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ABSTRACT

We use regression discontinuity and regression kink designs to estimate the impact of need-based grant aid on the borrowing and educational attainment of students enrolled in a large public university system. Pell Grant aid substantially reduces borrowing: among students who would borrow in the absence of a Pell Grant, every dollar of Pell Grant aid crowds-out over $1.80 of loans. A simple model illustrates that our findings are consistent with students facing a fixed cost of incurring debt. The presence of such a fixed cost may lead to the unintended consequence of additional grant aid decreasing some students' attainment. Empirically, we rule out all but modest average impacts of Pell Grant aid on attainment, and we provide suggestive evidence of heterogeneous effects consistent with our fixed-borrowing-cost model. We estimate an augmented Tobit model with random censoring thresholds to allow for heterogeneous fixed borrowing costs, and find that eliminating the fixed cost would increase borrowing by over 250 percent.

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An online appendix is available at:
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1 Introduction

In the United States, federal and state governments provide substantial subsidies to college students, with the intention of increasing low-income individuals' educational attainment. During the 2011-12 academic year, the U.S. Department of Education provided $34 billion in Pell Grant aid and $59 billion in federal direct loans to undergraduate students (U.S. Department of Education 2013).[1] Although many students are eligible for both Pell Grants and federal loans, little is known about how these programs interact, how grant aid affects students' borrowing decisions, and how borrowing responses alter the ability of grant aid to increase human capital.

In this paper, we use a combined regression discontinuity/regression kink design to identify the impact of need-based grant aid on college students' educational investment decisions, focusing on borrowing and educational attainment. We study City University of New York (CUNY) students who are eligible or nearly eligible for a Pell Grant. Pell Grant aid has large, negative, and statistically significant impacts on borrowing. We estimate that a dollar increase in Pell Grant aid induces first-year students to reduce borrowing by $0.43, on average. Among those students who would borrow in the absence of Pell Grant eligibility, Pell Grant aid crowds-out over 100 percent of loan aid – with an additional dollar of Pell Grant aid leading these first-year students to reduce borrowing by approximately $1.80 – a result at odds with traditional models of human capital investment under credit constraints.[2]

Crowd-out in excess of 100 percent can result when preferences or budget sets are discontinuous, as in the case of a fixed cost of borrowing. College students do not pay a monetary fixed cost of borrowing, but may face cognitive, psychic, and hassle costs. We develop a simple two-period model of students' joint borrowing and schooling choices in the presence of a fixed cost. Because students learn about their Pell Grant award after making the decision to enroll in college, a marginal increase in grant aid only increases the educational attainment of students at a borrowing threshold, such as a credit constraint (e.g., Becker 1975; Cameron and Taber 2004). A fixed cost of borrowing generates a discontinuity in students' budget sets, resulting in another such threshold at the first dollar of debt. Our model predicts that grant aid will increase the attainment of students at this threshold, even though they do not face binding credit constraints. Conversely, a small increase in grant aid may *reduce* educational attainment of students whose optimal debt is shifted to a level at which the fixed cost binds. For these students, a small increase in grant aid reduces the benefits of consumption smoothing to the point at which it is no longer worth paying the fixed cost of borrowing. Thus, our model generates ambiguous predictions for the average impact of grant aid on educational attainment in the presence of a fixed cost. Empirically, we can rule out all but modest impacts of Pell Grant aid on

[1] Total student loan disbursements calculated from the Department of Education's Title IV Program Volume Reports.
[2] Unless otherwise noted, all dollar amounts are inflated to 2012 dollars using the CPI-U.

attainment for CUNY students near the Pell Grant eligibility threshold, such as an additional $1,000 of Pell Grant aid leading to more than one additional credit earned by first-year students.

We provide evidence supporting the existence of a fixed cost of borrowing. Borrowing responses to Pell Grant aid occur primarily along the extensive margin, with quantile treatment effects suggesting smaller impacts of Pell Grant aid on borrowing at higher quantiles. Within-student regressions of educational attainment on Pell Grant aid and borrowing provide additional suggestive evidence; Pell Grant aid increases credits attempted by students whose borrowing decisions are not affected by grant aid, while students who stop borrowing following a small increase in Pell Grant aid reduce credits attempted and earned.

Finally, we characterize the unobserved fixed cost of borrowing by estimating the amounts that students are (un)willing to borrow. If the fixed cost of borrowing varies across students, the (unobserved) minimum acceptable loan amount will also vary, and we cannot employ standard censored regression models that require a known, constant censoring point. We instead construct a maximum likelihood estimator with random effects describing the minimum positive amount that each student would be willing to borrow. We estimate that eliminating the fixed cost of borrowing would increase the probability of borrowing and average student debt by more than 250 percent.

Our primary identification strategy for estimating the causal effect of grant aid on borrowing and attainment uses the nonlinearities in the Pell Grant Program's formula. A naïve regression of these outcomes on grant aid will conflate the effect of aid with the effect of unobserved factors that are correlated with aid, such as motivation or family support. To overcome this concern, we use regression discontinuity (RD) and regression kink (RK) designs (Hahn et al. 2001; Card et al. 2012). While a student's Pell Grant aid depends on the federal government's measure of need, this relationship is discontinuous at the Pell Grant eligibility threshold, causing students with similar characteristics to receive significantly different amounts of aid (Turner 2014).

Our paper contributes to the large literature on the effectiveness of financial aid in promoting educational attainment and highlights the importance of considering interactions between programs. Existing estimates suggest that increases in grant aid have the same impact on college attendance as similar decreases in tuition, as long as the grant application process is relatively simple. Across many studies, a $1,000 increase in financial aid (or decrease in tuition) is estimated to increase the probability of college attendance by 3 to 4 percentage points (Deming and Dynarski 2010). The Pell Grant Program aims to relax credit constraints and students targeted by the Pell Grant Program are especially needy. First-year, Pell Grant-eligible CUNY students in our sample, whose educational expenses and resources we show to be comparable to Pell Grant recipients across the country, received an award that represented 8 percent of family adjusted gross income

and 21 percent of the total cost of attendance, on average.[3] Despite the program's generosity, Pell Grant aid has not been found to increase most low-income students' college enrollment or college quality (e.g., Kane 1995; Rubin 2011; Carruthers and Welch 2014; Turner 2014).[4] In our setting, we estimate that an additional $1,000 in Pell Grant aid results in an insignificant 0.3 percentage point (2 percent) increase in the probability that an applicant enrolls in a given CUNY institution.[5] Furthermore, within the CUNY system, we find no evidence that Pell Grant aid induces students to "upgrade" from community colleges to more expensive four-year institutions. Thus, we are able to estimate the impact of need-based grant aid on attainment among students who have already made the decision to enroll in college.[6]

We also investigate the factors contributing to the fixed cost of borrowing faced by CUNY students. If students within and outside the CUNY system face similar psychic costs of borrowing, we should observe similar patterns of crowd-out among non-CUNY students with similar characteristics. However, even after reweighting a nationally representative sample of college students to resemble the average CUNY student, we find that Pell Grant aid has larger impacts on CUNY students' borrowing, suggesting that the fixed cost is not primarily psychic. Institutional financial aid procedures may also generate a fixed borrowing cost. Access to federal loan aid in the CUNY system is distinguished by two important features. First, the default loan offer in the CUNY system is $0, while many other schools offer nonzero loan awards to eligible students. Second, CUNY students must opt into borrowing by filling out an additional application for loans. We show that students who have access to online loan applications, and thus face lower hassle costs of applying for loan aid, behave no differently than students who must submit their application in person. By process of elimination, we conclude that the cognitive cost of deviating from the default loan of $0 is likely to be an important component of a fixed cost of borrowing at CUNY and at institutions with similar procedures.

Our hypothesis that the fixed cost of borrowing depends on the presentation of student loan offers is

[3]The average Pell Grant represented 17 percent of average family income (taxable and non-taxable) among all Pell Grant recipients in the country in 2012 (authors' calculations using Tables 1 and 2-A in U.S. Department of Education 2013).

[4]Bettinger et al. (2012) provide evidence that the complexity of the federal student aid application process substantially reduces the impact of Pell Grant eligibility on college-going. However, Seftor and Turner (2002) estimate that the introduction of the Pell Grant program did increase enrollment of non-traditional, older students.

[5]In comparison, estimates from research focusing on the enrollment effects of other need-based grant programs suggest that a $1,000 increase in grant aid leads to a 3 to 4 percentage point (3 to 9 percent) increase in college attendance (Dynarski 2003; Kane 2003; Castleman and Long 2013).

[6]Fewer studies examine the impact of need-based grant aid on attainment conditional on enrollment. Using data on public college students in Ohio, Bettinger (2004) finds positive impacts of Pell Grant aid on persistence, with an additional $1,000 in Pell Grant aid leading to an estimated 3 to 4 percentage point increase in reenrollment. These estimates are not robust to controlling for institution fixed-effects and interactions between Pell Grant aid and borrowing are not examined. Goldrick-Rab et al. (2014) show that Pell Grant recipients randomly assigned to receive a Wisconsin Scholars Grant experienced significant increases in persistence when the additional aid did not displace federal loans. Several other papers examine the impact of financial incentives on enrolled students' persistence and attainment. Angrist et al. (2009) study a program where students attending a non-selective Canadian public university were randomly assigned to earn aid based on maintaining a minimum GPA and course load. Male students were not affected, but the program had a small impact on the GPAs of female students that were also assigned to receive additional services, such as peer advising and study groups. However, a follow-up experiment with larger financial incentives found small effects (Angrist et al. 2014). Scott-Clayton (2011) finds that a conditional merit aid program in West Virginia, where recipients were required to meet minimum GPA and credit requirements to receive aid, increased educational attainment and graduation rates. A series of experiments run by MDRC that tested the effect of randomly assigned student incentives and find small, but significant impacts on attainment (Patel et al. 2013).

consistent with the literature on the importance of default options. For example, Pallais (forthcoming) examines an increase in the number of free score reports ACT test-takers can send to colleges. She estimates that reducing the price of the fourth ACT score report from $6 to $0 had substantial impacts on the quality of college attended by low-income students. Field (2009) studies an experiment conducted by New York University's law school, where prospective students were randomly assigned to receive either debt forgiveness or a tuition waiver tied to taking a job in the public sector. Although both options had the same present discounted value, tuition waiver recipients were significantly more likely to enter into a public sector career. Outside of higher education, Madrian and Shea (2001) and Choi et al. (2006) show that default options matter for decisions related to investment, saving, and 401(k) participation.

The remainder of our paper proceeds as follows: in Section 2, we describe the CUNY system. Section 3 outlines a simple conceptual framework allowing for discontinuous borrowing costs, which generates new predictions for how borrowing and attainment will respond to grant aid. We describe our data and sample in Section 4. In Section 5, we discuss our primary empirical approach, while in Section 6, we present reduced form estimates of the impact of Pell Grant aid on student loan debt and educational attainment. In Section 7, we characterize the fixed cost CUNY students incur when borrowing and investigate factors contributing to this cost. Section 8 concludes.

2 The CUNY System and Need-Based Student Aid

The City University of New York (CUNY) is the largest urban public university system in the country, encompassing 17 two- and four-year colleges that serve over 250,000 undergraduate students in a given year. CUNY institutions have low tuition and operate in a state with generous need-based grant aid. Online Appendix A provides additional details on the CUNY system, including tuition, fees, and living expenses faced by students during the years we examine. Similar to other urban public institutions, CUNY schools have low retention and graduation rates. Among first-time freshmen who enrolled in fall 2006, only 10 percent of students pursuing an associate's degree graduated in three years and only 41 percent of students in a bachelor's degree program graduated within six years.[7]

A centralized application system determines eligibility for federal student aid. Current and prospective students must submit a Free Application for Federal Student Aid (FAFSA) to the U.S. Department of Education every academic year. FAFSA inputs include a detailed set of financial and demographic information,

[7]Nationwide, 20 percent of first-time, full-time, degree-seeking students who entered a community college in 2005 received a degree within three years and 57 percent of first-time, full-time, degree-seeking students who entered a public four-year institution earned a degree within six years (National Center for Education Statistics 2013). Institutions located in urban areas tend to have lower graduation rates. For instance, the City College of Chicago system had an average three year associate's degree completion rate of 10 percent among 2008 entrants (see http://www.ccc.edu/menu/pages/facts-statistics.aspx).

such as income, untaxed benefits, assets, family size and structure, and number of siblings in college. The federal government calculates a student's expected family contribution (EFC) using a complicated, non-linear function of these inputs. Eligibility for Pell Grant aid and subsidized federal student loans are determined by a student's EFC and cost of attendance (COA), which includes tuition, fees, and estimated living expenses.

Students with EFC below a set threshold are eligible to receive the minimum Pell Grant award. Every $1 decrease in EFC leads to a $1 increase in (statutory) Pell Grant aid, up to the maximum Pell Grant award. Only students with a zero EFC receive the maximum award. A low COA could also limit the Pell Grant amount, as described in Online Appendix A, but this constraint does not bind for CUNY students with EFCs near the Pell Grant eligibility threshold, where Pell Grant aid is solely determined by EFC. A substantial portion of CUNY undergraduates receive Pell Grants; according to data from the Integrated Postsecondary Education Data System (IPEDS), across all CUNY institutions, 68 percent of first-time, full-time, fall 2012 entering undergraduate students received a Pell Grant.

Many CUNY undergraduates also receive state grant aid. According to the IPEDS, 60 percent of first-time, full-time, fall 2012 entering students received grant aid from New York State. The majority of this aid came from New York's Tuition Assistance Program (TAP). In the years we examine, the maximum Tuition Assistance Program (TAP) award was $5,000. New York State residents must complete a supplemental application for the TAP program, as TAP grant aid is determined by New York State taxable income, which cannot be calculated using FAFSA inputs. Importantly for our identification strategy, TAP grant aid is not awarded based on EFC. TAP provides grants to students much higher in the income distribution than the Pell Grant Program - up to $80,000 in New York State taxable income for dependent students.

CUNY institutions have very limited institutional grant aid. Again, using data from the IPEDS, we calculate that less than 3 percent of first-time, full-time, fall 2012 entering CUNY students received institutional grant aid. In comparison, across all public institutions, 31 percent of the fall 2012 entering cohort received institutional grant aid. This suggests that CUNY institutions' ability to manipulate institutional aid in response to Pell Grants, as illustrated by Turner (2014), will be limited.

Finally, CUNY students are eligible to borrow through the federal Direct Loan Program.[8] The terms of federal loan aid depend on a student's course load, tenure, and unmet need. Specifically, a student's unmet need, equal to the total cost of attendance (tuition, fees, and a cost of living allowance) minus EFC and grant aid, determines her eligibility for subsidized federal loans. First-year students are eligible for subsidized loan aid equal to the lesser of remaining need and $3,500. Dependent first-year students can borrow an additional $2,000 in unsubsidized loans while independent students can borrow an additional $6,000. All students are

[8]In general, private lenders and some institutions also offer student loans. CUNY schools do not offer loans, and we find that no CUNY students borrow through private lenders, most likely due to the superior terms on federal loans.

eligible for unsubsidized loans and even students that do not qualify for subsidized loan aid can still borrow up to the overall maximum in unsubsidized loans ($5,500 for first-year dependent students and $9,500 for first-year independent students). Subsidized loans do not accrue interest until six months after a student leaves school; after this period, students face an interest rate of between 3.4 and 6.8 percent, depending on the year in which the loan was disbursed. The cohorts we examine could borrow unsubsidized federal loans at an interest rate of 6.8 percent. Grant and loan aid is first used to pay direct costs (tuition and fees), with the student receiving any remaining aid directly. Online Appendix A provides additional information on the federal Direct Loan Program. Despite low tuition and generous state grant aid, most CUNY students remain eligible to borrow the maximum allowable subsidized federal loans.

The timing of the school and financial aid application processes lends credibility to the use of the Pell Grant formula as a quasi-experiment for estimating the impact of grant aid on borrowing and educational investment of enrolled students. Prospective students generally apply to CUNY schools in advance of completing a FAFSA. CUNY schools admit prospective students on a rolling basis, but students must submit an application by February 1st to be guaranteed consideration. Prospective students list up to six two- or four-year colleges within the system they would like to attend, in order of preference, as well as their planned attendance intensity (i.e., full-time or part-time). Because the FAFSA requires information on prior-year taxable income, prospective students generally wait to complete the FAFSA until after their family has filed their tax return (at best, early February). Students are notified of their EFC by the Department of Education shortly after submitting a FAFSA but do not learn of their financial aid eligibility until after they have been admitted to a college, generally six to eight weeks after submitting the CUNY application. Upon admission, the college provides the student with a financial aid package which specifies grant aid (federal, state, and institutional). During the months leading up to the fall semester, the student decides whether to accept the admissions offer and how much (if any) federal loan debt to incur.

Colleges participating in the federal loan program must allow students to borrow up to their full federal loan aid entitlement, but they have discretion over the presentation, or "packaging" of loans (Scott-Clayton 2013). Online Appendix Figure B.1 displays a sample CUNY financial aid award letter, which follows the "shopping sheet" template recommended by the Department of Education. Most four-year colleges populate the loan amounts in their award letters with the maximum amounts for which the student is eligible, but CUNY institutions and many community colleges offer a loan amount of zero to all students, including those eligible for subsidized loans. CUNY students face a default loan amount of $0 and, furthermore, must submit a separate application that specifies their desired amount of federal loan aid and whether they are willing to take on unsubsidized debt if they wish to borrow.[9] This practice may impose fixed costs in the form of

[9]Online Appendix Figure B.2 displays a sample of the additional loan application required by Hunter College. Approximately

both psychic costs of deviating from the zero-loan default and transaction costs of applying for loan aid. CUNY's loan packaging practices are not unique among community colleges. We gathered information on loan packaging procedures within 178 of the 251 largest community colleges participating in federal loan programs (excluding CUNY schools).[10] Of these schools, 45 percent follow the same procedure as CUNY, setting the default loan in the financial aid award letter to $0.

