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The impact of Korea's National Scholarship program on college students' academic achievement

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Abstract

This study investigates the impact of eligibility for Korea's National Scholarship program, a need-based grant for low- and middle-income college students, on students' GPA by using a regression discontinuity approach. Type I grant-eligible low-income students near the cutoff score for grant eligibility achieve lower GPA scores than ineligible students; the impact is notable for students from the lowest income class attending public institutions. Type II grant eligibility does not have a distinct effect. The findings do not support the human capital theory-based hypothesis that grant aid contributes to increasing student academic achievement. However, low-income college students near the cutoff are responsive to financial incentives and adjust their efforts accordingly. We suggest policy implications concerning academic requirement, aid amount, and predictability of aid awards.

Keywords: national scholarship, academic achievement, program effects, regression discontinuity, Korean higher education

Introduction

College tuition has been a serious social issue in many countries with different approaches to higher education financing. European countries that traditionally provided free higher education allowed higher education institutions to charge tuition for the sake of cost-sharing (Marcucci & Johnstone, 2007). Korea, on the other hand, has relied heavily on private financing for its unprecedented expansion of higher education over the past several decades (Shin & Harman, 2009). According to OECD indicators, the average tuition for higher education in Korea, in both the public and private sectors, ranked fourth highest as of 2010, and Korea has been classified as a country with high tuition but less-developed student support systems (OECD, 2013). In 2012, the Korean government introduced a large-scale National Scholarship program, a means-tested aid for postsecondary students.

The goal of the student aid reform was to relieve the financial burdens of those who were enrolled in higher education institutions. Korean higher education has been a system of universal access since 2000, according to Trow's (2007) phases of development of higher education. For example, the rate of college entrance among high school graduates reached 71.3% in 2012 (Korean Educational Development Institute[KEDI], 2012). Thus, college access is not a main policy concern. The high price of a college education, however, has been a serious concern, and the new aid program was devised to increase affordability for low- and middle-income students enrolled in higher education institutions.

What effects have resulted from this increased affordability in terms of academic success? College GPA is an important indicator of student success because it can have significant effects on a student's career trajectory and subsequent earnings (Betts & Morell, 1999; Stater, 2009). Thus, this study seeks to determine the effect of need-based grant eligibility[1)] on students' academic achievement, measured by GPA, and evaluates the effectiveness of a large-scale grant program using a micro-level analysis.

This study will not only contribute to the existing literature on the effects of student aid on Korean students' academic achievement, but will also provide empirical evidence of program effects for policymakers. First, the effects of college aid policy on various outcomes, such as enrollment, academic achievement, persistence, and completion, have been frequently investigated in the U.S. context (Deming & Dynarski, 2010; S. Dynarski & Scott-Clayton, 2013). The results of this study will add international evidence to the student aid literature. Second, it is of practical significance to evaluate the effectiveness of the program in terms of academic success given that the budget allocation consisted of nearly 38% of the government's total higher education budget in 2012 and that this share is likely to increase in the future (Korean Ministry of Education, 2011). Considering the huge investment in student assistance, a key policy question is whether an expanded budget allocation will eventually lead to desirable student outcomes. What contribution does the grant program make to improving academic achievement that will lead to the accumulation of human capital? Although the program is currently

in an early stage of implementation, it is important to examine its impact on students' academic achievement.

One particular policy debate about this grant program is whether to abolish the academic criterion that requires a minimum GPA of 3.0 for eligibility for a National Scholarship. Advocates of this academic requirement argue that moral hazard is likely to occur without a minimum GPA, even for need-based grant aid. To the contrary, those who propose to remove this academic criterion point out that the neediest students may not be able to receive grants because of their low GPAs. The latter argument comes mainly from the opposition party and NGOs that stress the welfare nature of the program. This study provides empirical evidence about which argument is supported by data.

The primary result is that the National Scholarship program did not increase the GPA of eligible low-income students who were near the academic requirement cutoff score. Regression discontinuity estimates were mostly negative and sometimes statistically significant, suggesting that ineligible students near the cutoff exerted more efforts to increase their GPAs. The National Scholarship appears to be regarded as tuition assistance, which motivates ineligible students near the eligibility cutoff rather than helping eligible students achieve more with grant aid. The finding that student aid may not be effective at enhancing the academic performance of eligible students near the cutoff is fairly consistent with J. Lee and Park (2012). Moreover, the results confirm the importance of an incentive mechanism in designing a scholarship program, as proposed by Cornwell, Lee, and Mustard (2005) and Scott-Clayton (2011). Students near the cutoff tend to show a keen interest in renewing their scholarships, particularly when the aid amount is large, and seem to adjust their efforts accordingly.

This paper proceeds as follows: the next section describes the background, context, and details of Korea's National Scholarship program. We then review the literature on the effects of aid on student outcomes, and present a conceptual framework of the study. The methods section describes the data used for the analysis and the estimation strategy. After presenting the results, we discuss the findings and their implications.

The National Scholarship program

Since the deregulation of college tuition and fees policy in 1989, the price of college education in Korea has risen sharply. From 2002 to 2011, the tuition of public and private colleges rose annually by an average of 6.4% and 4.9%, respectively, far exceeding the inflation rate of 3.3% (KEDI, 2012) (see Figure 1). Heavy financial burdens on students and families have become such a serious social and political issue that the government has been forced to respond. In 2005, the Korean government started increasing student aid amounts, primarily through loans; in

2008, it began a limited need-based grant program for students who receive basic livelihood security subsidies; and in 2010, an income-contingent loan program began. Figure 2 shows the magnitude and composition of college aid from 2005 to 2012. Up until 2011, more than 80% of the total aid was distributed through loans each year. In spite of continuous policy efforts, however, financial burdens were not sufficiently lightened, and the government finally forced higher education institutions not to raise tuition in 2012 with the introduction of a large-scale need-based grant called the National Scholarship program.

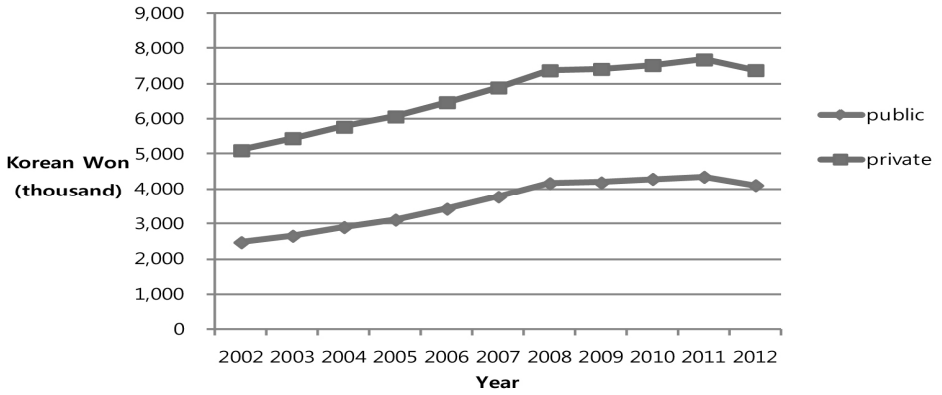

Figure 1. College tuition in Korea, 2002-2012

Source: Korean Educational Development Institute (2012).

