LOOKING BEYOND ENROLLMENT:

THE CAUSAL EFFECT OF NEED-BASED GRANTS ON COLLEGE ACCESS, PERSISTENCE, AND GRADUATION

Benjamin L. Castleman
Harvard Graduate School of Education

Bridget Terry Long
Harvard Graduate School of Education and NBER

November 2012

ABSTRACT

Gaps in average college success among students of differing backgrounds have persisted in the United States for decades. One of the primary ways that federal and state governments have attempted to ameliorate such gaps is by providing need-based financial aid to low-income students. In this paper, we examine the impact of eligibility for the Florida Student Access Grant (FSAG) on a range of college outcomes. Exploiting the cut-off in the index used to measure a family's ability to pay for college and determine grant eligibility, we utilize a regression-discontinuity (RD) strategy to estimate the causal effect of being eligible for the grant. We investigate whether being eligible for a need-based grant increases the probability that students enter college, remain continuously enrolled, accumulate more college credits, and ultimately earn a degree. Similar to other studies, we find that grant eligibility had a positive effect on attendance. Moreover, grant aid increased short-term persistence and the cumulative number of credits students earned over time. Most importantly, we find that FSAG increased the likelihood of bachelor's degree receipt within six years at a public college or university by 22 percent among students near the eligibility cut-off. The effects are largest for academically high-achieving students.

The authors' email addresses are castle@fas.harvard.edu and bridget_long@gse.harvard.edu. This research was conducted in collaboration with the National Center for Postsecondary Research (NCPR). The contents of this report were developed under grant R305A060010 from the Institute of Education Sciences, U.S. Department of Education and generous funding from The Bill and Melinda Gates Foundation. The views expressed in this article are those of the authors and do not necessarily reflect the views of the funders. The authors thank John Willett, Richard Murnane, Thomas Bailey, and participants in seminars and conferences for their comments on earlier versions. All errors, omissions, and conclusions are our own.

I. INTRODUCTION

Despite large increases in higher education enrollment over the past several decades, the college attendance rates of youth from low-income families continue to lag behind those of their middle- and upper-income peers. Among students who graduated high school in 2008, for instance, 55 percent of students in the lowest income quintile enrolled in college within twelve months of high school graduation, compared with 80 percent of students in the highest income quintile (Baum, Ma, & Payea, 2010). Even after controlling for academic achievement, low-income students have a lower probability of enrollment than do more affluent students (Ellwood & Kane, 2000). Gaps in college degree attainment by socioeconomic status are even more pronounced. Among the high school graduating class of 1992, only 7 percent of students from families in the lowest socioeconomic quartile completed a four-year college degree by age 26, compared with 51 percent of students from families in the highest socioeconomic quartile (Haveman & Smeeding, 2006).

One primary explanation for these persistent gaps is the lack of college affordability for low-income students. Since the 1970s, the cost of college has risen at a much faster rate than have median family wages, meaning that tuition—as a share of family income—has increased steadily (ACSFA, 2010). To address this problem, federal and state governments have employed need-based financial grants to mitigate the effect of rising college costs on the postsecondary decisions of students from low-income families. The largest of these grants (both in terms of the total number of awards and total dollars awarded) is the federal Pell Grant, a need-based grant awarded to low- and moderate-income students pursuing a college education at an accredited institution.

A key policy question is whether these grants lead to improvements in students' college outcomes. To date, there has been considerable research examining the causal effect of need-based grants on college access. For instance, there is robust evidence 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 between 3 to 4 percentage points, on average, for each additional $1,000 in grant aid eligibility (Deming & Dynarski, 2009). Several recent studies have examined the long-term effect of merit-based scholarships (grants awarded on the basis of academic achievement) on whether students earn a degree (Bruce and Carruthers, 2011; Dynarksi, 2008; Scott-Clayton, 2011). One study by Bettinger, *et al.* (2012) suggests that helping students apply for federal aid like the Pell Grant does help support college persistence. However, surprisingly little research has examined the effect of need-based grants on whether students persistent, accumulate more college credits, and ultimately complete a degree, despite the fact that need-based assistance accounts for the considerable majority of all grant aid awarded by the federal and state governments. As of the 2010-2011 academic year, federal need-based grants amounted to $38.4 billion and roughly two-thirds of state spending on grant aid (The College Board, 2011; NASSGAP, 2011). During the 2009-2010 academic year, state need-based awards totaled $6.2 billion (College Board, 2010).

In this paper, we investigate the effects of need-based grant eligibility on college attainment. Specifically, we focus on the impact of eligibility for the need-based Florida Student Access Grant (FSAG) on whether students enter, remain enrolled in, and graduate from college. As such, we contribute to the literature by focusing on the longer-term effects of need-based financial aid. In the early 2000s, colleges and universities in Florida determined eligibility for the FSAG using the federal need analysis calculation.[1] During the 2000-01 school year, students whose Expected Family Contribution (EFC) was less than $1,590 were eligible for a $1,300 FSAG (2000 constant dollars); this roughly translates to families with incomes below $30,000 that year ($40,300 in 2011 dollars) being eligible for a FSAG. The state grant was sufficient to cover 57 percent of the cost of tuition and fees at an average public, four-year university in Florida (IPEDS, 2011). These students also qualified for at least a $1,750 Federal Pell Grant. In contrast, students whose EFCs were just above $1,590 were not eligible for the FSAG and only received an Federal Pell Grant (up to $1,750). Capitalizing on this threshold that determined whether students were eligible for more, or less, need-based grant aid, we utilize a regression-discontinuity (RD)

[1] Applying for federal financial aid, and often for state and institutional aid, requires a student to complete the Free Application for Federal Student Aid (FAFSA). The FAFSA collects information on family income and assets to determine the Expected Family Contribution (EFC), the amount that a family is estimated to be able to give towards higher education expenses. Other information that affects this calculation is the size of the family, the number of family members in college, and the age of the oldest parent, as well as information on the student's earnings and assets. To calculate need, the government subtracts the EFC from the total cost of attendance. A student's financial need, in combination with his or her EFC, determines whether the student is eligible for certain grants and loans.

approach to estimate the causal effect of FSAG eligibility on whether students entered, persisted in, and completed college.

Our study contributes to the scant literature on the effects of financial aid, particularly need-based aid, on college persistence and degree completion. Moreover, because we are investigating the effects of a program that is in addition to other need-based aid (i.e. the Pell Grant), our results relate to current debates about whether to increase the financial aid awards of current programs rather than questions about whether some aid is better than no aid. Most notably, there is constant debate about whether increasing the size of the Pell Grant would have an effect on college outcomes, and our results provide some insight into this question. We also investigate how need-based aid interacts with merit-based aid.

Previewing our results, we find that FSAG eligibility had a positive impact on a host of short-, medium-, and long-term college outcomes. The additional $1,300 in grant aid eligibility (in 2000 dollars) increased the probability of immediate enrollment at a public, four-year university by 3.2 percentage points while also increasing the probability of staying continuously enrolled through the spring semester of students' freshman year by 4.3 percentage points. Most importantly, the additional $1,300 in aid eligibility increased the probability of earning a bachelor’s degree within six years by 4.6 percentage points, or 22 percent. FSAG had a particularly pronounced impact on students with higher GPAs in their senior year, both those who qualified for the state merit-based scholarship, Bright Futures, and separately students who had high senior year GPAs but did not qualify for Bright Futures.

We structure the remainder of the paper into four sections. In Section II, we review the existing literature on college access and success pertinent to our examination of need-based grants. In Section III, we describe our research design. Section IV presents our results of the causal effects of need-based grants on college access, persistence, and graduation. Section V concludes and discusses the implications of the results for policy and research.

II. LITERATURE REVIEW

Research on the Impact of Aid on College Enrollment

Economic theory predicts that financial aid may influence the college-going decisions of low-income students. In his model of human capital investments, Becker (1964) suggests that students will pursue a college education if the perceived present discounted value (PDV) of the benefits of higher education exceeds the PDV of the costs of going to college. Thus, by reducing the cost of going to college, financial aid may lower the real or perceived cost of attendance to the point where students on the margin of enrolling decide to matriculate.

The findings from the empirical literature are largely consistent with this prediction. Researchers have consistently found positive effects on college enrollment for grant programs that have transparent eligibility criteria and straightforward application processes (Deming and Dynarski, 2009). In an examination of the Social Security Student Benefit Program, which awarded substantial grants to the children of deceased, disabled, or retired Social-Security beneficiaries up until 1982, Dynarski (2003) found that a reduction in grant aid eligibility by $1,000 led to a 4 percentage point reduction in college enrollment. Kane (2003; 2004) found effects of a similar magnitude associated with eligibility for the Cal Grant and the D.C. Tuition Assistance Grant, which provided grants for students to attend four-year colleges in California and allowed D.C. residents to pay in-state tuition rates at public universities across the country, respectively. Dynarski (2000; 2004) found even larger effects (4 to 6 percentage points) for programs that were highly publicized and had clear, transparent rules determining the amount of aid for which students were eligible.

Research on the Impact of Aid on Persistence and Degree Completion

While theory and the research literature suggest that financial aid can impact initial college enrollment positively, economic theory is more ambiguous about the effect of financial aid on whether students *succeed* in college. Aid may have an indirect positive effect on academic success for students who have already committed to enrolling, reducing, for example, the amount of time that students need to work once they are enrolled. At the same time, aid may have no effect on college performance, or possibly a negative one, if the offer of grant aid induces students with a low probability of academic success to enroll because the financial costs they incur for their educations are artificially lowered.

Several recent studies have examined the impact of state merit-based scholarship programs on students' longer-term success in college. Dynarski (2008) found that the introduction of state merit scholarships in Arkansas and Georgia led to increases in the share of the population in each state with college degrees within 10 years of when the programs were introduced. Scott-Clayton (2011) found that students who were just above an arbitrary cut-off in the ACT exam score that determined whether students were eligible for the West Virginia PROMISE scholarship were 6.7 percentage points more likely to earn a bachelor's degree within four years than students just below the eligibility threshold. Similarly, Bruce and Carruthers (2011) exploited a cut-off in the ACT score that determines eligibility for Tennessee's HOPE merit scholarship to examine the effect of the grant on students' longer-term college attainment. In contrast to Dynarski (2008) and Scott-Clayton (2011), the authors found little evidence that Tennessee HOPE had a positive impact on whether students earned a degree.[2]

An open question is whether the results of these studies generalize to the impact of need-based grants on students' college attainment. One primary concern is that merit-based scholarships target a different population of students, on average, than the population of students targeted by need-based grants. For instance, in Florida, of students who qualified for the merit-based Bright Futures Scholarship in 2000, 78 percent were White and only 9 percent qualified for free or reduced lunch. By contrast, of students who qualified for the need-based Florida Student Assistance Grant, only 32 percent were White and 40 percent qualified for free or reduced lunch.

Very little research has investigated the effect of need-based grants on whether students persist in and complete college. The relative paucity of research on the long-term impacts of need-based grants can be attributed to three intertwined challenges.[3] First, until recently, little longitudinal data has been available to track students' success in college after the point of initial enrollment. Second, aid is not awarded randomly, and so it is methodologically difficult to separate out the unique effect of grant

[2] The level of academic achievement required to qualify for a merit scholarship varied across the states. Arkansas required students to have a composite score of 19 or above on the ACT, and a cumulative high school GPA of 2.5 or higher. Georgia required students to have a cumulative high school GPA of 3.0 or higher. Both West Virginia and Tennessee required students to have an ACT score of 21 or higher and a high school GPA of 3.0 or higher.

[3] While recent studies documenting the impact of merit-based aid on degree attainment have overcome these challenges, we are not aware of a study investigating the long-term impacts of need-based grant aid that has managed to do so.

eligibility from all of the other factors that influence whether students succeed in college. Without a source of exogenous variation in whether students are eligible for a grant or not, estimates of the effect of grant eligibility on degree attainment could be biased in either direction. Students who receive need-based aid may be more likely to succeed in college because they were motivated enough to seek out additional financial resources and complete the necessary application forms. This would lead to an overestimate of the effect of need-based aid eligibility on college attainment. Alternatively, student aid recipients could be less likely to earn a degree if need-based aid eligibility is correlated with factors that are traditionally barriers to degree attainment (e.g. having less academic preparation). This in turn would lead researchers and policymakers to underestimate the effect of need-based aid eligibility on college attainment.

