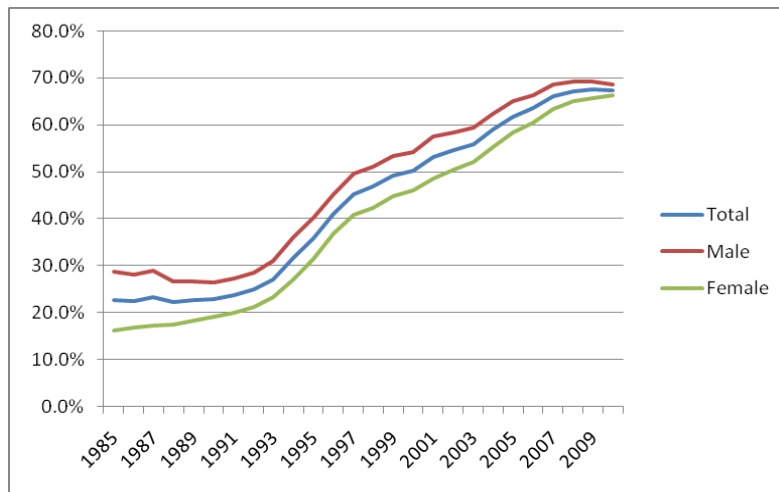
Note: gross higher education enrollment ratio = $\dfrac{\text{number of people aged 18 to 21 who enrolled in higher education}}{\text{munber of people aged 18 to 21}}$
Source: Statistics Korea (2011)

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

However, when we consider the qualitative aspect of higher education institutions, the situation becomes different. [Table 1-1] shows that the higher education entrance rates

2) 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.

by the type of institutions (A1, A2, B, C in [Table 1-1]) increase, as the income level increases except the overall colleges entrance rate. The degree of the relationship between the entrance rate and income level becomes stronger when it considers 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 entrance rates by income quartiles

	Summary of Income Quartiles			Entrance 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	213	25.00	0~225	79.3	47.4	59.8	6.1	1.9
2nd quartile	230	52.00	230~300	89.6	54.8	61.2	7.4	1.7
3rd quartile	207	76.29	306~400	93.2	60.9	65.3	12.1	4.8
4th quartile	202	100.00	410~2500	90.1	70.3	78.0	17.3	7.9
Total	852							

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) 4-year colleges (A1) entrance rate refers the gross rate calculated based on both higher education participants and non-participants, while 4-year colleges (A2) entrance rate 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) Due to the existence of same level of income, number of observations in each group is not equal.

As these evidences show, the gap of higher education entrance 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 percent[3] (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 entrance: short-term unaffordability to pay college tuition fees and the 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, develop a framework to solve the research question 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

In this part, I will review previous studies focusing on the cause of college

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3) 8 percent was the ratio of short-run credit constraint regarding the completion of 2-year colleges.

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).

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 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.

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

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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.

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).

Belley and Lochner(2007, 2008) 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. Based on this result, Belley and Lochner argued that borrowing constraints had become more important than Cameron and Heckman (1998, 2001) and Carneiro and Heckman (2002) suggested.

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 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 characteristics[6] 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, p.35) and critical period means a stage "if [the] stage alone is effective in producing a skill" (Cunha and Heckman, 2007, p.35). These two concepts realize two main features of the

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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.

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).

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 of early investment is low in regard of producing cognitive skills[7].

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[9].

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

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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).

9) 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). Refer the degree thesis to see the summary of those studies.

10) Refer the degree thesis version to see the summary of the studies on the current situation of Korean education gap.

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 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 that 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 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).

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 which 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 education[11]. 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.
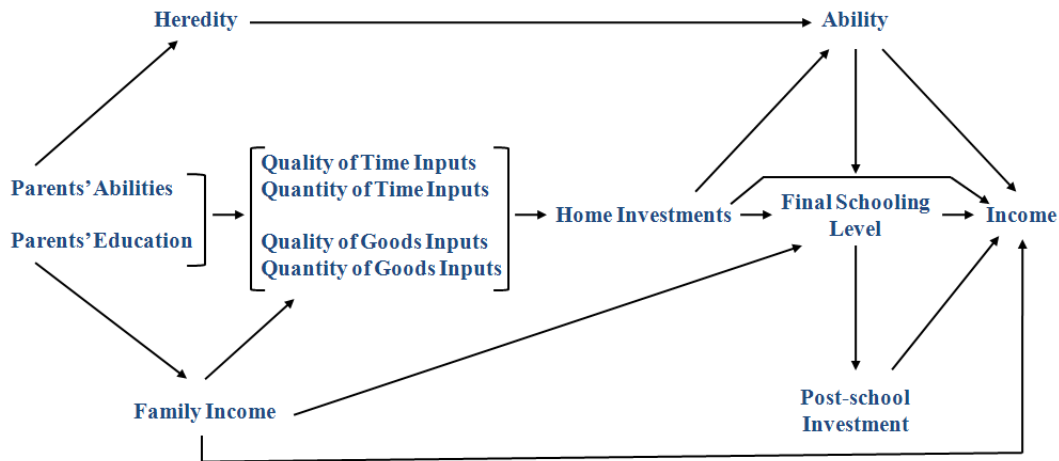
Source: Haveman and Wolfe (1995), Adapted from Leibowitz (1974).