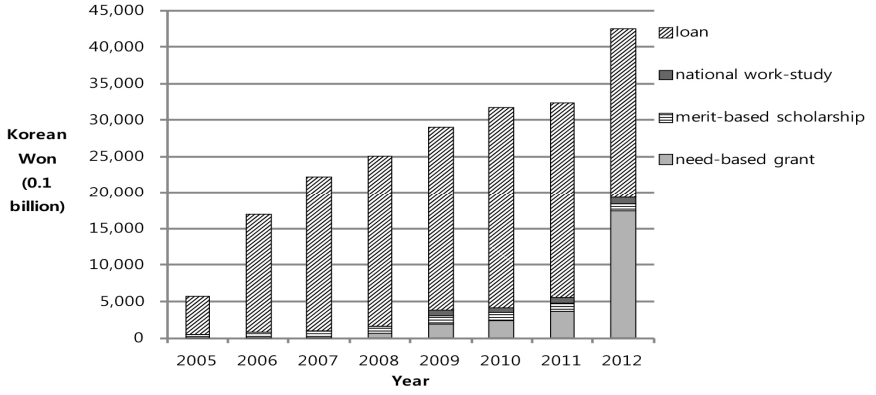

Figure 2. College student aid in Korea, 2005-2012

Source: Korea Student Aid Foundation (2012).

Integrating a prior need-based grant for students receiving basic livelihood security subsidies, the new National Scholarship program was designed to grant aid to a greater range of income classes encompassing low- to middle-income students. As a result, this reform shifted the Korean student aid policy orientation from loans

to grants, with grant amounts comprising more than 40% of the total college aid (Korea Student Aid Foundation, 2012).

The National Scholarship program was implemented in the first semester of 2012. The program consists of two types of grants. Type I grants are for low-income students whose household income is in the bottom three deciles of income distribution and for recipients of basic livelihood security subsidies, who belong to the lowest income decile (alternatively written as income decile 0 in this paper). Type II grants are for low- to middle-income students whose household income level is from the lowest through the seventh income deciles. Type I grants are awarded directly to students enrolled in any postsecondary education institution in Korea. Type II grants are similar to the Federal Supplemental Educational Opportunity Grant in the United States, which is administered by higher education institutions. In 2012, for college freshmen to be eligible for a type I grant, they had to earn a certain high school GPA or SAT score. The other enrollees had to complete 12 credits and earn a GPA of at least 3.0 (a grade B equivalent) or a percentile score of 80 in the previous semester of enrollment at postsecondary institutions in Korea.[2)] The type II grant was strategically designed to force higher education institutions to exert efforts to decrease tuition and increase institutional aid. The government distributed type II grant funds to colleges and universities according to the degree that they reduced tuition and increased institutional aid, and institutions determined the grant recipients from low- to middle-income families and the grant amounts. In summary, type I is a need-based grant for low-income students, similar to Pell grants in the United States, while type II is a campus-based grant that targets a wider range of income classes.

Another important feature is that the amount of the type I grant was fixed and varied depending on income deciles. For example, 4.5 million Korean won were awarded annually to the neediest students, whose households received basic livelihood security subsidies (income decile 0), 2.25 million Korean won were awarded to students with family incomes in the first decile, 1.35 million Korean won to those in the second decile, and 0.9 million Korean won to those in the third income decile. Considering the average annual tuition of 4.13 million Korean won at public universities and 7.38 million Korean won at private universities (Information Service of Higher Education in Korea, 2012), only type I grants for recipients of the basic livelihood security subsidies who attend public higher education institutions were sufficient to cover the full tuition.

Effects of financial aid on student outcomes

Prior literature on student aid and its effect on student outcomes, particularly in the field of the economics of education, is largely based on human capital theory. Developed by Becker (1993), human capital theory establishes the conceptual relationship among schooling, productivity, and the rate of return in the labor

market. Students will choose to go to college if the present discounted value of higher education benefits exceeds the present discounted costs. By reducing the cost of going to college, financial aid may lower the cost of attendance for marginal students deliberating whether or not to enroll in college. The empirical evidence on the effects of aid on college enrollment in the United States has provided the fairly consistent finding that aid of approximately $1,000 led to an increase in college enrollment of 4 to 6 percentage points (S. Dynarski, 2000, 2003; Kane, 2003, 2007).

However, both theory and empirical evidence remain ambiguous over the impact of student aid on academic success. Ben-Porath (1967) and Becker (1967) suggested that schooling activities will substitute only for work hours and that the efficiency of schooling activities decreases as hours of work increase. Aid may have a positive effect on academic performance if students increase study hours when aid helps them not have to work. Conversely, aid may have no effect or even a negative effect on academic performance if students allocate their time to leisure or extracurricular activities that are unrelated to academic activities. Another strand of literature on college departure or persistence by Tinto (1975) suggests that finances affect academic integration because higher costs of attendance could impede students from focusing on academic activities (Cabrera, Nora, & Castaneda, 1992; Cabrera, Stampen, & Hansen, 1990). Consequently, it is likely that grades will be negatively associated with tuition and positively with aid.

It is empirically evident that students are likely to reduce work hours when financial constraints are relaxed by student aid. DesJardins, McCall, Ott, and Kim (2010) found that a Gates scholarship targeting low-income, high-achieving minority students reduced hours worked per week but did not affect the number of credits students take or hours spent studying, relaxing, or in extracurricular activities. J. Lee and Park (2012) found that the income-contingent loan program in Korea reduced low-income private university students' probability of working during the semester. Yi and Kwak (2013) provided evidence that Korea's National Scholarship recipients in 2012 worked off-campus 0.9 hours less per week than non-recipients on average. However, whether reduced work hours are associated with an increase in study hours and subsequent increased academic achievement is still an open question. Some studies report that working students do not curtail their study time and instead reduce time spent sleeping, socializing, or in leisure activities (Cheng & Alcántara, 2007; Miller, Danner, & Staten, 2008), whereas others do not find that work hours are significantly related with academic performance (Dolton, Marcenaro, & Navarro, 2003; Svanum & Bigatti, 2009). Still others found little evidence that on- or off-campus employment detrimentally affects students' learning or cognitive development (Lundberg, 2004; Pascarella, Edison, Nora, Hagedorn, & Terenzini, 1998).

Empirical studies on the effect of aid on academic success measured by college GPA, academic credits, and degree attainment do not provide consistent results. The impacts of state merit-based scholarships were positive on longer-term success, such as degree attainment (S. Dynarski, 2008; Scott-Clayton, 2011). Merit-based scholarship-eligible students in West Virginia achieved a higher freshman GPA and

took more credits (Scott-Clayton, 2011). Castleman and Long (2013) examined the impact of eligibility for the Florida Student Access Grant on a range of college outcomes and found that need-based grant aid increased the cumulative number of credits and the likelihood of bachelor's degree receipt within six years.

A few empirical studies have examined the effect of student aid on academic achievement in Korea. Kim and Rhee (2009) examined the differential effects of financial aid on college GPA by income level and found that grants were effective in increasing the GPA of the lowest- and middle-income students, whereas loans contributed to increasing the GPA of higher-income students. J. Lee and Park (2012) conducted a regression discontinuity analysis to explore the intent-to-treat effects of income-contingent loans, which were introduced in 2010, on students' working and academic activities. They found that loan eligibility did not affect the study hours or GPA of college students, although it reduced low-income private university students' probability of working during the semester. Yi and Kwak (2013) explored the impacts of the National Scholarship program on college students' working and academic activities, using a difference-in-differences method. They found that grant recipients took 0.4 more course credits than non-recipients on average but that their study hours and GPA were not statistically different from those of non-recipients.