The final challenge in evaluating the impact of grant aid on student outcomes is that aid eligibility itself may affect enrollment in college, a necessary pre-cursor to a college credential. To illustrate this point, suppose for a moment that eligibility for a need-based grant is truly random so that eligible and non-eligible students are equal in expectation at the time they are notified of whether they receive the grant. Differences in enrollment rates between the two groups could then be attributed to the unique effect of grant eligibility, and it is quite likely that the subset of grant-eligible students who enroll in college differs substantively in non-random and meaningful ways from the subset of non-recipients who enroll in college. Because only a subset of each group would choose to enroll in college, and thus even have the possibility of completing a college degree, if one were just to compare the enrollees of each group when trying to establish the effect of aid on persistence, then one would violate the equal-in-expectation assumption on which causal inference rests. To address this concern, researchers have focused on intent-to-treat (ITT) estimates of the effect of financial aid. In contrast to treatment-on-the-treated (TOT) effects, which would focus on students who actually received the aid, ITT estimates include all students in the analysis, regardless of whether they enrolled and received the aid or not (i.e. all high school seniors). The advantage of this approach is that it avoids the endogeneity problems associated with conditioning the analysis on whether students initially enrolled in college. On the other hand, the set of research questions one can investigate using ITT estimates is different. For instance, it permits one to examine whether aid-*eligible* high-school seniors received a college degree by a certain year, and because only eligibility can be regulated by a policy, the ITT is the true estimate of the effect of the aid policy rather than the aid itself. Although this methodological concern is particularly relevant for understanding the effects of aid on college degree completion, researchers who examine the impact of aid on initial college enrollment also often focus on the ITT so that they can determine the effect of an aid *policy*, realizing that some students who are eligible for an aid award may not actually receive it.

A number of researchers have overcome the latter two challenges by identifying a source of quasi-random variation in why some students qualified for need-based aid while others did not. Some studies have only focused on the effect of need-based aid on college enrollment (e.g., Hansen, 1983; Kane, 1995; Kane, 2003), while others relied on data sources which provided coarse measures of students' educational attainment (e.g., Dynarski, 2003). None of these studies, however, have examined the impact of need-based aid on detailed measures of students' progress through, and completion of college. One exception, Bettinger (2004), exploited variation in the size of students' Pell Grant awards, based on changes in the eligibility formula over time and differences in family size, to investigate the effect of increases in Pell Grant eligibility on whether students stopped out of college. While Bettinger found suggestive evidence of the Pell Grant having a positive impact on college persistence (i.e. reducing the likelihood of a student stopping out), these results were sensitive to model specification and did not consider longer-term student outcomes including degree attainment.

Extending the Literature: Financial Aid in Florida

This paper focuses on the following research question: does eligibility for additional need-based grant funding (above the federal Pell Grant) increase the probability that a student will enroll in college, stay continuously enrolled, accumulate credits, and ultimately earn a degree? By focusing on this question, we hope to build on prior research in two concrete ways. First, we avoid the potential biases evident in some of the past research by exploiting a cut-off score in the index used to measure a family's ability to pay for college as a source of exogenous variation in whether students were eligible for a need-based grant in Florida. The actual cut-off received very little publicity, and the index was computed based a complicated algorithm that would be very difficult for families to replicate even if they were aware of the eligibility formula. Therefore, this cut-off provides a source of variation in aid eligibility that approaches randomization and can be used to estimate causal effects. Second, by drawing on state administrative data, we are able to examine the effect of need-based grant eligibility on outcomes (longer-term persistence, credit completion, and degree attainment) that have not been rigorously examined in prior studies of the causal effects of need-based aid.

To investigate our research question, we focus on Florida high school seniors in the 2000-01 school year. Florida offers many advantages as the geographic focus for our analysis. It is the fourth largest state in the country (U.S Census Bureau, 2010). Fourteen of the 100 largest school districts in the 2008-2009 academic year were located in Florida (NCES, 2010). Florida also represents the increasing racial and ethnic diversity of the country as a whole: 16 percent of its residents are Black, and 23 percent of its residents are of Hispanic or Latino origin (U.S Census Bureau, 2010).

Specific to the context of financial aid, in addition to federal grants and loans, Florida students could qualify for both need- and merit-based state grants. Each year, families must complete the Free Application for Federal Student Aid (FAFSA), which asks for information on income, assets, and family size. Using this information, the United States Department of Education (USDOE) estimates the families' ability to pay for college, which is called the Estimated Family Contribution (EFC). The USDOE uses the EFC, along with the cost of attendance at students' intended institutions, to determine each student's eligibility for financial aid like the Pell Grant. States also use the EFC to award need-based grants; during the 2009-2010 academic year, state need-based awards totaled $6.2 billion (College Board, 2010). To apply for the need-based FSAG, students needed to complete the FAFSA by March 1st of their senior year in high school. The Florida Department of Education sets annually a "maximum expected family contribution," which during the 2000-2001 academic year (the focal year of this analysis) was an EFC of $1,590 (Florida Postsecondary Education Planning Commission, 2001). Institutions were prohibited from awarding grants to students whose families exceeded this maximum (Florida Gen. Laws ch. 240, § 409), thus making this a sharp eligibility cut-off. Students could use the FSAG at any public two- or four-year college or university in Florida. During the 2000-01 academic year, the FSAG award amount for which students were eligible ($1,300) was sufficient to pay 57 percent of the average cost of tuition and fees at a public university in the state or about 28 percent of the average cost of tuition/fees, room, and board (IPEDS, 2011). Added on top of the federal Pell Grant, which all students around the FSAG cutoff were eligible to receive, students could receive up to $3,050 in need-based grants. The FSAG was also renewable from one year to the next, conditional on students being financially-eligible and maintaining a cumulative college GPA of 2.0 or higher.[4]

In addition to FSAG, students were also eligible for the merit-based Florida Bright Futures Scholarship. There were (and still are) two tiers of Bright Futures Scholarships. The lower tier, the Florida Medallion Scholars award (FMS), covered 75 percent of the cost of tuition and fees at public colleges and universities (or the monetary equivalent at in-state private institutions) for students who completed 15 core academic credits, had a cumulative weighted high school GPA of 3.0 or higher, and a composite SAT score of 970 or higher. During the 2000-01 school year, this amounted to about $1,700. Seventy percent of students who received a BFS award in the 2000-2001 academic year received a Medallion Scholars award.[5] The higher tier, the Florida Academic Scholars award (FAS), covered 100 percent of the cost of tuition and fees at public colleges and universities (or the monetary equivalent at in-state private institutions) along with a small living stipend. During the 2000-01 school year, this amounted to about $2,500. The Florida Academic Scholars award was offered to students who complete 15 core academic credits, had a cumulative weighted high school GPA of 3.5 or higher, and a composite SAT score of 1270 or higher. In our sample, about 30 percent of students were also eligible for Bright Futures, but important to our research methodology, this proportion does not vary around the cutoff for FSAG. We control for Bright Futures eligibility in our analysis to account for these other possible sources of aid.[6]

[4] There is no limit on the number of years for which students can renew the FSAG award.

[5] Note that in the 2000-2001 year, the Florida Medallion Scholars was referred to as the Florida Merit Scholars.

[6] In a separate study we exploit the interplay of the FSAG and BF eligibility rules as the source of identification to estimate the causal effect of being eligible for a need- and/or merit-based grant on students' college outcomes. The two studies entail entirely different student samples, In our other work, we condition both on students who have a non-missing EFC and the academic criteria that determines eligibility for the Bright Futures Scholarship. In this paper, we condition only on students who have a non-missing EFC. This allows us to draw inferences about the effect of FSAG eligibility on a larger group of low-income high-school seniors on either side of the EFC cut-off since the Bright Futures Scholarship targets a smaller subset of low-income, academically-accomplished students.

Figure 1 summarizes how the total grant aid for which students were eligible varied based on very small differences in family resources. Focusing on the area around the cutoff for FSAG, students ineligible for the Bright Futures Scholarship were eligible to receive $3,050 in total FSAG and Pell Grant funding if their EFC was less than $1,590, or only $1,750 in Pell Grants if their EFC was above $1,590. For students who met the criteria for Bright Futures eligibility, being above or below the FSAG cutoff resulted in the same difference in aid, but the levels of grant aid were higher. Students who were eligible for the lower tier of Bright Futures (BF-FMS) and who were just below the FSAG cut-off qualified for $4,750 in total BF-FMS, FSAG, and Pell Grant funding, while students who were eligible for the lower tier of Bright Futures and who were just above the eligibility threshold qualified for $3,450 in BF-FMS and Pell Grant funding (a difference of $1,300). Students who were eligible for the higher tier of Bright Futures (BF-FAS) and who were just below the FSAG cut-off qualified for $5,650 in total BF-FAS, FSAG, and Pell Grant funding, while students who were eligible for the higher tier of Bright Futures and who were just above the eligibility threshold qualified for $4,350 in BF-FAS and Pell Grant funding (a difference of $1,300). In our analyses, we examine the impact of being just below the FSAG eligibility cut-off on students' college outcomes, holding constant BF eligibility.

III. DATA AND RESEARCH DESIGN

Data

The data for this paper are from the Florida Department of Education K-20 Data Warehouse (KDW), which maintains longitudinal student-level records from primary school through postsecondary study at Florida public colleges and universities. We have data from the KDW secondary-school records, including demographics, high school transcript records, and college entrance examination scores. These data are linked to the KDW postsecondary data so that we also have the financial information that families supplied while completing the FAFSA and any private, institutional, state, or federal financial-aid disbursements students received while enrolled. The postsecondary data also tracks students' enrollment and course-taking histories, major(s) pursued, and degrees received.

While this data set does not include the postsecondary outcomes of students who attend out-of-state or private institutions, it captures college enrollment and completion records for a considerable majority of college-bound low-income Florida high school seniors. In the 2000-2001 academic year, 90 percent of Florida residents who enrolled in college for the first time did so at in-state institutions. During the same year, 74 percent of first-time freshmen attending college in Florida enrolled in public institutions (NCES, 2002). Low-income Florida residents may have been particularly unlikely to attend private or out-of-state colleges given that the average cost of attendance at these institutions was considerably higher than at Florida public colleges and universities.

For this analysis, our sample contains students who were seniors in Florida public high schools during the 1999-2000 academic year. From these 101,094 students, we restrict our analytic sample to include only students who submitted a FAFSA application since only they were eligible for both federal and state need-based aid. High-school seniors who did not submit the FAFSA likely differ on a number of dimensions from the students who did. For instance, they may not be intent upon enrolling in college or may not know about the FAFSA. Alternatively, students who do not complete the FAFSA may come from wealthy families and, therefore, assume that they are not eligible for aid. This restriction resulted in the exclusion of 55,309 students from our sample.[7] We discuss the implications of this sample restriction to the external validity of our results in Section V.

In Table 1, we present selected descriptive statistics for the full sample of students (column 1) and compare them with the same statistics for the sample after we impose our FAFSA-submission restriction (column 2) and to the sample used in the analysis of students who fall within a narrow window of the EFC cut-off for FSAG eligibility (±$1,000) and have complete information (column 3).[8] Notice that there are differences between the full census of public high school students in Florida and the sample of students who completed the FAFSA. For instance, the analytic sample is more heavily female than the full sample (59 versus 53 percent, respectively) and has a greater percentage of students of color (35 percent Black and Hispanic students in the full sample compared with 45 percent in the analytic sample).

[7] We drop 58 additional observations for students for whom we lack basic demographic information.

[8] As discussed below, +/-$1,000 is the optimal bandwidth for this analysis based on Imbens and Kalyanaraman's (2009) method for bandwidth selection.

On the other hand, students in the full sample have very similar high school senior year mean GPAs (2.84) to students in the analytic sample (2.87).

When we start to focus on a narrow window around the EFC cut-off for FSAG eligibility, we see additional differences in the sample.[9] Given our focus on a need-based aid program, the sample used for the analysis has lower parental incomes on average ($43,680 for the FAFSA sample compared with $28,035 within the narrow window around the cut-off). The sample for the analysis also has a somewhat higher proportion of students of color. However, there appears to be little difference in high school academic performance: the mean senior year GPA differs only by 0.04 from the full census of public high school seniors during 1999-2000.