[Figure 2-1] Home investments in children

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 by affecting the formation of human capital.

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 taxation 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, considering the fact that qualitative

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

differences in college attendance exists apparently, this study will include the research about the effect on prestigious college entrance of family background factors.

Ⅲ. Framework for Analysis

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 entrance 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 perspective[12], this study will consider both. More specifically, this study will examine the effects of various factors on the two dimensions of college entrance: i) 4-year college entrance[13], and ii) top 30 college entrance[14].

Second, following just the way which Carneiro and Heckman (2003) did, this paper will compare the constraint effects on 4-year college entrance of family income in 2nd to 3rd grade[15] at high-school and other family background factors that had militated for relatively longer period. The method will be explained specifically in Chapter Ⅳ.

3.2 Framework Development for Analysis

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 entrance. To solve 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

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

13) Even though college entrance gap in quantitative perspective can also be described as whether entering 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) entrance rate in [Table 1-1]) as most students 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 entrance gap.

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

15) More precisely, second half of 2nd grade and first half of 3rd grade in high school.

- 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 effect of family income on college entrance 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 under achievement 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.

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 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[16], 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,"[17] 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 factors[18] 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 background variables: the place of residence, parental education, father's occupation status, single parent, private education, and parents' interest in children. These family background factors have had a cumulative influence on students' college entrance in the long run by affecting their academic achievement from when they were young.

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16) 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).
17) The variables and data which this study used will be explained in detail in Chapter IV.
18) No effect of i) high school graduation or ii) college entrance on the test score

3.2.4 Framework for Analysis

Considering the findings documented above, this study can use following combinations 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

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 entrance, which had affected from when the students were relatively young.

The number of students in each cohort in the year 2004 (starting observations) was 2,000. 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[19]. Moreover, it excluded the students

―――――――――――――――
19) The variables were the place of residence, hours spent studying alone, private tutoring expenditure,

who entered colleges or changed the colleges they had entered by studying one more year[20]. The final number of observations in the data of this study is 852.

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 entrance gap of various factors. As mentioned at Chapter III, this study will use i) 4-year college entrance, and ii) top 30 college entrance 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] to refer to the list of top 30 and top 10 colleges.

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 of middle school as the family income during early adolescent years[21]. The income was measured as monthly average and the

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parental education, and father's occupation status.

20) Excepting students who studied one more year followed the way of data management used in Kim (2011)'s study. He says that considering students who try another year to enter college as those who don't enter college may cause a bias, as well-to-do students tend to choose the second try more easily. For the reference, there are 10 students who dropped out their college in year 2009. I did not exclude these students from the data set as the purpose of this study is to figure out the effects of some factors on "entrance." Their effects on college continuation and college completion will be another research topic.

21) 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 of middle school, which was the earliest among available data.

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. However, private tutoring expenditure will be presented as an average amount of the data measured in year 2004, 2005, 2006 and 2007.

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 1st graders in high school or vocational and technical school as dummy variables, because the information was provided from year 2005[22]. 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

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22) Even though KEEP provided the location of school in year 2004, the way the information was categorized was not relevant to this study.

referred from Byeon and Kim (2007).

c. Father's occupation status

Regarding the usage of occupation status variable, this paper will follow Kim and Jang (2005)'s study. They 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[23]. 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

KEEP data provides the monthly average of last 1 year's private tutoring expenditure[24] from year 2004 to 2007. This paper will use the average amount of those 4 year's data as a variable of private tutoring expenditure. Therefore, the variable reflects the period from when students were 2nd graders in middle school to when they were 3rd graders in high school or in vocational and technical school. If there is a missing value among 4year's data, I will calculate the average excepting the missing value.

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

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23) The classification criterion is presented in [Appendix 4] of degree thesis version.
24) In the case of year 2004, last 1 semester's private tutoring expenditure.

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).'

4.3 Analysis Methodology

4.3.1 Multiple Linear Regression

To find out the determining factors of college entrance and to compare combination i), ii), iii) respectively (refer 3.2.4 Framework for Analysis), this paper will use OLS multiple regression model as follows.

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

For the reference, regarding the problem of endogeneity which is pointed out often as a weakness of related studies, 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 entrance and explanatory variable should be low.

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 constrained[25] 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 entrance rate relative to top income[26] quartile within each ability[27] tercile. The weight was formed

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

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 entrance 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:

$$y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + !_3\beta_3 \tag{4.2}$$

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 quartile[28]. Those betas were acquired separately by AFQT tercile and income quartile, so Carneiro and Heckman calculated weighted averages 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:

$$y = \alpha + Q_1\gamma_1 + Q_2\gamma_2 + Q_3\gamma_3 + Inc17\beta \tag{4.3}$$

y = college attendance measure
Q_1, Q_2, Q_3 = dummy for being in each quartile of the family background index distribution
Inc17 = family income at age 17

(Carneiro and Heckman, 2003)

Similar to former formula, γ_1, γ_2, and γ_3 meant the percentage of people family

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26) This is family income in adolescent years. Carneiro and Heckman (2003) used "family income at 17."