3 Conceptual Framework

In this section, we outline our model of students' human capital investment decisions, which we tailor to match the key features of federal student loan programs. In particular, we focus on grants like the Pell Grant that are calculated and awarded after a student has made her enrollment decision. We abstract from any price effect of grants on initial enrollment decisions, an assumption we will show to be consistent with our empirical setting. Similarly, Pell Grant aid does not depend on course completion, and while a grant could affect a student's beliefs about future prices, our instruments for Pell Grant aid in a given year are not predictive of aid in future years. Thus, we abstract from any price effects on educational investment while in school. The resulting model is simplified so as to highlight the novel empirical implications of a fixed borrowing cost.

An individual lives for two periods. In the first period, she chooses schooling s and debt d to maximize lifetime utility, $U = u(c_0) + \beta u(c_1)$, where subscripts indicate the period, $\beta \in (0,1)$ is the time discount factor, and $u(\cdot)$ follows standard assumptions for instantaneous utility (strictly increasing, strictly concave, and twice continuously differentiable). In the first period, the student receives exogenous grants g from the government and has resources equal to her expected family contribution EFC and exogenous income ω, where ω represents the error term in the federal government's estimation of family resources, and can be positive or negative. The student faces costs $C(s)$ associated with her first period educational investment, which encompass both direct costs $C_t(s)$ (e.g., such as tuition and fees) and opportunity costs $C_i(s)$ (e.g., foregone earnings). $C(s)$ is twice continuously differential, with $C_t'(s) \geq 0$, $C'(s) > 0$ and $C''(s) \geq 0$. In the second period, the student receives earnings $w(s)$ where $w' > 0$ and $w'' \leq 0$.[11]

Borrowing is subject to multiple interest rates and potential constraints. The student can borrow an

one-third of the students in our sample attend an institution that provides an online application for federal loans. The remaining students must submit an application in person to their institution's financial aid office.

[10] Data on enrollment and federal student loan program participation was drawn from Cochrane and Szabo-Kubitz (2013) and http://projectonstudentdebt.org/files/pub//CC_participation_status_2010-11.pdf.

[11] If we allowed for heterogeneous costs of schooling effort by letting s enter directly into the period utility functions, as in Cameron and Taber (2004), or by letting ability vary across students, as in Lochner and Monge-Naranjo (2011), our model would yield similar predictions. We could also allow the cost of schooling to vary with resources but have chosen a more parsimonious form because institutional aid is limited at CUNY and the empirical results are robust to using either Pell Grants or total grants as the variable of interest.

amount d, which can be less than zero if the student prefers to save. The gross market interest rate is $R_m < \frac{1}{\beta}$, but the government subsidizes some student loans by charging the rate $R_s < R_m$.[12] The student receives the subsidized interest rate on all loans up to a limiting amount $d_s^{max} = \min\left\{\bar{d}, C_t(s) - g - EFC\right\}$, where $\bar{d}$ is a constant. This formulation captures the structure of the federal subsidized Direct Loan Program, which can be used to cover "unmet need", represented by $C_t(s) - g - EFC$, up to a fixed limit $\bar{d}$. Additionally, the student can borrow up to the overall federal loan limit $\bar{\bar{d}} > d_s^{max}$, where loans in excess of d_s^{max} are subject to the market interest rate.

The student also pays a fixed borrowing cost γ if she chooses any $d > 0$, which represents discrete monetary, time, and psychic costs of incurring debt. For notational convenience, we define indicator functions $\kappa_0 = \mathbf{1}\{d > 0\}$ (incurring positive debt), $\kappa_s = \mathbf{1}\{d > d_s^{max}\}$ (incurring positive unsubsidized debt), and $\xi = \mathbf{1}\left\{C_t(s) - g - EFC < \bar{d}\right\} = \mathbf{1}\{d_s^{max} = C_t(s) - g - EFC\}$ (being bound by the endogenous subsidized borrowing limit) to distinguish between cases.

The student faces budget constraints $c_0 \leq \omega + EFC + g + d - C(s) - \gamma \cdot \kappa_0$ in the first period and $c_1 \leq w(s) - R_s d - \kappa_s (R_m - R_s)\left(d - \bar{d} - \xi\left(C_t(s) - g - EFC - \bar{d}\right)\right)$ in the second period.[13] Assigning the variable λ for the Lagrange multiplier on the maximum-loan constraint, the student solves:

$$\max_{s,d} \{u(\omega + EFC + g + d - C(s) - \gamma \cdot \kappa_0) +$$

$$\beta u\left(w(s) - R_s d - \kappa_s (R_m - R_s)\left(d - \bar{d} - \xi\left(C_t(s) - g - EFC - \bar{d}\right)\right)\right) + \lambda\left(\bar{\bar{d}} - d\right)\}$$

Optimal schooling s^* and debt d^* will satisfy some combination of the first order conditions:

$$u'(c_0) = \beta\left(R_s + \kappa_s (R_m - R_s)\right) u'(c_1) + \lambda \tag{1}$$

$$C'(s)\, u'(c_0) = \beta\left(w'(s) - \xi\kappa_s (R_m - R_s)\, C_t'(s)\right) u'(c_1) \tag{2}$$

$$d = \bar{\bar{d}} \tag{3}$$

[12] If students were able to earn R_m on their savings, all students should either chose not to borrow, or borrow at or above the subsidized limit because for subsidized loans, students can borrow at R_s and earn $R_m > R_s$ by saving. However, in the years we examine, market interest rates were quite low and students faced a 1 percent origination fee on all loans, resulting in $R_s \approx R_m$. This is in contrast to the setting Cadena and Keys (2013) examine when investigating potential explanations for students' decisions to forgo subsidized loans. Thus, we only include two terms for gross interest rates - omitting a third term representing the market rate for savings does not affect our predictions.

[13] We assume the regularity condition $w''(s) \leq -R_m C_t''(s)$ for all s to ensure global concavity of the problem. We deem this condition reasonable because direct costs are linear or concave in schooling, depending on a student's course load: tuition is linear in credits attempted for part-time students, while full-time students (attempting 12 to 18 credits) are charged a flat rate. Additionally, we show in Online Appendix C that a weaker condition would suffice.

Which subset of the first-order conditions applies depends on which case the student falls into. For example, if the maximum loan constraint is not binding ($\lambda = 0$), the student's remaining need is greater than the subsidized loan limit ($\xi = 0$), and optimal borrowing is nonzero ($d^* \neq 0$) then conditions (1) and (2) hold, implying that $C'(s^*) = (R_s + \kappa_s (R_m - R_s))^{-1} w'(s^*)$. In such cases, s^* equates the present discounted values of the marginal costs and benefits of schooling. Optimal schooling does not depend on income or consumption in either period, implying that schooling will not respond to a marginal increase in grant aid. This result is standard: students who not do not face borrowing constraints will not increase their schooling in response to a marginal increase in grant aid.

For a given level of EFC, students can be ordered in terms of additional resources ω. A partition of this spectrum defines the different cases a student may fall into, which we label groups A through F. The chart below summarizes students' choices of debt and responses to grant aid in each potential case. Group A is made up of students with resources great enough that they choose to save (i.e., $d^* < 0$). Group F describes students who have so few resources that they would prefer to borrow more than the maximum allowable government loan $\bar{\bar{d}}$ but cannot. For groups between these extreme cases, the optimal level of debt is weakly decreasing in resources.[14] As long as $\gamma > 0$, there will be some minimum level of debt that students are unwilling to take on, which we denote as $\underline{d}$.

Optimal Borrowing and Educational Investment Decisions by Level of Exogenous Resources

Group	A	B	B/C Switchers	C	D	E	F
d^*	$(-\infty, 0)$	0		$(\underline{d}, d_s^{max})$	d_s^{max}	$\left(d_s^{max}, \bar{\bar{d}}\right)$	$\bar{\bar{d}}$
$\frac{\partial d^*}{\partial g}$	$(-1, 0)$	0	$\frac{\Delta d^*}{\Delta g} = \frac{0-\underline{d}}{\Delta g} < -1$	$(-1, 0)$	$\xi\left(\frac{\partial s^*}{\partial g} C_t'(s^*) - 1\right)$	$(-1, 0)$	0
$\frac{\partial s^*}{\partial g}$	0	$(0, \infty)$	$\frac{\Delta s^*}{\Delta g} = \frac{s_0 - \underline{s}}{\Delta g} < 0$	0	$(0, \infty)$	0	$(0, \infty)$

Notes: Groups are listed in decreasing order of exogenous resources ω, where group A has the highest resources and group F has the lowest resources. Observed debt is bounded from below by 0 and $d^* < 0$ implies saving.

The above table displays categories of students according to their optimal debt level and schooling and borrowing responses to grants. Though we distinguish six distinct groups of students, the groups fall into two general types: those choosing corner solutions for debt – who we label "threshold borrowers" – and those choosing interior solutions for debt. Groups A, C, and E choose interior levels of debt, and the amount they borrow therefore responds to the amount of grant aid they receive. Grant aid does not increase the educational attainment of students in these three groups. Threshold borrowers, however, arrive at a corner solution for borrowing due to the presence of fixed costs (Group B), kinks in the interest rate schedule (Group D), or credit constraints (Group F).

Panel A of Figure 1 displays the borrowing and consumption choices of Groups B, C, and D members on along the budget constraint. Members of Group A (not shown) locate to the left of the discontinuity

[14] See Online Appendix C for proofs.

in the budget set caused by the fixed cost, while individuals in Group B arrive at a corner solution and neither borrow nor save. Likewise, Group D members borrow at the subsidized maximum, arriving at a corner solution caused by the interest rate kink, and Group F members (not shown) borrow at the federal maximum, represented by the far right discontinuity in the budget constraint. Students in Group C locate between the discontinuity and the interest rate kink, while those in Group E (not shown) locate between the interest rate kink and discontinuity caused by the federal borrowing limit.

The remainder of Figure 1 provides an illustration of the impact of Pell Grant aid on students' borrowing decisions. Students in Group B remain at their borrowing thresholds when grants increase slightly but complete more schooling in order to raise the ratio of future income to current income (Panel B). Members of Groups D and F, follow a similar response.[15] Responses within and between these groups are all continuous except for students switching between Groups B and C (Panel C). Students whose optimal debt is close to $\underline{d}$ may be induced to switch to $d^* = 0$ by small increases in grant aid, Δg. Those who would have taken small loans in the absence of the fixed cost will instead choose not to borrow, which in turn, leads to a reduction in educational attainment. This unintended consequence of grant aid leads to our first and third empirical predictions described below.

3.1 Empirical predictions

Our framework generates three key predictions concerning how overall borrowing and educational investment respond to changes in grant aid in the presence of a fixed cost:

1. *If the fixed cost of borrowing $\gamma > 0$ then $\underline{d} > 0$, and an increase in grant aid may lead to a greater than \$1 for \$1 reduction in loans for borrowers.* This result allows for crowd-out to exceed 100 percent. If students have loans close to $\underline{d}$, a small increase in grants will cause a discrete drop in (observed) borrowing to zero. With no fixed borrowing cost, the amount of crowd-out is strictly bounded above by 100 percent because $\frac{\partial d^*}{\partial g}$ is bounded from below by -1 for all groups and there would be no groups between which there would be a discontinuity in optimal borrowing.

2. *Grants only increase threshold borrowers' educational attainment.* Students facing a straightforward borrowing choice (Groups A, C, and E) choose the level of schooling that equates current marginal cost with discounted future marginal benefit and then use debt to smooth income between periods (e.g., Figure 1, Panel D). An increase in grant aid has no impact on educational attainment; it only

[15] Students remain at their respective borrowing thresholds by keeping debt constant, except in the case of students in Group D for whom unmet need is less than the exogenous limit on subsidized loans ($\xi = 1$). For these students, grants reduce unmet need and consequently the amount they can borrow at the subsidized rate. These students adjust loans so as to remain at the kink but otherwise behave like other threshold borrowers, increasing schooling as grant aid rises.

induces these students to borrow less. On the other hand, threshold borrowers (Groups B, D, and F) are limited in their ability to offset small changes in grant aid by altering their borrowing. Only these groups respond to grant aid by increasing schooling (e.g., Figure 1, Panel B). Finally, students induced to switch from Group C to Group B will respond to a marginal increase in grant aid by reducing schooling (e.g., Figure 1, Panel C).

3. *Grants decrease educational attainment of students whose optimal debt level drops from (weakly) above $\underline{d}$ to a positive amount below $\underline{d}$.* Students whose optimal borrowing after grant aid falls below $\underline{d}$ will no longer be willing to pay the fixed cost of borrowing. Foregoing loans reduces current consumption but raises future consumption, causing these students to invest less in education in order to shift consumption to the present.

4 Data and Sample

In order to take advantage of the nonlinearities in the Pell Grant Program's schedule, we need data that contains information on the underlying assignment variable (EFC), our outcomes of interest (borrowing and educational investment), and a sufficient number of observations to focus on the outcomes of students on either side of the discontinuities in the Pell Grant formula. We use administrative data from the CUNY system that contains the universe of students from multiple entry cohorts. This data provides information on students' demographic characteristics, EFC, grant and loan aid, and measures of educational attainment (reenrollment, GPA, and credits attempted and earned for semesters between entry and spring 2011).

Our primary sample includes eight cohorts of first-time, degree-seeking freshmen who entered a CUNY institution in the fall of the 2004-05 through 2010-11 academic years (hereafter 2005 through 2011 academic years). We observe students in their first three years after entry. In all of our analyses, we distinguish between students in their first year of college and returning (second- and third-year) students. We only observe students' FAFSA information (most importantly EFC) between 2007 and 2011, and therefore the two earliest entry cohorts contribute to our sample of returning students but not the first-year student sample. We restrict our sample to US citizens or permanent residents. Non-citizens that are not permanent residents are ineligible for most federal and state grant aid and make up only 6 percent of students in the cohorts we examine. Additionally, 12 percent of eligible students in a given cohort do not complete a FAFSA and thus are dropped from our sample. Finally, we eliminate students with an EFC more than $4,000 from the threshold for Pell Grant eligibility. This window excludes students with an EFC equal to zero, who are eligible for the maximum Pell Grant award.

Table 1 displays the characteristics of first-year students by Pell Grant eligibility. Pell Grant eligible

students receive more TAP and other grant aid (a category that includes aid from smaller state and federal grant programs, as well as institutional aid) than ineligible students, while ineligible students take on greater debt. On average, both eligible and ineligible students borrow at low rates; only 12 percent of the sample takes on any debt in their first year, despite having substantial need and eligibility for subsidized loans. Less than 1 percent of our sample exhausts their total federal loan eligibility in their first year. Pell-ineligible students are more likely to borrow, with 24 percent taking on some debt. Finally, Pell Grant eligible students have different demographic characteristics than ineligible students - they are more likely to be nonwhite, have lower SAT scores, and are less likely to have a college educated parent. These differences in observable characteristics between Pell Grant recipient students and ineligible students motivate our use of RD and RK designs to identify the causal impact of grant aid on student outcomes.

4.1 Are CUNY Pell Grant recipients representative of the national population?

The majority of Pell Grant recipients attend public institutions (e.g., 64 percent in 2008 according to U.S. Department of Education 2009). To determine how representative CUNY Pell Grant recipients are relative to Pell Grant recipients attending public schools nationwide, we compare the demographic characteristics, cost of attendance, and financial aid received by the 2008 cohort of first-year, degree-seeking, CUNY Pell Grant recipients to a nationally representative sample of first-year, degree-seeking public school students using data from the 2008 National Postsecondary Student Aid Study (NPSAS).[16]

As shown in Table 2, Pell Grant recipients attending CUNY community colleges have greater need than the average Pell Grant recipient enrolled in a community college (approximately $10,000 versus $7,500), while four-year CUNY students have slightly lower need than the average four-year Pell Grant recipient (approximately $11,000 versus $14,000). CUNY community college students also receive more grant aid than the average two-year public college student. After taking into account EFC and federal, state, and institutional grant aid, CUNY community college students have around $5,300 in unmet need compared to $4,700 for the NPSAS community college sample, while CUNY four-year students faced approximately $4,000 in unmet need in comparison to the approximately $7,600 faced by four-year NPSAS students.

CUNY Pell Grant recipients borrow at substantially lower rates than the average Pell Grant recipient, despite having relatively similar levels of unmet need. While on average, 25 percent of Pell Grant recipients enrolled in community colleges borrow, only 3 percent of CUNY community college students incur any student loan debt in their first year. Differences in borrowing rates are even more pronounced when comparing four-

[16]The NPSAS is a a nationally representative, restricted-use, repeated cross-section of college students. A stratified random sample of Title IV-eligible institutions is first drawn, and from these institutions, degree-seeking students are selected into the NPSAS. We use the National Center for Education Statistics' publicly available PowerStats application to generate aggregate statistics from this underlying sample.

year CUNY students with their NPSAS counterparts, with only 4 percent of CUNY students borrowing compared to 63 percent of Pell Grant recipients attending public schools in the NPSAS. CUNY students entirely avoid private loans, while 12 percent of community college students and 11 percent of four-year college students nationwide take on private student loan debt.