Empirical Strategy

We use a regression-discontinuity (RD) approach to estimate the causal effect of FSAG eligibility on whether students enter, accumulate credits, remain continuously enrolled in, and complete college. Under this approach, we estimate and compare the probability of each college outcome for students just below the FSAG cut-off to students who are just above the cut-off. The RD design allows us to infer the effects of being eligible for the FSAG grant for students who are on the margin of grant eligibility (Shadish, Cook, & Campbell, 2002; Murnane & Willett, 2010). By virtue of focusing on intent-to-treat (ITT) estimates, we are able to employ a "sharp" RD design (Imbens & Lemieux, 2008). This means that we can directly interpret a jump in the probability of entering, remaining continuously enrolled in, or completing college at the FSAG cut-off as the causal effect of FSAG eligibility. The results will be relevant to marginal students around the cutoff but not necessarily infra-marginal students far from the threshold.

To estimate the causal effect of FSAG eligibility on college entry and attainment we fit the following statistical model:

[9] We selected this bandwidth using the Imbens-Kalyanaraman (2009) procedure for choosing optimal bandwidths. While optimal bandwidths vary for each outcome, the bandwidth of +/- $1,000 is common across several outcomes, and bandwidths for other outcomes are as wide or wider.

$$(1)\ COLLEGE_{ij} = \beta_0 + \beta_1 EFC_{ij} + \beta_2 FSAG_{ij} + \beta_3 FSAG_{ij} x EFC_{ij} + \gamma ACAD'_{ij} + \delta DEMOG'_{ij} + \rho SCHOOL'_{ij} + \epsilon_{ij}$$

where *COLLEGE* is one of several outcomes of interest corresponding to college entry, persistence, and success for student *i* attending high school *j* as a senior. *EFC* measures students' Estimated Family Contribution to college, and is centered at the FSAG cut-off. FSAG is an indicator variable that takes on the value of "1" if students are below the FSAG cut-off, and zero otherwise. The interaction of FSAG eligibility and EFC, captured by *FSAG x EFC*, allows the slope of the relationship between EFC and each outcome to vary on either side of the FSAG eligibility cut-off; *ACAD* is a vector of academic covariates, and *DEMOG* is a vector of demographic covariates. *SCHOOL* is a vector of high school fixed-effects to control for school-specific (and by proxy, neighborhood-specific) effects on students' educational attainment. ε_{ij} is a residual error term. We cluster errors at the high-school-level to adjust for the potential correlation of residuals within school. In this model, parameter β_2 is our coefficient of interest and describes the causal effect of being just below the FSAG cut-off on the probability that students will enter and/or succeed in college.

As indicated in equation (1), we incorporate a broad range of academic and demographic covariates into our analyses. We include measures of students' senior year high school GPA, whether students participated in a gifted and talented program during high school, parents' adjusted gross income as reported on the FAFSA, and students' gender, race/ethnicity, disability status, and age during senior year of high school. We also include a dummy variable that indicates whether students were eligible for a Bright Futures scholarship award to account for the potential effect of other financial aid eligibility on students' observed college outcomes.[10]

Using Imbens and Kalyanaraman's (2009) method for bandwidth selection, we determined a separate optimal bandwidth around the EFC cut-off for each outcome. The selection of bandwidth is a critical decision in RD analyses: the wider the bandwidth, the greater the statistical power to detect an effect. At the same time, however, a wider bandwidth makes it more difficult to appropriately model the

[10] Because all students are Pell eligible on either side of the cut-off for FSAG eligibility, and because Pell Grant awards are a linear function of EFC, the coefficient on EFC captures differences in Pell Grant receipt which may also contribute to differences in total aid received by students in our analytic sample.

functional form of the relationship between the forcing variable and the outcome. To examine the sensitivity of our results to the choice of bandwidth, we re-fit our models using varying window widths, and separately test polynomial specifications of the relationship between EFC and each outcome. We describe these sensitivity analyses in more detail in section IV.

We note two limitations to the external validity of our analyses. First, our inferences are limited to the effect of FSAG eligibility on whether students access and succeed at Florida public universities. Students who enrolled at a private or out-of-state institution would not appear in our data set, and we are unable to observe degree receipt at other types of institutions. While we do not directly observe enrollment at private in-state institutions, we do observe whether students received the Florida Resident Assistance Grant (FRAG), awarded to students attending four-year, private institutions in the state. We can therefore infer attendance at in-state private institutions based on FRAG receipt and investigate whether any college entry effects we observe are driven by inducing students away from attending private institutions.[11] Our findings are also of interest since most college students in Florida attend public institutions, and the findings are therefore drawn from a population that captures the college experiences of most students in the state. To the degree that Florida is demographically and socioeconomically representative of other large states in the country, our findings should also be relevant to the broader question of how state need-based financial aid impacts enrollment, persistence, and degree completion at in-state public institutions.

Second, given our sample restrictions, our inferences apply to low-income students with sufficient financial know-how and/or family- and school-based supports to complete the FAFSA. These students represent only a subset of college-bound low-income students. On the other hand, given the policy goal of increasing college success among socioeconomically disadvantaged students, one way to view this sample is as a subset of low-income students who are well-positioned to benefit from need-based aid.

[11] Booker *et al.* (2008) use this strategy in their examination of the impact of charter school attendance on college-going in Florida.

Testing for Statistical Equivalence around the Cutoff

The key assumption underlying an RD strategy to estimate causal effects is that students immediately on either side of the cut-off are “equal in expectation.” That is, we assume that students are equivalent, on average, on all observed and unobserved dimension and differ only in terms of whether they are eligible for the FSAG grant. One implication of this assumption is that the density of students should be smooth across the FSAG eligibility cut-off; an atypical spike in the density of students just below the cut-off could be evidence that students were manipulating their EFCs to position themselves to be eligible for the grant. This endogenous sorting would violate the equality-in-expectation assumption on which RD strategies depend (Urquiola & Verhoogen, 2009). In the case of the FSAG award this does not appear to be a major concern. Neither the Florida Department of Education Office of Student Financial Assistance website nor individual university financial aid websites made mention made of the specific EFC cut-off used to determine eligibility for FSAG. While Florida statutes from the time period refer to a maximum EFC beyond which students would not be eligible for the FSAG, an exhaustive search found only one document from the Florida Postsecondary Planning Commission (2001) that tangentially referenced the actual EFC cut-off. Given the difficulty low-income students often experience in completing complicated financial aid eligibility applications, combined with the amount of effort required to deduce the algorithm for calculating the EFC, it is unlikely that students in our study strategically positioned themselves around the EFC cut-off to receive FSAG grant funds.

We employ McCrary’s (2008) density test to provide statistical support for the argument that strategic positioning does not appear to be a major concern in our analyses. In Figure 2 we present a graphic depiction of this density test that compares students within ±$1,000 of the FSAG eligibility cut-off. A spike in the density of observations on either side of the cut-off would suggest that students were strategically positioning their EFC levels to be just above or below the cut-off. However, in Figure 2 the density of observations appears smooth across the cut-off. Therefore, endogenous sorting does not appear to be a major concern.

To further test the assumption of statistical equivalence, we regressed FSAG eligibility on a host of student-level academic and demographic covariates. If students were indeed equal in expectation on either side of the cut-off, we should find that the covariates jointly fail to predict variation in whether students were FSAG-eligible or not. We performed this analysis within a variety of narrow windows around the FSAG cut-off since we expect students to differ on both observed and unobserved dimensions the further we move away from the cut-off. In each analysis, we conducted an F-test to evaluate the null hypothesis that the covariates jointly failed to explain variation in whether students were FSAG-eligible. We present the results of these tests for baseline equivalence in Table 2.[12] We fit the regressions in progressively wider bandwidths, starting with ±$250 in column 1 and ending with ±$1,000 in column 4. All four columns include high school fixed effects. The key result, the p-value associated with the F-test for joint significance of the covariates in each model, are presented in the last row of Table 2.. Across all window widths, we fail to reject the null hypothesis that FSAG-eligible and ineligible students are statistically equivalent. These findings reinforce our use of the RD strategy to estimate the causal effects of need-based grant aid on students near the eligibility cut-off.

IV. RESULTS

Graphical Analysis

Following Imbens and Lemieux (2008), we begin our analyses with graphical descriptions of the bivariate relationship between the forcing variable (EFC) and our outcomes of interest. In Figure 3 we present a scatter plot with the forcing variable on the horizontal axis and the dependent variable on the vertical axis. Each point on the plot represents the mean value of the dependent variable within a $50 bin of EFC (which we have centered at the FSAG cut-off). We then superimpose upon these scatter plots linear regressions on either side of the cut-off to account for any secular trend in the bivariate relationship.[13] We focus on the bivariate relationship between EFC and four of the outcome variables used in our analysis: immediate enrollment in college assuming on-time high school graduate (i.e. fall 2000) in the top left; continuous enrollment into the spring of 2001 (top right); credits accumulated by the

[12] We also conducted individual t-tests of each covariate by FSAG eligibility through which we reached the same conclusion: based on observables, students appear to be equivalent on either side of the cut-off.

[13] In these plots and in all subsequent tables, the time periods (e.g., "3 years") refer to the length of time assuming entry into college the immediate fall after on-time high school graduation in spring 2000

spring of 2003, three years after on-time high school graduation (bottom left); and receipt of a bachelor's degree by the spring of 2006, six years after on-time high school graduation (bottom right). We selected these outcomes to explore the effect of FSAG eligibility on a range of short-, medium- and long-term college outcomes.

By visual inspection, it appears that FSAG eligibility has a substantial effect on all four college outcomes. As shown in Figure 3a, students just below the cut-off (i.e. students eligible for FSAG) appear to enroll immediately in college at a rate approximately four percentage points higher than students just above the cut-off (i.e. students not eligible for FSAG). The effect of FSAG eligibility on continuous enrollment into the spring of 2001 (Figure 3b) appears to be slightly larger in magnitude compared to the effect on immediate enrollment. Students just below the cut-off appear to accumulate roughly three more credits after three years than students above the FSAG threshold (Figure 3c). Most notably, as shown in Figure 3d, FSAG-eligible students appear to be approximately five percentage points more likely to earn a bachelor's degree within six years than students just above the cut-off. In short, this graphical analysis suggests that FSAG eligibility has a positive effect a range of short-, medium-, and long-term college outcomes.

RD Analysis: The Effects on Enrollment, Persistence, and Degree Completion

We now turn to the results of fitting our statistical models to the data, which largely confirm the conclusions from the graphical analyses above. In Table 3, we present results from our RD analyses of the main effect of FSAG eligibility on enrollment-related and early persistence outcomes. The first row in Table 3 presents the coefficient associated with the impact of FSAG eligibility on each outcome. Although ±$1,000 is the optimal bandwidth for most outcomes, we calculated a unique optimal bandwidth for each outcome using the Imbens-Kalyaranaman (2009).

The first four columns display the effect of FSAG eligibility on enrollment during Fall 2000, which was immediately after on-time high school graduate. We find that eligibility for FSAG increased the probability that students enrolled in any college immediately following high school by 3.2 percentage points (column 1), though this effect is imprecisely estimated and below the margin of statistical significance.[14] The results in column 2 imply that the impact of FSAG eligibility on whether students enroll is driven almost entirely by inducing students to attend a public, four-year university: students who were just below the FSAG cut-off were 3.2 percentage points more likely to enroll at a four-year university than students just above the cut-off. Compared to a mean four-year enrollment rate of 26 percent for the total sample of students within the EFC window of ±$1000, this effect represents a 12 percent increase.

The third column reflects whether students enrolled at an in-state private, four-year college or university based on whether they received the non-need-based Florida Resident Assistance Grant (FRAG), which is awarded to students who attended eligible in-state private institutions. This gives us a partial view of enrollment effects beyond Florida public institutions.[15] Our results suggest that there was no impact of FSAG eligibility on attendance at private institutions (column 3). Likewise, FSAG-eligible students were also not more likely to enroll in a Florida community college (column 4). Together, these results suggest that the FSAG impacts on enrollment are from drawing new students into college (not away from other in-state schools) or from pulling students who would have enrolled out-of-state back into the state. In column 5, we present the impact of FSAG eligibility on whether students enrolled at college at any point during the period in which we observe them in the data set (i.e. through the 2006-07 academic year). Students below the threshold were 2.5 percentage points more likely to enroll in college at some point within seven years (column 5), but the effect is not statistically significant.