27) In their study, this was measured as AFQT score.

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

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 compare combination iv) (refer 3.2.4 Framework for Analysis). There will be only two differences. First, this paper will use following family background variables: place of residence[29)] (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 entrance and top 30 college entrance. However, this paper will only present the ratio of family constraint concerning top 30 college entrance, because it is meaningless to figure out the ratio of short-term financial constraint regarding the case, as the tuition fees of top 30 colleges are not higher than other colleges.

4.4 Descriptive Statistics

4.4.1 Descriptive Statistics of the Variable for Multiple Linear Regression

[Table 4-1] shows the descriptive statistics of variables which will be used in this study. The percentage of entering 4-year colleges is 58% and that of entering 30 prestigious colleges is 11%.

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

〈Table 4-1〉 Descriptive statistics of variables

Variable			Mean	Std. Dev.
〈Dependent Variables〉				
	4-year college entrance	No=0, Yes=1	0.58	0.49
	30 prestigious colleges entrance	No=0, Yes=1	0.11	0.31
〈Independent Variables〉				
Core variables	Family income in 2007	monthly average household income during last 1 year, natural log value	5.71	0.60
	Family income in 2004	monthly average household income during last 1 year, natural log value	5.57	0.59
	Academic achievement in 2nd grade of middle school	ranking percentage	46.22	27.01
Family background variables	The place of residence in 2005	(Reference group: Rural areas)		
	- Seoul Metropolis		0.16	0.36
	- Metropolitan cities		0.28	0.45
	- Small to medium sized cities		0.30	0.46
	Father's education in 2004	years of schooling	12.36	2.92
	Mother's education in 2004	years of schooling	11.60	2.57
	Father's occupation status in 2004	(Reference group: Lower blue collars)		
	- Upper white collars		0.13	0.34
	- Lower white collars		0.19	0.39
	- Upper blue collars		0.48	0.50
	- Missing		0.05	0.22
	Single parent in 2004	(Reference group: Double parents)		
	- Single parent		0.01	0.08
	- Others except parents		0.01	0.08
	Private tutoring expenditure from 2004 to 2007	monthly average of expenditure, Unit: million KRW	22.02	23.49
	Conversation with family in 2004	Scarce=0, Yes=1	0.93	0.26
	Reading books to students	before entering elementary school, Scarce=0, Yes=1	0.71	0.45
Other control variables	Gender	Male=0, Female=1	0.53	0.50
	Hours spent studying alone in 2007	hours that students spent for studying alone in a week when they were 3rd graders in high/vocational & technical school	12.09	14.01
	Number of siblings		2.28	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 of middle school into 3 groups, and the details of each group are presented in [Table 4-3]. [Table 4-4] shows the details of family background index quartiles for 4-year college entrance and top 30 college entrance.

〈Table 4-2〉 Descriptive statistics of income quartiles (Income in 2007)

	No. of Obs	Cum. Percent	Mean of Monthly Income (10 thousand KRW)	Range of Monthly Income (10 thousand KRW)
			Summary of Income Quartiles	
1st quartile	213	25.00	159.42	0~225
2nd quartile	230	52.00	279.87	230~300
3rd quartile	207	76.29	370.00	306~400
4th quartile	202	100.00	622.84	410~2500
Total	852			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP).
Note: Due to the existence of same level of income, number of observations in each group is not equal.

〈Table 4-3〉 Descriptive statistics of ranking percentage terciles (Academic ranking percentage in 2nd grade of middle school)

	No. of Obs	Cum. Percent	Mean of Ranking Percentage (%)	Range of Ranking Percentage (%)
			Summary of Ranking Percentage Terciles	
1st tercile	284	33.33	15.62	0.2~31.0
2nd tercile	284	66.67	45.41	31.1~60.0
3rd tercile	284	100.00	77.64	60.2~100.0
Total	852			

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP).

〈Table 4-4〉 Descriptive statistics of family background index quartiles

	No. of Obs	Cum. Percent	Mean 4-year	Mean Top 30	Range 4-year	Range Top 30
			Summary of Family Background Index Quartiles			
1st quartile (Low)	213	25.00	0.2578	-0.0450	-0.2189~0.3930	-0.1620~0.0150
2nd quartile	213	50.00	0.4933	0.0634	0.3935~0.5845	0.0151~0.1061
3rd quartile	213	75.00	0.6799	0.1531	0.5861~0.7787	0.1067~0.1997
4th quartile (High)	213	100.00	0.8930	0.2510	0.7802~1.0979	0.2005~0.3665
Total	852					

Source: The figures were calculated using the data of Korean Education and Employment Panel (KEEP).
Note: 1) Refer 4.3.2 for the concept of family background index.
2) 4-year: index for 4-year college entrance, Top 30: index for top 30 college entrance

[Table 4-5] presents the joint distribution of two variables that are monthly household income in year 2007 and academic ranking percentage in middle school, which will be used for HCP calculation. The figures clearly show 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.

