More Money, More Opportunities: The Impact of a No-Loan Program on the Post-Baccalaureate Enrollment Decisions of Low-Income and First-Generation Students

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Abstract

To counter the rising costs of higher education, institutions have increasingly turned to no-loan programs to provide financial assistance to their low-income and first-generation students. However, little is known of the influence of these no-loan programs on post-enrollment outcomes. This study examines the impact of no-loan program participation on post-baccalaureate enrolment decisions using a regression discontinuity approach. Results from this study indicate a positive and statistically significant effect of no-loan program participation on graduate school enrollment for historically underrepresented and disadvantaged students.

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Introduction

First-generation and low-income students remain underrepresented within selective colleges and universities due largely to their lack of financial resources (Tierney & Venegas, 2009; Pallais & Turner, 2006; Nora, Barlow, & Crisp, 2006). These historically underrepresented students are concentrated primarily within community colleges and public regional institutions rather than the public flagships and more-selective private institutions that continue to enroll a disproportionate number of socioeconomically privileged students (Bastedo & Jaquette, 2011). Numerous researchers have found that a student's finances and ability to pay for college are significant barriers to enrolling at a college or university (Heller, 1997; St. John, Tuttle, & Musoba, 2006; Dynarski, 2008). Given these financial barriers to higher education, low-income students, many of whom are also first-generation students, often make enrollment decisions based on their ability to pay tuition and fees rather than their academic merit. One way for colleges and universities to reduce the financial barriers facing many first-generation and low-income students is to establish a no-loan program to cover unmet financial needs through direct institutional grants or tuition discounts (Hillman, 2012).

Various scholars have examined the impact of no-loan programs, finding that such programs have significantly increased undergraduate enrollment among low-income students at selective institutions (Avery et al., 2006; Fiske, 2010; Pallais & Turner, 2006; Waddell & Singell, 2011; Hillman, 2012). However, fewer researchers have examined the post-enrollment effects of no-loan programs, and no study has explored the effect of no-loan program participation on students' likelihood to enroll in graduate school. Graduate education has been shown to be positively associated with students' labor market outcomes and overall quality of life (Baum, Ma, & Payea, 2010). Many of the highest-paying professions are restricted to

individuals who have earned a graduate degree, but the social and financial advantages of graduate education appear to be distributed unequally, with low-income students being less likely than their peers to enroll in graduate school and eventually complete their graduate degree (Morelon-Quainoo et al., 2009).

Building on the work of Malcom and Dowd (2012) and Zhang (2013), who articulated the role of student debt on graduate school enrollment, this study analyzes the effects of no-loan program participation on students' post-baccalaureate enrollment decisions. Capitalizing on the strict income threshold, we use a student-level administrative data set from the University of Florida and matched data from the National Student Clearinghouse to estimate the effect of participation in the Machen Florida Opportunity Scholars Program (MFOSP), a no-loan program. Specifically, this study is guided by the following research questions:

Research Question 1: Does participation in MFOSP affect the post-baccalaureate enrollment decisions of low-income and first-generation college students?

Research Question 2: Does a reduction in student loans increase the likelihood of students' pursuing graduate or professional degrees?

Research Question 3: Do the effects of no-loan program participation vary according to demographic or academic characteristics?

Results from this study indicate that participation in MFOSP is positively related to graduate school enrollment. More specifically, we find that increases in the likelihood of enrolling in graduate school are concentrated primarily within underrepresented minorities who participated in MFOSP. Our results also indicate a divergent effect of MFOSP participation among STEM and non-STEM bachelor's degree recipients. Non-STEM graduates who participated in MFOSP were shown to be more likely to enroll in graduate school, while MFOSP

participation did not appear to make a statistically significant difference in the likelihood of graduate enrollment among STEM graduate when compared to similar STEM graduates who did not participate in MFOSP.

The Machen Florida Opportunity Scholars Program

In 2006, the University of Florida started MFOSP as a way of facilitating low-income students' access to and matriculation toward a college degree. Unlike most no-loan programs, MFOSP provides students with not only significant financial support but also access to academic counseling, cohort social engagement opportunities, and a community of student affairs practitioners who help participating students meet both academic and social challenges. Each year, the program is limited to approximately 300 incoming low-income (parental income of less than $40,000 annually), first-generation, and in-state students. Unfortunately, MFOSP has limited funding and cannot afford to serve all students who qualify to participate in the no-loan program. In addition to providing scholarship support, the program provides additional support in the form of peer mentors, financial literacy workshops, career planning, and one-on-one academic coaching. This study will compare and analyze the graduate enrollment indicators of students selected for MFOSP relative to students who have similar demographic and educational characteristics but did not participate in MFOSP.

Literature Review

The primary aim of this section is to review literature related to the influence of financial aid on student outcomes, previous research on no-loan programs, and the factors associated with graduate school enrollment. Several of these studies focus specifically on first-generation and low-income student populations within higher education. Accordingly, we draw on these distinct literature bases to motivate this study.

The Effect of Financial Aid on Postsecondary Students

Numerous studies have examined the role of financial aid—both need- and merit-based—on student enrollment, matriculation, and success. Deming and Dynarski (2009) found that need-based grant eligibility has a positive effect on whether students enroll in college, with the estimated probability of enrollment increasing by 3% to 4% for each additional $1,000 in grant aid eligibility. Additionally, Bettinger (2004) studied the persistence of Pell grant students and found that the availability of Pell grants strongly reduced student attrition. Additional scholars have suggested that the availability of need-based financial aid programs positively influences degree attainment (Tierney & Venegas, 2009; Heller, 2002; McPherson & Morton, 1997). Despite the well-established literature base on the role of need-based aid, surprisingly little research has explored the effect of need-based grants on post-enrollment outcomes, such as graduate enrollment decisions, even though need-based aid accounts for the vast majority of all grant aid awarded by the state and federal governments (Baum, 2016).

Since the adoption of the first statewide merit-based scholarship program—Georgia's HOPE Scholarship—in 1993, merit-based financial aid policies have been viewed as another mechanism for delivering financial aid to postsecondary students. Previous scholars have shown that merit-based aid programs typically achieve their stated goals of increasing in-state student enrollment (Dynarksi, 2002; Cornwell, Mustard, & Sridhar, 2006) and preventing talented students from pursuing higher education elsewhere (Zhang & Ness, 2010). In addition, several studies have examined the post-enrollment effects of merit-based scholarships on postsecondary students (Bruce & Carruthers, 2011; Dynarski, 2008; Scott-Clayton, 2011). This shift toward merit-based financial aid may limit the amount of postsecondary available to low-income

students, causing the postsecondary students with the greatest financial need to turn to loans to finance their postsecondary education.

Prior Research on No-Loan Programs

Although little is known about the influence of need-based grants on graduate school enrollment, the literature on the influence of no-loan programs on graduate school enrollment is even less robust. Regarding the impact of no-loan programs on undergraduate enrollment, Pallais and Turner (2006) found that the University of Virginia experienced an increase in the enrollment of low-income students in the first year of the implementation of its no-loan program. The authors also concluded that no-loan programs would have differential effects depending on the state in which they were located. The no-loan program at Harvard University, the Harvard Financial Aid Initiative, also appeared to lead to an increase in the proportion of low-income students among first-year undergraduate students in the fall of 2006 (Avery et al., 2006). Additionally, Linsenmeier, Rosen, and Rouse (2006) analyzed an anonymous institution's decision to eliminate loans for all students and reported that no-loan programs did not significantly increase enrollment among all types of low-income students but did positively and significantly affect the matriculation rate of low-income minority students.

Waddell and Singell (2011) examined low-income student enrollments before and after the introduction of no-loan policies within a national sample of public four-year universities. The authors found a positive effect on the number of low-income students after the adoption of a no-loan program. Waddell and Singell also reported that low-income students who participated in the no-loan program were more academically prepared and faced a lower risk of attrition when compared to their low-income peers who were not enrolled in a no-loan program. However, Hillman (2012) cautioned that the adoption of no-loan programs could further stratify

opportunities for low-income students within higher education by "skimming" the highest-achieving low-income students rather than adopting a broad strategy of support for all qualified low-income students. Although a number of researchers have examined the undergraduate enrollment effects of no-loan program adoption, this study represents the first attempt to examine the long-term influence of no-loan programs by examining the impact of no-loan program participation on the likelihood of enrolling in graduate school.

Factors Related to Graduate School Enrollment

Despite the well-established benefits of graduate education (Baum et al., 2010; Hearn & Holdsworth, 2004), historically underrepresented student populations are not as likely to enroll in graduate school (Perna, 2004). Low-income students, in particular, are less likely than their more affluent peers to enroll in graduate school (Morelon-Quainoo et al., 2009). Previous researchers have noted that additional factors may affect students' likelihood of enrolling in graduate school. Zhang (2005) found that attending a high-quality undergraduate institution increases the likelihood of attending graduate school—a predictable trend given that a larger share of advantaged and affluent students enroll in these high-quality institutions (Cabrera & La Nasa, 2001; Zhang, 2003). Academic disciplines (Bedard & Herman, 2008; Sax 2001), gender (Sax, 2001; Perna, 2004; Pascarella et al., 2004), and race (Perna, 2004; Pascarella et al., 2004) are also significant predictors of graduate school enrollment. Johnson (2013) found that graduate school enrollment is influenced by a host of external factors, such as local, state, and national economic indicators.

Although scholars have documented numerous factors affecting graduate school enrollment, much of the academic literature has focused on the role of undergraduate debt on graduate school enrollment. Fox (1992) found that undergraduate debt led to women becoming

slightly less likely to enroll in graduate and professional school, but the author also noted that undergraduate debt appears to lead to a shift in enrollment toward doctoral programs rather than other post-baccalaureate degree programs. Weiler (1994) extended earlier work and reported that the level of undergraduate student was not a significant factor in the decision to enroll in graduate school.

Millett (2003) quantified the relationship between undergraduate debate and graduate school enrollment, finding that students with student loan debt of $5,000 or higher are significantly less likely to apply to graduate or professional school relative to their peers who did not have educational debt. Zhang (2013) found that the negative relationship between undergraduate debt and graduate school enrollment were primarily concentrated within doctoral (Ph.D.), MBA, and first professional programs. Malcom and Dowd (2012) reported that borrowing at typical debt levels negatively affected graduate school enrollment for students of every racial/ethnic group included in their study. Although several studies appear to suggest a negative relationship between student loan debt and graduate school enrollment, the student population most negatively affected by student loan debt—low-income and first-generation students—has yet to be fully examined.

Conceptual Framework

To provide the rationale for this study, we are guided by the economic theory of human capital and the random utility model of student choice to explain the rationale for the analysis. In relation to higher education, the theory of investment in human capital (Mincer, 1958) suggests that students make decisions about continuing their education based on the costs and benefits associated with enrollment. For example, the decision to enroll in graduate school is subject to a variety of considerations, such as the direct costs of tuition and fees and the opportunity costs of

foregone earnings, before determining whether graduate education is a worthwhile investment. The prospective graduate student weighs the costs and expected benefits of graduate education and only enrolls in graduate school if the costs of graduate enrollment are outweighed by the expected benefits (DesJardins & Toutkoushian, 2005; Paulsen & Toutkoushian, 2008).