The final two columns examine the effect of FSAG eligibility on different durations of continuous enrollment: whether students were continuously enrolled from fall 2000 into the spring of 2001 (i.e., through the first year) in column 6 and into the fall of 2001 (i.e., into the second year) in column 7. In the near term, FSAG eligibility has a positive impact on whether students stay continuously enrolled: students who were just below the cut-off were 4.3 percentage-points more likely to remain

---

[14] In analysis not shown, we find that students who qualified for need-based aid in Florida were 3.6 percentage points more likely to enroll full-time, but this effect is imprecisely estimated and not statistically significant.

[15] The Florida Resident Assistance Grant was a non-need-based tuition assistance grant of $2,800, designed to offset the cost of tuition at private institutions. Eligible institutions included secular, non-profit institutions that granted bachelor's degrees and that received regional accreditation. Students attending eligible in-state private colleges full-time automatically received the grant, so it is a good indicator of attendance at those institutions.

continuously enrolled into the spring semester of 2001 (column 5). This represents a 7.8 percent increase above the mean continuous enrollment rate of 55 percent for the analytic sample. It is important to note that this outcome, and those that follow, are not conditional on enrollment. As such, these are ITT effects rather than the impact of FSAG on actual recipients or college attendants. FSAG eligibility appears to also have increased the probability that students below the cut-off remain continuously enrolled into the fall of 2002 (column 6), though the coefficient on FSAG is slightly below the margin of significance.

While students clearly need to remain enrolled to eventually earn a degree, continuous enrollment is a coarse measure of students' progression towards graduation. Two prototypical students could both stay in college for the same time period following high school but have completed a markedly different number of credits towards graduation. Similarly, a student who completed two semesters with full course loads but then took a semester off would still be further along than a student who remained continuously enrolled over the same time period but who only completed a handful of courses. To explore student progress to completion in more detail, we therefore examined whether FSAG eligibility affected students' cumulative credit completion through their first four years of college. The five columns in Table 4 pertain to the effect of FSAG eligibility on different time periods over which students could accumulate credits based on the assumption of on-time high school enrollment and immediate college entry: after one semester (i.e. Fall 2000) in column 1; after one year (i.e. Spring 2001) in column 2; after two years (column 3); after three years (column 4); and after four years (column 5). Once again, we adopt the same organization of rows as with Table 3.[16]

After the first semester following high school, students below the cut-off complete essentially the same number of credits as students just above the threshold (column 1). A full-year after high school (column 2), FSAG-eligible students earned 0.90 credits more than students just above the cut-off. By two years following high school, this margin had widened to 2.1 credits (column 3). This margin widens

[16] We obtained the results that follow by fitting linear probability models (LPM) to the data. However, because many students do not complete any college credits at a Florida public college or university, there is a large density of students with a value of "0" for each measure, and so Tobit models might be more appropriate. To test this, we explored the sensitivity of our findings by fitting Tobit models to the data. The point estimates on FSAG eligibility in the Tobit models are approximately a full credit larger across each time period. We present the results from the LPM models as a more conservative estimate of the impact of FSAG eligibility on students' credit accumulation. See Appendix Table 2 to compare the LPM and Tobit results for selected credit outcomes.

further after three years: FSAG-eligible students earned 2.9 more credits than students above the threshold; this represents a 9.4 percent increase over the analytic sample mean of 30.9. Put in different terms, students just below the cut-off were approximately one course ahead of students just above the cut-off after three years. Students just below the cut-off essentially maintain this margin after four years following high school (column 4).

In Table 5, we present results of the main effect of FSAG eligibility on whether students earn an associate's or a bachelor's degree. The first three columns pertain to the impact of FSAG eligibility on whether students earned an associate's degree within a certain number of years following on-time high school graduation: by the spring of 2003 or three years later (column 1); 2004 or four years later (column 2); and 2005 or five years later (column 3). The latter four columns present the effect of FSAG eligibility on whether students earned a bachelor's degree by the spring of 2004 (column 4); 2005 (column 5); 2006 (column 6); and 2007 (column 7). As shown, eligibility for the FSAG award had essentially no impact on whether students earned an associate's degree (columns 1-3), nor did it appear to increase the probability that students earned a bachelor's degree in four years (column 4). FSAG eligibility did, however, have a positive effect on whether students earned a bachelor's degree in five, six, and seven years. Students just below the cut-off were 3.2 percentage points more likely to earn a bachelor's degree by the spring of 2005 (column 5); 4.6 percentage points more likely to earn a bachelor's degree by the spring of 2006 (column 6); and 5.2 percentage points more likely to earn a bachelors' degree by the spring of 2007. These latter effects represent a 22 and 21 percent increase over the analytic sample mean probability of graduating in six or seven years, respectively.

RD Analysis: The Heterogeneous Effects of FSAG

The effects of FSAG may differ by type of student. As discussed in the literature review, previous studies have found merit-based aid to have an impact on persistence. These effects may be attributable to the relative transparency of merit-based aid programs, such as the Georgia Hope Scholarship. They may also indicate that academically-accomplished students' college outcomes are more responsive to either reductions in college costs or the performance incentives embedded in the requirements of many merit-based programs. Therefore, in Table 6, we explore the effects of FSAG eligibility on bachelor's degree attainment within six years after on-time high school graduation by the level of student achievement in high school.[17]

In column 1, we interact FSAG eligibility with high school senior year GPA and find a positive relationship, with a one-point increase in GPA being associated with an increase of 4.2 percentage points. We explore the relationship further by fitting a separate model (column 2) in which we use dummy variables for GPA quartile in place of the continuous GPA measure (with the second quartile being the excluded baseline category). We find that FSAG eligibility had a particularly pronounced impact for students with higher senior year GPAs: students with high school GPAs in the top 25 percent (GPA of at least 3.4; mean GPA 3.68) experienced much larger effects from FSAG eligibility relative to students in the second quartile (mean GPA 2.66). Relative to FSAG-eligible students in the 2nd GPA quartile, students in the 4th quartile who were just below the FSAG cut-off were 6.5 percentage points more likely to earn a bachelor's degree within six years.

Based on these estimated effects, one might wonder whether what we actually see is the effect of being eligible for both FSAG and the Bright Futures Scholarship, the state merit-based grant awarded partially based on high school GPA. Therefore, column 3 displays the results of interacting FSAG eligibility with Bright Futures eligibility. Though we estimate a positive relationship, it is not statistically significant and does not exactly mirror the results for students in the top 25 percent of the GPA distribution. This is at least partially be due to the fact that one-third of students with a high school GPA in the top 25 percent were not eligible for Bright Futures.[18] When jointly testing FSAG and FSAG-Bright Futures interaction for statistical significance, we do find a positive effect (p-value=0.02). The next column confirms this conclusion that FSAG eligibility has a pronounced impact for BF-eligible students.

[17] We also explored whether the effects of FSAG eligibility differed by student demographics using interactions with dummy variables for student gender (comparing the effects for female versus male students) and separately by race/ethnicity (comparing the effects for white versus black, Hispanic, and Asian students). None of these results were statistically significant.

[18] This often appears to be due to not meeting the test score requirements of Bright Futures. Students qualify for a BF Medallion Scholars award if they completed 15 core academic credits in high school, had a cumulative high school GPA of 3.0 or higher, and had a composite SAT of 970 or higher (or a composite ACT exam of 20 or higher). To qualify for the higher-tier FAS Scholars award, students needed to complete 15 core academic credits in high school, have a cumulative high school GPA of 3.5 or higher, and have a composite SAT of 1270 or higher (or a composite ACT exam of 28 or higher).

In column 4, we extend the analysis by investigating the results of splitting the sample by Bright Futures eligibility. Students who were eligible for FSAG *and* Bright Futures were estimated to be 9.1 percentage points more likely to complete a bachelor's degree within six years of assumed on-time high school graduation than students who were just eligible for Bright Futures. Based on the higher sample mean (a six-year completion rate of 44 percent for BF-eligible students compared to 21 percent for the entire analytic sample), this translates into a 21 percent increase, similar to the estimated effect for the entire sample (as shown in Table 5). In column 5, once focusing on these high achievers, we do not find differential effects by high school senior year GPA.

The differential results of FSAG eligibility by high school GPA remain strong once we focus on students not eligible for Bright Futures. Although the overall effects are not statistically significant for this group (column 6), as shown in column 7, the effects of eligibility are especially large and statistically significant for the 4th quartile group of high school GPA relative to the 2nd quartile (9.2 percentage points). The overall effect for these students with senior year GPAs in the top 25 percent who are not also eligible for Bright Futures is 11.9 percentage points, or a 52 percent increase based on a mean six-year completion rate of 23 percent for this group. Even if one assumes FSAG eligibility did not have an effect on degree completion for students with lower high school GPAs (given the estimate for FSAG eligibility for the baseline group in the 2nd quartile is not statistically significant), these results suggest a 40 increase for the 4th quartile. Taken together, we conclude that FSAG eligibility had the largest effects for high achievers, whether defined by senior year GPA or Bright Future eligibility. However, the largest effects were for students who did not qualify for Bright Futures but did well in high school.

Robustness Checks

To test the robustness of our results, we perform a number of tests. We first address the possibility that our results are sensitive to the particular EFC window in which we conducted our analysis. One way to examine this threat empirically is to repeat our analyses using a variety of window widths (Angrist & Lavy 1999; Murnane & Willett 2010). While we would expect standard errors to change as the sample size increases or decreases, the parameter estimates associated with FSAG eligibility should remain stable. For illustration purposes, we present in Table 7 the effect of FSAG eligibility on the six-year graduation rate using various window widths.[19] The models in this table include the same explanatory variables as the models in Table 5. Each of the columns presents the results of fitting the same model in a slightly different window width. Going from left to right, the columns present models in progressively narrower window widths, starting with ± $1200 in column 1 and ending with ± $800 in column 5. We observe little fluctuation in the coefficients on FSAG in the first row of the table. Overall, this analysis suggests that our overall results are in fact robust to the choice of window width.

Finally, our results may be sensitive to the functional form of the relationship between the forcing variable, EFC, and the college outcomes. Given the relatively small number of observations within our analytic windows, the fitted shape of a curvilinear relationship between EFC and each outcome would be very sensitive to the presence of atypical values just above or below the cut-off. This in turn could lead to highly biased estimates of the causal effect of FSAG eligibility (Murnane & Willett, 2010). Given the sensitivity of RD estimates to nonlinear specifications, Imbens & Lemieux (2008) recommend selecting a bandwidth within which the relationship between the forcing variable and outcome is locally linear. To further test whether the relationship between EFC and each outcome is linear within our selected bandwidths, we added polynomial specifications of EFC to each model in Tables 3 to 5, and included two-way interactions between each polynomial term in the specification of EFC and the binary indicator for FSAG eligibility. We present in Table 8 the results of these sensitivity analyses for the effect of FSAG eligibility on the probability of earning a bachelor's degree within six years.[20] None of the polynomial specifications of the relationship is statistically significant suggesting we do indeed have a bandwidth within which the relationship is locally linear.

Finally, we consider the possibility that what our graphical and statistical analyses indicate is the causal effect of FSAG eligibility on bachelor's degree attainment may, in actuality, be an idiosyncratic fluctuation in the data at the EFC cut-off of $1,590. If this were the case, we might equally expect to find

[19] We conducted similar analyses for the other outcomes for which we found a significant program effect. Across all of these outcomes, the parameter estimates are stable to the selection of window width.

