PLUS or Minus?
The Effect of Graduate School Loans on Access, Attainment, and Prices[*]

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May 2023

Abstract

In 2006, the federal government effectively uncapped student borrowing for graduate programs with the introduction of the Graduate PLUS loan program. Access to additional federal loans increased graduate students' borrowing and shifted the composition of their loans from private to federal debt. However, the increase in borrowing limits did not improve access to existing programs overall or for underrepresented groups. Nor did access to additional loan aid result in significant increase in constrained students' persistence or degree receipt. We document that among programs in which a larger share of graduate students had exhausted their annual federal loan eligibility before the policy change—and thus were more exposed to the expansion in access to credit—federal borrowing and prices increased.

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1. Introduction

Graduate school is an increasingly common educational choice. The number of adults with an advanced degree more than doubled between 2000 and 2021, and today, over 14 percent of American adults hold a postbaccalaureate degree.[1] Student loans are the predominant form of financial aid available for post-baccalaureate studies and, as more students enroll in graduate programs, graduate student debt makes up an increasing share of outstanding student loans. In the 2021-22 school year, nearly half of all new federal loans were disbursed to graduate students (Ma and Pender 2022). Yet surprisingly little is known about whether graduate students are helped or harmed by federal loans, and the extent to which increases in loan generosity provide incentives for institutions to increase prices.

We fill this gap by studying the large expansion in federal loan access caused by the 2006 creation of the Graduate PLUS Student Loan Program (hereafter, "Grad PLUS"). Grad PLUS effectively eliminated federal loan limits for a large number of graduate students by allowing students to borrow up to the total cost of attendance.[2] While essentially all graduate students can access Grad PLUS loans, some students and programs stood to benefit more, namely prospective students seeking to attend expensive programs, students constrained by pre-Grad PLUS limits, and programs in which many students had exhausted their federal loan eligibility.[3] We take advantage of variation in exposure to the increase in loan limits to estimate causal effects of increased loan access on graduate borrowing, enrollment, degree receipt, and program prices using detailed student-level administrative data covering graduate students enrolled in Texas public and nonprofit higher education institutions.

We find that Grad PLUS increased graduate student debt and shifted graduate borrowing from private to federal sources. Yet, the increase in loan limits due to Grad PLUS did not increase access to existing graduate programs overall or for underrepresented students. Similarly, among enrolled students who were constrained by federal borrowing limits, we find little

[1] See America Counts Staff (2019) and https://www.census.gov/data/tables/2021/demo/educational-attainment/cps-detailed-tables.html.

[2] The cost of attendance includes tuition and fees and the estimated cost of books, supplies, and living expenses for a student's graduate program. In the 2003-04 academic year, 37 percent of graduate students with federal loans were borrowing at the existing limit (Woo and Shaw 2015).

[3] Applicants that do not meet "adverse credit standards" can be denied a PLUS loan, but more typical measures of ability to repay/credit worthiness are not used, and in the event of a denial, many applicants are able to appeal and ultimately be approved. For example, in the 2011 academic year, less than 1 percent of PLUS loan applicants were ultimately denied (https://www2.ed.gov/policy/highered/reg/hearulemaking/2012/pii2-declinationrates.xls).

evidence of economically significant increases in persistence or degree receipt when these students gained access to additional federal loans through Grad PLUS. Finally, we find evidence that increases in federal borrowing following the creation of Grad PLUS led to significantly higher program prices.

Theoretically, increased availability of graduate student loans could raise student human capital investment and earnings by enabling constrained students to attend and complete higher-cost—and potentially higher-return—programs.[4] On the other hand, if additional graduate borrowing does not result in increases in students' human capital or students do not see returns to their additional investments, higher student loan debt may increase the risk of repayment difficulties.[5] Although most large-balance student loan borrowers accrued loan debt in graduate school, graduate student borrowers are less likely to fall delinquent or default on their loan payments than those who borrowed as undergraduates.[6] In recent years, however, loan repayment has fallen among high balance borrowers, suggesting an increasing burden of such debts (Looney and Yannelis 2019).