As noted by DesJardins and Toutkoushian (2005), the relative uncertainty of future benefits associated with graduate education coupled with an individual's willingness to accept risk can complicate the decision to enroll in graduate school. The random utility model of student choice can be used to explain an individual's decision despite under these types of uncertainty. This model has been used in earlier work to study student choice (DesJardins, Ahlburg, & McCall, 2006), as students will attempt to maximize their net utility when making their decision to choose among schooling and non-schooling alternatives (DesJardins & Toutkoushian, 2005).

Following the logic outlined by previous applications of the random utility model of student choice (DesJardins & Toutkoushian, 2005; Muñoz, Harrington, Curs, & Ehlert, 2016), we define the utility individuals receive based on their decision to attend graduate school as follows:

$$U_{ig} = U\left(F_g, F_i, N_i\right)$$

where U is the utility that individual i obtains from choosing to enroll in graduate school g. The inputs to the utility function are defined as follows: F represents the financial factors related to attending graduate school g (e.g., tuition and fees); F also represents financial factors associated with individual i (e.g., no-loan program eligibility); and N represents non-financial individual characteristics associated with the utility of the decision to enroll in graduate school (e.g., academic ability; undergraduate major).

Although an individual's utility is unobservable, we can deduce that utility is maximized based upon the student's decision. In other words, when a student chooses graduate school (g) over the non-graduate school alternatives (h), we can deduce that g provided the student with greater net benefits (utility) relative to the non-graduate school option of entering the labor market with sub-graduate level credentials. In line with DesJardins and Toutkoushian (2005) and Muñoz et al. (2016), we model utility maximization as $U_{ig} > U_{ih}$.

To examine whether participation in a no-loan program impacts the decision to enroll in graduate school, we apply the economic theory of human capital and the random utility model of student choice. As noted earlier, the student's decision is based upon whether the direct and opportunity costs of graduate enrollment are outweighed by the benefits associated with graduate education. Because prior work has shown that low-income students are debt-averse (Burdman, 2005), we hypothesize that students who participate in MFOSP (a no-loan program) are more likely to enroll in graduate school because their similar peers will be reluctant to take out student loan debt to pursue graduate studies. In addition, this debt aversion established in previous literature is compounded by informational asymmetries that lead many low-income and first-generation students to determine that the cost of graduate school is too high despite the well-established benefits of graduate education.

5.   Data and Research Design

To answer our research questions, we used student-level administrative data from the University of Florida and graduate school enrollment data from the National Student Clearinghouse's Student Tracker database. Specifically, we gained access to the administrative database for five cohorts of incoming first-year students (fall 2005 to fall 2009) and tracked their

bachelor's degree completion and post-baccalaureate enrollment decisions through fall 2016.[1]

Considering the nature of the no-loan program studied within this paper, we limited our sample

to first-generation college students.[2] Our total analytical sample included 8,570 students evenly

distributed across our analytical time period. In addition to offering access to bachelor's degree

completion and graduate school enrollment data, our analytical dataset includes (1) pre-college

academic characteristics, (2) family's educational and financial information, (3) student

demographic information, (4) postsecondary financial indicators (total loans, on-campus work

earnings, cumulative Pell Grant awards), and (5) postsecondary academic and enrollment

outcomes (credits earned, degree major, degree GPA, and enrollment patterns).

Variables

Independent/Forcing Variable

Despite the complexities associated with qualifying for MFOSP, first-generation status

and parental income levels are the primary requirements. Considering that we have restricted our

sample to first-generation college students, the independent/forcing variable for our regression

discontinuity design is parental income. Notwithstanding the widely distributed and known

income threshold of $40,000, prior research has demonstrated that students have a difficult time

manipulating parental income systematically (Rubin, 2011). Because students must have been

admitted to the university before being considered for the no-loan program, we find it unlikely

that students, or their parents, would purposely earn less than $40,000 to qualify for the program

without any guarantee of admission to the University of Florida.

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[1] We limited our analytical sample to fall 2009 enrollees to ensure enough time for students to graduate with a bachelor's degree and make a decision about graduate school enrollment.

[2] Based on the university's definition of "first-generation" and the requirements for participation within the no-loan program, first-generation status is given to students whose parents did not enter or complete any postsecondary education. Students whose siblings have completed or enrolled in college can be considered first-generation students.

Dependent Variables

To test the effect of no-loan program participation on post-baccalaureate enrollment outcomes, we use a variety of expected and actual graduate school enrollment indicators. First, we examine students' level of desire to enroll in graduate school while they are undergraduate students. Using administratively linked data from the Student Experience in the Research University (SERU) survey, we analyze the likelihood of students indicating that they expect to enroll in graduate school in either their third- or their fourth-year survey response. Second, we use graduate school enrollment data from the National Student Clearinghouse (NSC) to examine post-baccalaureate enrollment behaviors. NSC data allow us to analyze each program type (master's, doctoral, professional degree) at the student level. We are able to capture and code students who have enrolled in multiple graduate programs during the time period of our analytical sample. For example, a student who pursued a master's degree directly after graduation and a law degree three years later would be coded as having enrolled in both a master's degree program and a professional degree program. Because we wanted to capture student graduate program decision making, students enrolling in a Ph.D. program were not coded as having also enrolled in a master's degree, even though many Ph.D. program enrollees earn a master's degree as part of their Ph.D. studies.

Covariates

One of the primary assumptions surrounding our analytical strategy is that students on either side of the income threshold are "normally" distributed across factors that not only affect assignment to the treatment but also may affect dependent variables independently. To this end, we include a variety of the pre-college characteristics that are associated with enrollment and success in undergraduate education but may also directly affect the likelihood of graduate school

enrollment: (1) high school GPA, (2) SAT/ACT composite scores, (3) number of AP/IB courses completed, (4) parental income and financial asset information,[3] and (5) student race/ethnicity and gender.

Analytical Strategy

To estimate the causal effects of no-loan program participation on graduate school enrollment, we exploit the established and strict income cutoff required to qualify for no-loan program participation and apply a regression discontinuity research design to estimate the effects of falling just below (or above) the cutoff. We capitalize on the randomness of a student's position with respect to parental income and the differential effect of access to the no-loan program to identify the causal effects of participation in the no-loan program. Our analytical approach relies on a fuzzy regression discontinuity (FRD) design (Imbens & Lemeuix, 2008).

We operationalize our regression discontinuity design by using instrumental variables within a two-stage least squares estimation strategy. In our two-stage approach, we rely on the indicator of a student's position just below the income threshold as an instrumental variable for access to the no-loan program. In the first stage, we model the probability that a student has access to the no-loan program as a function of the cutoff on the income continuum and that student's position just below that cutoff using the following model:

$$\Pr(NL_{ic}) = \pi_0 + \pi_1 BELOW_{ic} + \pi_2 f(RV)_{ic} + \pi_3 BELOW \times RV_{ic} + X'_{ic}\beta + \gamma_i + \varepsilon_{ic} \quad (1)$$

In this model, $\Pr(NL_{ic})$ is the probability of accessing the no-loan program for student *i* in school *s* in entrance cohort *c*, RV_{ic} is our running or forcing variable—parental income—used to signal eligibility for the program, $BELOW_{ic}$ is a binary indicator of falling below the threshold, $BELOW \times RV_{ic}$ is an interaction term that allows the relationship between the forcing variable

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[3] Because we limited our sample to only first-generation college students, we did not include parental education level.

and outcome to differ for treated and nontreated students, $\boldsymbol{X}'_{ic}$ is a vector of student-level covariates to improve statistical precision (as shown in the appendix, the core results are not affected when including or excluding covariates, although including them improves statistical precision), γ_c is a set of application cohort fixed effects, and ε_{ic} is the error.

We then use the fitted probabilities that a student will access the no-loan program as the first stage in estimating the effect of participation in the no-loan program on our graduate enrollment outcomes (already discussed) by using the following specification:

$$Y_{ic} = \theta_0 + \theta_1 \widehat{\Pr(NL_{ic})} + \theta_2 f(RV)_{ic} + \theta_3 BELOW \times RV_{ic} + \boldsymbol{X}'_{ic}\boldsymbol{\beta} + \gamma_c + \varepsilon_{ic} \qquad (2)$$

In this specification, all terms are defined as they were previously, with only the fitted values from the first stage as a new term. The key parameter of interest is θ_1, which represents the local average treatment on graduate enrollment outcomes, relative to those of students just above the participation income threshold.

Testing Required Model Assumptions

Ensuring that the appropriate conditions are met to support the use of the regression discontinuity design is a necessary precursor for this analysis. Pursuant to established methodological literature (Imbens & Lemeuix, 2008; Schochet et al., 2010), a valid regression discontinuity (RD) design must demonstrate a smooth and continuous distribution of the forcing variable and balance of observable characteristics among units of analysis that fall just below or above the plausibly exogenous cutoff used to define the treatment. Our data satisfy both of these criteria across each of the thresholds that we evaluated. Figure 1 presents the distributions of observations along our forcing variable. We fail to find any visual evidence of manipulation at the $40,000 income cutoff. Additionally, we conduct an informal McCrary test of

manipulation—using the STATA command rddensity—and find no statistical evidence on differences in observations around the cutoff.

--- Figure 1 Here ---

In Figure 2, we present the distribution of the running variable on key pre-college factors. As we display later in this paper, there does not appear to be any visual evidence of discontinuities in any of our key pre-college characteristics. Table 1 provides our formal test of the differences among graduate enrollment outcomes and confirms no statistical differences around the threshold in key pre-college characteristics. We do find that MFOSP no-loan program participants have lower cumulative loan debt—$9,162.22 on average—which is expected given the intervention associated with no-loan program participation.

--- Figure 2 Here ---

--- Table 1 Here ---

Results

Descriptives

Table 2 provides means and standard deviations for our primary graduate school enrollment indicators and the key predictors discussed previously. Table 2 also provides a breakdown of these descriptive by group membership: (1) MFOSP participants, (2) MFOSP qualifier but nonparticipant, and (3) MFOSP non-qualifier.

---Table 2 Here ---

Our descriptive results suggest a potential difference between MFOSP participants and non-participants in terms of graduate school enrollment. This is most evident in master's degree programs, with 27.4% of MFOSP graduates enrolling in a master's program compared to 18.2% for qualifying non-participants and 19.5% for non-qualifiers. Enrollment in Ph.D. programs

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appears to be constant across our groups. Participants in MFOSP appear to be less likely to enroll in a professional degree program relative to members of the other two groups.

Overall Graduate School Enrollment

Table 3 provides our main RD effects on actual graduate school enrollment according to the type of degree program. Across each of our specifications, the core assumption of our fuzzy RD design—that the assignment variable serves an effective instrument for participation in the no-loan program—is met. We present three specifications to examine the influence of no-loan program participation on graduate school enrollment. Specification (1) presents our base FRD estimates. Specification (2) extends our first specification to include a cohort (time) fixed-effects to account for time since bachelor's degree completion. Specification (3) includes a binary indicator (yes or no) of whether the student indicated interest in enrolling in graduate school during his or her first or second year. This is important to include, as it accounts for baseline interest in graduate school enrollment and helps explain any endogenous influences (Xu, 2016). Specification (3) is our preferred specification, but it only enhances the precision of our estimates and does not change the directionality of our relationships.

We find that participation in the MFOSP no-loan program is associated with statistically significant increases in the likelihood of enrollment in graduate school—21.6% on average. This effect was primarily concentrated in master's-level programs. Interestingly, participation in the MFOSP no-loan program significantly decreases the likelihood of student enrollment in Ph.D. programs—11.3% on average. Although it is not statistically significant, we find suggestive evidence of a positive relationship between MFOSP no-loan program participation and enrollment in professional programs.