〈Table 4-5〉 Number of observations by income and academic ranking

No. of Obs (Frequency)		Academic Ranking % in 2nd grade of middle school			
		1st tercile (Highest)	2nd tercile	3rd tercile (Lowest)	Total
Average monthly income in 1 year before the college going age	4th quartile (Highest)	95	61	51	207
	3rd quartile	78	79	61	218
	2nd quartile	40	52	51	143
	1st quartile (Lowest)	71	92	121	284
	Total	284	284	284	852

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. <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] and [Table 5-4]) is to figure out the effect of ranking percentage in middle school alone on college entrance. 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 variables of parents' interest in children on college entrance, and [1-2] included the parent's interest variables. 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 (refer [Table 5-3] and [Table 5-6]) is to find out the effect of hours spent studying alone on college entrance, 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.

5.1.1 Results of MLR on 4-year College Entrance

[Table 5-1] shows the result of OLS regression on 4-year college entrance 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 entrance, and the effect is strongly significant. When the ranking percentage rises by 10, the possibility of entering 4-year colleges increases by 8 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 entrance. However, we can find out that the income barely maintains the significance of its effect at 10 percent level, 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 entrance. 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 at 1 percent and 5 percent level. Adding ranking percentage in middle school variable more to the model leads to the income in 2007's loss of significant effect even at 10 percent level. The effect of income in 2004 also decreases. The effect of the net asset loses its significance when controlling for ranking percentage or income in 2004.

〈Table 5-1〉 Determinants of 4-year college entrance: 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)		0.114***	0.049*			0.078**	0.035	0.054*	0.008	0.021	-0.010
		(0.028)	(0.025)			(0.034)	(0.031)	(0.030)	(0.028)	(0.036)	(0.032)
ln(income in 2004)				0.167***	0.105***			0.143***	0.102***	0.166***	0.135***
				(0.028)	(0.026)			(0.031)	(0.028)	(0.037)	(0.034)
ln(net asset in 2007)						0.026**	0.008			0.019	0.003
						(0.011)	(0.010)			(0.011)	(0.010)
Ranking % in middle S.	0.008***		0.008***		0.008***		0.008***		0.008***		0.008***
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)
Constant	0.963***	-0.073	0.676***	-0.349**	0.361**	-0.082	0.685***	-0.526***	0.334*	-0.611***	0.235
	(0.030)	(0.160)	(0.153)	(0.158)	(0.151)	(0.185)	(0.179)	(0.186)	(0.180)	(0.218)	(0.210)
R^2	0.20	0.02	0.21	0.04	0.22	0.02	0.21	0.04	0.22	0.05	0.22
N	852	852	852	852	852	636	636	852	852	636	636

Note. 1) * $p<0.1$, ** $p<0.05$, *** $p<0.01$
　　2) Standard error in parentheses

[Table 5-2] shows the regression result of <Step 2>. Among newly added family background variables, only living in Seoul metropolis, father's education, and private tutoring expenditure have significant effects. Students who live in Seoul show less 4-year college entrance 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 3.8 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 entrance, when other things are equal. Maybe this is because the effects of those factors are already reflected to other family background variables. Even though private tutoring expenditure has significant effect on 4-year college entrance, the degree is negligible.

〈Table 5-2〉 Determinants of 4-year college entrance: 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)			-0.033	-0.036			-0.042	-0.045
			(0.031)	(0.029)			(0.032)	(0.029)
ln(income in 2004)					0.042	0.044	0.050	0.053*
					(0.033)	(0.031)	(0.034)	(0.032)
Ranking % in middle School				0.007***		0.007***		0.007***
				(0.001)		(0.001)		(0.001)

Other family background variables[3]	Place of residence - S to M sized city	-0.032 (0.044)	-0.032 (0.044)	-0.032 (0.044)	0.009 (0.041)	-0.036 (0.044)	0.005 (0.041)	-0.037 (0.044)	0.004 (0.041)
	Place of residence - Metropolitan city	0.021 (0.045)	0.021 (0.045)	0.019 (0.045)	0.052 (0.042)	0.021 (0.045)	0.054 (0.042)	0.019 (0.045)	0.052 (0.042)
	Place of residence - Seoul Metropolis	-0.278*** (0.056)	-0.276*** (0.056)	-0.283*** (0.056)	-0.194*** (0.053)	-0.277*** (0.056)	-0.188*** (0.052)	-0.285*** (0.056)	-0.196*** (0.053)
	Father's years of schooling	0.038*** (0.008)	0.037*** (0.008)	0.038*** (0.008)	0.032*** (0.008)	0.036*** (0.008)	0.030*** (0.008)	0.037*** (0.008)	0.031*** (0.008)
	Mother's years of schooling	-0.002 (0.009)	-0.003 (0.009)	-0.002 (0.009)	-0.006 (0.008)	-0.004 (0.009)	-0.008 (0.008)	-0.003 (0.009)	-0.008 (0.008)
	Private tutoring expenditure (Unit: M KRW per month)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.002** (0.001)	0.004*** (0.001)	0.002*** (0.001)
Constant		0.115 (0.087)	0.074 (0.101)	0.232 (0.179)	0.750*** (0.172)	-0.115 (0.183)	0.379** (0.175)	0.046 (0.220)	0.554*** (0.208)
R^2		0.14	0.14	0.14	0.27	0.14	0.27	0.15	0.27
N		852	852	852	852	852	852	852	852

Note. 1) * p<0.1, ** p<0.05, *** p<0.01
　　 2) Standard error in parentheses
　　 3) The variables of 'father's job,' 'guardian,' 'conversation with family,' and 'reading books to students' are controlled.