Much of the difference in institutional borrowing rates can be accounted for by heterogeneity in the way that colleges inform students of their eligibility for loan aid. Colleges that participate in the student loan program cannot prevent students from borrowing up to their full loan eligibility, but they have discretion over the default loan amount that is offered in the financial aid award letter. Of the 178 largest community colleges that we were able to obtain loan packaging procedures from, 45 percent set the default loan amount presented in students' financial aid award letters to $0. We matched these schools to the Integrated Postsecondary Education Data System to obtain institutional borrowing rates. The borrowing rate among schools that, like CUNY, include no loan aid in students' financial aid package, was 10 percent, which is comparable to the CUNY sample borrowing rate of 12 percent reported in Table 1. In contrast, community colleges that include loan aid in students' award letters had borrowing rates over 27 percent. We explore the role of financial aid procedures in generating a fixed cost of borrowing in Section 7.

In terms of their demographic characteristics, on average, CUNY Pell Grant recipients are younger, more likely to be classified as dependent students, more likely to be Hispanic, and more likely to have parents who did not attend college (Panel B). CUNY students' SAT performance is comparable to that of the average Pell Grant recipient. Finally, CUNY Pell Grant recipients are more likely to be first- or second-generation immigrants, reflecting the fact that the majority of CUNY students attended New York City public schools. Burdman (2005) shows that first-generation college students are more likely to voice aversion to taking on student loan debt; thus, we examine whether our main estimates vary across a number of predetermined characteristics, including dependency, parental education, and immigrant status.

5 Empirical Framework

We use the variation induced by the kink and discontinuity in the Pell Grant Program's formula to identify the impact of Pell Grant aid on educational investment. The kink occurs where the slope of the statutory $Pell\,(EFC)$ schedule changes from 0 to -1, while the discontinuity comes from the increase in Pell Grant aid from $0 to the minimum Pell Grant award at the eligibility threshold. Figure 2 displays the empirical distribution of Pell Grant aid among first-year students, where EFC is standardized such to represent distance from the year-specific eligibility threshold. [17]

[17] Online Appendix Figure B.3 displays the empirical distribution of Pell Grant aid for returning students.

Let $Y = \tau Pell + g(EFC) + U$ represent the causal relationship between educational investment, Y, and Pell Grant aid, $Pell = Pell(EFC)$, where U is a random vector of unobservable, predetermined characteristics. The required identifying assumptions for the RK design are: (1) the direct marginal impact of EFC on Y is continuous (e.g., around the eligibility threshold, there are no discontinuities in the direct relationship between EFC and Y) and (2) the conditional density of EFC (with respect to U) is continuously differentiable at the threshold for Pell Grant eligibility (Card et al. 2012).[18] These assumptions encompass those required for identification using the RD design (Hahn et al. 2001). For estimates to describe a local average treatment effect, we must also make the monotonicity assumption - e.g., that no students increase borrowing when receiving more grant aid - which consistent with our model in Section 3. As long as the relationship between unobservable factors and EFC evolves continuously across the Pell Grant eligibility threshold, the RK design approximates random assignment in the neighborhood of the kink. Additionally, as in the case of the RD design, the second assumption generates testable predictions concerning how the density of EFC and the distribution of observable characteristics should behave in the neighborhood of the eligibility threshold.

If these conditions hold, and with locally constant treatment effects, then both the RK estimator, τ_{RK}, and the RD estimator, τ_{RD}, will identify the causal impact of Pell Grant aid:

$$\tau_{RK} = \frac{\lim\limits_{\varepsilon \uparrow 0}\left[\frac{\partial Y|EFC=efc_0+\varepsilon}{\partial efc}\right] - \lim\limits_{\varepsilon \downarrow 0}\left[\frac{\partial Y|EFC=efc_0+\varepsilon}{\partial efc}\right]}{\lim\limits_{\varepsilon \uparrow 0}\left[\frac{\partial Pell|EFC=efc_0+\varepsilon}{\partial efc}\right] - \lim\limits_{\varepsilon \downarrow 0}\left[\frac{\partial Pell|EFC=efc_0+\varepsilon}{\partial efc}\right]} = \tau \tag{4}$$

$$\tau_{RD} = \frac{\lim\limits_{\varepsilon \uparrow 0}[Y|EFC = efc_0 + \varepsilon] - \lim\limits_{\varepsilon \downarrow 0}[Y|EFC = efc_0 + \varepsilon]}{\lim\limits_{\varepsilon \uparrow 0}[Pell|EFC = efc_0 + \varepsilon] - \lim\limits_{\varepsilon \downarrow 0}[Pell|EFC = efc_0 + \varepsilon]} = \tau \tag{5}$$

Where efc_0 represents the Pell Grant eligibility threshold. Since not all students complete a full year of college, EFC imperfectly predicts a given student's Pell Grant. Therefore, in practice, our estimation strategy involves fuzzy RD/RK. Specifically, we use an instrumental variables approach to estimate τ_{RK} and τ_{RD}. Since the eligibility threshold changes as the size of the maximum Pell award increases, we first create a standardized measure of the distance a student's EFC falls from the Pell Grant eligibility threshold: $\widetilde{EFC}_{it} = EFC_{it} - efc_{0t}$.

Consider the following first stage and reduced form equations, where i indicates students, t indicates

[18] Card et al. (2012) impose the additional identifying assumption that the right and left limits of $Pell(EFC)$are equal at the eligibility threshold. This assumption is clearly violated in our case, as there is both a discontinuity and kink in Pell Grant aid. However, under the assumption of locally constant treatment effects - or that $\frac{\partial Y}{\partial Pell}$ does not vary in the neighborhood of the Pell Grant eligibility threshold - this assumption can be relaxed without affecting identification.

year, c indicates cohorts, and s indicates colleges, $f(\cdot)$ and $g(\cdot)$ are flexible functions of $\widetilde{EFC}$ that we allow to vary depending on the side of the eligibility threshold on which a student falls, and $\mathbf{X}$ is a vector of predetermined demographic characteristics:

$$Pell_{ist} = f\left(\widetilde{EFC}_{it}\right) + \beta_1 \mathbf{1}\left[\widetilde{EFC}_{it} < 0\right] + \beta_2 \widetilde{EFC}_{it} \times \mathbf{1}\left[\widetilde{EFC}_{it} < 0\right] + \boldsymbol{\eta}\mathbf{X_{it}} + \delta_{sc} + \nu_{ist} \tag{6}$$

$$Y_{ist} = g\left(\widetilde{EFC}_{it}\right) + \pi_1 \mathbf{1}\left[\widetilde{EFC}_{it} < 0\right] + \pi_2 \widetilde{EFC}_{it} \times \mathbf{1}\left[\widetilde{EFC}_{it} < 0\right] + \boldsymbol{\phi}\mathbf{X_{it}} + \alpha_{sc} + \epsilon_{ist} \tag{7}$$

We choose the degree of polynomial in $\widetilde{EFC}$ that minimizes the Akaike Information Criterion (AIC). In this framework, $\hat{\tau}_{RK} = \frac{\hat{\pi}_2}{\hat{\beta}_2}$ and $\hat{\tau}_{RD} = \frac{\hat{\pi}_1}{\hat{\beta}_1}$. The test of the equality of $\hat{\tau}_{RK}$ and $\hat{\tau}_{RD}$ is also a test of locally constant treatment effects. As, in practice, we do not reject this test, we use both the kink and the discontinuity for identification.[19] Additionally, we show that our results are robust to using only the kink or only the discontinuity for identification.

Table 3 displays first stage estimates of the impact of the kink and discontinuity on Pell Grant aid by student level, and pooling across all students, where $f(\cdot)$ and $g(\cdot)$ are quadratic functions of $\widetilde{EFC}$, estimated separately on either side of the eligibility threshold. On average, first-year students that are barely-eligible for Pell Grants aid experience an approximately \$390 increase in Pell Grant aid, and for every dollar decrease in EFC, their Pell Grant increases by approximately \$0.76. Point estimates for the set of second and third year students are similar.

We also test whether Pell Grant aid has persistent impacts on educational investment. We regress attainment in year $t+n$ on Pell Grant aid received in year t, and estimate 2SLS models where the second stage takes the form:

$$Y_{ist} = \tau_n \widehat{Pell}_{it-n} + g_n\left(\widetilde{EFC}_{it-n}\right) + \boldsymbol{\varsigma}\mathbf{X_{it}} + \varphi_{sc} + \varepsilon_{istn} \tag{8}$$

Here, τ_n represents the impact of an additional dollar of Pell Grant aid in year $t-n$ on the year t outcome, *vis-à-vis* all other intermediate outcomes affected by Pell Grant aid (including future grants awards). If Pell Grant aid received in one year affects aid received in subsequent years, $\hat{\tau}_n$ represents what Cellini et al. (2010) call the "intent to treat" effect and we would need to use their dynamic regression discontinuity methods to estimate the "treatment on the treated" effect (which holds constant the impact of year t Pell Grant aid on intermediate outcomes). We find that an additional dollar of Pell Grant aid in a student's first year leads to an approximately \$1.19 increase in cumulative Pell Grant aid received three years after entry (Online Appendix Table B.3). As \$1 of this amount comes from the mechanical impact of first-year Pell Grant aid on cumulative Pell Grant aid, we test for dynamic impacts of first-year Pell Grant aid on Pell

[19] Dong (2013) shows that with locally constant treatment effects, the combined RD/RK estimator $\frac{\hat{\pi}_1 + w\hat{\pi}_2}{\hat{\beta}_1 + w\hat{\beta}_2} = \tau$, where weights w are based on the relative strength of the first stage relationship.

Grant aid in future years by testing the hypothesis that cumulative impacts on Pell Grant aid are equal to one. We do not reject this hypothesis ($p = 0.140$), and given that Pell Grant aid in year t does not have impacts on Pell Grant aid in future years, we conclude that the model described by equation (8) will also produce estimates of the "treatment on the treated" impact of first-year Pell Grant aid on later outcomes.

5.1 Evaluating the RD and RK identifying assumptions

We evaluate the RD/RK identifying assumptions through three exercises. First, we test for discontinuities in the level and slope of the density of first-year CUNY students at the Pell Grant eligibility threshold. Second, we similarly test for any evidence of discontinuities in the probability of attendance conditional on submitting an application to a CUNY institution. Finally, we test for discontinuities in the level and slope of the distribution of observable characteristics, including gender, race, immigrant status, family adjusted gross income (AGI), parental education, and dependency status.

As shown in Panel A of Figure 3, the level and slope of the density function are continuous through the Pell Grant threshold.[20] Examining the density of first-year students around the eligibility threshold provides suggestive evidence that Pell Grant generosity does not influence students' enrollment decisions. However, finding no change in the density of CUNY students is not sufficient to rule out a more complicated story that includes both an increase in CUNY enrollment and some potential CUNY students "upgrading," or switching to more expensive schools upon receiving Pell Grant aid. Therefore, we also examine the density of applications and changes in the probability of attendance, conditional on applying, at the Pell Grant threshold. We match CUNY applicant data to FAFSA and enrollment information for the fall 2007 through fall 2010 applicant cohorts.[21] We observe each applicant's ranking of up to six CUNY institutions and at which institution (if any) she ultimately matriculated to. Panel B of Figure 3 displays the density of applications and the conditional probability of enrollment by $\widetilde{EFC}$. Although we find a slight decrease in the number of applications to the left of the threshold, the probability of enrollment conditional on application is continuous through the threshold.

We formally estimate the change in the probability of enrollment conditional on application via equations (6) and (7); results are displayed in Table 4. We include a linear term in $\widetilde{EFC}$, which minimizes the AIC in all first stage and reduced form specifications. The first three columns present estimated impacts on enrollment in a given CUNY institution, conditional on application, which enables us to test for "upgrading" from community colleges to four-year schools within the CUNY system. Each observation represents a prospective student by application combination. The fourth column presents estimates of the impact of Pell Grant aid

[20] Online Appendix Figure B.4 displays the density of returning CUNY students in our sample.

[21] Unfortunately, we were not able to obtain applicant data for the fall 2006 cohort or match applicant records to our main analysis sample.

on the probability of enrollment in any CUNY institution, and each observation represents a prospective student.

Panel A displays results from our first stage equation. As our sample of applicants does not include prospective students in the fall 2006 cohort, the estimated change in Pell Grant aid at the eligibility threshold is larger than our estimate displayed in Table 3. In the sample of pooled community and four-year college applicants, we estimate that a $1,000 increase in Pell Grant aid leads to an insignificant 0.003 percentage point increase in the probability of enrollment (Panel C, Column 1). Our 95 percent confidence interval excludes effects as small as an additional $1,000 of Pell Grant aid leading to a 0.8 percentage point increase in the probability of enrollment in a given CUNY school, which represents a 4.8 percent increase from the mean enrollment rate. Estimates from specifications that only use the discontinuity (Panel D) or kink (Panel E) in Pell Grant aid for identification are similar but less precise.

However, estimates from the pooled sample of applicants to two- and four-year CUNY institutions may understate the impact of Pell Grant aid on college going if Pell Grant aid causes students to upgrade to more selective institutions. Specifically, if Pell Grant aid increases the probability of enrollment in a CUNY community college while also inducing students who would have attended a four-year CUNY institution to enroll in a more expensive school, we might still find no impact on overall enrollment in the CUNY system. Therefore, we divide our sample of applicants into community college applicants and four-year college applicants. As shown in Columns 2 and 3, we find no evidence that, conditional on submitting an application, Pell Grant aid leads to significant increases in the probability of enrollment in a CUNY community college or four-year institution. In the community college sample, the point estimate from our main specification suggests that an additional $1,000 in Pell Grant aid results in an insignificant 1.1 percentage point (5 percent) increase in the probability of enrollment. In the four-year college sample, our point estimate suggest that an $1,000 Pell Grant award leads to an insignificant 0.5 percentage point (3.5 percent) decrease in enrollment among applicants. These small, insignificant effect sizes are consistent with evidence against Pell-related "upgrading" in the nationally representative sample examined by Turner (2014) and in the sample of Tennessee high school graduates that Carruthers and Welch (2014) study.

Our fourth specification examines impacts on enrollment in any CUNY institution as a function of Pell Grant aid. The point estimate from our main specification is significant at the 10 percent level but small in magnitude, suggesting that $1,000 increase in Pell Grant aid leads to a 1.4 percentage point increase in the probability of enrollment in any CUNY institution. Our 95 percent confidence interval allows us to rule out enrollment impacts greater than 2.2 percent. Finding no evidence of consistent effects on enrollment, we proceed by analyzing impacts of Pell Grant aid on the population of CUNY enrollees, for whom we observe borrowing and educational attainment outcomes.

We find little evidence of discontinuous changes in the level or slope of distributions of observable characteristics (Figure 4). Online Appendix Table B.1 contains corresponding point estimates from regressions of these characteristics on the kink and discontinuity, degree program and school by year fixed effects, and a polynomial in $\widetilde{EFC}$, allowed to vary on either side of the Pell Grant eligibility threshold. We estimate a statistically significant, negative relationship between AGI and Pell Grant eligibility for first and third-year students, although when we include higher order polynomials in $\widetilde{EFC}$, our estimates are no longer significant. Outside of AGI, only one of the 24 point estimates are statistically distinguishable from zero. We control for these characteristics in our main specification, while also showing that our estimates are robust to excluding these controls.

6 The Impact of Pell Grant Aid on Borrowing and Attainment

Our model suggests that Pell Grant aid will reduce unconstrained students' borrowing. Predicted effects on educational attainment vary, with "threshold borrowers" increasing schooling, unconstrained students not altering their schooling, and students who stop borrowing in response to additional Pell dollars experiencing a reduction in attainment. In this section, we first present graphical evidence of the reduced form impacts of Pell Grant eligibility and generosity on borrowing and then present estimates from our parametric specification.

6.1 Pell Grant aid reduces borrowing

Figure 5 displays mean student loan aid by distance from the Pell Grant eligibility threshold for first-year students.[22] Average loan aid falls discontinuously at the Pell Grant eligibility threshold, and the relationship between borrowing and EFC changes discontinuously, indicating that (on average) students reduce borrowing upon receiving additional grant aid.[23] These impacts are driven by a reduction in the probability of any borrowing at the threshold, as well as a reduction in the size of loans conditional on taking on any debt (Figure 6).

To quantify the contemporaneous impact of Pell Grant aid on borrowing, we estimate equation (7) separately for new and returning students (Table 5). Panel A presents reduced form impacts of Pell Grant eligibility and generosity on student loan aid. Panel B displays 2SLS estimates of the impact of Pell Grant aid on debt using both the kink and discontinuity as instruments for Pell Grant aid. An additional dollar of Pell Grant aid induces first-year students to reduce borrowing by approximately \$0.43. Returning students

[22] Online Appendix Figure B.5 displays corresponding results for returning students.