Thus, our paper first examines the extent to which Grad PLUS increased access to graduate education. By allowing students to borrow up to the total cost of attendance, the program may have facilitated access to programs for students who would have otherwise struggled to finance more expensive programs through savings or private loans. Such constraints may be especially relevant for Black students who – due to historic discrimination in housing and other markets – have access to much lower family wealth, on average, than white students.[7] To identify effects on access, we leverage variation in whether and how much borrowing limits increased across different programs due to the creation of Grad PLUS. Specifically, we compare the number and

[4] A growing literature documents the substantial variation in returns to attending different graduate programs and institutions (e.g., Altonji, Arcidiacono, Maurel 2016; Altonji and Zhong 2021; Altonji, Humphries, Zhong 2022).
[5] A related literature on the effect of undergraduate student loans finds that increases in loan access can improve student outcomes. Black et al. (2020) find that undergraduate students who are constrained by borrowing limits experience increases in educational attainment and earnings when they gain access to additional loans and several studies document increases in educational attainment for community college students (Dunlop 2013; Wiederspan 2016; Marx and Turner 2019; Barr et al. 2021) and low-income students within four-year institutions (Denning 2019).

[6] In 2014, almost two-thirds of borrowers with student loan balances exceeding $50,000 had borrowed to attend graduate school (Looney and Yannelis 2019).

[7] More generally, groups that are underrepresented in graduate school may also require a graduate credential to be on equal footing in the labor market. For example, in 2016, Hispanic workers with a graduate degree only earned slightly more than white workers with a bachelor's degree but no graduate education on average ($55,700 versus $50,000, respectively). See https://nces.ed.gov/programs/raceindicators/indicator_RFD.asp.

demographics of students entering programs with baseline prices exceeding the pre-Grad PLUS federal loan limit to programs in which students would not have experienced an expansion in loan access due to Grad PLUS (i.e., with baseline prices below the limit) before and after the program was created.[8] We find that students attending programs in which the price exceeded the baseline federal loan limit experienced larger increases in effective loan limits, yet enrollment in such programs did not increase. Estimated effects are small, precise, and statistically insignificant, and we can rule out effects greater than a 1.5 student increase in enrollment (1 percent relative to the average program size) per $1000 increase in loan limits. Nor did the demographics of entering cohorts of students change; our estimates exclude essentially any positive effect on the percentage of entering students who were Black or Hispanic.[9] School-level estimates are similar suggesting that the creation of new programs after Grad PLUS had no effects on access.

We next examine how expanded loan access affected the outcomes of enrolled students by comparing students who are likely to be affected by the increase in loan availability to those who are unlikely to be affected, before and after Grad PLUS was created. Intuitively, students who borrowed at the statutory federal loan maximum prior to the implementation of the policy should be more likely to take advantage of additional loan availability than those who borrowed less than the statutory limit. Consistent with this, we find that students who were constrained by the pre-Grad PLUS limit increased borrowing by a larger amount than borrowers who were unbound by the limit, and, similar to Bhole (2017), that Grad PLUS led to some substitution away from private loans. However, in contrast to prior research finding positive effects of increases in undergraduate loan limits on human capital accumulation (Black et al. 2020), we find no evidence that Grad PLUS affected constrained graduate students' persistence or degree receipt.

Expanded access to federal loans may also have unintended consequences if institutions and programs alter their prices to "capture" some portion of the additional funds. Previous tests of such behavior—labeled the "Bennett Hypothesis"—has focused on specific student groups, such as veterans (Baird et al 2022) or specific programs, such as undergraduate certificates in for-

[8] In practice, our preferred specification also uses variation in the magnitude of the loan limit increase, specifically the extent to which prices exceeded the pre-Grad PLUS borrowing limit.

[9] Denning and Turner (2023) show that enrollment in and access to graduate programs that tend to lead to high earnings was similarly unaffected.

profit institutions (Cellini and Goldin 2014).[10] Other work has examined student-level price discrimination (Turner 2017), abstracting from changes in the overall cost of attendance. One exception is Lucca, Nadauld, and Shen (2019), which considers an expansion in federal aid for undergraduates and documents that increases in federal loan aid led to increases in tuition.