When including income in 2007 to the model, the effect of the income on 4-year college entrance 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 entrance. When including income in 2004 rather than that in 2007, the effect of income in 2004 is insignificant either, as the effect is reflected in that of other long-term family background variables. 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] presents the OLS regression result on college entrance 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 entrance. More specifically, ten more hours spent studying alone a week leads to increase in the possibility of entering 4-year colleges by 8 percent. When a 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 and income in 2004 are still insignificant in the model. In the model that includes all control variables ([1-1]), 'living in Seoul' has negative effects on 4-year college entrance. This may be partly due to the current

situation that large numbers of highly-ranked colleges are located in Seoul. As many talented students from the whole country enter Seoul-based colleges, students who live in Seoul but have lower academic achievement have difficulty in entering the colleges near where they live. 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 enter 4-year colleges by about 3 percent. Similar to <Step 2>, the degree of private tutoring expenditure's effect is negligible. However, number of siblings and birth order have no effect on 4-year college entrance.

⟨Table 5-3⟩ Determinants of 4-year college entrance: 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)	-0.042	-0.040	-0.036	-0.034			-0.042	-0.042
		(0.030)	(0.029)	(0.031)	(0.029)			(0.031)	(0.030)
	ln(income in 2004)					0.030	0.039	0.038	0.047
						(0.033)	(0.031)	(0.033)	(0.032)
	Ranking % in middle School		0.006***		0.006***		0.006***		0.006***
			(0.001)		(0.001)		(0.001)		(0.001)
Other family background variables[3)	Place of residence - S to M sized city	-0.039	0.001	-0.046	-0.004	-0.050	-0.008	-0.049	-0.008
		(0.043)	(0.041)	(0.044)	(0.042)	(0.044)	(0.042)	(0.044)	(0.042)
	Place of residence - Metropolitan city	-0.007	0.036	-0.018	0.031	-0.017	0.032	-0.018	0.032
		(0.044)	(0.042)	(0.045)	(0.043)	(0.045)	(0.043)	(0.045)	(0.043)
	Place of residence - Seoul Metropolis	-0.331***	-0.228***	-0.333***	-0.229***	-0.326***	-0.222***	-0.333***	-0.229***
		(0.055)	(0.053)	(0.056)	(0.054)	(0.056)	(0.054)	(0.056)	(0.054)
	Father's years of schooling	0.033***	0.030***	0.033***	0.030***	0.031***	0.028***	0.032***	0.029***
		(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
	Mother's years of schooling	-0.002	-0.006	-0.004	-0.008	-0.005	-0.010	-0.004	-0.009
		(0.009)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)
	Private tutoring expenditure (Unit: M KRW per month)	0.004***	0.003***	0.004***	0.002***	0.003***	0.002**	0.004***	0.002***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Control variables	Gender (0=Male, 1=Female)			0.016	-0.011	0.015	-0.011	0.018	-0.008
				(0.032)	(0.031)	(0.032)	(0.030)	(0.032)	(0.031)
	Hours spent studying alone in 2007	0.008***	0.004***	0.008***	0.004***	0.008***	0.004***	0.008***	0.004***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	No. of siblings			-0.012	0.005	-0.012	0.006	-0.011	0.007
				(0.027)	(0.026)	(0.027)	(0.026)	(0.027)	(0.026)
	Birth order			-0.037	-0.039	-0.042	-0.044*	-0.038	-0.041
				(0.026)	(0.025)	(0.026)	(0.025)	(0.026)	(0.025)
	Constant	0.278	0.717***	0.359*	0.769***	0.068	0.445**	0.217	0.593***
		(0.175)	(0.171)	(0.185)	(0.180)	(0.194)	(0.187)	(0.223)	(0.215)
	R²	0.19	0.28	0.19	0.28	0.19	0.28	0.20	0.28
	N	852	852	852	852	852	852	852	852

Note. 1) * p<0.1, ** p<0.05, *** p<0.01,
2) Standard error in parentheses
3) The variables of 'father's job,' 'guardian,' 'conversation with family,' and 'reading books to students' are controlled.

Followings are the summary of the regression results on 4-year college entrance, which is based on analysis framework mentioned at Chapter III.

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

Even though family income in 2007 may seem to affect 4-year college entrance positively ([1-1] of <Step 1>), the effect decreases by half (coefficient: 0.054) and barely maintains its statistical significancy at 10 percent level, when the variable of family income in 2004 is added. However, the effect of the income in 2004 still remains (coefficient: 0.143). This shows that income from childhood to early adolescent years[30] as one of family background variables exerts more meaningful effect on 4-year college entrance than family income in just before college-going year.

i) Family income level in just before college-going year versus academic result at middle school
ii) Family income level in just before college-going year versus other family background factors

Ranking percentage in middle school which cumulatively reflects long-term family background always affects 4-year college entrance strongly. On the other hand, the effect of income in just before college-going year loses its statistical significancy 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 entrance.