--- Table 3 Here ---

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To test the robustness of our main estimates, we made our FRD point estimates across multiple bandwidths to ensure that our results would not be sensitive to sample inclusion decisions. Table 4 presents estimates associated with (1) our optimal bandwidth, as given in Table 3; (2) bandwidth of $10,000 on each side of the cutoff; (3) bandwidth of $20,000 on either side of the cutoff; and (4) bandwidth of $30,000 on either side of the cutoff. Across each of our selected bandwidths, we find consistent statistical evidence that participation in the MFOSP no-loan program significantly increased the likelihood of enrollment in graduate school. The magnitudes of our point estimates are actually larger and more statistically significant as we narrow our bandwidth around the cutoff, suggesting stronger effects on the margins.

--- Table 4 Here ---

Graduate School Enrollment by Undergraduate Degree Area

Given the lack of highly qualified STEM graduates and the fact that labor markets look different for STEM and non-STEM bachelor's degree recipients (Xu, 2013), we examine the effects of MFOSP no-loan program participation on graduate school enrollment by program type to compare STEM versus non-STEM undergraduates. Interestingly, our results indicate that the significant increases in likelihood of graduate school enrollment seen in Table 3 are entirely concentrated within non-STEM graduates. Non-STEM MFOSP participants were 30.7% more likely to enroll in graduate school. The effects of graduate school enrollment are primarily concentrated within master's-level programs (39.1% increase in likelihood) and professional degree programs (14.1% increase in likelihood).

--- Table 5 Here ---

We also find evidence suggesting that STEM bachelor's degree recipients are actually less likely to enroll in graduate school due to their participation in the MFOSP no-loan program.

This effect is shown primarily by the decreased likelihood of MFOSP participants enrolling in STEM Ph.D. programs.

Graduate School Enrollment by Race/Ethnicity

Despite the core focus of MFOSP on supporting first-generation and low-income students, MFOSP also enrolls a significant proportion of students from traditionally underrepresented and disadvantaged racial/ethnic groups. Table 6 provides our FRD estimates by both program type and race/ethnicity. Overall, we find that participation in the MFOSP no-loan program appears to positively affect the likelihood of graduate school enrollment for underrepresented students within higher education. This is particularly evident for participating Hispanic students, who had a 121% increase in likelihood of enrollment in graduate school. Although it is not statistically significant, we also find suggestive evidence of increases in the likelihood of graduate school enrollment for MFOSP participants identifying as African American or Black.

--- Table 6 Here ---

In addition to findings related to overall graduate school enrollment effects, we also found that the influence of participating in MFOSP varied according to the level of graduate programs. Participation in a no-loan program appeared to influence the type of graduate programs differently according to the MFOSP participant's race/ethnicity. For students who identified as Hispanic/Latino or African American/Black, participation in a no-loan program significantly increased the likelihood of enrollment in master's-level degree program (78.7% and 32.5%) and professional doctorate programs (39.4% and 8.4%). This is in stark contrast to students who identified as Asian or Pacific Islander, as these students had a significant decrease in their overall graduate school enrollment (52.8%) and master's program enrollment (60.4%)

but a significant increase in the likelihood that they would pursue a Ph.D. degree (11.8%).

Graduate school enrollment—regardless of the type of graduate program—for White or

Caucasian students was not significantly affected by participation in MFOSP.

Conclusion and Discussion

Graduate education has been identified as a primary way for underprivileged students to

climb the social ladder (Baum, Ma, & Payea, 2010). This study has examined the effect of

participation in a no-loan program on the likelihood of first-generation and low-income students

enrolling in graduate school. Overall, we found positive and statistically significant evidence that

participation in a no-loan program (MFOSP) increased graduate school enrollment for these

historically underrepresented and disadvantaged students. Our results are consistent with

previous findings related to the significant role that undergraduate student debt plays in students'

graduate school enrollment decisions (Malcom & Dowd, 2012; Zhang, 2013), as participating in

MFOSP effectively reduces the cost burden for students and enables them to pursue graduate

education. Although it is plausible that some students enter graduate school as a way of deferring

the repayment of their student loans (Baum & O'Malley, 2003), our estimates illustrate an

inverse relationship to such a claim by showing that students with significantly less student loans

have a higher likelihood of graduate school enrollment.

The positive effects of participation in the MFOSP on graduate school enrollment were

not uniform across graduate degree program types. Specifically, we found that a reduction in

student loans increased graduate school enrollment in master's and professional degree

programs. These results align with the work of Zhang (2013), who found that increases in

undergraduate student debt decrease the likelihood of enrollment in master's and professional

degree programs. Our findings suggest that removing the financial burden for first-generation

and low-income students may allow them to pursue graduate degree programs that would otherwise have significant tuition-related costs (e.g., MBA, JD, MD).

The differential effects associated with the influence of MFOSP participation on the type of graduate programs and racial/ethnic subgroup membership were also noteworthy. Our findings confirm the work of Kim, DesJardins, and McCall (2009), who also demonstrated that financial aid policies have varying effects on students from different racial/ethnic subgroups. Contrary to our expectations, participation in MFOSP had little or no effect on graduate school enrollment for White first-generation and low-income students. Results suggesting a positive effect of MFOSP participation on graduate school enrollment for African American/Black students confirm previous claims of students' elevated confidence to pursue advanced degrees associated previously with participation in the Gates Millennium Scholarship (GMS) program (Marks & Reid, 2013).

Participation in a no-loan program had the greatest effect for Hispanic students; this finding is in direct alignment with the work of Gross, Torres, and Zerquera (2013), who found that reductions in the cost of an undergraduate degree affected Hispanic/Latino student persistence and completion more than they did for any other racial/ethnic subgroup. The effects of Hispanic/Latino students' participation in MFOSP are particularly promising considering their significant underrepresentation in U.S. graduate education. According to the National Center for Education Statistics (NCES) *Digest of Education Statistics* (2013), Hispanic students make up the lowest proportion of students enrolled in graduate degree programs, with only 7% of the total number of graduate students identifying as Hispanic. That same NCES report reported that Hispanic/Latino students who did enroll in graduate school did so disproportionately in four fields: (1) education, (2) business, (3) health, and (4) law, which provides additional insight into

our finding suggesting that MFOSP participation significantly increases master's and professional degree program enrollment for Hispanic/Latino students.

Despite our analytical approach and the robustness checks we have employed, this study is subject to several limitations. First, we examine graduate school enrollment rather than applications to graduate school. Considering the multidimensionality of graduate school admissions—students apply but institutions admit—our estimates capture the desires of both students' and graduate institutions. Although we find similarities among students on undergraduate indicators (degree GPA and major choice), future research could examine the graduate school application behaviors of students. Second, our sample is limited to first-generation bachelor's degree completers at a single public research and state flagship institution, and this study cannot be considered generalizable across higher education. Finally, our analysis examined only enrollment in graduate school. Future studies can explore completion outcomes after students gain access to graduate school. Considering the influence of debt on the likelihood of completion within graduate degree programs (Malcom & Dowd, 2012; Zhang, 2013), one can reasonably deduce that participation in a no-loan program would have a similar positive effect on graduate degree completion.

As institutions continue to look for ways to support students, particularly those from low-income and first-generation backgrounds, no-loan programs have grown in popularity. Various scholars (Avery et al., 2006; Hillman, 2012; Waddell & Singell, 2011) have documented the positive effects of no-loan program adoption on undergraduate enrollment among low-income students. However, little is known of the long-term effects of no-loan program participation. This study adds to the growing evidence of the potential effect of no-loan programs by filling this gap within the academic literature. Adding to prior evidence of the potential externalities of no-loan

programs is particularly important considering the substantial institutional costs associated with

program implementation.[4] By complementing previous studies of the short-term effect of no-loan

program adoption with our findings related to the long-term impacts of MFOSP can potentially

help proponents of no-loan programs seeking to justify additional adoptions of no-loan programs

throughout higher education.

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[4] At the University of Florida, MFOSP—which is more targeted than most no-loan programs are—has an estimated cost of $13 million annually.

8.   References

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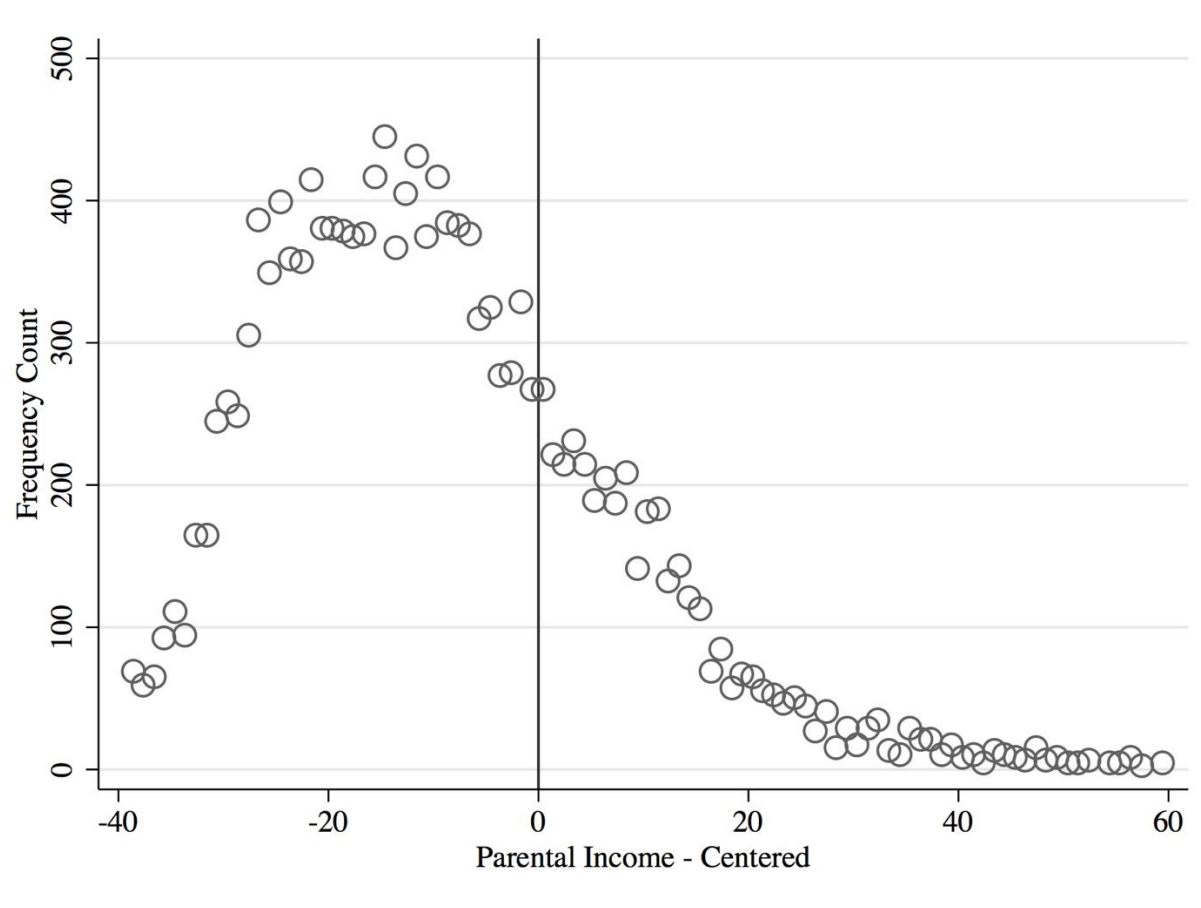Evaluation and Policy Analysis*, *32*(2), 143-165.