We use a framework that is similar in spirit to Lucca et al. (2019) but account for the wide variation in within-institution graduate program pricing and leverage detailed administrative data to provide some of the first causal evidence on the effects of federal aid generosity on graduate program prices. Student-level data allows for identification of the programs most likely to be affected by increases in availability of federal loans, namely those in which a larger share of students exhausted their federal loan eligibility in years preceding Grad PLUS. Recent work by Kelchen (2019, 2020) tests for the Bennett Hypothesis in the context of law, business, and medical school programs using the introduction of Grad PLUS using an interrupted time-series design and does not find evidence of a significant break in the growth rate of prices.[11] In contrast, our identification strategy with relies on variation in *exposure* to higher loan limits, can account for aggregate shocks occurring concurrently with the creation of Grad PLUS.

We find evidence of larger price increases among programs more exposed to Grad PLUS. Specifically, programs with more students constrained by federal loan limits in the years before the creation of Grad PLUS had significantly larger increases in both federal borrowing and prices following Grad PLUS implementation. Taken together, our estimates suggest that sticker prices went up approximately dollar for dollar with increases in federal loans.

Prior work on the Bennett Hypothesis has not been able to trace out the full effects of the policy. Importantly, in our setting, we are also able to test whether some of the revenue from these price increases was invested in students. We use student-level data on other sources of financial aid to test for changes in grant aid and implications for net prices, both overall and for

[10] Other work has focused primarily on other outcomes only discussing the effects on price in passing (Cornwell, Mustard, Sridhar 2006) or used a time-series variation in federal aid generosity (Singell and Stone 2007), which may be correlated with macroeconomic conditions and changes in student characteristics.

[11] The interrupted time-series design cannot account for other time-varying shocks around the creation of Grad PLUS which may have also affected pricing decisions, such as changes in economic conditions during the Great Recession. To address this concern, the author also uses a difference-in-differences design that compares changes in graduate tuition and fees to changes in undergraduate tuition and fees, before and after the creation of Grad PLUS. To identify causal effects, this approach requires the key assumption that trends in undergraduate prices following the creation of Grad PLUS provide a good counterfactual for how graduate prices would have trended in the absence of Grad PLUS. However, undergraduate loan limits increased twice following the creation of Grad PLUS and these increases have been shown to have effects on undergraduate prices (Lucca et al. 2019).

different student groups. On average, about one third of the price increase due to Grad PLUS was offset by increases in grant aid, and we estimate that on average, net prices increased by $0.64 per $1 increase in per-student federal borrowing. We find no evidence that the additional grants were directed at Black, Hispanic, or low-socioeconomic status students. The null estimated effects on enrollment and attainment outcomes suggest that the additional revenue from higher prices was not used to expand the size of incoming cohorts of students or to improve the outcomes of enrolled borrowers.

Our results suggest that Grad PLUS loans primarily benefited institutions and programs that were able to charge higher prices, while students substituted from private to federal loans. However, the program was established in an era with robust private student loan offerings and lenient underwriting standards (Consumer Financial Protection Bureau, 2012). As was the case with mortgage lending, the onset of the Great Recession led to substantial tightening of creditworthiness standards and contraction in private student loan availability. While our estimates of the effects of Grad PLUS do not appear to vary substantially before and after the start of the Great Recession, it is still possible that effects on access and success would be different in a setting with limited access to private student loans.

The rest of the paper proceeds as follows: Section 2 discusses the setting and policy environment. We describe our data and empirical methods in Section 3. Sections 4, 5, and 6 discuss our estimates of the effects of Grad PLUS on graduate program access, prices, and graduate student outcomes, respectively, while Section 7 concludes.