[20] We conducted similar analyses for the other outcomes for which we find a significant program effect, and reach the same conclusion that both the polynomial specifications of EFC and the interactions between FSAG and the EFC polynomial terms are unnecessary within our analytic window.

a jump in the probability of graduating within six years at other arbitrarily selected "cut-offs" in the distribution of EFC. We conduct this falsification test by re-fitting LLR models (again using an optimal bandwidth of ±$1,000) around three arbitrary cut-offs: $500 below the actual cut-off (an EFC of $1,090), $500 above the actual cut-off (an EFC of $2,090), and $1,000 above the actual cut-off (an EFC of $2,590). We include the same set of controls as those included in all our previous analyses. We present the results of this falsification exercise in Table 9. In column 1 we replicate the effects of bachelor's degree attainment around the true FSAG eligibility cut-off; in column 2 we present results around the EFC "cut-off" of $1,090; in column 3 we present the model around the EFC "cut-off" of $2,090; and in column 4 we present the model around the EFC "cut-off" of $2,590. The estimated effect of FSAG eligibility on whether students graduate within six years is not distinguishable from zero around all three artificial cut-offs in columns 2-4, suggesting that our analyses are detecting what appear to be causal effects, and not simply random fluctuations in the data around the EFC cut-off.

V. CONCLUSIONS AND IMPLICATIONS

Gaps in college success by socioeconomic status have persisted for decades. A primary way that state and federal governments have attempted to address these gaps is by providing need-based financial grants to needy students. The size of this investment is substantial: now well over $30 billion dollars a year in federal and state appropriations. In this study, we add to the financial-aid literature by examining the effect of need-based grant eligibility on the probability that students enter, persist, and complete college.

Using a regression-discontinuity design, we find a positive effect of FSAG eligibility on whether students enroll immediately at a public, four-year university. Once adjusting our estimates into magnitudes per $1,000 of aid eligibility, as is the convention in the literature, our results suggest that $1,000 in grant aid (in 2000 dollars) led to an enrollment effect of 2.5 percentage points.[21] This effect is in line with prior estimates of the effect of grant aid on immediate enrollment (e.g. Dynarski, 2003; Kane 2003), though slightly smaller than most. However, prior causal research has provided little

[21] FSAG is a $1,300 grant so the tables display larger estimates based on this slightly large aid amount.

information regarding how need-based aid eligibility impacts students' progress towards degree attainment, and our research addresses this question. We find that FSAG eligibility increased the probability of staying continuously enrolled through the spring semester of students' freshman year by 3.3 percentage points.[22] Furthermore, FSAG eligibility had a positive impact on students' rate of college credit accumulation and on whether they earned a bachelor's degree: $1,000 in grant eligibility (in 2000 dollars) increased the cumulative number of credits students completed after four years by 2.3 credits, and increased the probability of earning a bachelor's degree within five, six, and seven years by 2.5, 3.5, and 4.0 percentage points, respectively. The impact of FSAG eligibility on bachelor's degree attainment was particularly pronounced for students who were academically-accomplished in high school. Taken in concert, these results suggest that the impact of need-based aid eligibility extends well beyond initial enrollment.

It is important to note that FSAG is a renewal grant conditional on students having a 2.0 GPA in college and completing at least 12 credits per term. Due to this fact, one may wonder whether we are estimating the effect of aid eligibility for only the first year of college or whether our effects reflect the impact of multiple years of eligibility. While is possible for students to receive FSAG for multiple years, in practice, this rarely happens. Only 36 percent of students who got FSAG in their first year of college also receive it in their second year. By four years after high school, only 21 percent of eligible students receive the grant. Therefore, while we might interpret our results as representing the effects of multiple years of aid eligibility for some students, one should not think of this as a multi-year award for the majority of eligible students, even when focusing on students with high school GPAs in the top 25 percent of the distribution.

---

[22] On the surface it may seem surprising that we find an impact of FSAG eligibility on enrollment at four-year colleges, since studies of the federal Pell Grant, which also uses EFC to determine applicant eligibility, have not found impacts on enrollment at four-year institutions. However, there are several important differences between our study and the literature evaluating the Pell Grant. Many of the studies capitalize on the introduction of the Pell Grant in 1972 to identify the program effect. Our study takes place nearly 30 years later, and the impact of financial aid may differ across both time periods. Moreover, studies of the Pell Grant have typically employed data from the Current Population Survey in their analyses, and therefore do not condition on students who have applied for the FAFSA, as we do in our analyses. Our analytic sample may therefore be quite different than the analytic samples in the Pell studies. Finally, we estimate a local average treatment effect of the impact of FSAG eligibility for students just below the FSAG cut-off. The Pell studies have typically employed a difference-in-differences methodology, which provides an average treatment effect for all individuals in the analytic sample who became eligible for Pell when it was introduced in 1972.

While reflecting how to interpret the results, it is also worthwhile to consider whether our effects are the result of giving students an additional $1,300 and/or the possible incentive effects due to the fact that the award is only available to students who enroll for 12 credits per year in their first year and renewable if they complete 12 credits and reach a modest academic benchmark in college. However, it is important to note that all students in our analytic sample have an incentive to take 12 credits per term because their Pell Grant award maxes out at such a level.[23] In fact, when we estimate the impact of FSAG eligibility on whether a student completes at least 12 credits during either fall 2000 or spring 2001, we do not find statistically significant effects. The college GPA renewal requirement of a 2.0 is also much lower than the levels customary for merit-based aid and more in line with performance-based scholarship programs that have been implemented in sites such as Louisiana (Brock and Richburg-Hayes, 2006). While such a minimum standard may be related to early course passage rates, as found in Louisiana, it seems unlikely to have such a profound effect on bachelor's degree completion multiple years later, especially given the fact so few students get an FSAG award over the long term.[24] Thus, the effects we observe appear to be driven much more by the reduction in the cost of attendance at public, four-year institutions than by possible incentive effects.

Overall, our results suggest that not only does need-based aid have a positive effect on persistence and degree completion, but also that increasing the award amounts of current aid programs could have beneficial effects. In our sample, we compare students who received up to $1,750 in need-based aid (i.e. just the Pell Grant) to those receiving up to $3,050 (i.e. the Pell Grant and FSAG). This could effectively be seen as a test of whether increasing the size of programs like the Pell Grant would have a positive effect on college outcomes. This is a slightly different question than one about whether any aid at all (versus no aid) has positive effects. Given current expenditures of over $41 billion in need-based, government aid, understanding the effects of the marginal dollar of aid is particularly relevant to many

[23] The Pell Grant program considers 12 credits to be full-time attendance and thus will award students the maximum of their eligible amount if they enroll at this level.

[24] Having a FSAG for multiple years is slightly more likely among students also eligible for Bright Futures, which also has renewal requirements of a 2.75 GPA for the lower tier and 3.0 for the higher tier award. As such, the effects for the population of Bright Futures-eligible students could be interpreted as the result of being eligible for aid for more than one year and having performance incentives, though this conclusion should be tempered by the fact that, similar to the overall sample, less than half of Bright Futures recipients maintain FSAG into their second year and thereafter.

currently policy debates. It is also worth noting that our analysis takes into account multiple types of aid (both need- and merit-based; both federal and state) as student aid packages can be comprised of a variety of awards. Our results are relevant for students from families in the lower middle class with the mean family income for our sample being about $30,000 ($40,300 in 2011 dollars).

Given the positive impacts on degree attainment, a “back of the envelope” calculation suggests that the FSAG award is a beneficial social investment. Consider the population of Florida high school seniors to whom we can generalize our results. In regression discontinuity designs, results can only be generalized to students just above and below the cut-off. We make the simplifying assumption that 1,000 students were sufficiently close to the cut-off that our impact estimates would apply to them. Our results suggest that FSAG eligibility would have induced approximately 46 more students (or 4.6 percent) to earn a bachelor’s degree within six years. The total FSAG award amount for students close to the cut-off was $1300 per student, or $1.3 million total in this example. Therefore, the cost per student induced to earn bachelor’s degrees was approximately $28,000. Then consider the benefits of this increase in educational attainment. First, there is the differential in terms of earnings and tax payments between median full-time workers with a bachelor’s college and those with only some college, which was $13,800 in 2005 (Baum & Ma, 2007). On the simplifying assumption that this differential remained constant in subsequent years, the social and private benefits of FSAG would have exceeded the costs within three years.[25] Even if we were to consider the fact that some students received FSAG multiple years and the cost of graduating a student is more than just the cost of FSAG (i.e. college subsidies and resources for the additional courses taken to graduate), FSAG still looks to have a positive rate of return given our simple example underestimates the benefits of FSAG by not including the positive effects of eligibility on students who might not complete a degree by still got additional education.

This work prompts additional research questions that warrant further exploration. One question that emerges is whether need-based aid eligibility in successive years would result in longer-term impacts on college attainment. The existence of academic and financial cut-offs for FSAG renewal provide an opportunity to empirically assess whether being eligible for need-based assistance for two years increases

---

[25] In fact, the differential widened after 2005. See *Education Pays*, 2010.

the probability of earning a degree relative to statistically-equivalent students who are only eligible for need-based aid during their first year in college. There are also questions about the impact of financial aid on college outcomes such as course selection and major choice and whether increasing financial aid has a substitution effect with student employment.

In closing, our research lends new evidence that need-based grant eligibility has a positive and substantial effect not only on whether students enroll in college, but also on the number of credits they accumulate and on whether they earn a bachelor's degree. Especially in lean budgetary times, these findings provide policy makers with valuable information about the long-term benefits of public investments in need-based financial assistance for college, and suggest that investments in need-based grant aid generate substantial private and social monetary benefits.

REFERENCES

Advisory Committee on Student Financial Assistance. (2010). *The Rising price Of inequality: How inadequate grant aid limits college access and persistence.* Report to Congress and the Secretary of Education, June.

Angrist, J. D., & Lavy, V. (1999). Using Maimonides' Rule to estimate the effect of class size on scholastic achievement.î *Quarterly Journal of Economics*, *114*(2), 533-575.

Angrist, J.D., Lang, D., & Oreopoulos, P. (2009). Incentives and services for college achievement: Evidence from a randomized trial. *American Economic Journal: Applied Economics 1*(1): 136-163.

Baum, S., & Ma, J., (2007). *Education pays 2007: The benefits of higher education for individuals and society*. New York: The College Board.

Baum, S., Ma, J., & Payea, K. (2010). *Education pays 2010: The benefits of higher education for individuals and society*. New York: The College Board.

Becker, G.S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education.* Chicago: University of Chicago Press

Bettinger, E. (2004). How financial aid affects persistence. In C. Hoxby (Ed.), *College choices: The economics of where to go, when to go, and how to pay for it.* Chicago: University of Chicago Press.

Bettinger, E., Long, B.T., Oreopoulos, P, & Sanbonmatsu, L. (2012). *The role of simplification and information in college decisions: Results from the H&R Block FAFSA Experiment. Quarterly Journal of Economics 127(3).*

Booker, K., Sass, T., Gill, B., & Zimmer, R. (2008). Going beyond test scores: Evaluating charter school impact on educational attainment in Chicago and Florida. Rand Corporation Working Paper 610. Santa Monica, CA: The Rand Corporation.

Brock, T., & Richburg-Hayes, L. (2006). *Paying for persistence: Early results of a Louisiana scholarship program for low-income parents attending community college.* New York: Manpower Development Research Corporation.

Carnevale, A.P., Smith, N., & Strohl, J. (2010) *Help wanted: Projections of jobs and education requirements through 2018.* Georgetown University Center on Education and the Workforce.

The College Board. (2010). *Trends in student aid 2010.* New York: The College Board.

Deming, D., & Dynarski, S.M. (2009). *Into college, out of poverty? Policies to increase the postsecondary attainment of the poor.* National Bureau of Economic Research Working Paper 15387. Cambridge, MA: National Bureau of Economic Research.

Dynarski, S.M. (2000). Hope for whom? Financial aid for the middle class and Its impact on college attendance. *National Tax Journal 53*(3): 629-661.

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

Dynarski, S.M. (2004). The new merit aid. In C. Hoxby (Ed). *College choices: The economics of where to go, when to go, and how to pay for it.* Chicago: University of Chicago Press.

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

Dynarski, S.M., & Scott-Clayton, J.E. (2006). The cost of complexity in federal student aid: Lessons from optimal tax theory and behavioral economics. *National Tax Journal 59*(2): 319-356.

Ellwood, D. T., & Kane, T. J. (2000). Who is getting a college education? Family background and the growing gaps in enrollment. In S. Danzinger, & J. Waldfogel (Eds.), *Securing the future*. New York: Russell Sage.