[23] This reduction primarily comes from a fall in subsidized loans (Online Appendix Figure B.6), due to the fact that few borrowers take on unsubsidized debt.

respond to an additional dollar of Pell Grant aid by forgoing \$0.51 in loan aid. Finally, Panel C displays estimated impacts from separate IV-RD and IV-RK models, which largely support our assumption of locally constant treatment effects. Point estimates using only the discontinuity as an instrument for Pell Grant are larger in magnitude than estimates obtained from instrumenting with only the kink, but among new students, these estimates are not statistically distinguishable. Among returning students, differences between estimates obtained from IV-RD and IV-RK models are marginally significant, with $p = 0.098$.[24]

6.2 Crowd-out exceeds 100 percent among would-be borrowers

Given how few CUNY students borrow, the extent of loan crowd-out that we estimate suggests large borrowing responses among a subset of students. According to our model in Section 3, we can divide students at any level of EFC into three broad categories based on their extensive-margin borrowing response to additional Pell Grant aid. First are students in Groups A and B - those who will not borrow regardless of whether or not they experience an increase in Pell Grant aid. We label these students "never-borrowers." Second are students in Groups C, D, E, and F - those who borrow both before and after a marginal increase in Pell Grant aid, who we label as "always-borrowers." Third are Group C students for whom a marginal increase in Pell Grant aid causes the fixed cost of borrowing to bind and induces a switch to Group B. Among this group of "switchers," our model predicts that an increase in Pell Grant aid results in a substantially larger decrease in borrowing, and thus, crowd-out exceeds 100 percent. We show that under the assumption of monotonic extensive-margin borrowing responses to Pell Grant aid, we can formally test the assumption of crowd-out in excess of 100 percent among switchers.

Let $Pell_i$ indicate a baseline amount of Pell Grant aid (including \$0), and let $dPell_i$ denote the expected value of an additional amount of Pell Grant aid. Let Z_i be an indicator for whether a student is predicted to receive $dPell_i$ according to the Pell Grant schedule, and let $Y_i\left(Pell_i, Z_i\right)$ be the amount a student borrows. Let $D_i\left(Pell_i, z\right) = \mathbf{1}\left[Y_i\left(Pell_i, z\right) > 0\right]$ be a dummy for whether the student borrows when $Z_i = z \in \{0, 1\}$. Assuming monotonicity (that additional Pell Grant aid does not induce any student to start borrowing): $D_i(Pell_i, 1) = 1 \Rightarrow D_i(Pell_i, 0) = 1$. Under this condition, we can define the population shares of always-borrowers $\pi_A\left(Pell_i\right) = \Pr\left[D_i\left(Pell_i, 1\right) = D_i\left(Pell_i, 0\right) = 1\right]$ and switchers $\pi_S\left(Pell_i\right) = \Pr\left[D_i\left(Pell_i, 0\right) = 1,\, D_i\left(Pell_i, 1\right) = 0\right]$. To simplify notation, denote the following sets: always-borrowers for a given level of Pell Grant are the set $A\left(Pell_i\right) = \{i : D_i\left(Pell_i, 0\right) = D_i\left(Pell_i, 1\right) = 1\}$ and switchers are $S\left(Pell_i\right) = \{i : D_i\left(Pell_i, 0\right) = 1, D\left(Pell_i, 1\right) = 0\}$.

[24] Online Appendix Table B.2 displays estimated impacts of Pell Grant aid on subsidized and unsubsidized loan aid. Columns 2 through 4 of Online Appendix Table B.3 display estimates of the impact of an additional dollar of Pell Grant aid in a student's first year on cumulative student loan debt three years after entry, regardless of whether a student persists or leaves college. Pell Grant aid has persistent effects on borrowing and we estimate that an additional \$1,000 of Pell Grant aid in a student's first year reduces cumulative debt by close to \$600 three years after entry, a 57 percent decrease from the sample mean.

The total effect of $dPell_i$ on borrowing is:

$$E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)\right]=$$

$$\left\{\pi_A\left(Pell_i\right)E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)|A\left(Pell_i\right)\right]\right\}-\left\{\pi_S\left(Pell_i\right)E\left[Y_i\left(Pell_i,0\right)|S\left(Pell_i\right)\right]\right\}$$

Rearranging this expression yields:

$$E\left[Y_i\left(Pell_i,0\right)|S\left(Pell_i\right)\right]=$$

$$\frac{1}{\pi_S\left(Pell_i\right)}\left\{\pi_A\left(Pell_i\right)E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)|A\left(Pell_i\right)\right]-E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)\right]\right\}$$

If the intensive-margin responses of the always-borrowers adhere to the predictions of standard life-cycle models then $\forall Pell_i$, $dPell_i$, $Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)\in\left[-dPell_i,0\right]$ and $E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)|A\left(Pell_i\right)\right]\geq -dPell_i$.

We refer to the expression $\frac{1}{dPell_i}\frac{E[Y_i(Pell_i,1)-Y_i(Pell_i,0)]}{\Pr[D_i(Pell_i,0)=1]}$ as loan crowd-out among would-be borrowers. This ratio gives the per-grant-dollar reduction in loans among those who would have borrowed if not for the additional grant aid. Specifically, the group of would-be borrowers includes both always-borrowers and switchers and $\Pr\left[D_i\left(Pell_i,0\right)=1\right]=\pi_A+\pi_S$. The finding that such crowd-out is greater than one-for-one implies that $E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)\right]<-\Pr\left[D_i\left(Pell_i,0\right)=1\right]dPell_i$, and:

$$E\left[Y_i\left(Pell_i,0\right)|S\left(Pell_i\right)\right]=$$

$$\frac{1}{\pi_S\left(Pell_i\right)}\left\{\pi_A\left(Pell_i\right)E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)|A\left(Pell_i\right)\right]-E\left[Y_i\left(Pell_i,1\right)-Y_i\left(Pell_i,0\right)\right]\right\}$$

$$>\frac{1}{\pi_S\left(Pell_i\right)}\left\{-\pi_A\left(Pell_i\right)dPell_i+\Pr\left[D_i\left(Pell_i,0\right)=1\right]dPell_i\right\}$$

$$=\frac{dPell_i}{\pi_S\left(Pell_i\right)}\left\{-\pi_A\left(Pell_i\right)+\pi_A\left(Pell_i\right)+\pi_S\left(Pell_i\right)\right\}$$

$$=dPell_i$$

Intuitively, if the reduction in loans among would-be borrowers is greater than the value of additional grants received, then some portion of would-be borrowers must be reducing loans by more than 100 percent of the value of additional grants. In the presence of a fixed cost of borrowing, that group will be the students who switch from borrowing to not borrowing.

We can use both the kink and the discontinuity in the Pell Grant formula to identify crowd-out among

would-be borrowers. Let $\pi_B(Pell_i) \equiv \pi_A(Pell_i) + \pi_S(Pell_i) = \Pr[D_i(Pell_i, 0) = 1]$. At the discontinuity, we approximate $\pi_B(0)$ with the limit of the borrowing rate among ineligible students as $\widetilde{EFC}$ approaches the threshold by estimating equation (9) using only the sample of Pell ineligible students:

$$\Pr(loan > 0)_i = \pi_B + h\left(\widetilde{EFC}_i\right) + \omega_i \tag{9}$$

Where $h()$ is a quadratic in $\widetilde{EFC}$. We approximate $\frac{E[Y_i(Pell_i,1)-Y_i(Pell_i,0)]}{dPell_i}$ with $\hat{\tau}_{RD}$, the estimate of the impact of a dollar of Pell Grant aid on the dollar amount of loans and $\frac{\hat{\tau}_{RD}}{\hat{\pi}_B(0)}$ provides an estimate of crowd-out among would-be borrowers.

The kink in the Pell Grant formula results in increases in Pell Grant aid above the baseline amount $Pell_i = minPell$ as EFC decreases. Would-be borrowers are thus students who would have borrowed in the absence of a marginal increase in Pell Grant aid above the minimum Pell. Thus, we approximate $\pi_B(minPell)$ via equation (9) by restricting the sample to Pell-eligible students and $\frac{\hat{\tau}_{RK}}{\hat{\pi}_B(minPell)}$ provides a second estimate of crowd-out among would-be borrowers. Finally, to generate a conservative estimate of crowd-out among would-be borrowers, we scale our combined RD/RK estimator by the $\hat{\pi}_B(0)$ (which is larger than $\hat{\pi}_B(minPell)$).

As shown in Panel A of Table (6), our most conservative pair of estimates suggests that crowd-out of loans exceeds 100 percent among would-be borrowers. We generate standard errors using a block bootstrap that allows for clustering at the institution by year level. An additional dollar of Pell Grant aid crowds-out over \$1.80 in loan aid among first-year, would-be borrowers. Returning would-be borrowers reduce loans by close to \$1.90 for every dollar increase in Pell Grant aid, on average. We can reject the hypothesis that crowd-out for borrowers falls below 100 percent at the 99 percent level. We obtain similar estimates of crowd-out using only the discontinuity and kink as instruments (Panels B and C).

6.3 Robustness of the estimated impact of Pell Grant aid on borrowing

We perform a number of robustness tests to show that our borrowing results, including our finding of crowd-out exceeding 100 percent among would-be borrowers, are not driven by factors outside of the discontinuities in Pell Grant aid at the eligibility threshold. Our estimates are robust to allowing Pell Grant aid to affect students' receipt of other grant aid, restriction of the sample to avoid mechanical effects through loan eligibility limits, exclusion of covariates, alternative bandwidths and polynomials, and local linear regression.

Table 7 presents results from three robustness tests. First, we take into account sources of grant aid other than Pell Grant aid (Panel A). Given the finding of Turner (2014) that public colleges supplement Pell Grant aid with additional funds from institutional grants, we want to rule out the possibility that our

estimates of borrowing responses are large due to grant aid from other sources increasing in Pell Grant aid.[25] To do so, we replace the endogenous regressor in equation (7) with the sum of Pell Grant aid and other grant aid. Results are consistent with those generated by our main specification. In Panel B, we show that estimates from models that exclude all covariates besides the quadratic in $\widetilde{EFC}$ are also consistent with our main results.

In Panel C of Table 7, we address the potential concern that increases in Pell Grant aid may mechanically decrease borrowing among a subset of borrowers by reducing these students' eligibility for subsidized loans. Subsidized loans may not exceed unmet need (equal to the cost of attendance minus EFC and grant aid), and therefore if unmet need is low enough, crossing the Pell Grant eligibility threshold will reduce subsidized loan eligibility by an amount equal to the minimum Pell Grant. There are several reasons to doubt the importance of this "mechanical" effect. First, it is irrelevant for the regression kink design because every dollar increase in Pell Grant aid results from a dollar decrease in EFC, leaving unmet need and subsidized loan eligibility unaffected. Second, the effect on loan eligibility would only reduce borrowing among students who maximize their subsidized loans and don't take full advantage of unsubsidized loans because total loan eligibility is not affected by grant aid (Online Appendix A provides additional details on subsidized and unsubsidized loan determination). Third, the effect on subsidized loan eligibility itself would not generate loan crowd-out rates in excess of 100 percent unless students chose to reduce loans by more than the mechanical offset of 100 percent. Still, we present evidence that the effect on subsidized-loan eligibility is not an important factor by exploiting the fact that subsidized loans are also capped by a particular dollar amount for each year of schooling (e.g. \$3,500 for first-year students). We limit our sample to students whose cost of attendance minus EFC and non-Pell grant aid is greater than the subsidized loan cap for their year in school plus the minimum Pell Grant for the calendar year, a population for whom the Pell Grant would not affect eligibility for subsidized loans, and we obtain similar results.

Second, we wish to rule out the possibility that our estimates are driven by our choice of bandwidth or polynomial in $\widetilde{EFC}$. We estimate 2SLS models in which we focus on first-year students with EFCs within \$4,000, \$3,000, \$2,000, and \$1,000 of the Pell Grant eligibility threshold, and within each window around the eligibility threshold, we allow for up to a fourth degree polynomial in the running variable. For each window, the optimal degree of polynomial in $\widetilde{EFC}$ is chosen to minimize the AIC. Finally, we employ the

[25] Online Appendix Table B.4 presents estimated impacts of Pell Grant aid on other sources of grant aid. We find no evidence of a relationship between Pell Grant aid and grant aid from the New York State Tuition Assistance Program (TAP). A student's TAP grant is determined by her New York State Taxable Income, which does not have a one-to-one correspondence with EFC; thus, this exercise serves as a placebo test since we should not expect to find a relationship between two sources of aid that are independently determined. Pell Grant aid is positively correlated with other grant aid (a category which combines institutional, federal, and non-TAP New York State aid) for first- and second-year students, although this relationship is only statistically significant among first-year students, who receive an additional \$0.08 in other grant aid for every dollar of Pell Grant aid. Unfortunately, our data does not allow us to distinguish between institutional grant aid and non-Pell/non-TAP state and federal grant aid.

goodness-of-fit test suggested by Lee and Lemieux (2010), by testing the joint significance of \$200 $\widetilde{EFC}$ bin dummies added to our main specification (brackets contain p-values from this test). This exercise also directly tests for discontinuities in borrowing away from the Pell Grant eligibility threshold. Online Appendix Table B.5 displays impacts on first-year students' borrowing (impacts on borrowing among returning students and impacts on cumulative debt among are available upon request). Our estimates are robust to smaller windows and higher order polynomials. Although we lose precision, the point estimates increase in magnitude when we reduce the size of the window around the Pell Grant eligibility threshold. For instance, when we limit our sample to students with EFCs within \$1,000 of the threshold and allow for a cubic in $\widetilde{EFC}$, we estimate that every dollar of Pell Grant aid leads to a \$0.77 reduction in loans, which represents an approximately \$3.20 decrease among would-be borrowers. In fact, all but two of the 16 point estimates suggest that crowd-out among would-be borrowers significantly exceeds 100 percent (results available upon request).

We also estimate the impact of Pell Grant aid on first-year students' borrowing via local linear regression (Online Appendix Table B.6). In Panel A, we use the Imbens and Kalyanaraman (2012) optimal bandwidth. In Panel B, we follow Card et al. (2012) and use the Fan and Gijbels (1996) rule-of-thumb bandwidth, and Panel C uses the bandwidth chosen by the cross-validation procedure proposed by Ludwig and Miller (2005).[26] In all cases, we use a uniform (rectangular) kernel and cluster standard errors at the institution by year level. We report first-stage, reduced form, and 2SLS estimates (using either the kink, the discontinuity, or both as instruments) as well as estimated crowd-out for would-be borrowers. In the case of 2SLS specifications, we use the bandwidth chosen in the reduced form specification. In each case, our estimates are less precise but consistent with those obtained from our parametric specification.

6.4 Impacts on educational attainment

In Table 8, we present 2SLS estimates of the impact of an additional \$1,000 in Pell Grant aid on contemporaneous and longer-run educational outcomes, including reenrollment (measured by the probability remaining enrolled in the following academic year), effort (measured by academic and remedial credits attempted), attainment (measured by academic credits earned), and performance (measured by GPA).[27] Overall, Pell Grant aid has small and insignificant impacts on these outcomes. We find small, marginally significant impacts on credits attempted by first-year students, suggesting an additional \$1,000 of Pell Grant aid induces students to attempt an additional 0.5 credits (an approximately 2 percent increase from the mean credits attempted by Pell Grant ineligible students). This effect does not translate into an increase in academic

[26] We use the `rdrobust` Stata command to estimate the bandwidth chosen by the Ludwig-Miller cross-validation procedure (Calonico et al. 2014).

[27] Online Appendix Figure B.7 displays graphical evidence of the reduced form, contemporaneous relationship between Pell Grant eligibility and generosity and our measures of attainment among first-year students.

credits earned. We can rule out impacts of an additional $1,000 of Pell Grant larger than a 1 credit (6 percent) increase.[28]

Ultimately, we are interested in whether Pell Grant aid has longer-run impacts on attainment. As we find no evidence that first-year Pell Grant aid affects Pell Grant aid received in future years, we estimate the impact of first-year Pell Grant aid on future outcomes via equation (8). The second column of Table 8 displays estimates of first-year Pell Grant aid on reenrollment, cumulative credits attempted, and cumulative credits earned three years after entry. An additional $1,000 of Pell Grant aid in a student's first year leads to an insignificant 0.2 increase in cumulative credits earned. Furthermore, we can rule out impacts on cumulative credits that are larger than a 2.6 credit (6 percent) gain three years after entry, suggesting that, on average, Pell Grant aid does little to increase the longer-run educational attainment of CUNY students. Finally, Column 3 presents estimated impacts of contemporaneous Pell Grant aid aid on attainment among returning students, which are quite similar to estimated impacts on first-year students' attainment.

Our finding that the average impact of Pell Grant aid on educational attainment is not significantly different from zero is also consistent with heterogeneous treatment effects across student groups defined by borrowing responses to Pell Grant aid. Our model suggests that, in the presence of a fixed cost of debt, grant aid has ambiguous average impacts on educational attainment. Grants induce a subset of students to stop borrowing to avoid this fixed cost, leading to a decrease in these students' educational attainment. Conversely, threshold borrowers experience an increase in educational attainment in response to grant aid.

We provide suggestive evidence of heterogeneous educational effects consistent with this predicted pattern using an alternative identification strategy that exploits the panel nature of our data. We limit our sample to only include students that we observe at least twice within the $4,000 window around the Pell Grant eligibility threshold and estimate a model that includes student fixed effects, a flexible function of EFC, controls for time-varying student characteristics, and year, level, and years since entry fixed effects. Thus, we take advantage of within-student variation in Pell Grant aid over time, rather than across-student variation in Pell Grant within a given year. To account for concerns of reverse causality (e.g., that students who take less than a full courseload receive a prorated Pell Grant), we instrument for a student's actual Pell Grant with predicted Pell Grant for a full-time, full-year student. We divide students into groups according to their borrowing patterns over time.

To test the prediction that an additional dollar of grant aid increases the attainment of students already constrained by the fixed cost, we focus on the sample of students who never borrow, which includes these

[28]Our estimate is sufficiently large that we cannot rule out effects similar in size to those generated by randomly assigned performance-based aid. For example, (scaled) estimates from MDRC's Performance Based Scholarship Demonstration experiment in two CUNY community colleges suggests that the opportunity to earn a $1,000 performance-based scholarship resulted in a 0.3 credit (2 percent) increase (Patel et al. 2013).

students. The estimated effect of Pell Grant aid on credits attempted by these students is significant and positive, suggesting that an additional $1,000 in Pell Grant aid leads to an additional of 0.6 credits attempted (Column 1 of Table 9). The estimated impact of Pell Grant aid on credits earned is positive but insignificant.