Figure 1. Discontinuity of observations
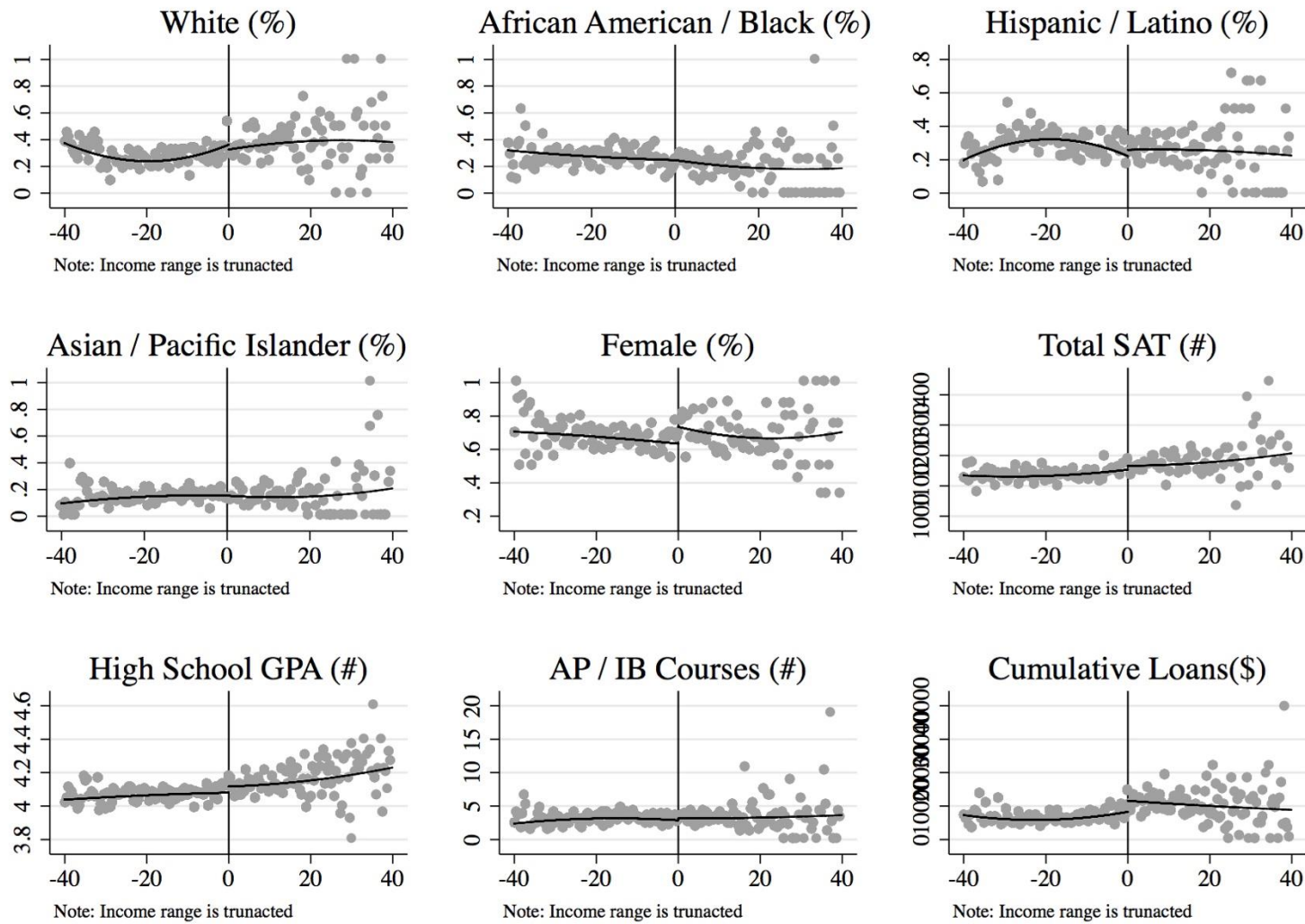
Figure 2. Distribution on Key Demographic Characteristics.

Table 1: RD Assumption Test

	White	Black	Hispanic	Asian	Other	Female	Total SAT	HS GPA	AP/IB	BA GPA	Cum Loans
All Students	-0.057	0.019	-0.048	0.063	0.023	-0.071	-3.747	-0.019	-2.533	0.018	-9,162.223***
	(0.065)	(0.063)	(0.062)	(0.047)	(0.016)	(0.067)	(20.072)	(0.052)	(1.745)	(0.061)	(2,489.661)
Functional Form	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Cohort Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Graduate School Desire	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080

*Notes. Standard errors in parentheses; + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 2: Descriptives on Key Outcomes and Predictors

	Total Sample		Group 1: MFOS		Group 2: Non-MFOS		Group 3: Non-Qualifiers	
Graduate School Enrollment								
Any Graduate School	0.383	(0.486)	0.407	(0.492)	0.349	(0.477)	0.367	(0.483)
Master's Program	0.233	(0.423)	0.274	(0.446)	0.182	(0.387)	0.195	(0.397)
Ph.D. Program	0.036	(0.187)	0.036	(0.187)	0.031	(0.174)	0.045	(0.208)
Professional Degree Program	0.106	(0.308)	0.094	(0.292)	0.122	(0.328)	0.113	(0.317)
Undergraduate Indicators								
Bachelor's Degree GPA	3.267	(0.403)	3.255	(0.401)	3.286	(0.404)	3.269	(0.41)
Cumulative Loan Debt	9,000.28	(15,839.80)	4,900.07	(12,381.88)	12,940.38	(15,884.55)	14,974.26	(21,000.71)
Bachelor's: Social Sciences	0.281	(0.45)	0.293	(0.455)	0.289	(0.454)	0.226	(0.419)
Bachelor's: STEM	0.159	(0.366)	0.135	(0.342)	0.174	(0.38)	0.208	(0.407)
Bachelor's: Business	0.104	(0.306)	0.111	(0.315)	0.091	(0.288)	0.104	(0.306)
Bachelor's: Education	0.014	(0.117)	0.014	(0.12)	0.013	(0.114)	0.014	(0.116)
Bachelor's: Arts / Humanities	0.119	(0.324)	0.126	(0.332)	0.112	(0.316)	0.109	(0.312)
Bachelor's: Health	0.215	(0.411)	0.214	(0.411)	0.214	(0.41)	0.222	(0.416)
Bachelor's: Agriculture	0.108	(0.311)	0.106	(0.308)	0.107	(0.309)	0.118	(0.323)
Four-Year Completion Rate	0.732	(0.443)	0.745	(0.436)	0.711	(0.454)	0.729	(0.446)
Six-Year Completion Rate	0.987	(0.114)	0.988	(0.107)	0.979	(0.143)	0.995	(0.067)
Pre-College / Demographic Indicators								
Initial Parental Income	28,028.95	(14,883.60)	22,946.17	(9,806.317)	23,812.07	(11,399.03)	51,248.32	(11,062.11)
Initial Parental Assets	10,157.93	(34,008.13)	3,694.463	(11,638.3)	20,672.92	(51,089.77)	12,096.82	(38,871.98)
First-Year Bright Futures	0.904	(0.294)	0.886	(0.318)	0.911	(0.284)	0.95	(0.218)
Race: White	0.228	(0.42)	0.211	(0.409)	0.24	(0.427)	0.262	(0.441)
Race: Black/African American	0.339	(0.473)	0.372	(0.484)	0.305	(0.461)	0.294	(0.457)
Race: Hispanic/Latino	0.266	(0.442)	0.282	(0.45)	0.247	(0.432)	0.249	(0.433)
Race: Asian / Pacific Islander	0.149	(0.356)	0.119	(0.324)	0.182	(0.387)	0.186	(0.39)
Race: Other/Multi-Racial	0.018	(0.132)	0.016	(0.125)	0.026	(0.159)	0.009	(0.095)
Gender: Female	0.663	(0.473)	0.682	(0.466)	0.641	(0.48)	0.643	(0.48)
Total SAT Score ^	1,132.05	(154.338)	1,115.57	(154.169)	1,145.47	(151.278)	1,160.23	(154.48)
Final High School GPA	3.881	(0.418)	3.84	(0.428)	3.917	(0.413)	3.945	(0.382)
AP/IB Credits Completed	10.547	(11.649)	9.331	(10.992)	11.107	(11.737)	13.376	(12.918)
Observations	1296		691		384		221	

Notes. Standard deviations in parentheses; ^ students submitting ACT scores were converted to their corresponding SAT composite score for comparison

Table 3: RD Regression Estimates on Graduate School Enrollment (by degree type)

	(1)	(2)	(3)
Panel 1: Any Graduate Degree	0.106	0.109	0.216*
	(0.078)	(0.071)	(0.086)
Panel 2: Master's Degree	0.136 +	0.129 +	0.135*
	(0.073)	(0.073)	(0.064)
Panel 3: Ph.D. Programs	-0.095***	-0.095***	-0.113***
	(0.026)	(0.027)	(0.033)
Panel 4: Professional Degree Programs	0.091	0.105	0.092
	(0.064)	(0.064)	(0.060)
Functional Form	Linear	Linear	Linear
Cohort Year Fixed-Effects	No	Yes	Yes
Graduate School Desire	No	No	Yes

Notes. Standard errors in parentheses; $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Table 4: Robustness Check of Graduate School Enrollment Estimates (by bandwidths)

	Optimal	BW: -/+ 10	BW: -/+ 20	BW: -/+ 30
Panel 1: Any Graduate Degree	0.216*	0.235**	0.156*	0.147**
	(0.086)	(0.088)	(0.062)	(0.050)
Panel 2: Master's Degree	0.135*	0.160*	0.119*	0.102*
	(0.064)	(0.077)	(0.056)	(0.045)
Panel 3: Academic Doctorate	-0.113***	-0.120***	-0.073**	-0.046*
	(0.033)	(0.032)	(0.024)	(0.020)
Panel 4: Professional Doctorate	0.092	0.088	0.022	0.047
	(0.060)	(0.059)	(0.039)	(0.031)
Functional Form	Linear	Linear	Linear	Linear
Cohort Year Fixed-Effects	Yes	Yes	Yes	Yes
Graduate School Desire	Yes	Yes	Yes	Yes

*Notes. Standard errors in parentheses; + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 5: Graduate School Enrollment by STEM and Non-STEM

	STEM		Non-STEM	
	(1)	(2)	(1)	(2)
Panel 1: Any Graduate Degree	-0.571*	-0.223	0.395***	0.307**
	(0.239)	(0.173)	(0.114)	(0.096)
Panel 2: Master's Degree	-0.435+	-0.158	0.395***	0.391***
	(0.225)	(0.168)	(0.109)	(0.110)
Panel 3: Academic Doctorate	-0.141+	-0.160+	-0.048	-0.052
	(0.083)	(0.095)	(0.031)	(0.035)
Panel 4: Professional Doctorate	-0.123	-0.070	0.195**	0.141*
	(0.134)	(0.120)	(0.073)	(0.062)
Functional Form	Linear	Linear	Linear	Linear
Cohort Year Fixed-Effects	Yes	Yes	Yes	Yes
Graduate School Desire	No	Yes	No	Yes

*Notes. Standard errors in parentheses; + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 6: RD Regression Estimates on Graduate School Enrollment (by Race/Ethnicity)

	All Students	Asian	Black	Hispanic	White
Panel 1: Any Graduate Degree	0.216*	-0.528+	0.217	1.215***	-0.010
	(0.086)	(0.305)	(0.149)	(0.311)	(0.176)
Panel 2: Master's Degrees	0.135*	-0.604*	0.325**	0.787**	0.012
	(0.064)	(0.293)	(0.117)	(0.276)	(0.171)
Panel 3: Academic Doctorate	-0.113***	0.118*	-0.037	-0.305*	0.024
	(0.033)	(0.058)	(0.052)	(0.147)	(0.234)
Panel 4: Professional Doctorate	0.092	-0.147	0.084+	0.394*	-0.050
	(0.060)	(0.165)	(0.047)	(0.186)	(0.113)
Cohort Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes
Graduate School Desire	Yes	Yes	Yes	Yes	Yes

*Notes. Standard errors in parentheses; + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

The Influence of Pell Grants on Graduate School Enrollment

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Abstract

The federal Pell Grant program is the largest source of need-based aid available to undergraduate students, but we know very little regarding its impact after students graduate. This study examines the influence of Pell Grants on graduate enrollment using a regression discontinuity design. Descriptive evidence suggests that increases in the level of need-based aid may be positively related to the likelihood of graduate school enrollment. Our empirical results indicate that African American or Black students who receive Pell Grants are more likely to enroll in post-baccalaureate professional degree programs.