In summary, the literature provides mixed results on the effects of aid on academic success. Some reported positive effects on college completion or credit accumulation, whereas others found no significant effect on academic achievement (such as GPA), while still others found a positive effect on GPA. Further, it is important to note that state merit-based scholarships seem to have positive effects on success when grants are implemented with appropriate renewal requirements. For example, Scott-Clayton (2011) found that impact was concentrated around the annual requirements for scholarship renewal, and suggested the importance of linking financial aid to academic achievement to ensure aid effectiveness. As academic criteria are one of the key policy controversies surrounding Korea's National Scholarship program, we examine the relevance of the policy suggestion by S. Dynarski and Scott-Clayton (2013)—that grants with no strings attached tend to be ineffective—in the Korean context.

Conceptual framework and research questions

The conceptual framework of this study is based on the hypothesis of human capital theory, that low- and middle-income students who are eligible for the national scholarship will likely increase their study hours and academic efforts, which will, in turn, contribute to enhancing their academic achievement. It is noteworthy, however, that the dataset used for the current analysis does not include information on the time allocation of college students. Because of this data limitation, we investigate the relationship between aid eligibility/receipt as a treatment variable

and GPA as a dependent variable.

It is likely that the effect of National Scholarships will vary by income classes and by control of the institutions of attendance, due to differences in aid amounts for various income deciles and private institutions' higher tuition. In addition, tuition varies across majors, institution types (two/three- vs. four-year institution), and location (Seoul vs. non-Seoul): the tuition of humanities and social science majors is lowest, whereas that of medicine and health science majors is highest; four-year institutions charge higher tuition than two- or three-year institutions; and institutions in the Seoul area charge higher tuition than those outside it. We hypothesize that a larger amount of aid will be more effective because students' financial constraints will be relaxed to a higher extent. It is also likely that the effect will be more apparent if the ratio of aid to tuition is higher.

Given this conceptual framework, we formulate our research questions as follows:

1. Does type I grant eligibility/receipt positively affect low-income students' GPA? Does the effect vary across income deciles and institutional controls?
2. Does type II grant eligibility positively affect middle-income students' GPA? Does the effect vary across income deciles?
3. Do the effects of type I grant eligibility/receipt and type II grant eligibility on GPA differ for subgroups of students?

Methods

Data

The data for this paper were obtained from the Korea Student Aid Foundation (KOSAF), which implements government-supported aid programs. Prior research that attempted to determine the effect of student aid on academic achievement used self-reported survey data, which may have resulted in measurement errors. This study differentiates itself from the previous Korean empirical research on student aid by relying on administrative data.

The database is constructed as follows. Higher education institutions provide diverse information on enrollees, such as gender, enrollment status, major, credit hours completed, and GPA on a semester basis. When college students apply for a National Scholarship before the semester starts, KOSAF inquires about individual students' household income levels with the National Health Insurance Service to determine the income deciles of applicants. If applicants' income, credit hours, and GPA meet the predetermined criteria, KOSAF informs higher education institutions of its type I grant offer decisions for individual students. The institutions determine to whom and how much type II grants are offered, although the government provides guidelines.

We used data for the first and second semesters of 2012, which were matched using unique student IDs from KOSAF. The first-semester data include demographic

variables including income deciles, prior-semester GPA (which is used as an assignment variable), and whether and which type of National Scholarship was awarded during the semester. The second semester data include students' completed course credits and GPA for the previous semester, which was the first semester of 2012. In our results, 'prior-semester GPA' refers to an assignment variable, and current-semester GPA refers to the first semester of 2012, when the expanded National Scholarship program was first implemented.

Our analysis sample is restricted to two- or three-year college and four-year university students who applied for a National Scholarship in both the first and second semesters of 2012[3] and who belonged to the seventh and lower income deciles, which makes them eligible for the National Scholarship in 2012.[4] Those who have no college GPA and who earned less than 12 credits in the previous semester, which are critical criteria for the grant award decisions, are excluded so that we can focus on prior-semester GPA as a sole assignment variable. Thus, freshmen in the first semester of 2012 are not included in this analysis. Finally, we excluded students with missing or inconsistent majors and students who moved from one institution to another during the observation period. The final sample consisted of 384,926 observations, 250,440 (65%) of which are low-income students (from the bottom 0 to the third income deciles) and 134,486 (32%) of which are middle-income students (from the fourth to the seventh income deciles). Tables 1 and 2 present the descriptive statistics of the sample means.

Table 1. Sample means and means at and below the cutoff score for low-income students

Variable	Full sample	Type I eligible (recipients)	Type I ineligible (non-recipients)	All applicants with prior-semester GPA equal to the		*p* value
				Cutoff score	Cutoff score - 1	
Current semester GPA	87.54	88.44	80.16	82.02	82.00	.81
Credits earned	18.97	18.99	18.80	18.72	18.82	.04
Female	0.58	0.59	0.48	0.52	0.51	.17
Age	21.43	21.47	21.11	21.21	21.15	.33
Sophomore	0.50	0.49	0.60	0.55	0.56	.21
Junior	0.30	0.31	0.27	0.28	0.28	.93
Senior	0.19	0.20	0.13	0.16	0.15	.07
Humanities or social science major	0.38	0.38	0.33	0.35	0.34	.48
Education major	0.05	0.05	0.03	0.04	0.03	.76
Natural science or engineering major	0.39	0.38	0.46	0.43	0.45	.05
Medicine or health sciences major	0.07	0.07	0.07	0.08	0.07	.44
Art, music, or sport major	0.11	0.11	0.12	0.11	0.10	.25
Total grant aid amount (Korean won)	1,587,262	1,754,527	217,957	1,615,177	239,612	.00
Four-year university	0.70	0.71	0.68	0.71	0.71	.63
Private control	0.81	0.80	0.84	0.81	0.82	.75
Located in Seoul areas	0.32	0.33	0.31	0.30	0.30	.73
Number of observations	250,440	223,178	27,262	7,195	4,980	

Note. The cutoff score for a type I grant was exactly 80 in percentile score of a prior-semester GPA. All tests of differences were Fisher exact tests for equality based on categorical data except for GPA, credits, age, and aid amount which were simple *t*-tests for difference in means.

Table 2. Sample means and means at and below the cutoff score for middle-income students

Variable	Full sample	Type II eligible	Type II ineligible	All applicants with prior semester GPA equal to the		*p* value
				Cut-off score	Cut-off score - 1	
Current semester GPA	87.85	88.68	80.38	82.26	82.13	.41
Credits earned	18.87	18.89	18.70	18.62	18.80	.01
Female	0.56	0.57	0.45	0.48	0.48	.67
Age	21.52	21.54	21.34	21.43	21.24	.03
Sophomore	0.48	0.47	0.59	0.51	0.55	.00
Junior	0.31	0.31	0.28	0.31	0.30	.43
Senior	0.21	0.22	0.14	0.18	0.16	.01
Humanities or social science major	0.36	0.37	0.32	0.33	0.34	.44
Education major	0.05	0.05	0.02	0.04	0.03	.34
Natural science or engineering major	0.41	0.40	0.48	0.46	0.46	.61
Medicine or health sciences major	0.07	0.07	0.06	0.07	0.07	.57
Art, music, sport major	0.11	0.11	0.12	0.11	0.10	.32
Total grant aid amount (Korean won)	745,162	809,925	162,021	595,854	189,785	.00
Four-year university	0.76	0.76	0.73	0.77	0.76	.27
Private control	0.81	0.80	0.85	0.80	0.82	.19
Located in Seoul areas	0.35	0.35	0.31	0.32	0.31	.69
Number of observations	134,486	121,043	13,443	3,733	2,511	

Note. The cutoff score for a type II grant was 80 in percentile score of a prior-semester GPA, but discretion to make the award rested with each higher education institution. All tests of differences were Fisher exact tests for equality based on categorical data except for credits, GPA, age, and aid amount which were simple *t*-tests for difference in means.