To test the prediction that a marginal increase in grant aid will lower attainment among students induced to cease borrowing, we examine the impact of Pell Grant aid on the attainment of students who borrow at least once. We first present results using the same same specification we employ to examine impacts on never-borrowers (Column 2 of Table 9), and find small and insignificant impacts of Pell Grant aid on attainment. Next, we estimate an additional specification, in which we include an indicator for whether a student does not borrow in the given year and an interaction between this indicator and the student's Pell Grant (for which we instrument using the interaction between this indicator and a student's predicted Pell Grant). Because an increase in grant aid first decreases attainment when a student switches to not borrowing, and then immediately increases attainment because the student is now constrained by the fixed cost, negative impacts should be found when grant aid is just barely sufficient to induce switching out of borrowing. We account for this mixed effect of an increase in Pell Grant aid with the the indicator for not borrowing, which represents the estimated impact of switching from borrowing to not borrowing as changes in Pell Grant aid shrink to zero, and with the interaction term that allows for a different effect of additional aid. As shown in Column 3, when students switch from borrowing to not borrowing, they attempt and complete significantly fewer credits (1.8 and 1.2 fewer credits attempted and earned, respectively). This approach underestimates the impact of borrowing on attainment if unobservable financial shocks cause students to borrow more and take fewer credits. The true nature of the endogeneity being unknown implies that stronger identifying assumptions are required for a causal interpretation, and thus, we take these results to be suggestive.

6.5 Heterogeneity

Our estimates of the impact of Pell Grant aid on borrowing and attainment are local to CUNY students with EFCs near the Pell Grant eligibility threshold. CUNY students are more likely to be first or second generation immigrants, more likely to be considered dependent students, and are less likely to have a college educated parent. Given the differences in the demographic characteristics of CUNY students and public school students as a whole shown in Table 2, we would like to determine the extent to which our results are driven by the distinct characteristics of the CUNY population. In Table 10, we present estimates of the impact of Pell Grant aid on borrowing (Panel A) and credits earned (Panel B) by first-year students from fully-interacted models by immigrant status, dependency status, and parental education (Columns 1 through 3). We also test for heterogeneity college type (community versus four-year college). We test the

equality of overall impacts on borrowing and impacts among would-be borrowers between groups defined by these characteristics; we display the respective p-values below point estimates. We find evidence of smaller unconditional crowd-out among immigrants, but none of the estimated impacts on would-be borrowers are statistically distinguishable along these dimensions. We also find evidence of heterogeneous impacts of Pell Grant aid on attainment by dependency status, with a $1,000 increase in Pell Grant aid leads to a statistically significant 3 credit increase among independent students and a negative and insignificant impact on credits earned by dependent students. We can reject the equality of estimated impacts on credits earned by dependency status at the 5 percent level. Online Appendix Table B.7 contains estimates for the sample of returning students, which are generally quite similar.

The possibility of nonlinear treatment effects in grant aid raises another potential concern for the generalizability of our results. For example, it could be that the minimum Pell Grant is not large enough to improve educational outcomes but that larger grants would be effective. Similarly, a marginal increase in grant aid may have different effects on students with different base amounts of grant aid. To address these concerns, we first test whether our main estimates vary by whether a student received a TAP grant. Approximately 74 percent of students in our sample receive a TAP grant and, conditional on receipt, average TAP aid equals $1,815. Second, we test whether the estimated impact of Pell Grant aid varies with the size of the minimum Pell Grant. The minimum Pell Grant was $400 in 2007 and 2008, increased to $890 in 2009 and again to $976 in 2010, and fell back to $555 in 2011 (all in nominal terms). We test for heterogeneity by "high minimum Pell" years (2009 and 2010) in which, on average, the minimum Pell Grant was more than twice as large as in lower minimum Pell Grant years (2007, 2008, and 2011). Online Appendix Table B.8 displays these estimates. Neither TAP grant receipt nor the size of the minimum Pell Grant significantly interact with Pell Grant aid, and the point estimates shift in opposite directions, providing support for our assumption of linearity in the impacts of Pell Grant aid.

Finally, our estimates of crowd-out for would-be borrowers are driven by "switchers" who are induced to cease borrowing after receiving a marginal increase in grant aid. If switchers have unique characteristics, our crowd-out estimates may not be generalizable to the broader population of Pell-eligible and near-eligible students. Although switchers cannot be identified individually, it is possible to identify their average characteristics under the assumption of monotonicity, which in our setting implies that increases in Pell Grant aid do not cause any students to switch from not borrowing to borrowing (Abadie 2003).[29] Online Appendix Table B.9 shows the mean value of various characteristics among switchers and compares these to the sample mean of students near the Pell Grant eligibility threshold. Switchers do not significantly differ from other students in any observable characteristics, supporting the generalizability of our estimates.

[29] We thank an anonymous referee for this suggestion.

7 Characterizing the Fixed Cost of Borrowing

A fixed cost of borrowing can rationalize our finding that an additional dollar of grant aid induces some students to reduce student loans by more than a dollar. In the absence of a fixed cost of borrowing, a student equates her current and future marginal utility of consumption and therefore saves only a portion of the marginal grant dollar for the future by reducing debt. When borrowing entails a fixed cost, however, the receipt of an additional dollar of grant aid may cause a student to switch from borrowing hundreds or thousands of dollars to borrowing nothing. This is because there is a range $(0, \underline{d})$ in which the amount of debt that would solve the first-order condition (1) would produce only a small utility gain over not borrowing and hence would not be worth paying the fixed cost. As a result, few students should borrow in small amounts and we expect crowd-out to be largest among students who would, in the absence of Pell Grant aid, would take-up small loans. We provide evidence of both of these predictions, and outline a strategy for quantifying the impact of the fixed cost on borrowing rates and debt.

As shown in Figure 7, which displays the distribution of loans among first-year borrowers subject to the exogenous subsidized loan limit of $3,500, students are unlikely to take up small amounts of debt. A Tobit model that treats $\underline{d}$ as exogenous (i.e., equal to zero or some other small amount) fails to capture this feature of the distribution and, in order to fit the low share of students with loans, offers the unrealistic prediction that the average student's latent desired loan amount is a large negative (i.e., that the average student wishes to *save* tens of thousands of dollars while in college). An alternative model, in which students exhibit heterogeneous fixed borrowing costs, is consistent with an upward sloping density at small loan values, as can be seen in Figure 7 for values between zero and $2,000.[30]

Estimates of the quantile treatment effects of grant aid on loans reinforce the fixed cost interpretation by showing that the impact of Pell Grant eligibility on borrowing is larger for quantiles corresponding to small positive amounts of debt. Figure 8 provides inverse CDFs of loan amounts for first-year (Panel A) and returning students (Panel B) with EFCs within $1,000 of the Pell Grant eligibility threshold. The vertical distance between the curves provides a reduced-form estimate of the quantile treatment effects of Pell Grant eligibility. Among first-year students, Pell Grant eligibility does not affect borrowing below the 76th quantile because three-quarters of students borrow nothing irrespective of their eligibility for Pell Grant aid. Differences in borrowing between eligible and ineligible students are also small at the highest quantiles, but at intermediate quantiles, a less than $1,000 Pell Grant reduces borrowing by close to $3,000. The patterns for quantiles in which ineligible students borrow but eligible students do not borrow suggests

[30] Alternative economic models with discrete adjustments, such as a labor supply model with adjustment frictions, could generate crowd-out rates exceeding 100 percent but would not predict reductions specifically among small loans without strong assumptions. Indeed, crowd-out of loans is likely *reduced* to the extent that grants induce students to make discrete reductions in work hours rather than responding only through borrowing.

heterogeneous values of $\underline{d}$ that may reach into the thousands of dollars. These patterns are suggestive but cannot provide an unbiased estimate of $\underline{d}$ if Pell Grants induce students to switch quantiles (i.e., if the assumption of rank-invariance is violated).

7.1 Model and implementation

To estimate the threshold loan amounts below which students are unwilling to borrow, we employ a maximum likelihood approach. The econometric model is similar in spirit to a Tobit model, but we treat the censoring threshold as a random effect that varies across students.

Student i in year t has latent, desired loans $d_{it}^{*} = \mathbf{X_{it}}\beta + e_{it}$ and borrowing threshold $\underline{d}_i$, where $\underline{d}_i$ is exponentially distributed with density $f\left(\underline{d}_i, \theta_d\right) = \xi e^{-\xi \underline{d}_i}$ and e_{it} is normally distributed with cumulative distribution $G\left(e_{it}, \theta_e\right) = N\left(0, \sigma^2\right)$ and density $g\left(e_{it}, \theta_e\right)$. We focus on subsidized loans, which are capped by loan limit d_{it}^{max}, because these loans make up the majority of CUNY students' borrowing and are utilized before unsubsidized loans.

The likelihood of the observed data conditional on parameter values must be specified for each student over each possible value of $\underline{d}_i$. Not borrowing (i.e., $d_{it} = 0$) is a possibility for any value of $\underline{d}_i$, so that the probability of not borrowing conditional on $\underline{d}_i$ must be integrated over the entire distribution of $\underline{d}_i$. Similarly, a student will ultimately choose $d_{it} = d_{it}^{max}$ when $d_{it}^{max} < \underline{d}_i \leq d_{it}^{*}$, and so all values of $\underline{d}_i$ are possible when $d_{it} = d_{it}^{max}$ is observed. However, if $0 < d_{it} < d_{it}^{max}$, then $\underline{d}_i \leq d_{it}$, and hence the observed loan amount provides the upper limit of integration. Because the other terms in the likelihood function for the individuals will not depend on $\underline{d}_i$, they can be factored out and the integral written simply as $F\left(d_{it}, \theta_d\right)$.

We make two adjustments to allow for the possibility that students round up to their subsidized loan limits to account for the observed bunching at loan limits. First, we over-censor loans from above at $d_{it}^{max} - 1500$ to avoid obtaining identification from the region just below d_{it}^{max} from which students are most likely to round up, replacing $d_{it} \in [d_{it}^{max} - 1500, d_{it}^{max}]$ with $\tilde{d}_{it}^{max} := d_{it}^{max} - 1500$. Second, we allow for a share ρ of students who, conditional on $d_{it}^{*} \geq \underline{d}_i$, round up and choose $d_{it} = d_{it}^{max}$ rather than $d_{it} = d_{it}^{*} < d_{it}^{max}$.

The log likelihood function is:

$$\log L\left(\theta | d_{it}, \mathbf{X_{it}}\right) =$$

$$\sum_{d_{it}=0} \log\left(\int_0^{\infty} G\left(\underline{d}_i - \mathbf{X_{it}}\beta, \theta_e\right) f\left(\underline{d}_i, \theta_d\right) d\underline{d}_i\right) + \sum_{0<d_{it}<\tilde{d}_{it}^{max}} \log\left(\left(1-\rho\right) g\left(d_{it} - \mathbf{X_{it}}\beta, \theta_e\right) F\left(d_{it}, \theta_d\right)\right)$$

$$+ \sum_{d_{it}=\tilde{d}_{it}^{max}} \log\left[\rho \int_0^{\tilde{d}_{it}^{max}} \left(1 - G\left(\underline{d}_i - \mathbf{X_{it}}\beta, \theta_e\right)\right) f\left(\underline{d}_i, \theta_d\right) d\underline{d}_i + \int_{\tilde{d}_{it}^{max}}^{\infty} \left(1 - G\left(\tilde{d}_{it}^{max} - \mathbf{X_{it}}\beta, \theta_e\right)\right) f\left(\underline{d}_i, \theta_d\right) d\underline{d}_i\right]$$

We implement the estimation by numerically maximizing the log likelihood. We restrict attention to students whose unmet need is greater than their exogenous loan limit. We include a subset of covariates from our reduced-form models in $\mathbf{X_{it}}$, and use the kink and discontinuity instruments to identify shifts in the distribution of d^*. To do so, we first estimate equation (6) by OLS to obtain predicted values $\widehat{Pell}_{it}$, and we then include $\widehat{Pell}_{it}$ as one of the covariates $\mathbf{X_{it}}$, while excluding the instruments. We calculate standard errors corrected for the fact that $\widehat{Pell}_{it}$ is a generated regressor, following Murphy and Topel (1985). This two-step procedure provides an estimate of $\frac{\partial d^*}{\partial Pell}$, the amount by which grant aid affects desired debt, which our model predicts will fall within $[-1, 0]$. [31]

7.2 Estimation results

Estimates indicate that CUNY students at all levels have large thresholds below which they will not borrow (Table 11). We estimate that average desired debt, d^*, falls below \$500. Desired debt responds to grant aid as predicted, with $\frac{\partial d^*}{\partial Pell} = -0.82$ among first-year students and $\frac{\partial d^*}{\partial Pell} = -1$ among returning students. However, few students actually borrow in small amounts due to high borrowing thresholds ($\underline{d}_i$). The median value of $\underline{d}_i$ is approximately \$3,400 among first-year students and \$2,800 among returning students. Differences in estimated thresholds between new and returning students are consistent with borrowing thresholds decreasing as students become more experienced with federal student aid programs (e.g., if students initially adhere to the default but then learn about their borrowing eligibility or costs over time).[32]

With the estimated model, we can describe a counterfactual world with no fixed cost of borrowing (Table 12). We estimate that the share of first-year students who borrow would quadruple, rising from 15 to 60 percent (Table 12). Because many of the newly-observed loans would come from the lower part of the distribution where the fixed cost is most prohibitive, the size of loans conditional on borrowing would decrease slightly, while unconditional mean borrowing would increase by approximately 270 percent. Consistent with smaller borrowing thresholds for returning students, more upper-year students borrow, and the projected increase in borrowing when the fixed cost is removed is smaller but still substantial.

Panel A of Figure 9 displays actual, predicted, and counterfactual borrowing rates of first-year students as a function of $\widetilde{EFC}$. In the presence of the fixed cost, the model predicts borrowing rates (red plus markets) that match empirical borrowing rates (blue circles) fairly well at all levels of EFC. In particular, the probability of borrowing falls discretely when a student becomes eligible for a Pell Grant and decreases

[31] The log likelihood is maximized numerically using the optim command in R. Alternative models that allowed $\underline{d}_i$ to vary as a quadratic function of EFC and in which students know d_{it}^{max} before applying were both rejected using the Akaike Information Criterion. The covariates of $\mathbf{X_{it}}$ used in both steps are a quadratic in $\widetilde{EFC}$ and indicators for dependency status, race, gender, and degree program.

[32] Among first-year students, estimated robust standard errors for the parameters of interest do not differ from classical standard errors (corrected for two-step estimation) by more than 8.2 percent of the value of the corresponding parameter, suggesting that model misspecification is limited.

as Pell Grant aid rises. Predicted borrowing rates when fixed costs are removed (green X markers) are dramatically higher. Predicted borrowing still decreases with Pell Grant aid, but borrowing rates are higher at all levels of EFC. The model projects that close to 90 percent of Pell-Grant-ineligible students would incur federal loans if borrowing did not entail a fixed cost. In Panel B, we plot the corresponding results for the amount borrowed by first-year students. The pattern is quite similar, with predicted values of the model with fixed costs matching the data fairly closely, and substantial increases in average loan aid when the fixed cost is removed. Among Pell-ineligible students, borrowing would more than triple in the absence of a fixed cost.[33]

As an informal test of the model, we compare our structural estimates to bounds of $E[d^*]$ suggested by our reduced-form estimates and theoretical framework. Under the assumption that crowd-out among always-borrowers falls between 0 and 100 percent, the borrowing rates for students on either side of the Pell Grant eligibility threshold allow us bound mean desired debt of switchers who are induced to stop borrowing due to a small increase in Pell Grant aid. Focusing on the reduced form impact of Pell Grant eligibility for first-year students (Online Appendix Table B.2, Panel A), we can decompose the \$165 decrease in subsidized borrowing at the Pell Grant eligibility threshold into the borrowing response of among never-borrowers, always-borrowers, and switchers: $-165 = \pi_N \triangle loans_N + \pi_A \triangle loans_A + \pi_S \triangle loans_S$, where π again indicates the share of students in each group. We estimate π_A via the share of students borrowing immediately to the right of the Pell Grant eligibility threshold (19.4 percent). Given monotonicity, the difference in the borrowing rate at the Pell Grant eligibility threshold, which we estimate to be 4.1 percentage points, provides an estimate of π_S. Assuming that the average change in Pell Grant aid at the eligibility threshold (\$389) does not vary across the three groups and that crowd-out among always-borrowers is bounded by 0 and 100 percent, $\triangle loans_A \in (-\triangle Pell, 0)$. By definition, $\triangle loans_N = 0$. Plugging in the respective share of students that are always-borrowers and switchers and using these bounds in turn yields bounds for the change in borrowing among switchers: $\triangle loans_S \in (-1730, -3056)$. Our maximum likelihood estimate of average subsidized loan aid among switchers if they were to borrow, \$2,795, falls comfortably within these bounds.