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Introduction

The federal Pell Grant program—which was formerly known as the Basic Educational Opportunity Grant program—is the largest source of need-based aid available to undergraduate students. Although federal loans are available to all postsecondary students, Pell Grants are only available to low-income undergraduate students who demonstrate financial need (U.S. Department of Education, 2017). The Pell Grant is designed to promote access to higher education among low-income and historically underrepresented student populations, as it is the primary form of financial aid that does not need to be repaid by student recipients. Previous researchers have found a positive relationship between need-based aid and the probability of enrolling in college (Kane, 1999, 2003; Seftor & Turner, 2002; Dynarski, 2003), but these studies focus solely on undergraduate enrollment.

Prior research has shown that graduate education is related to greater labor market outcomes and a higher quality of life (Baum, Ma, & Payea, 2010). Many high-paying professions, such as doctors, lawyers, and pharmacists, are only available to individuals who have earned their graduate degree (Morelon-Quainoo et al., 2009). Individuals who earn graduate degrees are also more likely to have children who eventually obtain higher levels of education when compared to those who did not earn a graduate degree (Baum et al., 2010). However, the social and financial advantages associated with graduate education appear to be distributed unequally, with low-income students being less likely than their peers to enroll in graduate school and obtain a graduate degree (Morelon-Quainoo et al., 2009).

With the rising cost of higher education (Clotfelter, 1996; Millett, 2003; Bowen, 2013; Cheslock, Ortagus, Umbricht, & Wymore, 2016), students have been forced to increase their reliance on student loans (Hearn & Holdsworth, 2004). This trend is especially disconcerting for

low-income students, who accrue a disproportionate amount of loan debt relative to their peers (Price, 2004). Despite the well-established benefits of graduate education (Baum et al., 2010; Hearn & Holdsworth, 2004), the prospect of undertaking additional student loan debt to enroll in graduate coursework may dissuade otherwise-capable applicants from pursuing graduate studies. Because Pell Grants are designed to provide aid in ways that reduce low-income students' dependence on loans, Pell-eligible students may be able to limit their loan debt and become more willing to undertake student loan debt to experience the benefits of graduate education. To examine the relationship between Pell Grants and graduate enrollment, this study addresses the following research question: *To what extent do Pell Grants impact the likelihood of graduate school enrollment?*

Literature Review

Given that need-based aid accounts for the considerable majority of all grant aid awarded by state and federal governments (Baum, 2016), numerous studies have examined the effect of need-based financial aid on student outcomes. The majority of these studies focus solely on the impact of need-based aid on the short-term outcomes of students by concentrating their analyses within a narrow time period immediately following high school graduation (Dynarski, 2003; Ehrenberg & Sherman, 1984; Leslie & Brinkman, 1987; Kane, 1999). Our study complements previous literature by looking at the longer-term impact of need-based aid by examining the impact of Pell Grants on the likelihood of graduate school enrollment. This review of relevant literature will focus primarily on enrollment trends of low-income students, the effect of need-based aid on student outcomes, and factors influencing the likelihood of enrolling in graduate school.

The college enrollment rates of individuals from low-income families are significantly lower than their middle- and upper-income peers. Even after controlling for academic ability, college enrollment rates are between 25 and 30 percentage points lower for high school graduates whose families are in the lowest quintile of total income relative to their peers from the highest-earning families (Baum & Ma, 2007). Trends within graduate school enrollment for low-income students follow a similar pattern, with low-income students failing to enroll in graduate school at the same pace as their academically similar peers from higher socioeconomic backgrounds (Malcom & Dowd, 2012).

Deming and Dynarski (2009) found that need-based grant eligibility can have a strong and positive effect on whether students enroll in college, with the estimated probability of enrollment increasing by 3% to 4% for each additional $1,000 in grant aid eligibility. However, Rubin (2011) examined the effect of Pell Grant eligibility on college enrollment and found no effect. Rubin explained this finding by suggesting that the minimum Pell Grant amount may be inadequate given the continually rising price of college attendance. Additional studies have examined the post-enrollment effect of merit-based scholarships on postsecondary students (Dynarksi, 2008; Scott-Clayton, 2011), but surprisingly little research has examined the effect of need-based grants on long-term student outcomes, such as graduate school enrollment.

Low-income students are far more likely than their peers to accrue student loan debt to pay for their undergraduate education. In an analysis of bachelor's degree recipients from public universities, Baum and Payea (2012) found that roughly 68% of students from families earning less than $30,000 per year had an average cumulative debt of at least $16,500. However, only 40% of students from families earning more than $120,000 accrued any debt, with the average amount of student loan debt at $14,500. Because we know that providing financial aid can

reduce financial burdens and improve undergraduate for low-income students (Dynarski & Scott-Clayton, 2013), one can reasonably deduce that need-based aid (Pell Grants) obtained as an undergraduate can reduce financial barriers to graduate enrollment and positively impact the likelihood of low-income students enrolling in graduate school.

Although graduate education has been found to be beneficial across student types (Baum et al., 2010; Hearn & Holdsworth, 2004), prior research has shown that historically underrepresented student populations are not as likely to enroll in graduate school (Perna, 2004). For example, low-income students were found to be less likely than their peers to engage with graduate education (Morelon-Quainoo et al., 2009). Previous researchers have consistently found a positive relationship between a student's academic achievement and likelihood of enrolling in graduate school (Mullen, Goyette, & Soares, 2003; Zhang, 2005); however, there is not a clear consensus in the literature regarding the impact of financial considerations on the likelihood of graduate school enrollment. For example, the influence of undergraduate debt on graduate school enrollment has been examined by numerous researchers (Schapiro, O'Malley, & Litten, 1991; Fox, 1992; Weiler, 1994; Heller, 2001; Millett, 2003;), but the findings generated from these studies vary considerably and offer little clarity for policymakers or researchers seeking to understand the relationship between student loan debt and graduate school enrollment.

As institutions, states, and the federal government continue to make considerable financial investments into need-based financial aid programs, rigorous projections of their impact on long-term outcomes, such as the likelihood to enroll in graduate school, are needed. Our study will complement the studies outlined previously by focusing on the post-baccalaureate impact of need-based financial aid through an examination of the influence of Pell Grants on graduate enrollment among low-income students.

Conceptual Framework

This study draws from the economic theory of human capital and the random utility model of student choice to explain the rationale for the analysis. In the context of higher education, the theory of investment in human capital (Mincer, 1958) suggests that students make decisions about continuing their education based on the costs and benefits associated with enrollment. The decision to enroll in graduate school, for example, is subject to a variety of considerations, such as the direct costs of tuition and fees and the opportunity costs of foregone earnings, before determining whether graduate education is a worthwhile investment. Before deciding to attend graduate school, the prospective student weighs the costs and expected benefits of graduate education and enrolls in graduate school if the costs of graduate enrollment are outweighed by the expected benefits (DesJardins & Toutkoushian, 2005; Paulsen & Toutkoushian, 2008).

The uncertainty of future benefits associated with graduate education and an individual's willingness to accept risk can complicate the decision to enroll in graduate school (DesJardins & Toutkoushian, 2005). The random utility model of student choice can be used to explain an individual's decision despite under these types of uncertainty. This model has been used in earlier work to study student choice (DesJardins, Ahlburg, & McCall, 2006), as students will attempt to maximize their net utility when making their decision to choose among schooling and non-schooling alternatives (DesJardins & Toutkoushian, 2005).

In line with the logic outlined by previous applications of the random utility model of student choice (DesJardins & Toutkoushian, 2005; Muñoz, Harrington, Curs, & Ehlert, 2016), we define the utility individuals receive based on their decision to attend graduate school as follows:

$$Uig = U(Fg, Fi, Ni)$$

where *U* is the utility that individual *i* obtains from choosing to enroll in graduate school *g*. The inputs to the utility function are defined as follows: *F* represents the financial factors related to attending graduate school *g* (e.g., tuition and fees); *F* also represents financial factors associated with individual *i* (e.g., Pell eligibility); and *N* represents non-financial individual characteristics associated with the utility of the decision to enroll in graduate school (e.g., ability; undergraduate major).

Although an individual's utility is unobservable, we can deduce that utility is maximized based upon the student's decision. In other words, when a student chooses graduate school (*g)* over the non-graduate school alternatives (*h*), we can deduce that *g* provided the student with greater net benefits (utility) relative to the non-graduate school option of entering the labor market with sub-graduate level credentials. Following DesJardins and Toutkoushian (2005) and Muñoz et al. (2016), we model utility maximization as $U_{ig} > U_{ih}$.

We apply the economic theory of human capital and the random utility model of student choice to show how Pell Grants influence the decision to enroll in graduate school. The student's decision is thereby contingent upon whether the direct and opportunity costs of graduate enrollment are outweighed by the benefits associated with graduate education. Because previous researchers have shown that low-income students are debt-averse (Burdman, 2005), we hypothesize that students who receive Pell Grants are more likely to enroll in graduate school because their otherwise-similar peers will decline to take out additional student loan debt to pursue graduate studies. This debt aversion is exacerbated by informational asymmetries that lead many low-income students to deem the cost of graduate school to be too high despite the well-established, long-term benefits of graduate education.

<center>**Data and Methods**</center>

Data

To examine the influence of Pell Grants on graduate school enrollment, we use a nationally representative longitudinal sample survey of bachelor's degree recipients provided by the National Center for Education Statistics (NCES)—Baccalaureate and Beyond Longitudinal Study (B&B:08/12). The survey is restricted to postsecondary students who completed the requirements to obtain a bachelor's degree during the 2007-08 academic year. B&B:08/12 addresses issues related to the education and employment experiences of bachelor's degree experiences and includes two follow-up surveys. The survey also addresses questions related to bachelor's degree recipients' participation in financial aid programs and undergraduate debt. The first follow-up for B&B:08/12 occurred one year after graduation (2009), and the second follow-up occurred three years later (2012). The final B&B:08/12 dataset has approximately 17,160 participants, including any student who participated during the first year and was deemed eligible for the first follow-up based on the transcripts or interviews. For data preparation and analyses, we used revised panel weights to investigate the impact of Pell Grants on students' post-baccalaureate enrollment decisions.