Regression discontinuity design

In this paper, we employ a regression discontinuity design (RDD) to obtain causal estimates of the effect of National Scholarship eligibility on GPA. Since Thistlethwaite and Campbell (1960) first used RDD to study the effect of receiving a National Merit Scholarship, the method has frequently been used in the student aid literature (Castleman & Long, 2013; DesJardins et al., 2010; DesJardins & McCall, 2014; Goodman, 2008; Kane, 2003; Scott-Clayton, 2011; Van der Klaauw, 2002).

RDD is a quasi-experimental design in which subjects are assigned to treatment (e.g., scholarship recipients) and control groups (e.g., non-recipients) based on a score on predetermined criteria (Shadish, Cook, & Campbell, 2002). Individuals just above and below the cutoff can be assumed to be very similar in observed and unobserved characteristics, and thus we may assume that students close to the cutoff score would have the same academic performance in the absence of a scholarship.

In a sharp design, all individuals at or above a specific cutoff score—for example, a letter grade B average or 3.0 GPA, which is converted to a percentile score of 80—receive the treatment, while those below the cutoff belong to control group. In a fuzzy design, the probability of treatment increases discontinuously at the cutoff score. In the analysis sample, no individuals below the cutoff score received a type I grant, whereas some individuals below the cutoff score received

a type II national scholarship.[5] Therefore, a sharp RD is used to estimate the effects of a type I grant, whereas a fuzzy RD is used for type II grant effect estimation (G. W. Imbens & Lemieux, 2008). It is important to note that all type I eligible students received the grant, whereas not every type II eligible students did. In other words, eligibility for a type I grant coincides with receipt, but eligibility for type II does not. To maintain consistency of terminology, we use eligibility/receipt for type I grants throughout the paper.

To estimate the causal effect of eligibility for a national scholarship on academic performance, we fit the following statistical model:

$$y_i = \beta_0 + \beta_1 D_i + \beta_2(x_i) + \beta_3 x_i \times D_i + \epsilon_i$$

where y_i is student i's GPA in the current semester. D_i is an indicator variable that takes a value of 1 if students are at or above the prior GPA cutoff and zero otherwise. β_i is a coefficient of interest that describes the impact of the treatment (D_i) on E(y_i). x_i is the forcing variable, which measures the applicant's prior-semester GPA and is re-centered so that it has a value of zero at the cutoff score, 80. The interaction of x_i and D_i allows the slope of the relationship between prior GPA and current GPA to vary on either side of the eligibility cutoff. ε_i is a residual error term. We also added academic and demographic covariates such as credits earned, gender, age, grade year, and major; institutional characteristics such as institution type (four-year vs. two- or three-year college), controls (private vs. public), and locations (Seoul vs. non-Seoul), as well as financial variables such as an additional type II grant and/or institutional aid to the model to eliminate any small biases that may be present in the basic specification (G. W. Imbens & Lemieux, 2008).

We employed a nonparametric strategy, the so called local linear regression model (Hahn, Todd, & Van der Klaauw, 2001; G. W. Imbens & Lemieux, 2008), using the triangle kernel developed by Nichols (2007). As estimates are sensitive to the choice of bandwidth, two additional bandwidths were reported in addition to the preferred optimal bandwidth proposed by G. Imbens and Kalyanaraman (2011). These different bandwidths and the estimates thereof can test their robustness. To examine the heterogeneity of the impact across the student population, we ran regression discontinuity estimates for student subpopulations.

The key assumption of the RD strategy in estimating causal effects is that students on either side of the cutoff are equal in expectation. That is, subjects should be randomly distributed around the cutoff and equivalent in all observed and unobserved dimensions. To explore this, we first tested for statistically significant differences in the average values of the observed characteristics between those at the cutoff score and those one point below the cutoff score and found no evidence of statistically significant differences (see Tables 1 and 2). However, it is worth noting that in Table 2, more sophomore students are ineligible for type II grants, while more senior students are eligible for type II grants. Second, we checked the density of the forcing variable to assess internal validity to determine whether there was any

particular manipulation of ratings around the cutoff score (Figure 3). It seems that students at the cutoff score improved to a larger extent than at one point below the cutoff, but this does not seem to threaten the internal validity when we consider the other side of distribution—for example, at 15 or 16 in Figure 3. Moreover, inspection of the fairly smoothed density in Figure 3 does not reveal unusual behavior, even in the density estimates (McCrary, 2008). Therefore, strategic positioning does not appear to be a major concern in employing the RD design.

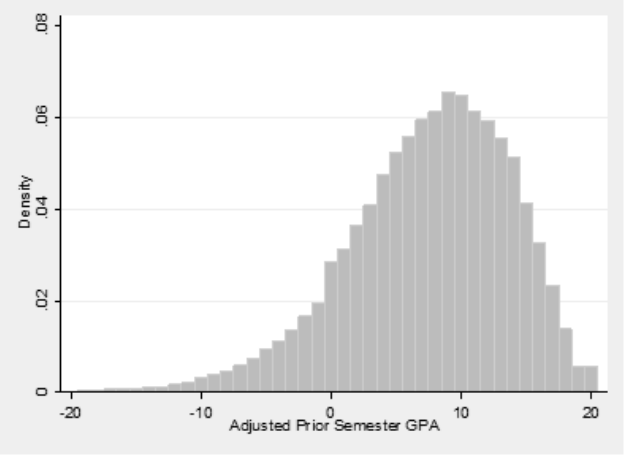

Figure 3. Histogram of prior-semester GPA

Note. GPA score is adjusted by subtracting the actual score from the eligibility cutoff, 80.

The Korean government announced the academic criteria for this new National Scholarship in November 2011, and students started applying in December (Korean Ministry of Education, 2011). As a result, it is possible that students who scored less than the cutoff may have asked their teachers for a favor to meet the academic criteria of the National Scholarship. However, we can assume that not every teacher complied. Moreover, students do not know exactly which income deciles they belong to before the KOSAF inquires with the National Health Insurance Service. Thus, full manipulation may not be the case here. D. S. Lee (2008) also proposed that localized random assignment can occur even in the presence of endogenous sorting as long as the test score contains a random error component.

To supplement the graphical analysis, we regressed an indicator variable—academic eligibility—on the covariates described above. An F-test showed that eligible and non-eligible students at the cutoff and one point below the cutoff were statistically equivalent.[6] These findings justify our use of the RD strategy to estimate the causal effects of the National Scholarship on students' achievement near the eligibility cutoff.

The major limitation of the RD strategy is that it estimates impacts only for those near the eligibility threshold. Thus, the results will be relevant to marginal

students around the cutoff, but not necessarily to infra-marginal students far from the threshold. In summary, the RD strategy is excellent at securing the internal validity, but has a limitation regarding external validity (Shadish et al., 2002).