Our estimates indicate that the fixed costs faced by CUNY students substantially alter borrowing decisions. The finding that a majority of CUNY students behave as if facing a fixed cost sufficient to prevent them from borrowing less than several thousand dollars is in line with estimated costs of deviating from defaults in other financial settings. For instance, Bernheim et al. (2011) estimate that the median cost of deviating from the default 401(k) contribution rate exceeds 5.5 percent of income (approximately \$2,200 for a

[33] Online Appendix Figure B.8 shows the strong fit of the model to the distribution of loan amounts and the fact that removing the fixed cost increases the number of small loans. Online Appendix Figure B.9 shows the estimated distribution of borrowing thresholds.

worker earning $40,000). Whether complete elimination of the fixed cost represents a realistic counterfactual depends on the nature of the fixed cost, to which we now turn.

7.3 Factors contributing to the fixed borrowing cost

Thus far, we have remained agnostic about what factors lead CUNY students to behave as though they face a fixed cost of borrowing. This behavior may be influenced by some combination of psychic costs caused by debt aversion, hassle and administrative costs caused by paperwork and other requirements, or cognitive costs caused by deviating from the default offer of $0. Under the assumption that CUNY students face similar psychic costs of borrowing as other public school students, we can investigate the importance of debt aversion by examining the impact of Pell Grant aid on borrowing in the nationally representative NPSAS sample. As shown in Online Appendix Figure B.10, we find no evidence of a discontinuity or kink in total federal loan aid or the probability of borrowing at the Pell Grant eligibility threshold among first-year NPSAS students attending public institutions. Due to small sample sizes in the NPSAS, we cannot reject the possibility that NPSAS and CUNY students have similar borrowing responses to a marginal increase in Pell Grant aid, although estimated crowd-out in the nationally representative sample is always smaller than estimates using the CUNY sample (results available upon request).

However, CUNY students' demographic characteristics differ from those of the nationally representative NPSAS sample, and these differences may influence both borrowing costs and desired debt. We use propensity score reweighting to determine the role that observable characteristics play in the differences in borrowing between CUNY and other public school students, and estimate a borrowing rate of 32 percent in the reweighted sample of first-year NPSAS public school students.[34] To match this borrowing rate using our model, we must decrease the median value of $\underline{d}_i$ to $1,069, less than a third of the estimated $3,439 median threshold faced by first-year CUNY students. Thus, while students across the country still appear to face some common fixed cost of borrowing, such as a psychic cost, the students of CUNY face costs that are far greater.

Although all CUNY institutions offer a default federal loan package of $0, schools differ in the process through which students can request loan aid. All CUNY schools require a short supplemental application. However, four of the 17 CUNY schools allow students to submit this application online, while the remainder require students to submit the application in person to their institution's financial aid office. If hassle and time costs are important factors contributing to the fixed borrowing cost we observe, we would expect that crowd-out would be lower among students who could submit an application online. Under the identifying

[34]The model we use to estimate the propensity score incorporates all observable and predetermined characteristics that are available in both the CUNY and NPSAS data, fully interacted with dependency status.

assumption that schools that offer an online loan application do not differ from those that do not in ways that also influence borrowing decisions, we can test for heterogeneity in the impact of Pell Grant aid on borrowing along this dimension. We estimate our main specification, fully interacting an indicator for having an online loan application with Pell Grant aid; results are displayed in Online Appendix Table B.10. We find no evidence that the impact of Pell Grant aid on borrowing varies by the availability of an online loan application. Estimates of crowd-out among would-be borrowers are very similar for students attending colleges that offer an online application (-1.72) and colleges that do not (-1.87). Since all CUNY schools provide a default loan offer of zero, we cannot investigate the extent to which default offers influence behavior directly. However, given that we find no evidence that borrowing patterns vary by implied time and hassle costs, we conclude that default loan offers potentially have important impacts on students' borrowing and educational investment decisions.

8 Conclusion

In this paper, we take advantage of the nonlinearities in the Pell Grant Program's formula to estimate the impact of need-based grant aid on borrowing and educational attainment. Our main findings - that Pell Grant aid reduces borrowing and has small to zero impact on educational outcomes - is consistent with traditional models of educational investment under credit constraints. We observe very few CUNY students exhausting their federal loan eligibility, suggesting most students do not face borrowing constraints.

However, among students who would borrow in the absence of Pell Grant aid, an additional $1 of Pell Grant aid leads to a greater than $1 reduction in loans, which is inconsistent with traditional life-cycle models in which the marginal cost of borrowing is continuous in the amount borrowed. To explain this irregularity, we extend the traditional credit constraints framework to allow for a fixed cost of borrowing. We estimate that this cost induces a substantial portion of CUNY students to forgo borrowing in a given year. Our model predicts that grant aid may actually reduce the educational attainment of a subset of these students, offsetting the expected improvements among students constrained by loan limits, and provide suggestive evidence in support this effect, potentially explaining our finding of no aggregate impact of Pell Grant aid on attainment. The possibility of a subsidy having the opposite of the desired effect when the desired activity is related to a lumpy decision may prove applicable in many other settings, such as retirement savings programs with default saving rates or the taxation of pollutants with adjustment costs in production.

Our findings are likely relevant for a substantial portion of federal student aid recipients. On average, a Pell Grant recipient is more likely to attend a community college than any other type of institution. Among

large community colleges, CUNY's practice of $0 loan offers is not uncommon.[35] Within the set of large community colleges from which we were able to obtain information on loan packaging practices, fewer than half packaged both subsidized and unsubsidized loans, and 45 percent were similar to CUNY institutions in not packaging any loans.[36] If the fixed cost we identify is driven by the default loan amount being set to zero, such schools can reduce or eliminate the fixed cost with little or no expense by switching to a non-zero default loan amount or requiring students to make an active decision. Moreover, several thousand colleges with a combined enrollment exceeding one million students do not participate in the student loan program, imposing additional borrowing costs by limiting students to the private loan market.

In 2014, outstanding student loan debt exceeded $1.1 trillion (Federal Reserve Bank of New York 2014). The choice of the default loan offered to low income students may have important implications for students' borrowing decisions. While Dunlop (2013) estimates that access to federal loan aid increases educational attainment of low-income community college students, in general, there is limited evidence concerning the impact of federal loan aid on student outcomes.[37] Furthermore, while estimated returns to higher education suggest that borrowing to finance college is optimal (Avery and Turner 2012), student loan debt may impose costs that alter students' behavior when they enter the labor force or while students are still making educational investments (e.g., Field 2009; Rothstein and Rouse 2011). Imposing a fixed borrowing cost may reduce welfare by reducing educational attainment or increasing other debt, but it may enhance welfare if student debt distorts future decisions. We leave welfare analysis and estimation of these interesting parameters to future work.

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[35] We are not aware of any four-year institutions outside of the CUNY system make $0 loan offers.

[36] Many institutions placed additional requirements on potential borrowers, such as attending loan counseling in person, developing an education plan with a school counselor, and/or obtaining a sufficiently high score on an in-person or online financial literacy assessment.

[37] Avery and Hoxby (2004) provide evidence that high-ability students respond similarly to offered loans and offered grants when deciding between colleges.

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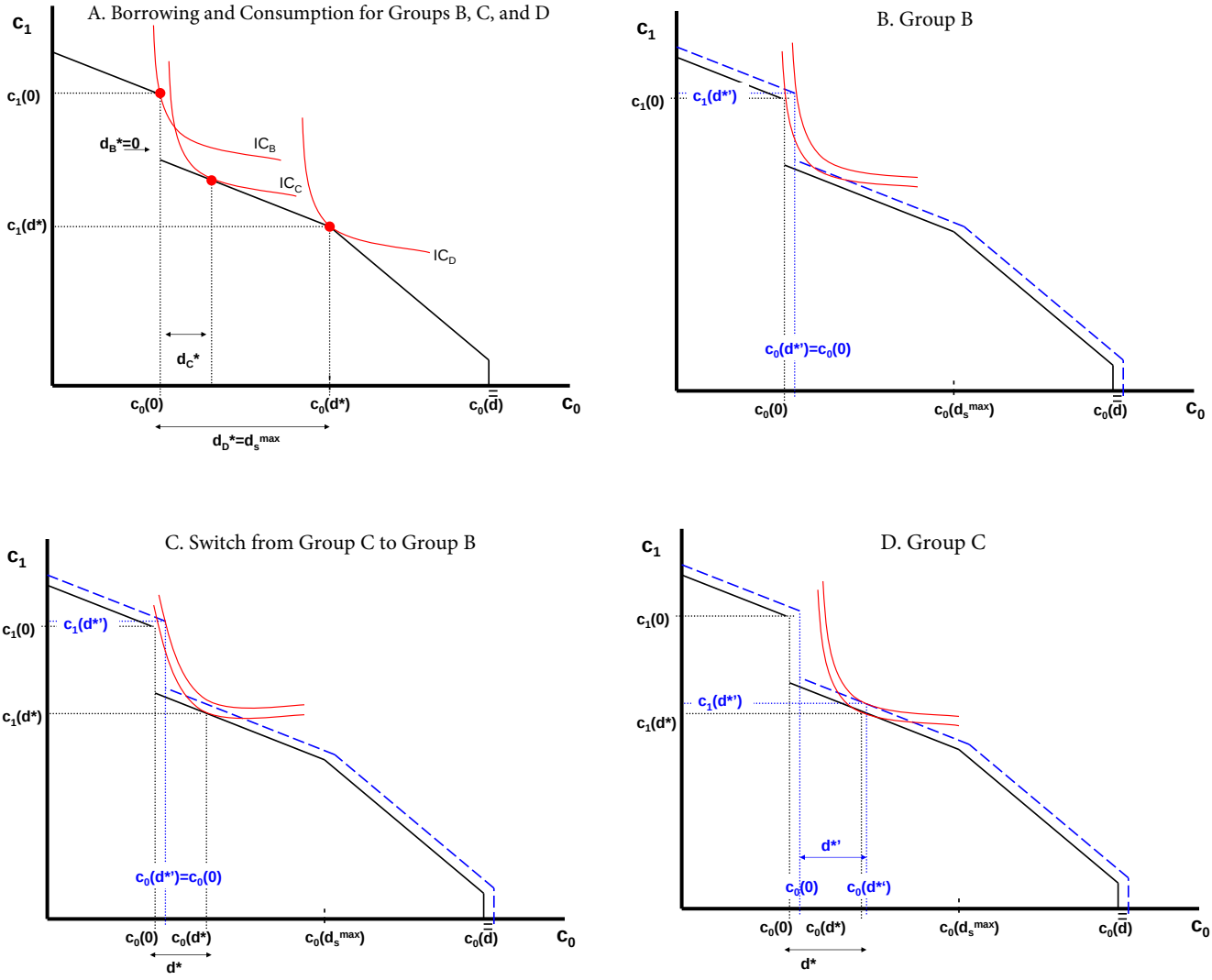
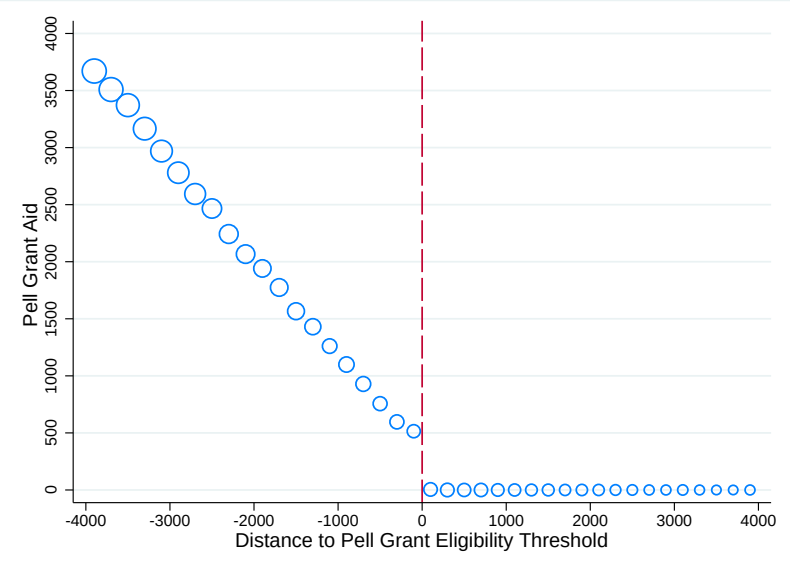
Figures and Tables

Figure 1: The Impact of Pell Grant Aid on Debt by Level of Exogenous Resources



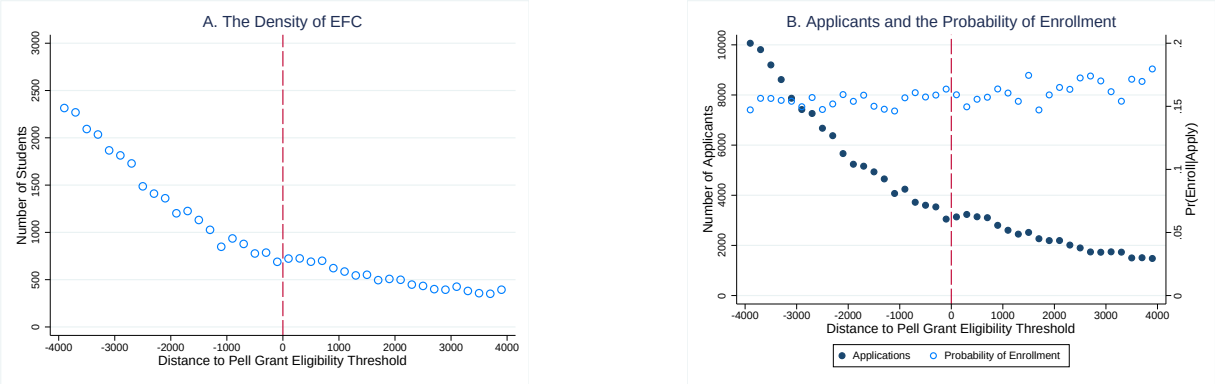
Notes: The black line represents the student's budget constraint in the absence of grant aid (e.g., Panel A), the dashed line represents the student's budget constraint upon the receipt of grant aid, c_0 is consumption in the first period, while c_1 is consumption in the second period. See Section 3 for descriptions of groups. Panel B – $\frac{\partial d}{\partial g} = 0$ and $\frac{\partial s}{\partial g} > 0$. Panel C – $\frac{\triangle d}{\triangle g} < -1$ and $\frac{\triangle s}{\triangle g} < 0$. Panel D – $\frac{\partial d}{\partial g} \in (-1, 0)$ and $\frac{\partial s}{\partial g} = 0$.

Figure 2: The Empirical Distribution of Pell Grant Aid by Distance to Eligibility Threshold



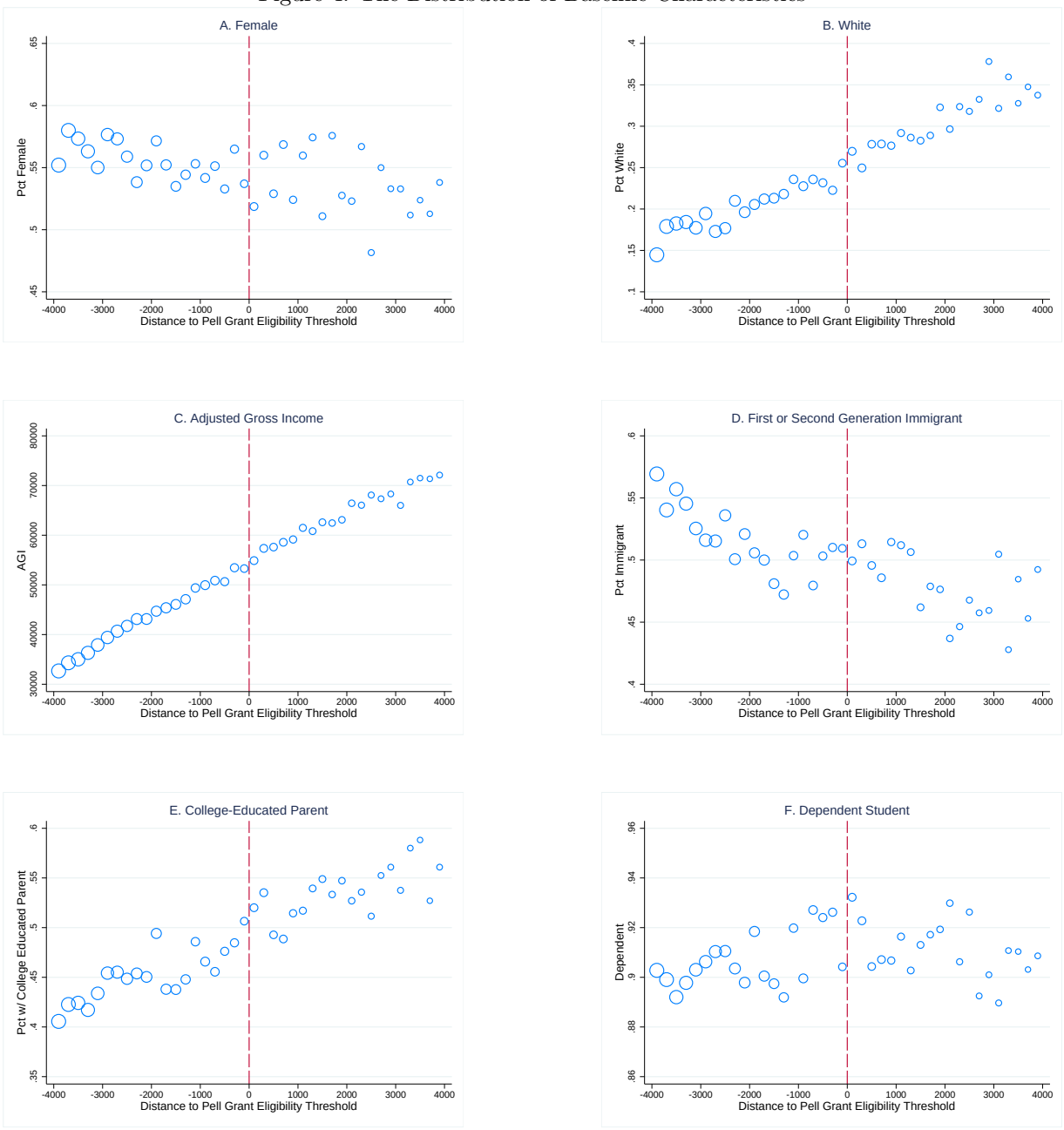
Notes: First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. $200 EFC bins. Each circle represents the average Pell Grant aid received by students in the bin. Larger circles represent a larger underlying sample size. All dollar amounts adjusted to represent constant 2012$.