Variables

Independent/forcing variable. The primary mechanism used to award Pell Grants is the federally calculated expected family contribution (EFC). Information for EFC is captured from student submissions on the Free Application for Federal Student Aid (FAFSA). Included within the EFC calculation are taxed and untaxed income, assets, and social service benefits. Additionally, family size and the number of family members attending postsecondary institutions are included. Students with an EFC less than or equal to zero qualify for a Pell Grant. The Pell

Grant award amount is dependent on the EFC level, with the lowest EFC receiving larger Pell awards. The continuous nature of EFC, along with the strict eligibility cutoff for a Pell Grant, allows us to employ it as an effective forcing variable for our analytical strategy.

Dependent variable. We employ a variety of graduate school enrollment indicators to test the effect of Pell Grants on graduate school enrollment. In addition to post-baccalaureate enrollment, the B&B:08/12 dataset also captures the type of programs in which students enroll. The B&B:08/12 includes information regarding degree type (e.g., master's, doctoral) as well the subject area of the graduate or professional program (e.g., law, business, science). We leveraged the information pertaining to the type of graduate or professional degree to examine the heterogeneous effects of receiving a Pell Grant. However, we were unable to examine specific subject areas given concerns over power and the limited sample sizes of our fuzzy regression discontinuity cutoff.

Covariates. One of the primary assumptions surrounding our analytical strategy is that students on either side of the income threshold are "normally" distributed across factors that may affect assignment to the treatment and independently affect the dependent variables. To this end, we include a variety of the pre-college characteristics that are associated with enrollment and success in undergraduate education and may directly affect graduate school enrollment: (1) high school GPA, (2) SAT/ACT composite scores, (3) number of AP/IB courses completed, (4) parental income and financial asset information, (5) parental education level, and (6) student race/ethnicity and gender.

Analytical Strategy

We exploit the established and strict income cutoff required to qualify for a Pell Grant and apply a regression discontinuity research design to estimate the effects of falling just below

(or above) the cutoff. To do so, we capitalize on the randomness of a student's position with respect to parental income to identify the causal effects of Pell Grant participation on post-baccalaureate enrollment decisions. Since compliance is not perfect, our analytical approach relies on a fuzzy regression discontinuity (FRD) design (Imbens & Lemeuix, 2008).

We operationalize our regression discontinuity design by using instrumental variables within a two-stage least squares estimation strategy. In our two-stage approach, we rely on the indicator of a student's position just below the expected family contribution (EFC) threshold as an instrumental variable for access to a Pell Grant. In the first stage, we model the probability that a student has access to Pell Grants as a function of the student's position being just below the cutoff on the EFC continuum:

$$\Pr(PG_i) = \pi_0 + \pi_1 BELOW_i + \pi_2 f(RV)_i + \pi_3 BELOW \times RV_i + X_i'\beta + \varepsilon_i \qquad (1)$$

In this model, $\Pr(PG_i)$ is the probability of receiving a Pell Grant for student i[5], RV_i is our running or forcing variable—expected family contribution (EFC)—used to signal eligibility for the Pell program, $BELOW_i$ is a binary indicator of falling below the threshold, $BELOW \times RV_i$ is an interaction term that allows the relationship between the forcing variable and outcome to differ for Pell-receiving and non-Pell students, X_i' is a vector of student-level covariates to improve statistical precision (as shown in the appendix, the core results are not affected when including or excluding covariates, although including them improves statistical precision), and ε_i is the error.

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[5] Given the nature of our analytical dataset, we-included time/cohort fixed-effects within our estimation. Additionally, we did not include institutional fixed-effects, as we find that institutional type is quasi-randomly distributed across Pell and non-Pell students.

We then use the fitted probabilities that a student qualifies for a Pell Grant as the first

stage in estimating the effect of receiving a Pell Grant on our graduate school enrollment

outcomes (already discussed) by employing the following specification:

$$Y_i = \theta_0 + \theta_1 \widehat{\Pr(NL_i)} + \theta_2 f(RV)_i + \theta_3 BELOW \times RV_i + X_i'\beta + \varepsilon_i \qquad (2)$$

This specification uses previously defined terms, with only the fitted values from the first stage

as a new term. The key parameter of interest, θ_1, represents the local average treatment on

graduate school enrollment outcomes, relative to those of students just above the EFC threshold.

Testing Required Model Assumptions

The primary assumption of an RD approach is that a discontinuity exists in treatment

take-up. Figure 1 demonstrates the probability of receiving a Pell Grant by EFC.[6] Since Pell

Grants are awarded based on a strict need-based cutoff, we expect students above the specified

cutoff (an EFC of zero) to have a very low probability of receiving a Pell Grant, and students

below the cutoff (or those demonstrating need) to have a high likelihood of receiving a Pell

Grant (Figure 1). Students with an EFC above zero have little to no chance of receiving a Pell

Grant, and students who have demonstrated need have an 85% likelihood of becoming Pell Grant

recipients. There are a number of reasons for not having 100% Pell Grant take-up. More

specifically, Pell Grants are limited to students attempting to earn their first bachelor's degrees,

possessing a social security number, and maintaining "satisfactory" progress toward an

undergraduate degree (among other requirements).

--- Figure 1 Here –

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[6] According to the U.S. Department of Education, the EFC determines students' eligibility for federal student aid. The EFC formulas use the financial information provided on students' FAFSA. The EFC is then subtracted from students' cost of attendance (COA) to determine federal need.

Appropriate conditions must be met to support the use of the regression discontinuity design before the analysis. Pursuant to the established methodological literature (Imbens & Lemeuix, 2008; Schochet et al., 2010), a valid regression discontinuity (RD) design must demonstrate a smooth and continuous distribution of the forcing variable, as well as balance of observable characteristics among units of analysis that fall just below or above the plausibly exogenous cutoff used to define the treatment. Our data satisfy both of these criteria across each of the evaluated thresholds. We fail to find any visual evidence of manipulation at the $40,000 income cutoff. Additionally, we conduct an informal McCrary test of manipulation—using the STATA command RD density—and find no statistical evidence of differences in observations around the cutoff. In Figure 2, we present the distribution of the running variable on key factors. As will be seen, there does not appear to be any visual evidence of large and systematic discontinuities in any of our identified characteristics.

--- Figure 2 Here ---

Table 1 provides our formal test of the differences among these characteristics accounting for Pell Grant take-up and optimal bandwidth selection. Table 2 suggests that there may be a slight discontinuity in the likelihood that a student receiving Pell Grant is not White and that those who receive Pell Grants have slightly lower amounts of cumulative student loans at the time of graduation. However, we did not find any systematic evidence that respondents receiving a Pell Grant had any statistical difference in their desire to enroll and complete a graduate degree when asked during the first year of their undergraduate education. Combined with our analytical approach, this finding allows us to attribute any differences in graduate school enrollment as related to the receipt of a Pell Grant and not to students' pre-college desires related to graduate school enrollment.

--- Table 1 Here ---

Results

Table 2 provides descriptive statistics—means and standards deviations—for our treatment and control groups on graduate school enrollment outcomes. Given that the receipt of the Pell Grant is an annual qualification, we have provided descriptive statistics for students who 1) never received Pell Grants, 2) received Pell Grants at any time during the analytical period, 3) received the Pell Grant for only one year, 4) received Pell Grants for two years, 5) received Pell Grants for three years, and 6) received Pell Grants for four or more years. The primary comparison should be made between (1) and (6) and examine the effects of receiving Pell Grants during the entire time as an undergraduate and never receiving the Pell Grant. In general, those receiving Pell Grants were slightly more likely to enroll in graduate school (49% vs. 50%) but less likely to enroll in a master's degree program (35% vs. 33%). Pell Grant recipients' enrollment was higher for doctorate (4% to 6%) than professional degree programs (9% vs. 12%). Additionally, the number of years students receive the Pell Grant appears to be linked with graduate school enrollment, with each additional year increasing the likelihood of enrollment in any graduate school across various types of programs.

--- Table 2 Here ---

Before examining the local average treatment effects, we further unpacked post-baccalaureate enrollment by the level of Pell Grant awards in Table 3. As with the majority of state and federal need-based financial aid policies, the amount of Pell Grant awarded is related to the level of need, with students who demonstrate the largest need receiving the largest award. Table 3 provides the graduate school enrollment likelihoods for Pell Grant recipients by the level of the cumulative award. Across the overall sample and various student subgroups, we find

descriptive evidence of a relationship between the amount of Pell Grants received and the likelihood of graduate school enrollment. In general, we show the amount of cumulative Pell Grants appears to have a positive relationship with the likelihood of graduate school enrollment, particularly for underrepresented minority students pursuing doctoral or professional degree programs. For example, African American/Black students who are in the lowest quartile of cumulative Pell Grants awarded had a doctoral degree program enrollment percentage of 2.7% compared to 7.0% for African American/Black students in the highest quartile of cumulative Pell Grants awarded. Hispanic/Latino students in the lowest quartile had a 4.3% enrollment percentage within professional degree programs, but those in the highest quartile had a 15.8% enrollment percentage. These trends were not only isolated to select racial/ethnic subgroups, as similar trends held for the subgroup of first-generation college students.

--- Table 3 Here ---

Figure 4 provides the graphical representation of our RD analysis by graduate program degree type, showing a potential positive discontinuity between Pell recipients and non-recipients on doctorate and professional degree programs. We also find limited visual evidence of a difference in overall graduate school enrollment and master's program enrollment. Given that master's program enrollment is the primary type of graduate school enrollment, it is not surprising to see similar results between master's program and overall graduate school enrollment.

--- Figure 3 Here ---

Table 4 provides our FRD estimates for the effects of Pell Grants on post-baccalaureate enrollment decisions by degree type and the number of Pell Grants awarded. Within Table 3, we specify three different RD estimates, with Model 1 being our base FRD approach, Model 2

building on Module 1 to include NCES sample weights for the nationally representative sample, and Module 3 adding covariates to Module 2 to increase robustness and strengthen the precision of our analysis. In general, we find limited statistical evidence that receiving a Pell Grant induces students to enroll in graduate school. While not statistically significant, we find negative point estimates for enrollment in any graduate program or master's degree programs and positive point estimates for doctoral or professional programs. Additionally, the strongest impacts appear to be concentrated within our analysis examining non-Pell recipients and students receiving a Pell Grant for four or more years, which aligns with our conceptual framework and suggests a cumulative effect of receiving Pell Grants.

--- Table 4 Here ---

Heterogeneous Effects by Student Groups

Prior work by Gross, Torres, and Zerquera (2013) indicates that various student subgroups respond differently to financial aid. To this end, Figure 4 and Table 5 examine the effect of Pell Grants on post-baccalaureate enrollment across subgroups. Figure 4 provides a graphical representation of enrollment in any graduate school by race/ethnicity and first-generation status. Figure 4 shows visual evidence that White, Black, and first-generation Pell Grant recipients who demonstrate the most need appear to be the most likely to enroll in graduate school, even when compared alongside their more affluent peers within the same race/ethnicity or first-generation subgroups, which confirms some of the early descriptive results presented earlier in Table 3.

--- Figure 4 Here ---

We formally test the impact of Pell Grants on graduate school enrollment for a variety of student groups in Table 5. Similar to our estimates in Table 4, we provide limited statistical

evidence the receipt of Pell Grants impacts graduate school enrollment among students from various subgroups, such as race/ethnicity and first-generation status. The lone exception within our results is that African American/Black students have an increased likelihood (33%) of enrolling in a graduate professional program after receiving a Pell Grant.