5.1.2 Results of MLR on Top 30 College Entrance

It is natural that there is little short-term financial constraint in top 30 college entrance 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 students[31] 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,

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30) 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.

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

[Table 5-4] and [Table 5-5] show that income in 2007 mostly 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 entrance 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 entrance focusing on family background variables.

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

〈Table 5-4〉 Determinants of top 30 college entrance: 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)		0.060***	0.028*			0.062***	0.039*	0.035*	0.012	0.037	0.020
		(0.017)	(0.017)			(0.022)	(0.021)	(0.019)	(0.018)	(0.024)	(0.023)
ln(income in 2004)				0.075***	0.045***			0.060***	0.039**	0.075***	0.058**
				(0.018)	(0.017)			(0.020)	(0.019)	(0.025)	(0.024)
ln(net asset in 2007)						0.006	-0.003			0.003	-0.005
						(0.008)	(0.007)			(0.008)	(0.007)
Ranking % in middle S.	0.004***		0.004***		0.004***		0.004***		0.004***		0.004***
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
Constant	0.292***	-0.238**	0.125	-0.312***	0.035	-0.295**	0.112	-0.427***	-0.008	-0.533***	-0.082
	(0.020)	(0.100)	(0.100)	(0.099)	(0.099)	(0.123)	(0.124)	(0.117)	(0.118)	(0.146)	(0.146)
R^2	0.12	0.01	0.13	0.02	0.13	0.02	0.13	0.02	0.13	0.03	0.14
N	852	852	852	852	852	636	636	852	852	636	636

Note. 1) * $p<0.1$, ** $p<0.05$, *** $p<0.01$
2) Standard error in parentheses

As shown in [Table 5-5] (<Step 2>), the effects of income in 2007 as well as income in 2004 become insignificant when controlling for family background variables. Among family background variables, only higher white collar father and private tutoring expenditure are significant. Students whose fathers are higher white collars have a higher chance to enter top 30 colleges by about 9 percent than those whose fathers are lower blue collars. The effect of private tutoring expenditure on top 30 college entrance is negligible.

〈Table 5-5〉 Determinants of top 30 college entrance: 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)				-0.007	-0.008			-0.009	-0.011
				(0.020)	(0.019)			(0.021)	(0.020)
ln(income in 2004)						0.011	0.012	0.013	0.014
						(0.022)	(0.021)	(0.022)	(0.021)
Ranking % in middle School					0.004***		0.004***		0.004***
					(0.000)		(0.000)		(0.000)
Other family background variables 3)	Father's job - Higher Blue Collars	-0.019	-0.021	-0.020	-0.009	-0.023	-0.013	-0.022	-0.012
		(0.032)	(0.032)	(0.033)	(0.031)	(0.033)	(0.031)	(0.033)	(0.031)
	Father's job - Lower White Collars	0.019	0.018	0.019	0.012	0.015	0.007	0.016	0.008
		(0.039)	(0.039)	(0.040)	(0.038)	(0.040)	(0.038)	(0.040)	(0.038)
	Father's job - Higher White Collars	0.097**	0.093**	0.095**	0.084*	0.089*	0.077*	0.091**	0.079*
		(0.045)	(0.045)	(0.046)	(0.044)	(0.046)	(0.044)	(0.046)	(0.044)
	Father's job - Missing Value	-0.002	-0.002	-0.002	0.025	0.002	0.030	0.002	0.030
		(0.054)	(0.054)	(0.054)	(0.052)	(0.055)	(0.053)	(0.055)	(0.053)
	Private tutoring expenditure (Unit: M KRW per month)	0.002***	0.002***	0.002***	0.001***	0.002***	0.001**	0.002***	0.001***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant		-0.036	-0.030	0.002	0.266**	-0.080	0.172	-0.045	0.214
		(0.057)	(0.066)	(0.116)	(0.115)	(0.119)	(0.117)	(0.143)	(0.139)
R^2		0.07	0.07	0.07	0.16	0.07	0.16	0.07	0.16
N		852	852	852	852	852	852	852	852

Note. 1) * p<0.1, ** p<0.05, *** p<0.01
   2) Standard error in parentheses
   3) The variables of 'place of residence,' 'parents' years of schooling,' 'guardian,' 'conversation with family,' and 'reading books to students' are controlled.

When adding other control variables (<Step 3>, [Table 5-6]), income variables are still insignificant and the effects of ranking percentage in middle school, higher white collar father, and private tutoring expenditure remain almost the same. Similar to the case of 4-year college entrance, hours spent studying alone has positive effect on top 30 college entrance 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 school[32]. 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 entrance case, may mean that the gap in academic ability which is needed for entering prestigious colleges

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32) The correlation between two variables is 0.377.

and formed earlier is difficult to overcome by student's own effort. Meanwhile, female students have about 5 to 6 percent higher possibility to enter 30 prestigious colleges than male students. 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, number of siblings and birth order have no significant effect on top 30 college entrance.