Figure 3: The Density of EFC and Probability of Enrollment at the Pell Grant Eligibility Threshold



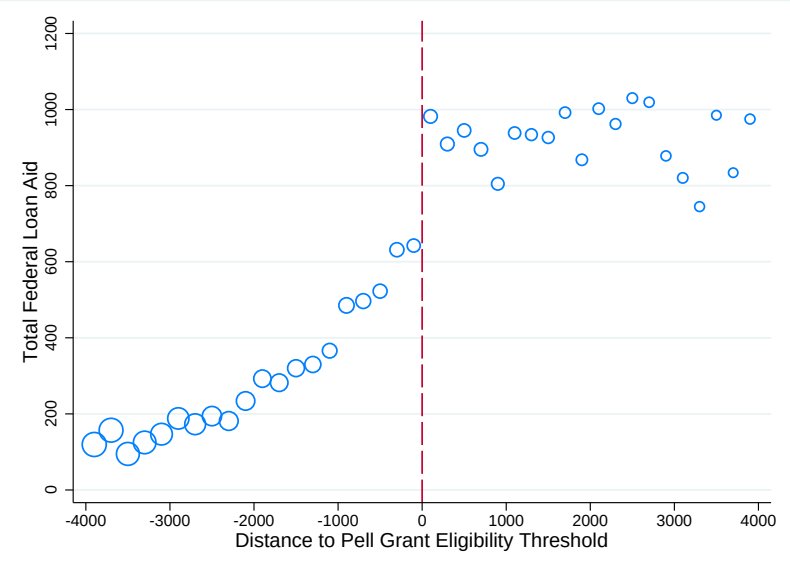
Notes: Panel A includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Panel B includes first-year CUNY undergraduate degree-seeking applicants; 2008 to 2011 cohorts. $200 EFC bins. In Panel A, each circle represents the total number of students in the bin. In Panel B, solid circles represent the total number of applicants in the bin while hollow circles represent the probability of enrollment conditional on submitting an application for individuals in the bin. All dollar amounts adjusted to represent constant 2012$.

Figure 4: The Distribution of Baseline Characteristics



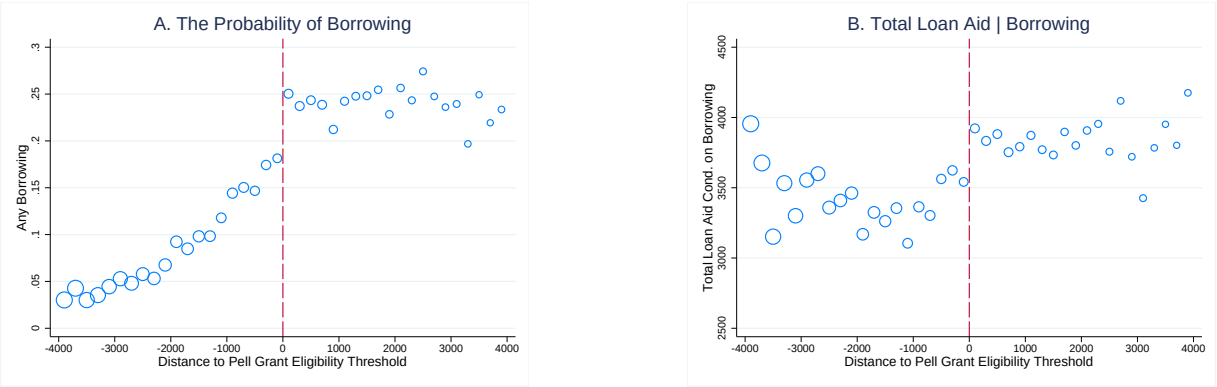
Notes: First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. $200 EFC bins. Each circle represents the average characteristic of students in the bin. Larger circles represent a larger underlying sample size. All dollar amounts adjusted to represent constant 2012$.

Figure 5: The Reduced Form Impact of Pell Grant Eligibility and Generosity on Total Borrowing



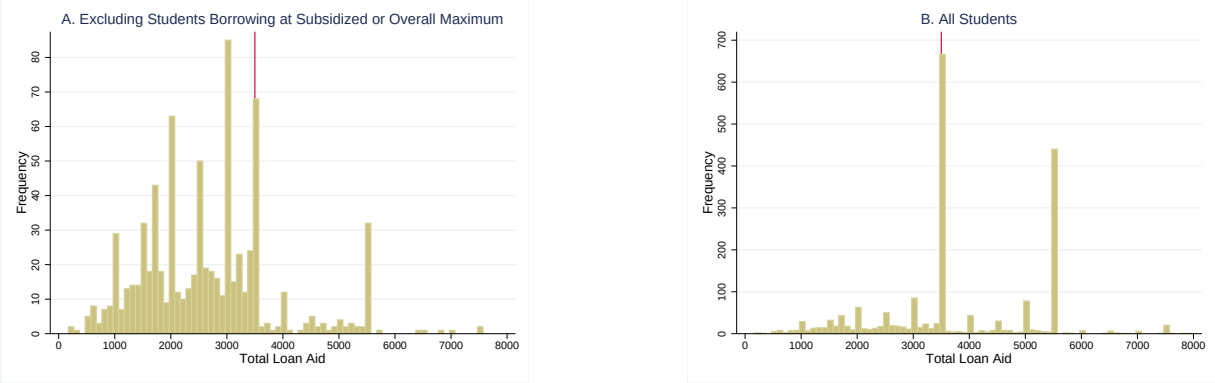
Notes: First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. $200 EFC bins. Each circle represents average loan aid (subsidized + unsubsidized Federal Direct Loans) received by students in the bin. Larger circles represent a larger underlying sample size. All dollar amounts adjusted to represent constant 2012$.

Figure 6: Both the Probability of Borrowing and the Size of Loan Aid Conditional on Any Borrowing Responds to Pell Grant Eligibility and Generosity



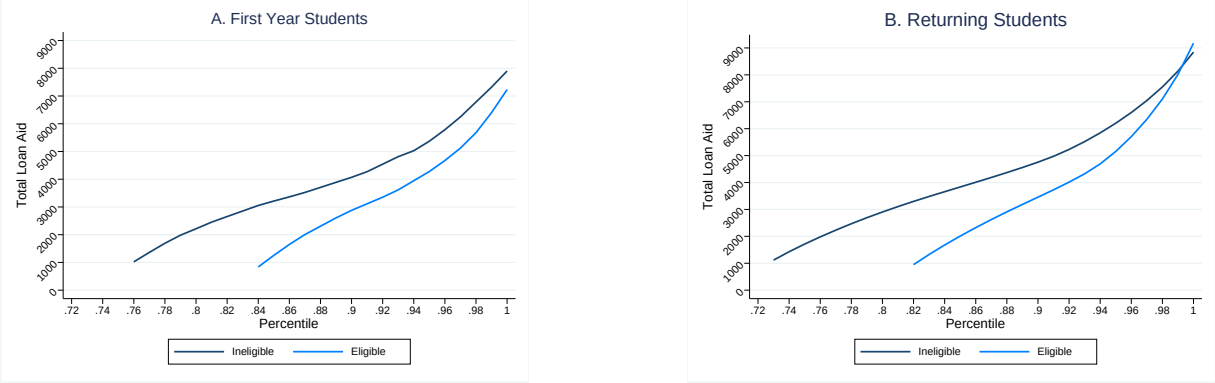
Notes: First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. $200 EFC bins. Each circle represents average probability of borrowing (Panel A) or average Federal Direct Loan aid received by borrowers (Panel B) in the bin. Larger circles represent a larger underlying sample size. All dollar amounts adjusted to represent constant 2012$.

Figure 7: The Distribution of Loans: First-Year Borrowers Subject to the Exogenous Subsidized Borrowing Limit



Notes: First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. $100 bins. Dollar amounts in nominal terms.

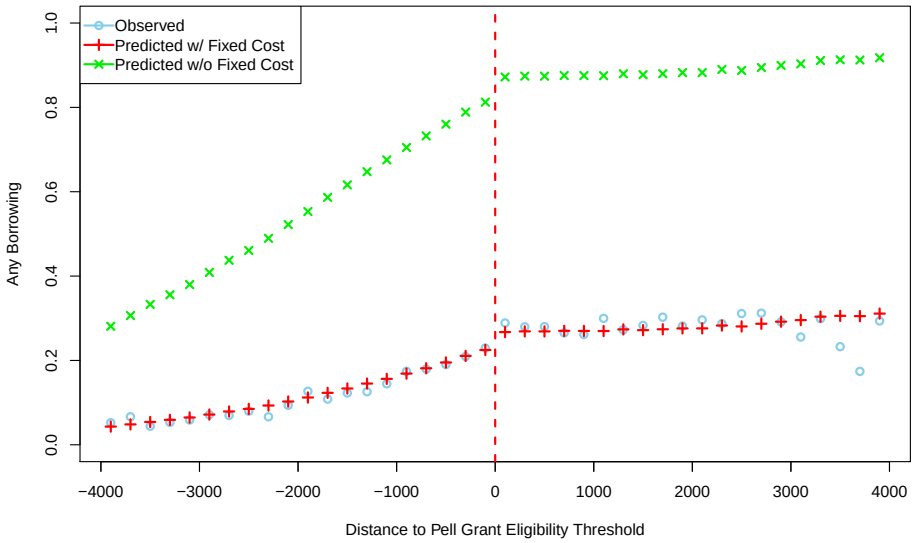
Figure 8: Quantiles of Student Loans by Pell Grant Eligibility



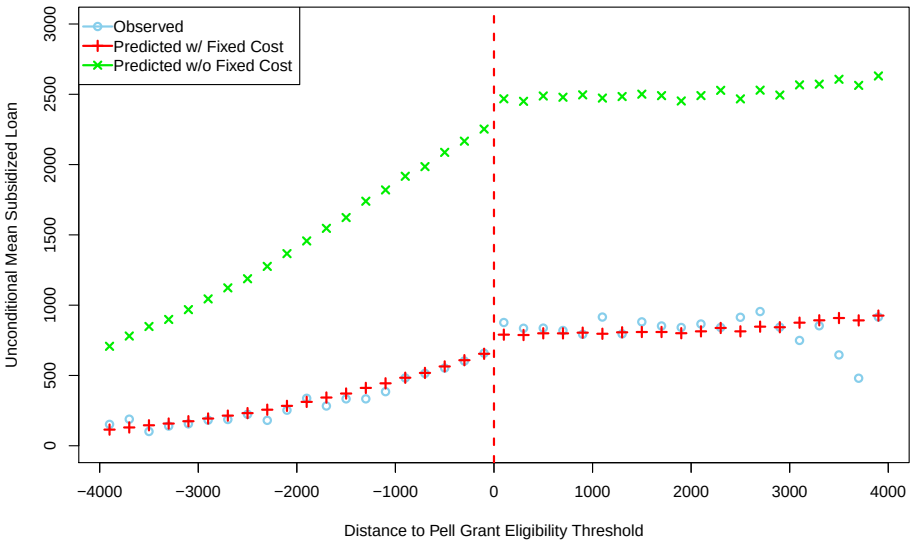
Notes: Panel A: first-year CUNY undergraduate degree seeking students; 2007 through 2011 cohorts. Panel B: Second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Students in percentiles that are not listed take on $0 debt. Limited to students with an EFC less than $1000 to the Pell Grant eligibility threshold. All dollar amounts adjusted to represent constant 2012$.

Figure 9: Actual and Counterfactual Borrowing

A. Probability of Borrowing



B. Average Subsidized Loan Aid



Notes: First-year CUNY undergraduate degree seeking students subject to the exogenous subsidized loan limit; 2007 through 2011 cohorts. $200 EFC bins. Circles indicate averages (probability of borrowing in Panel A, amount borrowed in Panel B) among students in the bin. Red plus markers represent predicted borrowing outcomes from the maximum likelihood model. Green X markers are predictions for a counterfactual situation with no fixed cost of borrowing. All dollar amounts adjusted to represent constant 2012$.

Table 1: Characteristics of First-Year Students by Pell Grant Eligibility

	(1) Ineligible	(2) Eligible	(3) Full sample
A. Cost of attendance and financial aid			
Expected family contribution (EFC)	$6,451	$2,254	$3,381
Total need (= cost of attendance - EFC)	$6,772	$10,406	$9,430
Total grant aid	$1,012	$4,313	$3,411
Pell Grant aid	$0	$2,394	$1,751
TAP Grant aid	$753	$1,573	$1,352
Unmet need (= COA - EFC - grants)	$5,739	$6,054	$5,969
Any borrowing?	0.24	0.07	0.12
Borrowing at subsidized limit	0.19	0.04	0.08
Subject to endogenous limit	0.38	0.33	0.34
Subsidized borrowing limit	$2,836	$2,936	$2,909
Total loan aid	$923	$244	$427
Share subsidized	0.73	0.80	0.76
B. Student demographic characteristics			
Female	0.54	0.56	0.55
Dependent student	0.91	0.90	0.91
Black	0.30	0.34	0.33
Hispanic	0.27	0.33	0.32
White	0.30	0.19	0.22
SAT percentile	38.8	32.4	34.2
Foreign-born	0.15	0.19	0.18
Foreign-born parent(s)	0.41	0.47	0.45
Parents' highest education			
Less than high school	0.04	0.06	0.06
High school	0.37	0.40	0.40
College	0.53	0.45	0.47
Parents' resources			
Adjusted gross income	$64,405	$42,522	$48,434
Savings	$6,860	$3,794	$4,618
Student's resources			
Adjusted gross income	$4,422	$3,044	$3,414
Savings	$498	$305	$357
Initial degree program = BA/BS	0.44	0.35	0.37
Number of students	10,231	27,869	38,100

*Note*s: First-year CUNY undergraduate degree seeking students; 2007 through 2011 cohorts. COA represents the total cost of attendance (equal to tuition and fees, books and supplies, and living expenses). Race and parental education categories may not sum to one due to missing values. Mean SAT percentile calculated for students with nonmissing SAT math and verbal scores ($N = 24,760$). Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 2: Comparing CUNY Students with a Nationally Representative Sample: First-Year, Degree Seeking, Fall 2007 Entering Students who Received Pell Grants

	Community colleges		Four-year colleges	
	1. CUNY	2. NPSAS	3. CUNY	4. NPSAS
A. Cost of attendance and financial aid				
Expected family contribution (EFC)	$549	$734	$617	$877
Total need (= cost of Attendance - EFC)	$10,040	$7,534	$11,027	$13,907
Total grant aid	$4,776	$2,861	$6,969	$6,359
Pell Grant aid	$3,207	$2,178	$3,425	$2,863
Unmet need (= COA - EFC - grants)	$5,344	$4,673	$4,149	$7,550
Any borrowing?	0.03	0.25	0.04	0.63
Total loan aid	$105	$918	$111	$3,143
Share subsidized	0.86	0.63	0.89	0.58
Share private	0	0.12	0	0.11
B. Student demographic characteristics				
Female	0.57	0.65	0.59	0.59
Dependent student	0.81	0.44	0.94	0.76
Age	20	25	18	21
Race/ethnicity				
Black	0.30	0.29	0.28	0.31
Hispanic	0.45	0.19	0.34	0.22
White	0.11	0.59	0.16	0.56
SAT verbal percentile	0.18	0.22	0.30	0.34
SAT math percentile	0.18	0.19	0.35	0.30
Parents' highest education				
Less than high school	0.12	0.13	0.12	0.08
High school	0.49	0.41	0.48	0.36
College	0.38	0.46	0.40	0.56
First generation immigrant	0.27	0.13	0.25	0.12
Second generation immigrant	0.23	0.17	0.31	0.19
Adjusted gross income	$20,172	$18,089	$22,607	$22,224
Initial degree program = BA/BS	0	0.02	0.63	0.90

*Note*s: The sample in Columns 1 and 3 includes first-year CUNY undergraduate degree seeking Pell Grant recipients attending community colleges (Column 1) or four-year colleges (Column 3). The sample in Columns 2 and 4 includes first-year undergraduate degree-seeking Pell Grant recipients from 2008 National Postsecondary Student Aid Study (NPSAS) attending community colleges (Column 2) or four-year colleges (Column 4). NPSAS statistics generated using the National Center for Education Statistics' online PowerStats application. COA represents the total cost of attendance (equal to tuition and fees, books and supplies, and living expenses). Measures of parental education exclude observations with missing values. Measures of race exclude students with missing race. First generation immigrants are students who were not born in the United States. Second generation immigrants are students who were born in the United States with parents that were foreign-born. Dollar amounts in nominal terms (2008$).