--- Table 5 Here ---

Conclusion and Implications

Numerous empirical studies examine the relationship between undergraduate student debt and graduate enrollment decisions (Schapiro, O'Malley, & Litten, 1991; Fox, 1992; Heller, 2001; Millett, 2003), but fewer studies have connected need-based aid and graduate enrollment decisions. This study seeks to assess the impact of the federal Pell Grant program—the nation's largest need-based aid program—on post-baccalaureate enrollment decisions. Capitalizing on the strict qualification threshold, we generate one of the first causal estimates on the effect of Pell Grant participation on graduate school enrollment.

Although we provide descriptive evidence of a relationship between the amount of Pell Grants received and the likelihood of graduate school enrollment, our empirical results lack statistically significant evidence of the impact of Pell Grants on graduate school enrollment, with a few exceptions. Our heterogeneous results confirm the earlier work of Kim, DesJardins, and McCall (2009), who demonstrated that students from different racial/ethnic subgroups respond differently to various financial aid policies. Contrary to the work of Gross, Torres, and Zerquera (2013), we found that African American/Black students appeared to be more sensitive to receiving a Pell Grant when deciding whether to enroll in graduate school. More specifically, the impact of receiving Pell Grants on graduate enrollment appears to be concentrated within

African American/Black students pursuing professional degree programs (e.g., J.D., MBA), many of which are associated with higher tuition and fees.

The relative lack of significant empirical results related to the impact of receiving the Pell Grants on graduate school enrollment may be due to the variability of the Pell Grant award. Specifically, students on the margins of qualifying for Pell Grants received the minimum award amount of $600 per year, whereas compared to those receiving the maximum Pell amount of 5,750 per year.[7] Because we examine the impact of Pell Grants for students just below and above the qualification threshold, this study would not capture students receiving the highest allocations of Pell Grant awards within the empirical analyses.[8] In line with our conceptual framework (DesJardins & Toutkoushian, 2005; Mincer, 1958; Muñoz, Harrington, Curs, & Ehlert, 2016), we provide suggestive evidence that the level of the Pell Grant award appears to be positively related to the likelihood of enrolling in graduate school.

This study is subject to multiple limitations. First, because we examine the effects of receiving a Pell Grant on graduate school enrollment among students just above and below the threshold, our results should be viewed solely as the local average treatment effect of receiving Pell Grants rather than the treatment effect of receiving Pell Grants. Despite the strict income threshold for qualifying for a Pell Grant—a key assumption of the RD design—the declining nature of the Pell Grant award for students who are closer to the income threshold serves to add to the level of complexity of our analysis. To this end, our local average treatment effects should be taken in combination with our descriptive results to demonstrate a connection between not only receiving a Pell Grant but also the amount of Pell Grants received and post-baccalaureate

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[7] The 4-year average of the minimum and maximum Pell Grant awards between 2008 and 2012. The 4-year average annual Pell Grant award was $3,820 during the same period.
[8] Descriptive results pertaining to the influence of the level of Pell Grants on graduate enrollment can be found in Table 3.

decision making. Second, while this study leverages a nationally representative dataset, our analysis may be slightly underpowered and therefore reliant on survey response data. Finally, we examine graduate school enrollment as the sole outcome and do not account for the graduate school application process. Given that graduate enrollment requires that students apply to graduate school and institutions subsequently offer admission to those prospective students, our analysis cannot account for students' desire to pursue graduate education.

Combined with the literature connecting undergraduate debt and need-based financial aid with graduate school enrollment, we provide additional nuance to this important topic area and add to our collective understanding of undergraduate financial aid on post-baccalaureate enrollment decisions. Despite the relative lack of significant empirical results, our study complements this previous work and adds insight into the mechanisms at play during the post-baccalaureate decision-making process. Future research can continue to examine the connection between need-based aid and post-baccalaureate enrollment decisions, particularly the impact of levels of need-based aid on the likelihood of graduate school enrollment.

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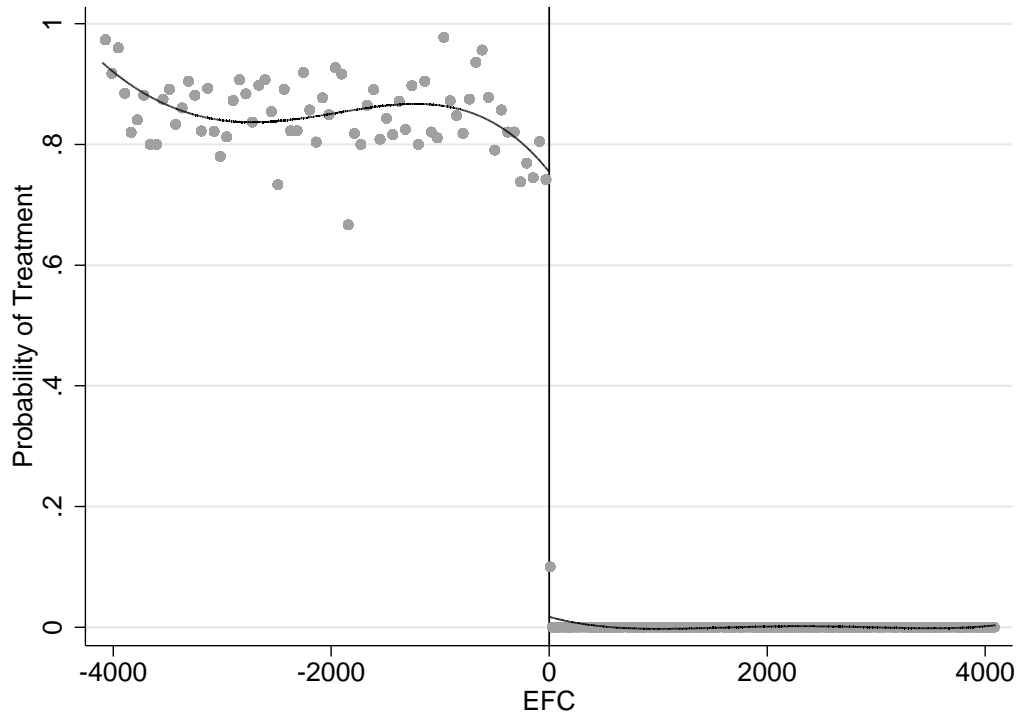   undergraduate majors. *The Review of Higher Education, 28*(3), 313–338.

Figure 1: Pell Grant take-up by expected family contribution (EFC)
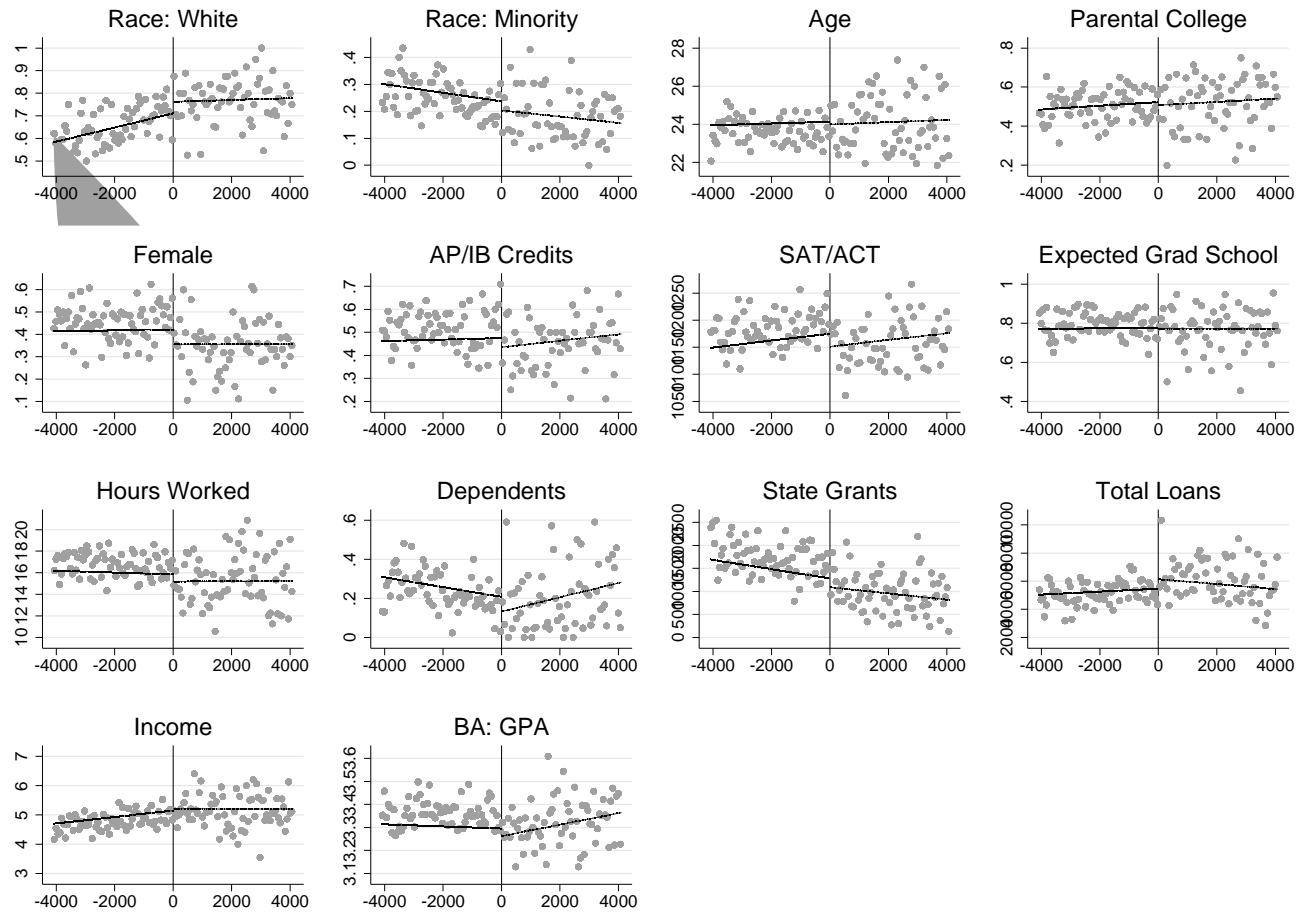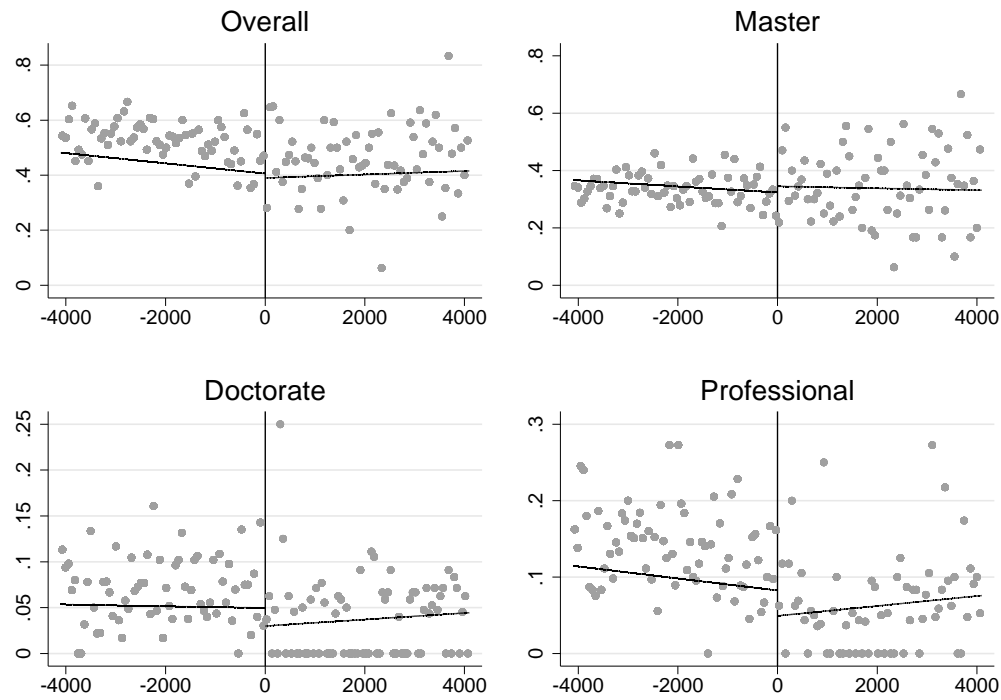
Figure 2: Distribution on key covariates