2. Setting and policy environment

Before the introduction of Grad PLUS, most graduate students could borrow up to $18,500 per year from the federal government through the Stafford Loan Program.[12] Some health professional programs had higher limits.[13] The Deficit Reduction Act of 2005 established the

[12] Only $8,500 of this amount could be in the form of subsidized loans. The Budget Control Act of 2011 eliminated subsidized loan eligibility for graduate students after June 30, 2012. Prior to 2007, graduate students faced a lifetime federal borrowing limit of $138,500. Students attending programs with a cost of attendance below the Stafford Loan limit could only borrow up to the cost of attendance.

[13] Medical students (including those studying osteopathic medicine, dentistry, veterinary medicine, and optometry) could borrow an additional $20,000 per academic year while students in public health, health administration, pharmacy, clinical psychology, and chiropractic graduate programs could borrow an additional $12,500 per academic year. Students in these programs faced correspondingly higher lifetime federal borrowing limits as well. See Hegji (2021), Appendix C for additional details.

Grad PLUS Loan Program, effective July 2006, by allowing graduate students to participate in the Parent Loan for Undergraduate Students (PLUS) Loan Program.[14] Stafford Loan limits also increased by $2,000.

Prior to Grad PLUS, graduate students who faced a cost of attendance that exceeded the Stafford Loan limit needed to make up the difference with private loans, savings, or another source of financing. With the creation of Grad PLUS, students could cover these costs completely with federal loans. Specifically, the Grad PLUS Program allowed a student to borrow up to the total cost of attendance (COA) less any other grants and federal Stafford loans. A student's COA equals their tuition and fees plus an allowance for estimated living expenses and books and supplies. The allowance for estimated living expenses is almost always set at the institution level and does not vary across students who are not living in housing owned by the institution.[15] However, tuition charges and the estimated cost of books and supplies can vary substantially across graduate programs. As a result, after the creation of Grad PLUS, the only constraint on how much students could borrow from the federal government was determined by institutions' pricing decisions.

3. Data and analysis samples

We use de-identified administrative data from the Texas Education Research Center (ERC). These data come from the Texas Higher Education Coordinating Board (THECB), a state agency that oversees post-secondary education in Texas and contain individual-level information on enrollment, graduation, and financial aid for all graduate students enrolled in public and nonprofit higher education institutions. We observe the program of study for the vast majority of graduate students attending public institutions and for a subset of private nonprofit graduate students.[16] We link student records to data from the Texas Workforce Commission containing

[14] The PLUS loan program was previously limited to parents of dependent undergraduate students, and we distinguish between this and the program we study by always referring to the Graduate PLUS Loan Program as "Grad PLUS" and the parent program as "Parent PLUS".

[15] Universities have a good deal of discretion over estimated living expenses (Kelchen, Goldrick-Rab, Hosch 2017).

[16] Appendix B provides additional details on the subset of programs in private nonprofit institutions that are observable prior to degree completion. While some information on for-profit institutions and students is available in THECB data in more recent years, we do not observe graduate student enrollment or outcomes in this sector during the years surrounding the creation of Grad PLUS. Nationally, only 8 percent of graduate students attended for-profit institutions in 2004 (authors' analysis of 2004 National Postsecondary Student Aid Study data, via PowerStats). In Texas, only 2 percent of graduate enrollment was in for-profit institutions in 2004 through 2006 (authors' analysis of IPEDS 12-month enrollment data).

quarterly earnings records for all workers covered by the Texas Unemployment Insurance (UI) system.[17] Our data starts in the 2000-2001 (hereafter, 2001) academic year, which is the first year in which financial aid information is available.[18]

Nationwide, public and nonprofit institutions produce more than 91 percent of master's degrees and 95 percent of doctoral degrees (de Brey et al. 2022). Thus, the coverage of the ERC data makes it close to ideal for studying how the Grad PLUS program and expanded access to loans affected the decisions of most graduate students and schools.