Results

We conducted a graphical analysis ahead of fitting the regression models, following G. W. Imbens & Lemieux (2008). Figure 4 shows the relationship between the prior-semester GPA (relative to the cutoff) and the current-semester GPA, by income groups. Low-income students who belong to 0 through the third income deciles are eligible for type I grants, while middle-income students who belong to the fourth through seventh income deciles are only eligible for type II grants. As expected, students who earned a higher GPA in the previous semester are more likely to achieve a higher GPA in the current semester. However, the students on the right side of the cutoff who were eligible for a National Scholarship do not appear to achieve distinctively higher GPAs compared to those on the left side of the cutoff, which makes the discontinuity less clear. The graphical description does not provide a clear pattern, and a need for more sophisticated statistical estimation arises. In particular, it is important to note that the amount of scholarship awarded varied across income deciles and that the degree to which financial burdens were lessened will vary depending on college controls because of differences in college costs between public and private institutions. Thus, we need to examine heterogeneous effects across income deciles, college controls, and so forth.

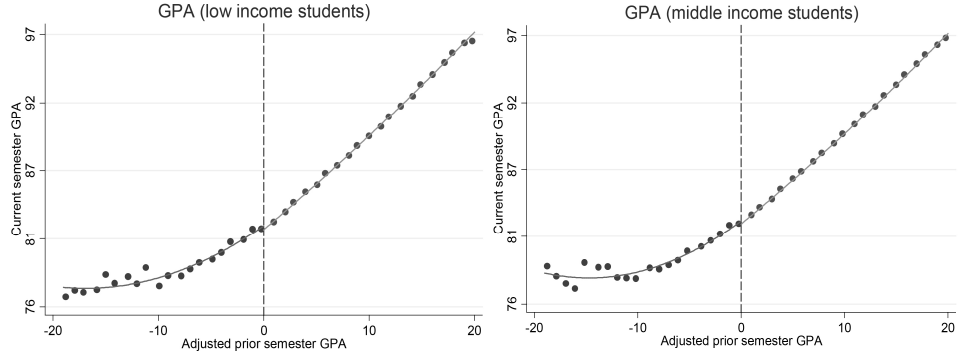

Figure 4. The relationship between prior-semester GPA and current-semester GPA

Effects of type I grant eligibility/receipt on GPA

We now turn to the results of fitting statistical models to the data. The first

research question was whether type I grant eligibility/receipt positively affects the GPA of low-income students. Contrary to the hypothesis based on human capital theory, which predicts that relaxed financial constraints will lead to more time for study and increased achievement, almost all the regression discontinuity estimates show negative effects of grant eligibility/receipt on GPA, although some are statistically significant and others are not.

Table 3 provides the regression discontinuity estimates of the effects of type I grant eligibility/receipt on the GPA of overall low-income students and by income deciles. The first row of Table 3 shows that type I eligible college students achieved a GPA 0.3 lower than that of ineligible students near the cutoff, for which estimates were statistically significant with 150% and 200% bandwidths. When considering the regression discontinuity estimates by income deciles, no estimates are statistically significant and the signs are negative. Finally, we selected those who attended public institutions and belonged to the income decile 0 and checked whether there was any effect of grant eligibility/receipt. Those who were eligible and barely succeeded in receiving a type I grant achieved a 1.5 (150% of optimal bandwidth) to 1.8 (optimal bandwidth) lower GPA than those who were ineligible and barely failed to receive a type I grant. However, eligible students from the income decile 0 attending private institutions near the cutoff did not show statistically significantly different achievement from ineligible students. We checked whether a similar pattern would appear among other students attending public institutions from the other income deciles and found no statistically significant effect of type I grant eligibility/receipt on GPA (results not shown).

Table 3. Regression discontinuity estimates of type I grant eligibility/receipt on GPA, by income deciles

	GPA Bandwidth			
	Optimal(n)	100%	150%	200%
All	3.93	-0.274	-0.311**	-0.282**
	(250,440)	(0.153)	(0.115)	(0.099)
Income decile 0	3.54	-0.436	-0.415	-0.404
	(23,059)	(0.509)	(0.384)	(0.328)
Income decile 1	3.63	-0.189	-0.168	-0.185
	(65,511)	(0.307)	(0.233)	(0.199)
Income decile 2	2.55	-0.465	-0.227	-0.287
	(87,439)	(0.348)	(0.262)	(0.214)
Income decile 3	3.28	-0.382	-0.375	-0.338
	(74,431)	(0.304)	(0.238)	(0.198)
Public, Income decile 0	4.03	-1.849*	-1.546*	-1.216
	(3,991)	(0.922)	(0.746)	(0.670)
Private, Income decile 0	3.84	-0.191	-0.244	-0.220
	(19,068)	(0.550)	(0.402)	(0.344)
Controls		Y	Y	Y

Note. Standard errors are reported in parentheses. Controls include credits earned, gender, age, grade year, major, institutional aid, type-II grant aid, institution type (four-year vs. two- or three-year college), institutional control (private vs. public), and location (Seoul vs. non-Seoul).
***$p < .001$. **$p < .01$. *$p < .05$.

Effects of type II grant eligibility on GPA

Our next research question was whether type II grant eligibility positively affects the GPA of middle-income students. Table 4 presents the regression discontinuity results. The first row of Table 4 shows that the overall effect of type II grant eligibility is negative but not statistically significant. That is, those who are eligible for a type II grant achieved a 0.3 to 0.6 lower GPA than ineligible students near the cutoff, but the estimates are not statistically significant. A further check of the estimates of the subdivided income deciles shows only one statistically significant effect. For those who belong to the seventh income decile, type II grant-eligible students achieved a 1.1 lower GPA than ineligible students (with 200% of the optimal bandwidth). However, the estimates across different bandwidths differ substantially, from 0.1 to 1.1, which makes the effects less reliable. For students from the fourth income decile, type II grant eligibility seems to affect GPA positively, but the estimates are not statistically significant. Overall, type II grant eligibility does not appear to affect middle-income students' academic achievement significantly, as shown in Table 4.

Table 4. Regression discontinuity estimates of type II grant eligibility on GPA by income deciles

	GPA bandwidth			
	Optimal (n)	100%	150%	200%
All	2.970	-0.605	-0.382	-0.346
	(134,486)	(0.454)	(0.288)	(0.246)
Income decile 4	4.27	0.371	0.415	0.173
	(43,870)	(0.520)	(0.402)	(0.350)
Income decile 5	3.69	-1.318	-0.904	-0.667
	(34,607)	(0.681)	(0.511)	(0.440)
Income decile 6	4.22	-0.608	-0.443	-0.483
	(30,738)	(0.609)	(0.488)	(0.426)
Income decile 7	3.33	-0.087	-0.677	-1.066*
	(25,271)	(0.815)	(0.631)	(0.520)
Controls		Y	Y	Y

Note. Standard errors are reported in parentheses. Controls include credits earned, gender, age, grade year, major, institutional aid, institution type (four-year vs. two- or three-year college), institutional control (private vs. public), and location (Seoul vs. non-Seoul).
***$p < .001$. **$p < .01$. *$p < .05$.

Heterogeneous effects by subgroups

We assume that the effects of aid eligibility/receipt vary depending on the level of tuition and the student demographic characteristics. Table 5 presents the regression discontinuity estimates for the sub-samples to answer the third research question.