Figure 3: Graphical representation of RD estimates on Pell and Graduate School Enrollment
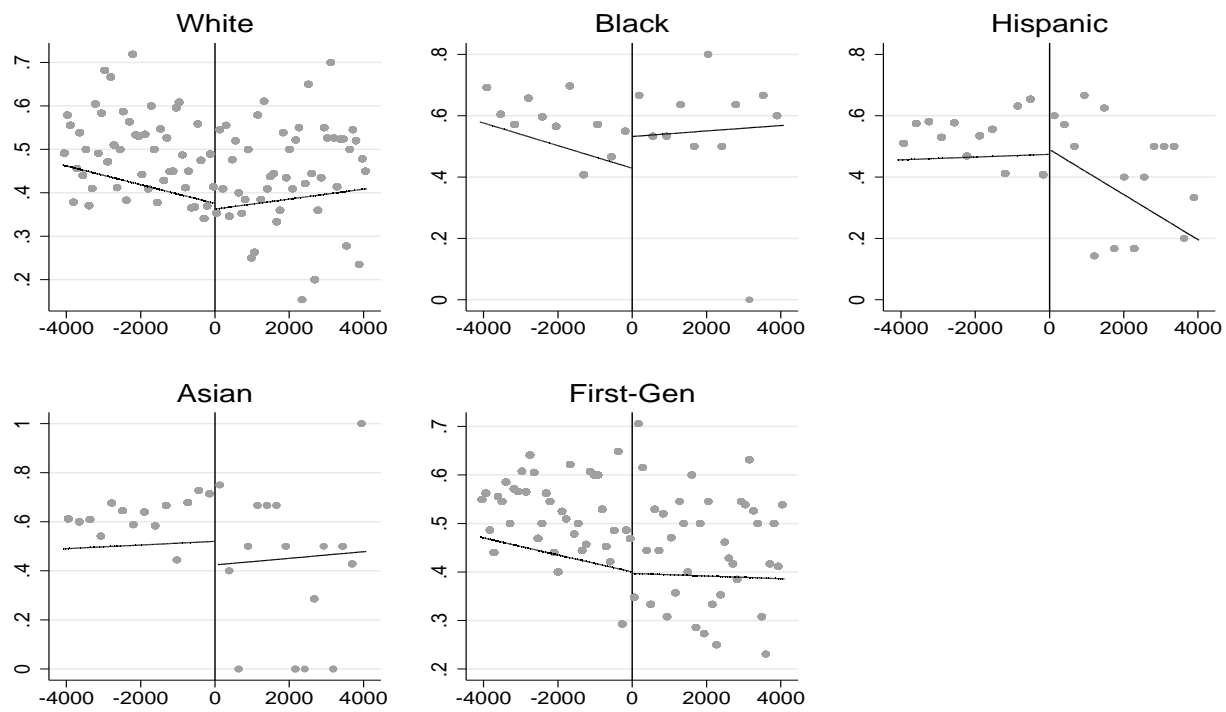
Figure 4: Graphical representation of RD estimates on Pell and Graduate School Enrollment by Student Subgroups

Table 1: RD Assumption Test on Key Covariates

	IV Estimates of on RD Assumption													
	Race: White	Race: Minority	Age	Parent: BA	Female	AP/IB Credits	ACT/SAT Score	Grad School Expect	Hours Worked	# of Dependents	Total State Grants	Total Loans	Income	Degree GPA
All Students	-0.253+	0.190	-1.853	-0.033	0.078	0.200	20.048	-0.170	2.978	-0.241	519.624	-3,791.524+	0.087	-0.115
	(0.146)	(0.163)	(2.007)	(0.179)	(0.150)	(0.169)	(45.873)	(0.159)	(3.230)	(0.204)	(653.645)	(2,046.546)	(0.759)	(0.162)
Functional Form	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Survey Weights Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student-level Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237

Table 2: Descriptive Statistics

	Pell: No	Pell: Yes	Pell: 1 Year	Pell: 2 Years	Pell: 3 Years	Pell: 4+ Years
Any Graduate School Enrollment	0.49	0.50	0.45	0.51	0.50	0.51
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Master's Program Enrollment	0.35	0.33	0.31	0.37	0.33	0.34
	(0.48)	(0.47)	(0.46)	(0.48)	(0.47)	(0.47)
Doctoral Program Enrollment	0.04	0.06	0.05	0.07	0.06	0.06
	(0.20)	(0.24)	(0.23)	(0.25)	(0.24)	(0.25)
Professional Degree Program Enrollment	0.09	0.12	0.10	0.10	0.13	0.13
	(0.29)	(0.32)	(0.30)	(0.30)	(0.34)	(0.33)
Observations	6,159	6,223	1,204	967	1,005	3,047

Notes. Standard deviations in parentheses

Table 3: Descriptives by Level of Percentile of Cumulative Pell Grant Awards

	Any Graduate Program				Master's Program				Doctoral Program				Professional Degree Program			
	0 - 25th	26th-50th	51st-75th	76th-100th	0 - 25th	26th-50th	51st-75th	76th-100th	0 - 25th	26th-50th	51st-75th	76th-100th	0 - 25th	26th-50th	51st-75th	76th-100th
All Students	0.400	0.428	0.483	0.510	0.335	0.348	0.366	0.379	0.039	0.043	0.073	0.073	0.070	0.084	0.117	0.133
	(0.49)	(0.50)	(0.50)	(0.50)	(0.47)	(0.48)	(0.48)	(0.49)	(0.19)	(0.20)	(0.26)	(0.26)	(0.26)	(0.28)	(0.32)	(0.34)
Caucasian / White	0.368	0.416	0.411	0.467	0.304	0.330	0.313	0.343	0.039	0.046	0.060	0.083	0.066	0.082	0.094	0.115
	(0.48)	(0.49)	(0.49)	(0.50)	(0.46)	(0.47)	(0.46)	(0.47)	(0.19)	(0.21)	(0.24)	(0.28)	(0.25)	(0.27)	(0.29)	(0.32)
African American / Black	0.482	0.578	0.570	0.586	0.446	0.495	0.520	0.487	0.027	0.051	0.089	0.070	0.039	0.085	0.085	0.112
	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)	(0.16)	(0.22)	(0.29)	(0.26)	(0.19)	(0.28)	(0.28)	(0.32)
Hispanic / Latino	0.457	0.548	0.430	0.517	0.418	0.421	0.355	0.369	0.017	0.044	0.036	0.046	0.043	0.140	0.071	0.158
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.48)	(0.48)	(0.13)	(0.21)	(0.19)	(0.21)	(0.20)	(0.35)	(0.26)	(0.37)
First-Generation	0.387	0.436	0.486	0.515	0.331	0.353	0.412	0.364	0.034	0.029	0.049	0.069	0.053	0.086	0.081	0.142
	(0.49)	(0.50)	(0.50)	(0.50)	(0.47)	(0.48)	(0.49)	(0.48)	(0.18)	(0.17)	(0.22)	(0.25)	(0.22)	(0.28)	(0.27)	(0.35)

Notes. Standard deviations in parentheses; 0 percentile = lowest cumulative Pell Grant award; 100th percentile = largest cumulative Pell Grant award

Table 4: RD Effects on Graduate School Enrollment (by Pell Dosage)

	IV Estimates of Pell Grant Receipt											
	Any Graduate Program			Master's Program			Doctoral Program			Professional Degree Program		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Panel 1: All Students	0.008	-0.018	-0.010	-0.042	-0.046	-0.023	0.028	0.005	0.011	0.041	0.010	0.018
	(0.055)	(0.055)	(0.054)	(0.059)	(0.071)	(0.068)	(0.027)	(0.031)	(0.032)	(0.038)	(0.055)	(0.047)
Panel 2: Pell ≥ 4 Yrs vs. No Pell	-0.003	-0.011	0.013	-0.080	-0.044	0.010	0.063	0.047	0.064	-0.006	-0.054	-0.040
	(0.116)	(0.169)	(0.122)	(0.135)	(0.186)	(0.174)	(0.050)	(0.059)	(0.062)	(0.079)	(0.099)	(0.100)
Panel 3: Pell ≥ 3 Yrs vs. No Pell	-0.034	-0.058	-0.066	-0.101	-0.091	-0.079	0.030	0.010	0.025	0.035	-0.003	0.003
	(0.067)	(0.093)	(0.093)	(0.094)	(0.118)	(0.093)	(0.040)	(0.044)	(0.045)	(0.052)	(0.064)	(0.061)
Panel 4: Pell ≥ 2 Yrs vs. No Pell	-0.015	-0.030	-0.021	-0.074	-0.084	-0.061	0.023	0.004	0.012	0.066	0.038	0.040
	(0.062)	(0.062)	(0.062)	(0.069)	(0.087)	(0.081)	(0.032)	(0.036)	(0.037)	(0.042)	(0.054)	(0.051)
Functional Form	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Survey Weights Included	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Student-level Covariates	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
# of Observations	7,217	7,217	7,217	7,217	7,217	7,217	7,217	7,217	7,217	7,217	7,217	7,217

*Notes. Standard errors in parentheses; + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 5: RD Effects on Graduate School Enrollment (by Student Groups)

	IV Estimates of Pell Grant Receipt			
	Any Graduate Program	Master's Program	Doctoral Program	Professional Degree Program
All Students	-0.010	-0.023	0.011	0.018
	(0.054)	(0.068)	(0.032)	(0.047)
White Students	-0.045	-0.046	0.031	0.001
	(0.080)	(0.067)	(0.030)	(0.041)
Black / African American Students	-0.212	-0.533	0.046	0.332*
	(0.313)	(0.339)	(0.049)	(0.168)
Hispanic / Latino Students	-0.001	0.110	0.002	-0.018
	(0.528)	(0.481)	(0.169)	(0.036)
Asian / Pacific Islander Students	-0.179	0.133	0.002	-0.319
	(0.403)	(0.424)	(0.169)	(0.324)
First-Generation Students	-0.079	-0.094	0.002	0.018
	(0.087)	(0.090)	(0.169)	(0.049)
Functional Form	Linear	Linear	Linear	Linear
Survey Weights Included	Yes	Yes	Yes	Yes
Student-level Covariates	Yes	Yes	Yes	Yes

Notes. Standard errors in parentheses; + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001