Florida Department of Education (2010). *Florida Bright Futures scholarship program.* Retrieved December 2010 from http://www.floridastudentfinancialaid.org/ssfad/bf/

Florida Gen. Laws ch. 240, § 409.

Florida Postsecondary Education Planning Commission (2001). *State student financial aid policy.* Council for Education Policy Research and Improvement. Retrieved December 2010 from http://www.cepri.state.fl.us/pdf/flfinaid.pdf

Hansen, W.L. (1983). The impact of student financial aid on access. In Joseph Froomkin, ed., *The crisis in higher education*. New York: Academy of Political Science.

Haveman, R., & Smeeding, T. (2006). The role of higher education in social mobility. *The Future of children*. Princeton, NJ: The Brookings Institution.

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

Imbens, G. W., & Kalyanaraman, T. (2009). *Optimal bandwidth choice for the regression discontinuity estimator*. National Bureau of Economic Research Working Paper 14726. Cambridge, MA: National Bureau of Economic Research.

Kane, T.J. (1995). *Rising public college tuition and college entry: How well do public subsidies promote access to college?* National Bureau of Economic Research Working Paper 5164. Cambridge, MA: National Bureau of Economic Research.

Kane, T.J. (2003). *A quasi-experimental estimate of the impact of financial aid on college-going*. National Bureau of Economic Research Working Paper 9703. Cambridge, MA: National Bureau of Economic Research.

Kane, T.J. (2004). *Evaluating the impact of the D.C. Tuition Assistance Grant Program.* National Bureau of Economic Research Working Paper 10658. Cambridge, MA: National Bureau of Economic Research.

King, J.E. (2004). Missed opportunities: Students who do not apply for financial aid. Washington, D.C.: American Council on Education.

Long, B.T. (2007). The contributions of economics to the study of college access and success. *Teachers College Record*, *109*(10): 2367.

Manski, C., & Wise, D. (1983). *College choice in America*. Cambridge, MA: Harvard University Press.

Murnane, R.J., & Willett, J.B. (2010). *Methods matter: Improving causal inference in educational and social science research*. Oxford: Oxford University Press.

National Center for Education Statistics. (2002). *Digest of education statistics 2002.* Tables 182 and 203. Washington D.C.: United States Department of Education.

National Center for Education Statistics. (2010). *Characteristics of the 100 public elementary and secondary school districts in the United States: 2008-2009.* Table D-3. Washington, D.C.: United States Department of Education.

Oreopoulos, P., & Salvanes, K.G. (2009). *How large are returns to schooling? Hint: Money isn't everything.* National Bureau of Economic Research Working Paper 15339. Cambridge, MA:

National Bureau of Economic Research.

Pascarella, E. T., & Terenzini, P. T. (2005). *How colleges affect students: A third decade of research* (1st ed.). San Francisco: Jossey-Bass.

Seftor, N., & Turner, S. (2002). Back to school: Federal student aid policy and adult college enrollment. *Journal of Human Resources*. *37*(2): 336-352.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston, MA: Houghton Mifflin.

Turner, S. E. (1998). The vision and reality of Pell grants: Unforeseen consequences for students and institutions. In L. Gladieux (Ed.), *Memory, reason, imagination: A quarter century of Pell grants.* Washington, DC: The College Board.

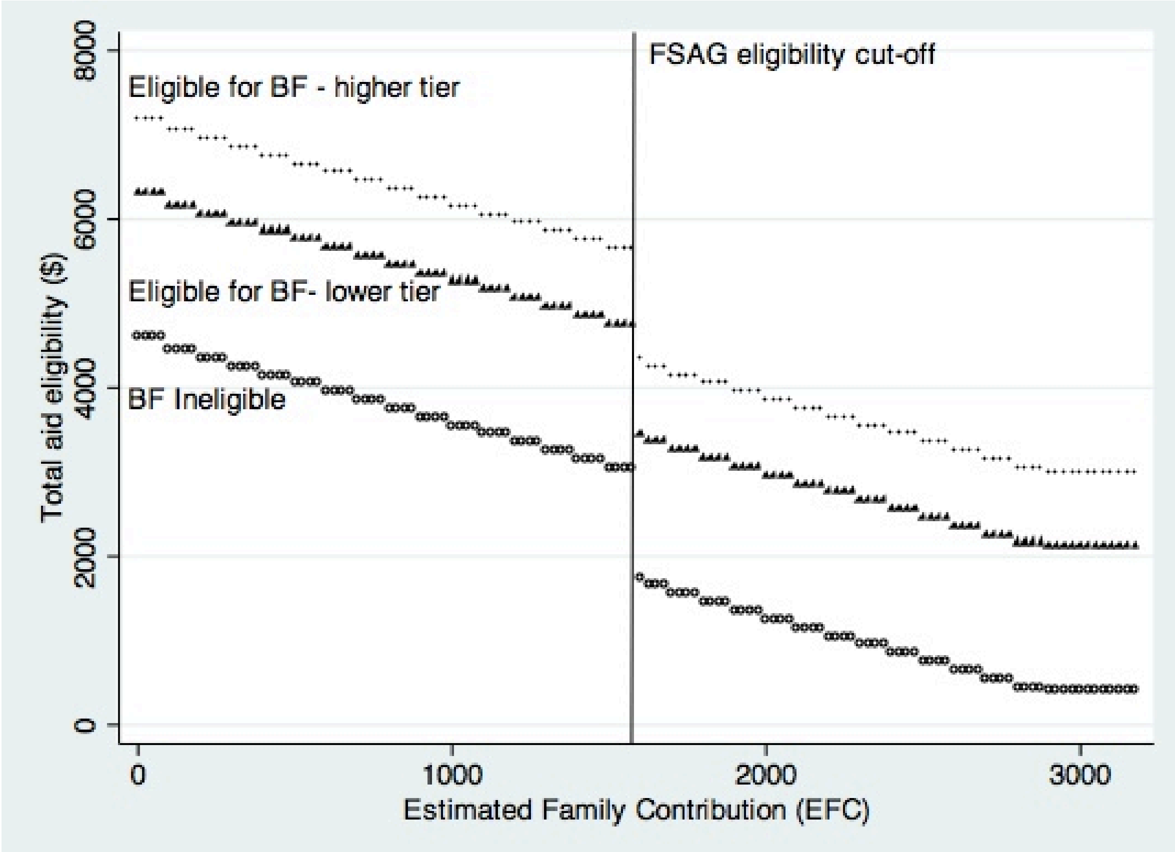
United States Census Bureau. (2011). *State and county quick facts.* Retrieved October 25th, 2011 from http://quickfacts.census.gov/qfd/index.html

United States Department of Education. (2010). *2009-2010 Federal Pell Grant Program End-of-Year Report.* Washington, D.C.: The United States Department of Education.

United States Department of Education. (2011). *Federal Pell Grant Program.* Retrieved October 11th, 2011 from http://www2.ed.gov/programs/fpg/index.html

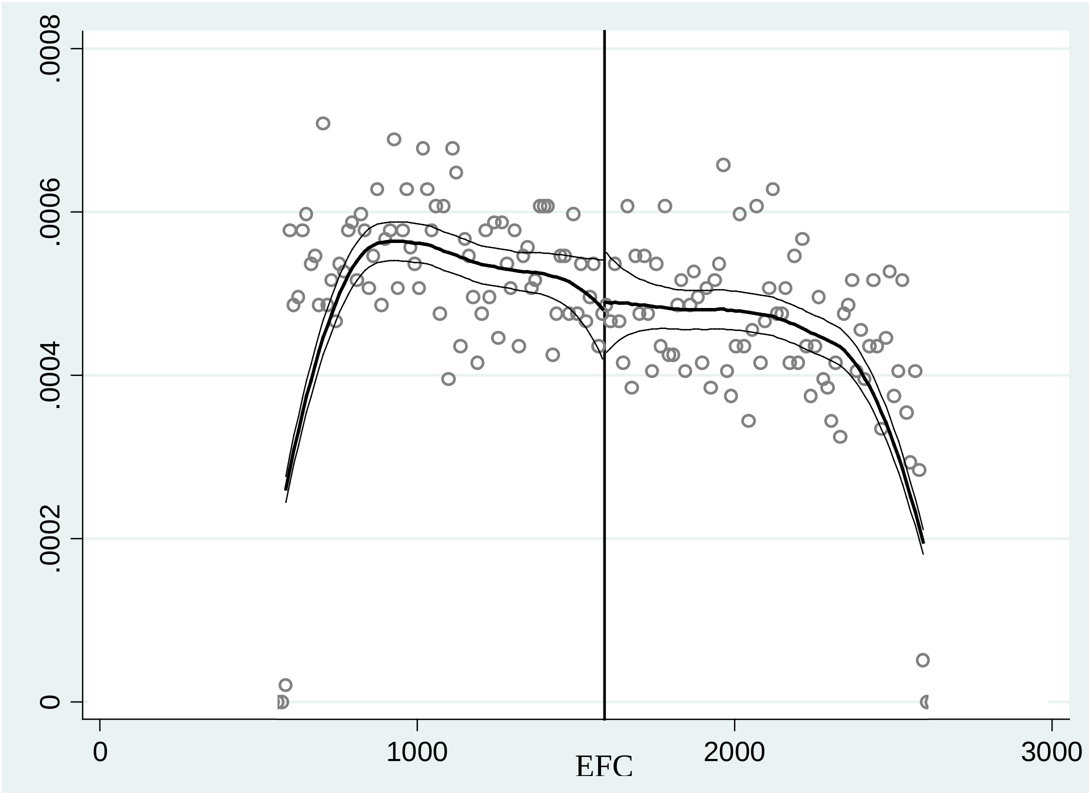
Urquiola, M., & Verhoogen, E. (2009). Class-size caps, sorting, and the regression discontinuity design. *American Economic Review, 99*(1), 179.

Figure 1: Federal and Florida Grant Aid Eligibility by Expected Family Contribution (EFC)



Notes: EFC is calculated by the U.S. Department of Education based primarily on income, assets, and family size information collected on the Free Application for Federal Student Aid (FAFSA). Grant aid eligibility is the sum of the Federal Pell Grant, Florida Student Access Grant (FSAG), and the merit-based, state Bright Futures Scholarship (BF). During the study period, students with an EFC of $0 to $3100 were eligible for a Pell Grant ranging from $200 to $4,050. FSAG was also awarded based on need with families with EFCs below $1,590 being eligible for $1,300. There are two tiers of BF. The lower-tier BF Medallion Scholars award covered 75 percent of tuition and fees at in-state public colleges and universities (or the monetary equivalent at in-state private institutions). Students qualify for a BF Medallion Scholars award if they completed 15 core academic credits in high school, had a cumulative high school GPA of 3.0 or higher, and had a composite SAT of 970 or higher (or a composite ACT exam of 20 or higher). The higher-tier BF FAS Scholars award covered 100 percent of tuition and fees at in-state public colleges and universities (or the monetary equivalent at in-state private institutions). Students qualified for a BF Florida Academic Scholars award if they completed 15 core academic credits in high school, had a cumulative high school GPA of 3.5 or higher, and had a composite SAT of 1270 or higher (or a composite ACT exam of 28 or higher).

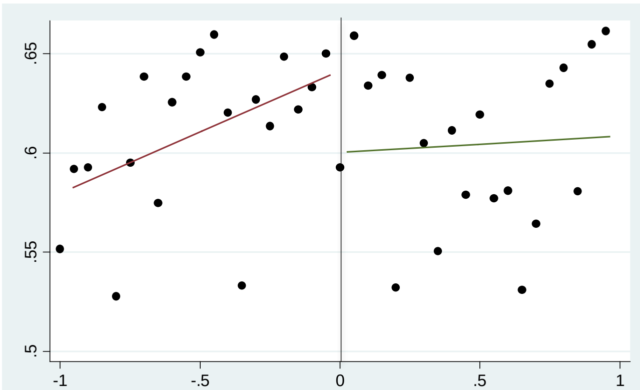
Figure 2: Density of observations within ±$1,000 around the FSAG eligibility cut-off



Notes: EFC is calculated by the U.S. Department of Education based on income, asset, and family size information collected on the Free Application for Federal Student Aid (FAFSA). The density function of EFC was estimated using McCrary's (2008) test for manipulation of the forcing variable in regression discontinuity analyses.