⟨Table 5-6⟩ Determinants of top 30 college entrance: 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)		-0.010	-0.009	-0.014	-0.013			-0.016	-0.016
		(0.020)	(0.019)	(0.020)	(0.020)			(0.021)	(0.020)
ln(income in 2004)						0.008	0.013	0.011	0.016
						(0.022)	(0.021)	(0.022)	(0.021)
Ranking % in middle School			0.003***		0.003***		0.003***		0.003***
			(0.000)		(0.000)		(0.000)		(0.000)
Other family background variables[3]	Father's job - Higher Blue Collars	-0.012	-0.008	-0.011	-0.006	-0.015	-0.011	-0.013	-0.009
		(0.032)	(0.031)	(0.033)	(0.031)	(0.033)	(0.031)	(0.033)	(0.032)
	Father's job - Lower White Collars	0.025	0.013	0.027	0.016	0.022	0.010	0.025	0.013
		(0.039)	(0.038)	(0.039)	(0.038)	(0.039)	(0.038)	(0.040)	(0.038)
	Father's job - Higher White Collars	0.102**	0.085*	0.102**	0.086**	0.095**	0.078*	0.099**	0.081*
		(0.045)	(0.044)	(0.045)	(0.044)	(0.046)	(0.044)	(0.046)	(0.044)
	Father's job - Missing Value	0.007	0.026	0.007	0.027	0.010	0.032	0.011	0.032
		(0.054)	(0.052)	(0.054)	(0.052)	(0.055)	(0.053)	(0.055)	(0.053)
	Private tutoring expenditure (Unit: M KRW per month)	0.002***	0.001***	0.002***	0.001***	0.002***	0.001**	0.002***	0.001***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Control variables	Gender (0=Male, 1=Female)			0.061***	0.046**	0.061***	0.046**	0.062***	0.047**
				(0.021)	(0.020)	(0.021)	(0.020)	(0.021)	(0.021)
	Hours spent studying alone in 2007	0.003***	0.000	0.003***	0.000	0.003***	0.000	0.003***	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	No. of siblings			-0.012	-0.003	-0.012	-0.002	-0.012	-0.002
				(0.018)	(0.017)	(0.018)	(0.017)	(0.018)	(0.017)
	Birth order			0.014	0.013	0.012	0.011	0.013	0.012
				(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Constant		0.018	0.262**	0.003	0.227*	-0.096	0.110	-0.039	0.167
		(0.116)	(0.115)	(0.122)	(0.121)	(0.128)	(0.126)	(0.147)	(0.144)
R²		0.09	0.16	0.10	0.16	0.10	0.16	0.10	0.16
N		852	852	852	852	852	852	852	852

Note. 1) * p<0.1, ** p<0.05, *** p<0.01
2) Standard error in parentheses
3) The variables of 'place of residence,' 'parents' years of schooling,' 'guardian,' 'conversation with family,' and 'reading books to students' are controlled.

Summary of regression results on top 30 college entrance, which is based on analysis framework mentioned at Chapter III, is as follows.

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

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 entrance ([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 years[33] in the regression model ([4-1] of <Step 1>). However, the effect of those two incomes vanishes or decreases when ranking percentage in middle school and other family background variables are controlled for.

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

Academic ranking in middle school has significant effect on top 30 college entrance. Similar to the case of 4-year college entrance, the effect of income in just before college-going year hardly have significant effect on top 30 college entrance when ranking percentage in middle school or other family background variables are controlled for.

5.2 Results of HCP Calculation

This study followed the method of Carneiro and Heckman (2003) to compare the constraint effect on college entrance 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 Entrance

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

First, this study regressed 4-year college entrance on income quartiles and family background variables (refer formula (4.2)) and then obtained the gaps between each

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33) 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 entrance).

income quartile and top income quartile as [Table 5-7]. A beta with "minus" sign indicates that there is a college entrance gap relative to the highest income quartile. Among the betas in the table, only -0.1631 (q3-q4 of ranking percentage tercile 2), -0.1027, and -0.0924 (q1-q4 and q2-q4 of not conditioning on ranking percentage) are significant at the level of 5 percent.

〈Table 5–7〉 Gaps in 4-year college entrance relative to higher 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	-0.0150	0.0729	-0.21	-0.0802	0.0896	-0.90	-0.0723	0.0847	-0.85	-0.1027	0.0498	-2.06
q2-q4	0.0311	0.0647	0.48	-0.0772	0.0829	-0.93	-0.1356	0.0843	-1.61	-0.0924	0.0469	-1.97
q3-q4	-0.0093	0.0628	-0.15	-0.1631	0.0811	-2.01	0.0624	0.0883	0.71	-0.0574	0.0469	-1.22

Note) 1) q1–q4 = gap in 4–year college entrance between quartile 4 and 1
     2) q2–q4 = gap in 4–year college entrance between quartile 4 and 2
     3) q3–q4 = gap in 4–year college entrance 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 4-5]. The result is shown in [Table 5-8]. Overall weighted gap is -0.0431, and we can say about 4.3 percent of students experience short-term financial constraint. When only significant values are considered, the figure decreases to 1.5 percent. Therefore, we can conclude that the ratio of short-term financial constraint on 4-year college entrance is at most 4.3 percent[34], conditioning on family background and academic ranking percentage in 2nd grade of middle school.