Table 5. Regression discontinuity estimates of national scholarship eligible students on GPA, by subgroups

	Type-I eligible low-income students' GPA				Type-II eligible middle-income students' GPA			
	Bandwidth				Bandwidth			
	Optimal (n)	100%	150%	200%	Optimal (n)	100%	150%	200%
Female	2.60	-0.317	-0.199	-0.273	3.77	0.379	0.150	0.066
	(144,711)	(0.274)	(0.204)	(0.165)	(75,617)	(0.472)	(0.349)	(0.302)
Male	3.31	-0.449	-0.349	-0.283	3.18	-1.424**	-0.854*	-0.757*
	(105,279)	(0.242)	(0.191)	(0.158)	(58,869)	(0.530)	(0.394)	(0.329)
Sophomore	3.42	-0.336	-0.272	-0.238	3.92	0.119	0.038	-0.170
	(125,668)	(0.218)	(0.169)	(0.144)	(64,446)	(0.455)	(0.338)	(0.291)
Junior	2.96	-0.330	-0.372	-0.414*	4.07	-0.654	-0.648	-0.622
	(76,375)	(0.361)	(0.240)	(0.205)	(41,621)	(0.536)	(0.410)	(0.354)
Senior	4.25	-0.463	-0.424	-0.309	4.2	-1.183	-0.670	-0.504
	(48,397)	(0.342)	(0.268)	(0.234)	(28,419)	(0.730)	(0.601)	(0.537)
Four-year universities	3.11	-0.459*	-0.292	-0.260*	2.79	-1.384**	-0.909**	-0.755**
	(175,984)	(0.214)	(0.157)	(0.132)	(101,612)	(0.495)	(0.340)	(0.286)
Two- or three-year colleges	3.1	-0.488	-0.449	-0.513*	4.57	1.007	0.684	0.312
	(74,456)	(0.331)	(0.242)	(0.204)	(32,874)	(0.610)	(0.482)	(0.415)
Public institutions	4.09	-0.415	-0.417	-0.366	3.93	-0.779	-1.241**	-1.275**
	(48,125)	(0.342)	(0.262)	(0.226)	(25,877)	(0.528)	(0.418)	(0.372)
Private institutions	3.06	-0.468*	-0.291*	-0.305*	2.64	-0.709	-0.363	-0.143
	(202,315)	(0.208)	(0.147)	(0.124)	(108,609)	(0.552)	(0.402)	(0.312)
Humanities and social science major	2.894	-0.923**	-0.429	-0.375	4.062	-1.242	-0.745	-0.763
	(93,988)	(0.346)	(0.233)	(0.198)	(48,883)	(0.954)	(0.703)	(0.592)
Education major	4.128	-1.417*	-1.444**	-1.205**	6.132	-1.852	-2.180	-1.776
	(11,891)	(0.670)	(0.523)	(0.462)	(6,280)	(1.560)	(1.232)	(1.053)
Natural science or engineering major	3.475	-0.232	-0.226	-0.234	3.314	-0.357	-0.286	-0.262
	(97,797)	(0.246)	(0.189)	(0.161)	(55,338)	(0.684)	(0.551)	(0.460)
Medicine or health sciences major	3.876	-0.444	-0.381	-0.247	3.705	2.236	1.895	0.415
	(18,283)	(0.442)	(0.338)	(0.297)	(8,783)	(2.042)	(1.469)	(1.141)
Art, music, or sport major	3.986	0.378	-0.066	-0.191	5.073	-0.084	-0.178	-0.450
	(28,481)	(0.482)	(0.366)	(0.309)	(15,202)	(1.388)	(1.112)	(0.972)
In Seoul area	2.704	-0.280	-0.165	-0.163	3.306	-0.304	-0.391	-0.260
	(80,930)	(0.378)	(0.276)	(0.221)	(46,663)	(0.690)	(0.537)	(0.450)
Outside of Seoul area	3.206	-0.445*	-0.364*	-0.374**	3.564	-0.537	-0.294	-0.455
	(169,510)	(0.201)	(0.154)	(0.129)	(87,823)	(0.747)	(0.569)	(0.479)
Controls		Y	Y	Y		Y	Y	Y

Note. Standard errors are reported in parentheses. Controls include credits earned, gender, grade year, major, institutional aid, type-II grant aid for low income students, institution type (four-year vs. two- or three-year college), institutional control (private vs. public), and location (Seoul vs. non-Seoul).
***p < .001. **p < .01. *p <.05.

First, type I grant-eligible students are likely to have lower achievement than ineligible students who barely failed to receive a type I grant. Statistically significant estimates appear for student groups in four-year universities, private institutions, humanities and social science majors, education majors, and non-Seoul-area higher

education institutions when we consider only the optimal bandwidth. For juniors and two- or three-year colleges, the regression discontinuity estimates are statistically significant only with 200% of the bandwidth. More specifically, type I eligible students attending four-year universities achieve a 0.5 lower GPA than ineligible students near the cutoff. Type I eligible students attending private institutions achieve a 0.3 to 0.5 lower GPA than ineligible students near the cutoff. Type I eligible students majoring in humanities and social science achieve a 0.9 lower GPA than ineligible students near the cutoff. The largest estimates are found with education majors. Type I eligible students majoring in education achieve a 1.2 to 1.4 lower GPA than ineligible students near the cutoff. Finally, type I eligible students who attend non-Seoul-area higher education institutions achieve a 0.4 lower GPA than ineligible students near the cutoff.

Second, subgroup analyses of the effect of type II grant eligibility on GPA reveal that the effects are negative in most student subgroups, but there are a few cases that show positive effects, although no estimates are statistically significant. Among the statistically significant effects, type II eligible male students achieve a 0.8 to 1.4 lower GPA than ineligible students near the cutoff. Type II eligible students attending four-year universities achieve a 0.8 to 1.4 lower GPA than ineligible students near the cutoff. Type II eligible students attending public institutions achieve a 1.2 to 1.3 lower GPA than ineligible students near the cutoff, with 150% and 200% of the bandwidth, respectively. All the other estimates are statistically insignificant, which means that type II grant eligibility does not affect students' GPA, either positively or negatively.

The type I grant, targeting low-income students, and the type II grant, targeting a wider range of income groups, seem to have different effects on GPA by subgroups. As expected, the type I grant for low-income students appears to have a statistically significant impact on GPA in various subgroups, whereas the type II grant has some estimates of a positive sign, but none is statistically significant. Both type I grant eligibility/receipt and type II grant eligibility seem to affect the GPA of students attending four-year universities. The effects of institutional control (public or private) between the type I and type II grants are not consistent.

The regression discontinuity estimates presented in Tables 3, 4, and 5 are fairly consistent across the differing bandwidths with which their robustness is tested. It is again worth emphasizing that all these estimates apply to those who are near the cutoff score and do not provide the average treatment effects of the program.

Discussion

This paper explored the effect on academic achievement, measured by GPA, of eligibility for Korea's recently introduced National Scholarship program, using data collected by the KOSAF. Given the conceptual framework that hypothesizes that

low- and middle-income students may increase their study efforts when provided with financial aid, which would likely result in higher achievement, we conducted a regression discontinuity analysis to find the causal effect of aid eligibility (aid receipt, in the case of the type I grant).