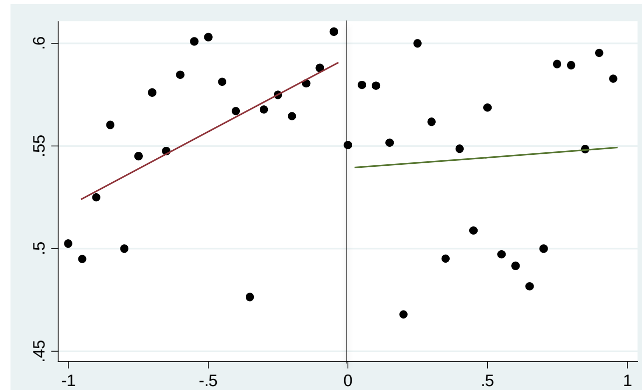
Figure 3: Bivariate relationship between EFC and selected outcomes, with locally linear regressions fit on either side of the FSAG cut-off

A. Immediate Enrollment



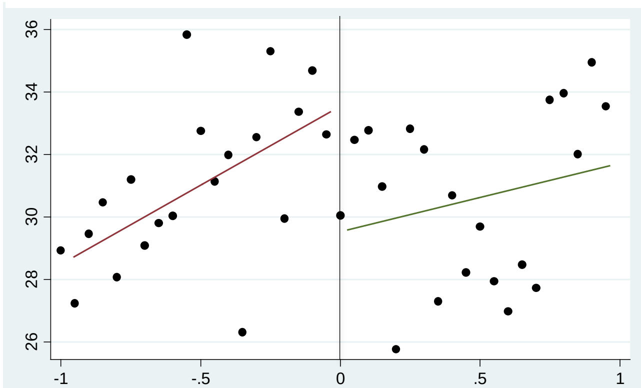
EFC

B. Persist to spring of freshman year



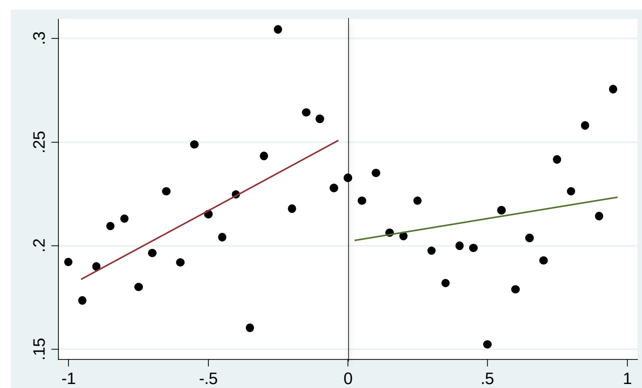
EFC

C. Credits accumulated after three years



EFC

D. BA/BS within 6 years



EFC

Notes: In these plots, EFC is divided by $1,000 and centered at the FSAG cut-off. Each point represents the mean of the dependent variable within a $50 bin of EFC. The trend lines present uncontrolled, locally-linear regressions on either side of the cut-off. We selected the bandwidth of ±$1,000 using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths.

Table 1: Summary Statistics of the Data

	Full Sample All seniors in public Florida high schools 1999-2000 (1)	*Restricted Sample* Completed the FAFSA (2)	*Analytic Sample* EFC values that fall within $1,000 of the cut-off (3)
Female	0.53	0.59	0.60
White	0.62	0.51	0.45
Black	0.20	0.27	0.30
Hispanic	0.15	0.18	0.21
Other Race	0.04	0.04	0.04
Age during senior year of high school	17.92 (0.57) [99,067]	17.88 (0.55) [44,865]	17.88 (0.54)
Expected Family Contribution (EFC)	$6,889 ($12,128) [45,785]	$6,894 ($12,132)	$1,541 ($570)
Parents' Adjusted Gross Income (AGI)	$43,662 ($41,607) [43,784]	$43,680 ($41,634) [42,933]	$28,035 ($9,926)
Student's Adjusted Gross Income (AGI)	$3,497 ($13,663) [34,227]	$3,433 ($13,051) [33,508]	$2,784 ($2,523) [5,101]
HS senior year GPA (weighted 4.5 scale)	2.84 (0.75) [57,021]	2.87 (0.69) [41,316]	2.80 (0.68)
Observations	101,094	45,727	6,917

Source: Florida Department of Education K-20 Data Warehouse.
Notes: Means are shown with standard deviations in parentheses and the number of observations in brackets if it is less than the full sample. The sample in column 3 is comprised of students with non-missing values for all variables except Student's Adjusted Gross Income.

Table 2: Test for baseline equivalence on either side of the FSAG eligibility cut-off

	EFC Window around the FSAG Eligibility Cut-off			
	±$250 (1)	±$500 (2)	±$750 (3)	±$1,000 (4)
Demographic Variables				
Black	0.014 (0.022)	-0.006 (0.013)	-0.004 (0.011)	0.001 (0.009)
Hispanic	0.027 (0.025)	0.006 (0.016)	-0.003 (0.013)	-0.003 (0.011)
Other race/ethnicity	0.005 (0.038)	-0.032 (0.026)	-0.020 (0.020)	-0.005 (0.017)
Female	-0.024* (0.015)	-0.014 (0.010)	-0.013* (0.008)	-0.010 (0.006)
Age during senior year of HS	0.001 (0.015)	0.011 (0.001)	0.009 (0.007)	0.001 (0.006)
Financial Variables				
Expected Family Contribution (EFC)	-2.96*** (0.036)	-1.51*** (0.012)	-1.00*** (0.006)	0.759*** (0.004)
Parents' adjusted gross income (AGI)	0.001 (0.001)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)
Academic covariates				
Eligible for Bright Futures	-0.020 (0.017)	-0.017 (0.011)	-0.014 (0.009)	-0.006 (0.008)
In a gifted/talented program	0.014 (0.012)	0.019 (0.026)	0.044* (0.027)	0.046* (0.024)
HS senior year GPA (weighted 4.5 scale)	0.014 (0.012)	0.017** (0.008)	0.009 (0.006)	0.006 (0.005)
Observations	1,758	3,471	5,237	6,917
R^2	0.81	0.78	0.77	0.77
p value on F-test for joint significance	0.556	0.195	0.255	0.518

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. All models also include school fixed effects. The F-test for joint significance tests whether the explanatory variables in the model jointly explain variation in whether students were just above or below the FSAG cut-off. A constant is also included in all the models.

Table 3: The effect of FSAG eligibility on whether students enrolled at a Florida college or university

	College enrollment immediately after High School (Fall 2000)				Ever enroll 2000-01 to 2006-07	Continuous enrollment from Fall 2000	
	Any College	Initially FL Public Four- year	Initially FL Private Four-year	Initially FL Public Two- year		…Through 1st Year (Spring 2001)	…Into 2nd Year (Fall 2001)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Eligible for FSAG	0.032 (0.023)	**0.032*** **(0.019)**	0.00 (0.013)	0.001 (0.022)	0.025 (0.019)	**0.043*** **(0.024)**	0.027 (0.023)
EFC (Centered at the cut-off) (000s)	0.003 (0.032)	0.017 (0.026)	-0.01 (0.019)	-0.021 (0.027)	0.040** (0.019)	-0.001 (0.031)	0.012 (0.029)
FSAG x Centered EFC	0.049 (0.041)	0.042 (0.036)	-0.01 (0.023)	0.024 (0.037)	-0.035 (0.026)	0.066 (0.042)	0.022 (0.038)
Eligible for Bright Futures	0.087*** (0.015)	0.351*** (0.014)	0.04*** (0.009)	-0.261*** (0.013)	0.022* (0.011)	0.122*** (0.015)	0.150** (0.015)
EFC window	±$1,000	±$1,000	±$1,000	±$1,100	±$1,200	±$1,000	±$1,100
Observations	6,917	6,917	6,917	7,553	8,161	6,917	7,553
R^2	0.11	0.26	0.08	0.16	0.09	0.13	0.15
Mean of outcome	0.61	0.26	0.07	0.34	0.80	0.55	0.47

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; high school senior year GPA (weighted 4.5 scale); whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant. A unique optimal bandwidth for each outcome was calculated using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths. The bandwidth is indicated by the EFC window row. In column 4, we infer whether students enrolled at a Florida private college or university based on whether they received the non-need-based Florida Resident Assistance Grant (FRAG), awarded to students who attend in-state private institutions.

Table 4: The effect of FSAG eligibility on cumulative credit completion at Florida public colleges and universities

	Cumulative College Credit Completion				
	…After Fall 2000 (one semester) (1)	…After Spring 2001 (one year) (2)	…After Spring 2002 (two years) (3)	…After Spring 2003 (three years) (4)	…After Spring 2004 (four years) (5)
Eligible for FSAG	0.230 (0.275)	**0.901*** **(0.486)**	**2.077**** **(0.917)**	**2.893**** **(1.317)**	**2.994*** **(1.690)**
EFC (Centered at the FSAG cut-off)	0.053 (0.326)	0.403*** (0.596)	1.185*** (1.132)	1.275 (1.642)	0.719 (2.115)
FSAG x CEFC	0.206 (0.410)	0.472 (0.753)	0.442 (1.387)	1.263 (1.967)	2.570 (2.530)
Eligible for Bright Futures	1.668*** (0.180)	3.475*** (0.332)	7.453*** (0.613)	11.811*** (0.863)	16.164*** (1.138)
Observations	7,553	7,553	7,553	7,553	7,553
R^2	0.16	0.18	0.18	0.21	0.22
EFC window	±$1,100	±$1,100	±$1,100	±$1,100	±$1,100
Sample mean of outcome	5.92	11.67	22.05	30.88	38.66

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; high school senior year GPA (weighted 4.5 scale); whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant. A unique optimal bandwidth for each outcome was calculated using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths. The time periods (e.g., "one semester") refer to the length of time assuming entry into college the immediate fall after on-time high school graduation in spring 2000. However, the estimates are not conditional on high school graduation or immediate college enrollment.

Table 5: The effect of FSAG eligibility on whether students earned a degree at a Florida public college or university

	Earned an Associates' degree in:			Earned a Bachelor's degree in:			
	By Spring 2003 (3 years) (1)	By Spring 2004 (4 years) (2)	By Spring 2005 (5 years) (3)	By Spring 2004 (4 years) (4)	By Spring 2005 (5 years) (5)	By Spring 2006 (6 years) (6)	By Spring 2007 (7 years) (7)
Eligible for FSAG	0.001 (0.012)	0.007 (0.016)	-0.003 (0.016)	0.004 (0.012)	**0.032*** **(0.018)**	**0.046**** **(0.020)**	**0.052**** **(0.021)**
EFC (Centered at the FSAG cut-off)	-0.008 (0.013)	-0.001 (0.019)	-0.006 (0.016)	0.007 (0.014)	-0.010 (0.023)	0.005 (0.026)	0.014 (0.027)
FSAG x EFC	0.013 (0.017)	0.019 (0.024)	0.011 (0.020)	-0.006 (0.018)	0.058* (0.031)	0.055 (0.034)	0.048 (0.034)
Eligible for Bright Futures	0.023** (0.010)	-0.003 (0.012)	-0.007 (0.012)	0.110*** (0.010)	0.214*** (0.014)	0.240*** (0.138)	0.250*** (0.014)
Observations	8,846	8,161	9,501	8,161	6,917	6,917	6,917
R^2	0.10	0.10	0.09	0.14	0.21	0.23	0.22
EFC window	±$1,300	±$1,200	±$1,400	±$1,200	±$1,000	±$1,000	±$1,000
Outcome Mean	0.09	0.14	0.17	0.07	0.16	0.21	0.25

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; high school senior year GPA (weighted 4.5 scale); whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant. A unique optimal bandwidth for each outcome was calculated using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths. The time periods (e.g., "one semester") refer to the length of time assuming entry into college the immediate fall after on-time high school graduation in spring 2000. However, the estimates are not conditional on high school graduation or immediate college enrollment.