〈Table 5–8〉 Weighted Gaps in 4-year college entrance relative to highest income quartile

	Ranking % Tercile 1 (Highest)	Ranking % Tercile 2	Ranking % Tercile 3 (Lowest)	Total
	Beta	Beta	Beta	
q1-q4	-0.0013	-0.0087	-0.0103	-0.0202
q2-q4	0.0015	-0.0047	-0.0081	-0.0114
q3-q4	-0.0009	-0.0151	0.0045	-0.0115
Total				-0.0431

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

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34) The figure was 1 percent when degree thesis version of paper calculated the value without excluding students who tried another year to enter colleges from the data set.

(ii) Obtaining the ratio of family constraint

First, this study regressed 4-year college entrance 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. Then this study obtained the 4-year college entrance gaps between each family background index quartile and top family background index quartile by regressing 4-year college entrance 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 4-5]. [Table 5-9] 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 28.81 percent. In other words, about 29 percent of students experience family constraint when they enter 4-year colleges, even conditioning on family income in just before college going year. This is contrasting to the fact at most 4 percent of students 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 5-9〉 Gaps / Weighted Gaps in 4-year college entrance relative to the highest family background index quartile

| | 4-year college entrance | | | |
	Coefficient	Std. Err.	t-stat	Weighted Gaps
q1-q4	-0.6354	0.0429	-14.80	-0.1589
q2-q4	-0.3663	0.0422	-8.68	-0.0916
q3-q4	-0.1507	0.0421	-3.58	-0.0377
Total				-0.2881

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

Summary of this result based on 4th analysis framework of this paper is as follows.

iv) Short-term financial constraint versus disadvantaged family background

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

5.2.2. HCP Calculation for Top 30 College Entrance (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 entrance[35]. Similar to HCP calculation for 4-year college entrance, this study obtained the family background index first. Then this study regressed top 30 college entrance on the family background index quartiles and family income in 2007 to identify the entrance 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 4-5] (No. of Observations), this study calculated the weighted gaps. [Table 5-10] shows the result in regard of top 30 college entrance. These gaps are all strongly significant, and the overall weighted gap is 14.8 percent. Even though the degree is weaker than that on the 4-year college entrance, there is also substantial family constraint on top 30 college entrance as about 15 percent of students experience family constraint when they try to enter top 30 colleges even conditioning on family income.

〈Table 5-10〉 Gaps / Weighted Gaps in top 30 college entrance relative to the highest family background index quartile

| | Top 30 college entrance | | | |
	Coefficient	Std. Err.	t-stat	Weighted Gaps
q1-q4	-0.2396	0.0292	-8.22	-0.0599
q2-q4	-0.2058	0.0287	-7.18	-0.0515
q3-q4	-0.1453	0.0286	-5.08	-0.0363
Total				-0.1477

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

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35) For the reference, degree thesis version provides the HCP calculation result on the ratio of short-term financial constraint for entering top 30 colleges. The result naturally shows that there's no short-term financial constraint relative to the highest income quartile.

Ⅵ. Conclusion

6.1 Summary and Policy Implications

This study found out the existence of the gap in 4-year college entrance 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 entrance 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. According to the result of the analysis <Step 3>, 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 entrance. Meanwhile, when the academic ranking percentage in middle school increased by 10, the possibility of entering 4-year colleges increased by 6 percent. Father's years of schooling also has positive effect on 4-year college entrance. Besides, this study performed same analysis on top 30 college entrance rate to figure out the effect of family background on prestigious college entrance. The result showed that when the academic ranking percentage in middle school increased by 10, the possibility of entering top 30 college increased by 3 percent. At the same time, having higher white collar father increases the possibility of entering top 30 colleges.

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 at most 4.3 percent that lower income group students entered college less than highest income group students due to incapacity to pay tuition fees. On the other hand, the percentage was 28.8 percent that students from lower family background index group entered college less than students from highest family background index group. The percentage that family background constrained the entrance of top 30 colleges was 14.8 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 entrance, while the effect of long-term family background constraint apparently existed in 4-year college entrance and top 30 college entrance 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 entrance 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. 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 entrance rate as well as 4-year college entrance rate increase through fair competition. This may be a fundamental solution that can reduce college entrance gap and increase social mobility. 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.

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. 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 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).

Lastly, 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.

6.2 Limiation 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, 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. Third, 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 entrance significantly. Fourth, this paper only contemplates the effect of tuition fees on college entrance 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 entrance 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 entrance may also be interesting topic for future studies.

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Joongang Ilbo, February 2nd, 2010.

Joongang Sunday, January 31st, 2010.

[Appendix] 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 Naiontal 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.

⁞ Abstract ⁞

What causes the college entrance gap in Korea?
: short-term financial constraint vs. long-term family background constraint

Lee, Seung-Eun

This paper aims to investigate which factor would be more important in constraining 4-year college entrance 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 entrance while academic performance in middle school and a few family background variables 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 which reflects long-term family background. This result provides important policy implication to current situation that tries to find out the solution for college education gap across income groups from simply reducing tuition fees.

Key words: college entrance gap, tuition fees, family background, early intervention