The findings demonstrate that the regression discontinuity estimates present unexpected results from the perspective of human capital theory: type I eligible students who barely passed the cutoff score achieved a lower GPA than ineligible counterparts. In other words, ineligible students who barely failed to receiving a type I grant because of unmet academic criteria seem to have made greater efforts to meet the academic requirements and achieved a higher GPA than their eligible counterparts. The effect of type II grant eligibility was not distinct, however. We propose two reasons for this: the amount of the type II grant is much smaller than that of the type I grant, and type II grant eligibility does not coincide with receipt.

The effect of type I grant eligibility/receipt on GPA was notable for students from the lowest income decile attending public institutions. The type I grant amount for the income decile 0 could fully cover the average tuition of public institutions. Therefore, those who barely failed to receive a type I grant may have had a very strong incentive to increase their GPA for a future scholarship.

It is important to note that the average current-semester GPA of applicants with a prior-semester GPA score at the cutoff and one point below the cutoff score was about 82, as presented in the first rows of Tables 1 and 2. That is, both eligible and ineligible students near the cutoff achieved a higher GPA in the current semester than in the previous semester. From this, we can infer that eligible students who barely met the academic requirement kept their effort at a reasonably safe level, whereas ineligible students who barely failed to receive a National Scholarship exerted more effort to increase their GPA to meet the academic criteria. Although college GPA is determined by various factors, the academic requirement for a National Scholarship may have served as a major motivation. Nevertheless, it is not certain that academic requirements for grant eligibility increased ineligible students' genuine academic efforts. Cornwell et al. (2005) showed that students responded to the retention rules of the Georgia HOPE program by decreasing full-load enrollments, increasing course withdrawals, and adding summer school credits. For example, low-income students who were ineligible because their GPA was slightly lower than 80 in the previous semester may have chosen easy courses, which offer relatively higher grades, to increase their current-semester GPA.

From the subgroup analyses of the type I grant for low-income students, eligible students attending a four-year university achieved a lower GPA than their ineligible counterparts. Although the ratio of aid to tuition is lower on average at four-year universities, more years of schooling and higher total costs of college education may make students more responsive to grant opportunities. Eligible students majoring in the humanities and social sciences or education achieved a lower GPA than ineligible students. The tuition of these two majors is lowest and the ratio of aid to tuition is highest. GPA scores of students in these two majors tend to be higher, on average,

than those of other majors. Consequently, it seems that students in these two majors are more responsive to grant receipt. Type I grant-eligible students attending non-Seoul-area universities achieved a lower GPA than ineligible students. The ratio of aid to tuition at those institutions is also higher, which seems to affect GPA to a greater extent.

Among the findings of subgroup analyses, public versus private institutions show contradictory results between type I and type II grants. Type I grant-eligible students attending private institutions achieved a lower GPA score than ineligible students, whereas type II grant-eligible students from public institutions achieved a lower GPA score (with 150% and 200% of the bandwidth, respectively). The latter confirms a high level of price sensitivity for students attending public institutions. Because of the different costs between public and private higher education institutions (as presented in Figure 1), students who choose to attend a public institution are likely to be more responsive to price discounts. This unexpected effect of type I grant eligibility/receipt on students attending private institutions needs more in-depth investigation.

Our results are fairly consistent with the empirical findings of J. Lee and Park (2012), and Yi and Kwak (2013). Although this study could not directly observe the time allocation of students, the National Scholarship program may have eased the financial burdens of low- and middle-income students and helped them decrease work hours, as found by Yi and Kwak (2013). However, this paper did not find that lessened financial constraints translated to increased academic achievement. Rather, ineligible students who barely failed to receive a type I grant achieved a higher GPA than eligible students near the cutoff. Hence, this paper suggests that those who just fail to receive a type I grant seem to have a stronger incentive to achieve a higher GPA than those who just meet the eligibility criteria. This evidence is in line with the finding of S. Dynarski and Scott-Clayton (2013), that "for students who have already decided to enroll, grants that link financial aid to academic achievement appear to boost college outcomes more than do grants with no strings attached" (p. 1). When the amount of aid is not large (as with the type II grant), however, the effect of aid eligibility is hard to discern. In addition, it is more likely that aid receipt or aid eligibility has an effect on GPA when the ratio of aid to tuition is high.

Implications

Our results have a specific implication for a policy debate surrounding the academic requirements of the National Scholarship for low-income students. These requirements seem to work in such a way that ineligible students near the cutoff improve their GPA. Grant opportunities should motivate low-income students near the cutoff to increase their efforts to meet the academic requirements, whether this effort is genuine or instrumental. It is beyond the scope of this study to disentangle

the chain of psychological or behavioral change patterns of students with scholarship availability, but the academic requirements for the scholarship seem to affect ineligible low-income students near the cutoff so that they improve their academic performance. In this respect, abolishment of the academic requirements should be considered with caution when designing the program. Without minimum academic requirements, low-income students near the cutoff will not necessarily maintain their efforts to meet the cutoff score. Second, a small amount of aid seems to be less effective in promoting academic performance. Middle-income students who are eligible for type II grants are only affected if they are male or attending public institutions. Two possible reasons for this include the small amount of aid and uncertainty of receipt. For grants to have an impact on students' GPA, the amount should be sufficiently large to lessen the financial burden, and aid should be awarded in a more transparent and predictable manner.

There are some limitations to this study. First, the regression discontinuity analysis provides local estimates near the cutoff and does not provide the overall average treatment effects. Thus, the findings should not be generalized to the entire student population considered for the study. Second is a data limitation; students whose GPA was below the academic criteria may not have applied for the scholarship in the first place. As the dataset used for this study only includes applicants, there may be a bias in this respect. Third, the observation period of this study was only two semesters, which is too short for us to find a substantive impact of the aid program.

The National Scholarship program is in an early stage of implementation, and future studies should examine the long-term impacts of the program. For instance, future studies may consider the effects of the program on the enrollment of low-income students, college choice, and longer-term success, such as college completion and labor market outcomes.

1) In this paper, we examine the effect of grant "eligibility" on college GPA. Type I grant eligibility coincides with grant receipt, whereas type II grant eligibility does not. Award decisions of type II grant aid for low- and middle-income students are made by higher education institutions.
2) Seventy two percent of four-year college students achieved a grade of B or higher in the 2012 academic year (Information Service of Higher Education in Korea, 2013).
3) This restriction resulted in a larger proportion of female students 58%, as shown in Table 1. Korean male students have obligatory military enlistment, with them usually stopping out during their college years.
4) In 2013, the income eligibility of the type I and II grants was expanded to the eighth income decile, and the academic eligibility criterion for freshmen was removed.
5) The only exception allowed was for handicapped college students, who had to attain C (or 2.0, which is converted to a percentile score of 70). For the analysis in this paper, we excluded those who scored less than 80 and received a type I grant, assuming that they are handicapped. Academic requirements for type II grants made it possible for those who scored below 80 and above 70 in the previous semester to receive a National Scholarship.
6) The regression and test results are not shown because of space limitations, but are available upon request.

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References

Becker, G. S. (1993). *Human Capital: A theoretical and empirical analysis with special reference to education* (3rd ed.). Chicago, IL: The University of Chicago Press.

Ben-Porath, Y. (1967). The production of human capital and the life cycle of earnings. *The Journal of Political Economy*, *75*(4), 352–365.

Betts, J., & Morell, D. (1999). The determinants of undergraduate grade point average: The relative importance of family background, high school resources, and peer group effects. *Journal of Human Resources*, *34*(2), 268–293.