Table 3: Impact of Pell Grant Eligibility on Pell Grant Aid

	(1) First-year students	(2) Returning students
Pell Grant eligible	388.69	349.15
	(27.60)**	(24.19)**
× Distance from threshold	-0.761	-0.752
	(0.020)**	(0.019)**
Observations	38,100	46,744

*Note*s: OLS estimates of the impact of Pell Grant eligibility on Pell Grant aid. Column 1 sample includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Column 2 sample includes second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Each column contains estimates from a separate regression. Clustered standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. All regressions also include controls for age, family AGI, and indicators for race (white versus nonwhite), dependency status (dependent versus independent), parents' highest level of education (college, high school, less than high school, or missing), level of attendance (for federal loan eligibility purposes), degree program (AA versus BA), school by year fixed effects, years since entry fixed effects, and a quadratic in student expected family contribution ($\widetilde{EFC}_{it} = EFC_{it} - efc_{0t}$, where efc_{0t} is the threshold for Pell Grant eligibility in year t), allowed to vary on either side of the eligibility threshold. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 4: The Relationship between Pell Grant Aid and the Probability of Enrollment

	Enrollment | application			
	(1) Pooled	(2) Community colleges	(3) 4-year colleges	(4) Any enrollment | any application
A. OLS estimates: impacts on federal grant aid				
Pell Grant eligible	476.51	407.93	497.07	447.54
	(23.39)**	(44.43)**	(26.78)**	(31.30)**
× Distance from threshold	-0.649	-0.658	-0.647	-0.628
	(0.005)**	(0.008)**	(0.006)**	(0.009)**
Observations	161,841	39,056	122,785	38,971
B. OLS estimates: impacts on Pr(Enroll)				
Pell Grant eligible	-0.002	0.011	-0.005	0.002
	(0.004)	(0.007)	(0.005)	(0.010)
× Distance from threshold	-0.000002	-0.000006	-0.0000004	-0.000009
	(0.000002)	(0.000004)	(0.000002)	(0.000005)+
Mean | Pell Grant ineligible	0.162	0.236	0.141	0.629
Observations	161,841	39,056	122,785	38,971
C. 2SLS estimates: impacts on Pr(Enroll)				
Federal grant aid ($1k)	0.003	0.009	0.0002	0.014
	(0.003)	(0.006)	(0.003)	(0.007)+
95% CI	[-0.003, 0.008]	[-0.003, 0.021]	[-0.005, 0.006]	[-0.0001, 0.028]
Observations	161,841	39,056	122,785	38,971
D. 2SLS estimates (RD only): impacts on Pr(Enroll)				
Federal grant aid ($1k)	-0.003	0.027	-0.010	0.005
	(0.009)	(0.015)+	(0.010)	(0.023)
95% CI	[-0.020, 0.014]	[-0.002, 0.056]	[-0.029, 0.009]	[-0.04, 0.05]
Observations	161,841	39,056	122,785	38,971
E. 2SLS estimates (RK only): impacts on Pr(Enroll)				
Federal grant aid ($1k)	0.003	0.009	0.001	0.014
	(0.003)	(0.006)	(0.003)	(0.007)*
95% CI	[-0.002, 0.008]	[-0.003, 0.021]	[-0.005, 0.006]	[0.0001, 0.028]
Observations	161,841	39,056	122,785	38,971

*Note*s: CUNY undergraduate degree-seeking applicants; fall 2007 through fall 2010. The sample in Columns 1 through 3 includes one observation per prospective student-application (up to 6 per student) while the Column 4 sample includes one observation per student. Each column within a panel contains estimates from a separate regression. The dependent variable in Panel A is total federal grant aid. The dependent variable in Panels B through E is the probability of enrollment conditional on submitting an application. Clustered standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. All regressions also include school by year fixed effects, student expected family contribution ($\widetilde{EFC}_{it} = EFC_{it} - efc_{0t}$, where efc_{0t} is the threshold for Pell Grant eligibility in year t), allowed to vary on either side of the eligibility threshold, and an indicator for Pell Grant eligibility $\mathbf{1}[\widetilde{EFC}_{it} < 0]$. Columns 1 through 3 specifications also include school ranking fixed effects. Excluded instruments are $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ and $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ (Panel C), $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ (Panel D), or $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ (Panel E). Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 5: The Impact of Pell Grant Aid on Borrowing

	(1) First-year students	(2) Returning students
A. OLS estimates		
Pell Grant eligible	-224.45	-273.99
	(53.76)**	(55.88)**
× Distance from threshold	0.295	0.335
	(0.075)**	(0.073)**
Observations	38,100	46,744
B. 2SLS estimates: combined RD/RK		
Pell Grant aid	-0.428	-0.508
	(0.092)**	(0.095)**
Observations	38,100	46,744
C. 2SLS estimates: RD or RK		
Pell Grant aid (RD)	-0.577	-0.785
	(0.138)**	(0.171)**
Pell Grant aid (RK)	-0.387	-0.446
	(0.098)**	(0.099)**
Test of equality (p-value)	0.169	0.098
Observations	38,100	46,744

*Note*s: Column 1 sample includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Column 2 sample includes second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Each column contains estimates from a separate regression. Clustered standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. All regressions also include controls for age, family AGI, and indicators for race (white versus nonwhite), dependency status (dependent versus independent), parents' highest level of education (college, high school, or less than high school), level of attendance (for federal loan eligibility purposes), degree program (AA versus BA), school by year fixed effects, years since entry fixed effects, and a quadratic in student expected family contribution ($\widetilde{EFC}_{it} = EFC_{it} - efc_{0t}$, where efc_{0t} is the threshold for Pell Grant eligibility in year t), allowed to vary on either side of the eligibility threshold. Excluded instruments are $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ and $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ (Panel B) or $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ in IV-RD model and $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ in IV-RK model (Panel C). F-stat from test of significance of excluded instruments in Panel B: 917 (first-year student sample), 854 (returning student sample). F-stat from test of significance of excluded instruments in Panel C: 199 (first-year student sample, RD model), 1463 (first-year student sample, RK model), 209 (returning student sample, RD model), 1517 (returning student sample, RK model). Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 6: The Impact of Pell Grant Aid on Borrowing Among Would-be Borrowers

	(1) First-year students	(2) Returning students
A. Combined RD/RK		
Pell Grant aid	-1.821	-1.892
	(0.281)**	(0.250)**
H_0: crowd-out > -1, *p*-value	0.002	<0.001
Observations	38,100	46,744
B. RD only		
Pell Grant aid	-2.455	-2.918
	(0.472)**	(0.516)**
H_0: crowd-out > -1, *p*-value	0.001	<0.001
Observations	38,100	46,744
C. RK only		
Pell Grant aid	-1.995	-2.069
	(0.421)**	(0.388)**
H_0: crowd-out > -1, *p*-value	0.009	0.003
Observations	38,100	46,744

*Note*s: 2SLS estimates of the impact of an additional dollar of Pell Grant aid on borrowing among students who would have borrowed in the absence of the increase in Pell Grant aid (see Section 6 for details). Column 1 sample includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Column 2 sample includes second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Each column within a panel contains estimates from a separate specification. Bootstrapped standard errors (clustered at institution by year); ** p<0.01, * p<0.05, + p<0.1. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 7: The Impact of Pell Grant Aid on Borrowing: Robustness Tests

	(1) First-year students	(2) Returning students
A. Accounting for other grant aid		
Pell + other grant aid	-0.386	-0.523
	(0.079)**	(0.097)**
Crowd-out | borrower	-1.617	-1.933
	(0.232)**	(0.253)**
H_0: crowd-out >-1, *p*- value	0.004	<0.001
Observations	38,100	46,744
B. Excluding covariates		
Pell Grant aid	-0.415	-0.540
	(0.096)**	(0.099)**
Crowd-out | borrower	-1.766	-2.059
	(0.306)**	(0.247)**
H_0: crowd-out >-1, *p*- value	0.006	<0.001
Observations	38,100	46,744
C. Eliminating mechanical effect on subsidized loan eligibility		
Pell Grant aid	-0.373	-0.505
	(0.117)**	(0.138)**
Crowd-out | borrower	-1.634	-1.696
	(0.418)**	(0.423)**
H_0: crowd-out >-1, *p*- value	0.064	0.050
Observations	23,762	24,191

*Note*s: 2SLS estimates of the impact of an additional dollar of Pell Grant aid on borrowing for all students and borrowing among students who would have borrowed in the absence of the increase in Pell Grant aid (see Section 6 for details). Column 1 sample includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Column 2 sample includes second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Each point estimate within a panel contains estimates from a separate specification. Clustered and bootstrapped standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. In Panel A we instrument for total grant aid rather than Pell Grant aid. In Panel C, we limit the sample to students for whom receipt of the Pell Grant does not or would not affect eligibility for subsidized loans (cost of attendance less EFC and other grant aid is greater than the sum of the minimum Pell Grant and the statutory maximum subsidized loan). Panel A and B regressions also include controls specified in Table 5 notes. Excluded instruments are $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ and $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ except as indicated in Panel A. Students with EFC greater than $4,000 from Pell Grant eligibility threshold in their first year are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 8: The Impact of Pell Grant Aid on Educational Attainment

	First-year students		Returning students
	(1) Current	(2) Cumulative	(3) Current
A. Reenrollment			
Pell Grant aid ($1k)	0.012	-0.002	0.015
	(0.020)	(0.023)	(0.015)
	[-0.03, 0.05]	[-0.05, 0.04]	[-0.01, 0.04]
Mean | Pell Grant ineligible	0.79	0.67	0.71
Observations	38,100	32,271	46,744
B. Credits attempted (academic + remedial)			
Pell Grant aid ($1k)	0.490	0.539	0.450
	(0.266)+	(1.190)	(0.341)
	[-0.03, 1.01]	[-1.79, 2.87]	[-0.23, 1.11]
Mean | Pell Grant ineligible	25.5	59.8	24.5
Observations	38,100	32,271	46,744
C. Credits earned (academic only)			
Pell Grant aid ($1k)	0.212	0.223	0.492
	(0.410)	(1.233)	(0.372)
	[-0.59, 1.02]	[-2.19, 2.64]	[-0.24, 1.22]
Mean | Pell Grant ineligible	17.6	44.7	19.8
Observations	38,100	32,271	46,744
D. Cumulative grade point average			
Pell Grant aid ($1k)	-0.025	--	0.003
	(0.035)	--	(0.032)
	[-0.09, 0.04]	--	[-0.06, 0.07]
Mean | Pell Grant ineligible	2.65	--	2.75
Observations	34,203	--	44,231

*Note*s: 2SLS estimates of the impact of an additional $1000 of Pell Grant aid on the outcome specified in a given panel in year of school specified in each column. The sample in Columns 1 and 2 includes first-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Column 3 sample includes second- and third-year CUNY undergraduate degree-seeking students; 2005 through 2011 cohorts. Each column within a panel represents estimates from a separate regression. Clustered standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. The corresponding 95 percent confidence interval is displayed below each point estimate in brackets. The point estimate listed in the "Year 3" cumulative column represents the impact of an additional $1000 of Pell Grant aid in a student's first year on enrollment, cumulative credits attempted, cumulative credits earned, and cumulative GPA three years after entry. "Reenrollment" indicates the probability of re-enrolling the following year. Credits attempted represents academic and remedial course credit equivalents. Students do not earn credits for remedial courses, but CUNY converts the hours students spend in such courses into credit equivalents. Grade point average is measured on a four-point scale. See Table 5 notes for a list of controls and excluded instruments. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 9: Estimates of the Impact of Pell Grant Aid and Borrowing on Educational Attainment from Student Fixed-Effects Models

	(1) Never borrowers	Ever borrowers (2)	Ever borrowers (3)
A. Credits attempted			
Pell Grant Aid ($1k)	0.636	-0.083	0.049
	(0.255)*	(0.344)	(0.332)
1[No loans]			-1.833
			(0.257)**
x Pell Grant aid ($1k)			0.232
			(0.125)+
Observations	38,421	10,075	10,075
B. Credits earned			
Pell Grant Aid ($1k)	0.344	0.072	0.151
	(0.264)	(0.371)	(0.364)
1[No loans]			-1.167
			(0.261)**
x Pell Grant aid ($1k)			0.180
			(0.133)
Observations	38,421	10,075	10,075

*Note*s: 2SLS estimates of the impact of an additional $1000 of Pell Grant aid and borrowing on the outcome specified in a given panel. First-, second-, and third-year CUNY undergraduate degree-seeking students with an EFC within $4,000 of the Pell Grant eligibility threshold and at least two years of college attendance; 2005 through 2011 cohorts. Each column within a panel represents estimates from a separate regression. Clustered standard errors (by student) in parentheses; ** $p<0.01$, * $p<0.05$, + $p<0.1$. Credits attempted represents academic and remedial course credit equivalents. Students do not earn credits for remedial courses, but CUNY converts the hours students spend in such courses into credit equivalents. All regressions also include student fixed effects, a cubic in EFC, year fixed-effects, years since entry fixed effects, and controls for age, AGI, and level of attendance (for federal loan eligibility purposes). The excluded instruments are predicted Pell Grant aid assuming full-time, full-year attendance (Columns 1 and 2) and both predicted Pell Grant aid and an interaction between predicted Pell Grant aid and an indicator for not borrowing (Column 3). All dollar amounts adjusted to represent constant 2012$.

Table 10: Heterogeneity in the Impact of Pell Grant Aid on Borrowing

Student has characteristic:	(1) Immigrant		(2) Dependent student		(3) College educated parent		(4) Attending community college	
	N	Y	N	Y	N	Y	N	Y
A. Dependent variable = total loans								
Pell Grant aid	-0.613	-0.255	-0.424	-0.433	-0.457	-0.458	-0.355	-0.555
	(0.141)**	(0.115)*	(0.436)	(0.087)**	(0.118)**	(0.150)**	(0.118)**	(0.147)**
Test of eq: *p*- value	0.053		0.984		0.998		0.29	
Crowd-out | borrower	-2.229	-1.294	-1.689	-1.858	-1.961	-1.877	-1.511	-2.313
	(0.344)**	(0.465)**	(1.492)	(0.250)**	(0.369)**	(0.424)**	(0.375)**	(0.464)**
H_0: crowd-out > -1, *p* -value	<0.001	0.263	0.322	<0.001	0.005	0.019	0.087	0.002
Test of eq: *p*- value	0.614		0.972		0.966		0.681	
Observations	38,100		38,100		35,011		38,100	
B. Dependent variable = credits earned								
Pell Grant aid ($1k)	0.061	0.440	3.371	-0.003	-0.068	0.690	0.525	-0.232
	(0.543)	(0.551)	(1.292)**	(0.431)	(0.715)	(0.538)	(0.482)	(0.737)
Test of eq: *p*- value	0.600		0.016		0.434		0.389	
Observations	38,100		38,100		35,011		38,100	

*Note*s: 2SLS estimates of the impact of an additional dollar of Pell Grant aid on borrowing for all students and borrowing among students who would have borrowed in the absence of the increase in Pell Grant aid (Panel A) or credits earned during academic year (Panel B). First-year CUNY undergraduate degree-seeking students; 2007 through 2011 cohorts. Each column within a panel represents estimates from a separate regression. Clustered standard errors (institution by year) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 5 notes for a list of additional controls. All covariates are fully interacted with indicator for whether a student is a first- or second-generation immigrant (Column 1 specification), is a dependent student (Column 2 specification), has a college educated parent (Column 3 specification), or is attending a community college (Column 4 specification). Excluded instruments are $\mathbf{1}[\widetilde{EFC}_{it} < 0]$ and $\widetilde{EFC}_{it} \times \mathbf{1}[\widetilde{EFC}_{it} < 0]$ interacted with indicator for having the listed characteristic. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 11: Characterizing the Fixed Cost of Borrowing: MLE Parameter Estimates

	(1) First-year students	(2) Returning students
Desired debt d*:		
Mean	444	203
	(12)	(21)
Standard deviation	1,432	2,162
	(0.26)	(0.61)
$\frac{\partial d^*}{\partial Pell}$	-0.82	-1.02
	(0.01)	(0.050)
Median borrowing threshold $\underline{d}$:	3,439	2,817
	(0.004)	(0.01)
Share rounding up to loan limit:	0.71	0.58
	(0.02)	(0.05)
Observations	21,577	19,418

*Note*s: First-, second-, and third-year CUNY undergraduate degree-seeking students subject to the exogenous subsidized loan limit; 2005 through 2011 cohorts. See Section 7 for description of parameters and estimation. Robust standard errors in parentheses. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.

Table 12: Observed and Counterfactual Borrowing

	(1) Empirical moments	(2) Counterfactual: no fixed cost of borrowing	(3) Percentage change
A. First-year students			
Share borrowing	0.147	0.598	306%
Mean loan | borrowing	$1,767	$1,619	-8%
Unconditional mean loan	$260	$968	272%
B. Returning students			
Share borrowing	0.188	0.531	182%
Mean loan | borrowing	$2,216	$1,967	-11%
Unconditional mean loan	$417	$1,044	150%

*Note*s: Panel A sample includes first-year CUNY undergraduate degree-seeking students subject to the exogenous subsidized loan limit; 2007 through 2011 cohorts. Panel B sample includes second- and third-year CUNY undergraduate degree-seeking students subject to the exogenous subsidized loan limit; 2005 through 2011 cohorts. Column 1 displays the share of students in the designated sample that take out subsidized federal loans. Column 2 displays the predicted share of students in the sample that would borrow if the fixed cost of borrowing was eliminated (see Section 7 for estimation details). Column 3 displays the percentage change in the borrowing rate with the elimination of the fixed cost. Students with EFC greater than $4,000 from Pell Grant eligibility threshold are excluded. All dollar amounts adjusted to represent constant 2012$.