Table 6: Differential effects of FSAG eligibility on whether students earned a Bachelor's Degree by Spring 2006 (six years after on-time high school graduation) at a Florida public college or university (EFC window= ±$1,000)

	Whole Sample			Eligible for Bright Futures		Not Eligible for Bright Futures	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Eligible for FSAG	**-0.070* (0.037)**	0.036 (0.025)	**0.031 (0.020)**	**0.091* (0.047)**	0.059 (0.067)	0.021 (0.019)	0.027 (0.025)
EFC (Centered at the FSAG cut-off)	0.007 (0.026)	0.009 (0.026)	0.003 (0.026)	0.039 (0.061)	0.040 (0.061)	-0.015 (0.026)	-0.015 (0.026)
FSAG x EFC	0.053 (0.034)	0.048 (0.034)	0.052 (0.033)	0.040 (0.088)	0.041 (0.088)	0.056* (0.034)	0.056 (0.034)
FSAG x BF eligible			0.034 (0.022)				
Eligible for Bright Futures	0.240*** (0.014)	0.243*** (0.014)	0.250*** (0.016)				
FSAG x HS senior year GPA	**0.042*** (0.013)**						
HS senior year GPA (weighted 4.5 scale)	0.107*** (0.011)		0.114*** (0.008)				
FSAG x GPA 4th quartile		**0.065** (0.031)**			0.058 (0.069)		**0.092** (0.043)**
FSAG x GPA 3rd quartile		0.012 (0.031)			0.022 (0.074)		-0.005 (0.033)
FSAG x GPA 1st quartile		-0.025 (0.023)			-0.008 (0.110)		-0.036* (0.022)
GPA 4th quartile		0.120*** (0.024)		0.115*** (0.034)	0.085* (0.051)	0.136*** (0.023)	0.085*** (0.032)
GPA 3rd quartile		0.063*** (0.022)		0.062 (0.039)	0.049 (0.055)	0.053*** (0.014)	0.055** (0.022)
GPA 1st quartile		-0.061*** (0.016)		-0.118** (0.053)	-0.117 (0.080)	-0.064*** (0.010)	-0.043*** (0.016)
Observations	6,917	6,917	6,917	2,305	2,305	4,612	4,612
R^2	0.23	0.22	0.24	0.19	0.19	0.14	0.14
p-value on F-test for FSAG x GPA quartile interactions	--	0.01	--	--	0.75	--	0.01
Sample mean of outcome	0.21	0.21	0.21	0.44	0.44	0.11	0.11
Sample mean of outcome for students in top GPA quartile	0.41	0.41	0.41	0.49	0.49	0.23	0.23

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant. We calculated the optimal bandwidth using the Imbens-Kalyaranaman (2009) method.

Table 7: Robustness of the estimated FSAG effect on Bachelor's Degree receipt by Spring 2006 (six years after on-time high school graduation) to differing window widths around the FSAG cut-off

	EFC Window around the Cut-off				
	±\$1200	±\$1100	±\$1000 (optimal)	±\$900	±\$800
	(1)	(2)	(3)	(4)	(5)
Eligible for FSAG	**0.046****	**0.041****	**0.046****	**0.042****	0.030
	(0.018)	**(0.019)**	**(0.020)**	**(0.021)**	(0.023)
EFC (Centered at the FSAG cut-off)	0.029	0.008	0.005	-0.002	-0.026*
	(0.021)	(0.023)	(0.026)	(0.031)	(0.035)
FSAG x EFC	0.004	0.037	0.055	0.050	0.073
	(0.027)	(0.028)	(0.034)	(0.042)	(0.498)
Eligible for Bright Futures	0.239***	0.237***	0.240***	0.239***	0.240***
	(0.013)	(0.014)	(0.138)	(0.015)	(0.015)
HS Fixed Effects	Yes	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes
Observations	8,161	7,553	6,917	6,283	5,601
R^2	0.22	0.22	0.23	0.23	0.23

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; high school senior year GPA (weighted 4.5 scale); whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant.

Table 8: Robustness of FSAG effect on Bachelor's Degree receipt by Spring 2006 (six years after on-time high school graduation) to specification of the functional form of the relationship between the forcing variable and the outcome (EFC window= ±$1,000)

	(1)	(2)	(3)	(4)
Eligible for FSAG	**0.046****	0.046	0.022	0.030
	(0.020)	(0.029)	(0.040)	(0.047)
EFC (Centered at the cut-off)	0.005	-0.140	0.018	0.205
	(0.026)	(0.099)	(0.246)	(0.486)
EFC^2		0.147	-0.254	-1.105
		(0.096)	(0.574)	(2.045)
EFC^3			0.271	1.610
			(0.382)	(0.3.152)
EFC^4				-0.676
				(1.594)
FSAG x EFC	0.055	0.095	-0.015	-0.215
	(0.034)	(0.139)	(0.322)	(0.705)
FSAG x EFC^2		-0.251*	0.268	1.060
		(0.123)	(0.798)	(2.740)
FSAG x EFC^3			-0.192	-1.624
			(0.506)	(4.291)
FSAG x EFC^4				0.630
				(2.119)
Observations	6,917	6,917	6,917	6,917
R^2	0.07	0.21	0.23	0.23
p value on the joint F-test of the FSAG x EFC interactions	--	0.123	0.288	0.489

*** p<0.01 ** p<0.05 * p<0.10

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. A constant is also included in all the models. All models also include high school fixed effects. A unique optimal bandwidth for each outcome was calculated using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths.

Table 9: Falsification test for whether estimated effects of FSAG eligibility on Bachelor's degree attainment within six years are unique to the actual FSAG cut-off

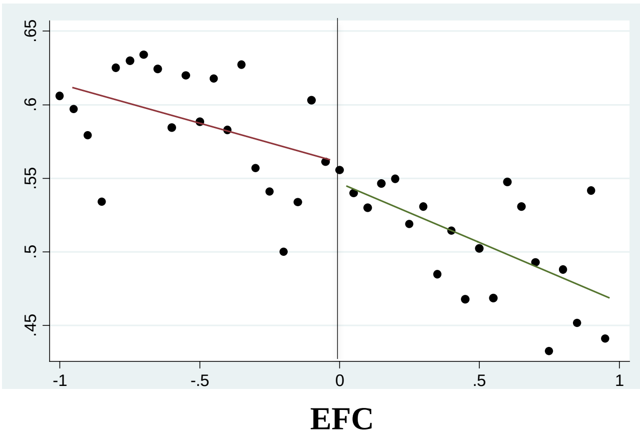
	Eligibility Cut-off at…			
	EFC=$1,590 (*actual cut-off*) (1)	EFC=$1,090 (2)	EFC=$2,090 (3)	EFC=$2,590 (4)
Eligible for FSAG	0.046** (0.020)	-0.023 (0.018)	0.014 (0.020)	-0.019 (0.020)
EFC (Centered at the FSAG cut-off)	0.005 (0.026)	-0.041* (0.023)	0.055** (0.025)	0.014 (0.027)
FSAG x EFC	0.055 (0.034)	0.059* (0.031)	-0.090*** (0.033)	-0.020 (0.038)
Eligible for Bright Futures	0.240*** (0.138)	0.257*** (0.014)	0.229*** (0.015)	0.223*** (0.016)
N	6,917	7,515	6,252	5,699
R^2	0.23	0.23	0.23	0.22
Sample mean of outcome	0.21	0.21	0.21	0.21

*** p<0.01 ** p<0.05 * p<0.10

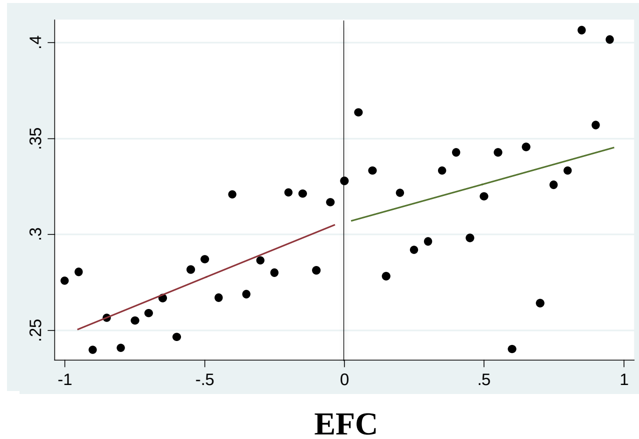
Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. A constant is also included in all the models. All models also include high school fixed effects. We calculated the optimal bandwidth using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidth. For each model, we restrict the data to ±$1,000.

Figure A1: Bivariate relationship between the forcing variable, EFC, and three selected covariates, with locally linear regressions fit on either side of the FSAG cut-off

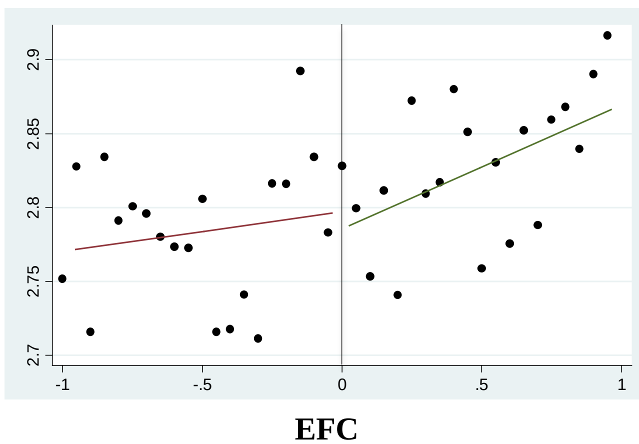
A. Percent students of color



B. Eligibility for Bright Future Scholarship



C. HS senior year GPA



Notes: EFC refers to students' Estimated Family Contribution to college, as calculated by the United States Department of Education based on income, asset, and family size information students supply on the Free Application for Federal Student Aid (FAFSA). In these plots, EFC is divided by $1,000 and centered at the FSAG cut-off. Each point represents the mean of the dependent variable within a $50 bin of EFC. The trend lines present uncontrolled, locally-linear regressions on either side of the cut-off. We selected the bandwidth of ±$1,000 using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths.

Table A1: The effect of FSAG eligibility on cumulative college credits completed, comparing linear probability models (LPM) with Tobit models

	…After Spring 2001 (one year)		…After Spring 2002 (two years)		…After Spring 2003 (three years)	
	LPM (1)	Tobit (2)	LPM (3)	Tobit (4)	LPM 5)	Tobit (6)
Eligible for FSAG	0.901* (0.486)	1.530** (0.700)	2.077** (0.917)	3.196*** (1.195)	2.893** (1.317)	4.350*** (1.660)
EFC (Centered at the FSAG cut-off)	0.403*** (0.596)	0.634 (0.850)	1.185 (1.132)	1.853*** (1.470)	1.275 (1.642)	2.237 (2.075)
FSAG x CEFC	0.472 (0.753)	0.911 (1.071)	0.442 (1.387)	0.823 (1.807)	1.263 (1.967)	1.289 (2.486)
Eligible for Bright Futures	3.475*** (0.332)	4.497*** (0.454)	7.453*** (0.613)	8.976*** (0.775)	11.811*** (0.863)	14.053*** (1.068)
n	7,553	7,553	7,553	7,553	7,553	7,553
R^2	0.18	0.18	0.18	0.18	0.21	0.21
EFC window	±$1,100	±$1,100	±$1,100	±$1,100	±$1,100	±$1,100
Sample mean of outcome	11.67	11.67	22.05	22.05	30.88	30.88

Notes: Robust standard errors, clustered at the high school level, are shown in parentheses. The Florida K-20 data warehouse reports whether students were eligible for Bright Futures as of the end of senior year in high school. Also included in the model are the following covariates: race dummy variables (Black, Hispanic, and Other race/ethnicity); female dummy variable; high school senior year GPA (weighted 4.5 scale); whether the student was in a gifted and talented program; parental adjusted gross income (AGI); and student age. All models also include high school fixed effects and a constant. A unique optimal bandwidth for each outcome was calculated using the Imbens-Kalyaranaman (2009) method for selecting optimal bandwidths. The time periods (e.g., "one semester") refer to the length of time assuming entry into college the immediate fall after on-time high school graduation (i.e. spring 2000). However, the estimates are not conditional on high school graduation or immediate college enrollment.