Cabrera, A., Nora, A., & Castaneda, M. (1992). The role of finances in the persistence process: A structural model. *Research in Higher Education*, *33*(5), 571–593.

Cabrera, A., Stampen, J., & Hansen, W. (1990). Exploring the effects of ability to pay on persistence in college. *Review of Higher Education*, *13*(3), 303–336.

Castleman, B. L., & Long, B. T. (2013). *Looking beyond enrollment: The causal effect of need-based grants on college access, persistence, and graduation* (Working, Paper No. 19306). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w19306

Cheng, D. X., & Alcántara, L. (2007). Assessing working students' college experiences: A grounded theory approach. *Assessment & Evaluation in Higher Education*, *32*(3), 301–311.

Cornwell, C. M., Lee, K. H., & Mustard, D. B. (2005). Student responses to merit scholarship retention rules. *The Journal of Human Resources*, *40*(4), 895–917.

Deming, D., & Dynarski, S. (2010). College aid. In P. B. Levine & D. J. Zimmerman (Eds.), *Targeting investments in children: Fighting poverty when resources are limited* (pp. 283–302). Retrieved from http://www.nber.org/chapters/c11730.pdf

DesJardins, S. L., & McCall, B. P. (2014). The impact of the Gates Millennium Scholars Program on college and post-college related choices of high ability, low-income minority students. *Economics of Education Review*, *38*, 124–138.

DesJardins, S. L., McCall, B. P., Ott, M., & Kim, J. (2010). A quasi-experimental investigation of how the Gates Millennium Scholars Program is related to college students' time use and activities. *Educational Evaluation and Policy Analysis*, *32*(4), 456–475.

Dolton, P., Marcenaro, O. D., & Navarro, L. (2003). The effective use of student time: A stochastic frontier production function case study. *Economics of Education Review*, *22*(6), 547−560.

Dynarski, S. (2000). *Hope for whom? Financial aid for the middle class and its impact on college attendance* (Working Paper No. 7756). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w7756

Dynarski, S. (2008). Building the stock of college-educated labor. *Journal of Human Resources*, *43*(3), 576−610.

Dynarski, S. M. (2003). Does aid matter? Measuring the effect of student aid on college attendance and completion. *The American Economic Review, 93*(1), 279−288.

Dynarski, S., & Scott-Clayton, J. (2013). *Financial aid policy: Lesson from Research* (Working Paper No. 18710). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w18710

Goodman, J. (2008). Who merits financial aid?: Massachusetts' Adams Scholarship. *Journal of Public Economics*, *92*(10-11), 2121−2131.

Hahn, J., Todd, P., & Van der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression discontinuity design. *Econometrica*, *69*(1), 201−209.

Imbens, G., & Kalyanaraman, K. (2011). Optimal bandwidth choice for the regression discontinuity estimator. *The Review of Economic Studies*, *79*(3), 933−959.

Imbens, G. W., & Lemieux, T. (2008). Regression discontinuity designs: A guide to practice. *Journal of Econometrics*, *142*(2), 615−635.

Information Service of Higher Education in Korea. (2012). *Main indicators of Korean higher education*. Retrieved from http://www.academyinfo.go.kr/

Information Service of Higher Education in Korea. (2013). *Main indicators of Korean higher education*. Retrieved from http://www.academyinfo.go.kr/

Kane, T. (2003). *A quasi-experimental estimate of the impact of financial aid on college-going* (Working Paper No. 9703). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w9703

Kane, T. (2007). Evaluating the impact of the DC tuition assistance grant program. *Journal of Human Resources*, *42*(3), 555−582.

Kim, J.-H., & Rhee, B.-S. (2009). Examining the differential impacts of financial aid on college GPA by income level. *The Journal of Education Administration*, *27*(3), 447−470. (In Korean)

Korea Student Aid Foundation. (2012). *KOSAF Annual report*. Seoul: Author. (In Korean)

Korean Educational Development Institute. (2012). *Brief statistics on Korean education*. Seoul: Author. (In Korean)

Korean Ministry of Education. (2011). *Plan for the National Scholarship Program 2012*. Seoul: Author. (In Korean)

Lee, D. S. (2008). Randomized experiments from non-random selection in U.S. House elections. *Journal of Econometrics*, *142*(2), 675−697.

Lee, J., & Park, H.-J. (2012). An intent-to-treat analysis of the effects of income contingent loan on low- or middle-income college students' working and academic activities. *The Journal of Education Administration*, *30*(1), 105−134. (In Korean)

Lundberg, C. A. (2004). Working and learning: The role of involvement for employed students. *NASPA Journal*, *41*(2), 201−215.

Marcucci, P. N., & Johnstone, D. B. (2007). Tuition fee policies in a comparative perspective: Theoretical and political rationales. *Journal of Higher Education Policy and Management*, *29*(1), 25−40.

McCrary, J. (2008). Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics*, *142*(2), 698−714.

Miller, K., Danner, F., & Staten, R. (2008). Relationship of work hours with selected health behaviors and academic progress among a college student cohort. *Journal of American College Health*, *56*(6), 675−679.

Nichols, A. (2007). Causal inference with observational data. *Stata Journal, 7*(4), 507−541. Retrieved from http://www.stata-journal.com/article.html?article=st0136

OECD. (2013). *Education at a glance 2013, OECD Indicators*. Retrieved from http://dx.doi.org/10.1787/eag-2013-en

Pascarella, E., Edison, M., Nora, A., Hagedorn, L., & Terenzini, P. (1998). Does work inhibit cognitive development during college? *Educational Evaluation and Policy Analysis*, *20*(2), 75−93.

Scott-Clayton, J. (2011). On money and motivation: A quasi-experimental analysis of financial incentives for college achievement. *Journal of Human Resources*, *46*(3), 614−646.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Regression discontinuity designs. In W. R. Shadish, T. D. Cook, & D. T. Campbell (Eds.), Experimental and quasi-experimental designs for generalized causal inference (pp. 207−245). Belmont, CA: Wadsworth Cengage Learning.

Shin, J. C., & Harman, G. (2009). New challenges for higher education: Global and Asia-Pacific perspectives. *Asia Pacific Education Review*, *10*(1), 1−13.

Stater, M. (2009). The impact of financial aid on college GPA at three flagship public institutions. *American Educational Research Journal*, *46*(3), 782−815.

Svanum, S., & Bigatti, S. M. (2009). Academic course engagement during one semester forecasts college success: Engaged students are more likely to earn a degree, do it faster, and do it better. *Journal of College Student Development*, *50*(1), 120−132.

Thistlethwaite, D. L., & Campbell, D. T. (1960). Regression-discontinuity analysis: An alternative to the ex post facto experiment. *Journal of Educational Psychology*, *51*(6), 309.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, *45*(1), 89−125.

Trow, M. (2007). Reflections on the transition from elite to mass to us universal access: Forms and phases of higher eucation in modern societies since WWII. In J. Forest & P. Altbach (Eds.), *International handbook of higher education* (pp. 243−280). Dordrecht, The Netherlands: Springer.

Van der Klaauw, W. (2002). Estimating the effect of financial aid pffers on college enrollment: A regression−discontinuity approach. *International Economic Review*, *43*(4), 1249−1287.

Yi, P., & Kwak, J. (2013). A quasi-experimental analysis of the impacts of national scholarship program on college students' work and academic activities. *The Journal of Economics and Finance of Education*, *22*(4), 213−242. (In Korean)