A. Defining Graduate Programs

Conceptually, a program of study is a series of courses in the same field of study in which students seek the same degree from a given institution (e.g., master's degree in social work degree at the University of Texas at Austin) and face admissions criteria, tuition, and requirements that are relatively similar within broad categories (e.g., in-state versus out-of-state students). Of particular interest is distinguishing between (primarily doctoral) academic degree programs and professional degree programs because of substantial differences in funding, admissions requirements, and prices. Unfortunately, we do not observe specific programs of study directly in the data, only the credential level (master's degree, professional degree, or doctoral degree) and Classification of Instructional Program (CIP) code, which we use to identify the field of study.[19]

For professional degree-seeking students, we define a program as a unique 4-digit CIP code (i.e., field of study) by institution combination. Distinguishing between master's and doctoral degree-seeking students, however, is more challenging. Specifically, for some 4-digit CIP codes, doctoral degree-seeking students who are likely entering a PhD program are initially classified as master's degree-seeking if they do not hold a master's degree when they first enroll in the program. Thus, to distinguish between students in terminal professional master's degree programs and students in academic PhD programs who are initially misclassified, we assign

[17] UI records cover employers who pay at least $1500 in gross wages to employees or have at least one employee during twenty different weeks in a calendar year. Students employed by their college or university are not included in these data, but work study funding is observable in the THECB data.

[18] Information on enrollment and attainment within nonprofit institutions is available starting in 2003.

[19] A small number of CIP codes are added, deleted, or combined every decade. We use NCES crosswalks to adjust observed CIP codes to ensure that fields of study are measured consistently over the years our data span. We exclude students listed as being in a medical residency as their field of study. Online Appendix B provides additional details.

programs as professional (i.e., nonacademic) based on the percentage of terminal degrees awarded at the master's and doctoral levels within a given 4-digit CIP. Specifically, if more than 85 percent of degrees within a 4-digit CIP by institution cell are terminal master's degrees, we classify the program as a professional master's degree program. If less than 85 percent of degrees are terminal master's degrees, we classify it as an academic doctoral program.[20] We make a few exceptions to this classification scheme: all medical/allied health and education programs are classified as professional degree programs.[21] Our results are robust to using alternative cut-offs in our classification of academic and professional programs.

We combine programs that are classified as academic doctoral degree programs into a single broad category of "academic" programs because it is common for students enrolling in an academic PhD program to receive tuition waivers and stipends, which is generally very different than the (much more limited) funding available to professional degree-seeking graduate students.[22] We also create a few broad groupings of terminal master's and professional degree programs within 2-digit CIP codes: engineering, law, theological and ministerial studies, and education.[23] Remaining students are assigned programs based on 4-digit CIP codes. We only observe nonprofit students' program of study in a limited number of cases: theology, education,

[20] We classify a student as receiving a terminal master's degree if they receive a master's degree but no additional degrees in that CIP by institution combination. As an example, if over 85 percent of degrees awarded to graduates with a CIP code of 4506 (Economics) at the University of Texas at Austin were master's degrees (not followed by any subsequent doctoral degree in the same CIP code), this would be classified as a professional master's degree in economics, but if less than 85 percent of degrees awarded were terminal masters, all students would be classified as academic doctoral students (even if their highest degree obtained was a master's degree). The one exception to this classification scheme is health programs. Students in a program with a 2-digit CIP code of 51 (Health Professions) are considered to be in a professional degree program even if most of the degrees granted are doctoral in the data. The 85 percent terminal master's degree cut-off results in around 80 percent of graduate students in our sample being classified as entering a non-academic program. Additional details can be found in Online Appendix B.

[21] Medical/allied health programs are those with a 2-digit CIP code of 51, education programs are those with a 2-digit CIP code of 13. This is to match the treatment of these programs in other nationally representative data sets, such as the NPSAS, which classifies health and education programs (including doctoral programs) as being distinct from academic PhD programs.

[22] For example, in 2004, 33 and 61 percent of graduate students entering an academic PhD program received a tuition waiver and grant, respectively compared to 2 and 7 percent of MBA students (estimates from the 2004 NPSAS via PowerStats, table reference: lezyxo).

[23] We defined these programs differently because these large fields of study tend to share common resources and require a common set of classes within the broader 2-digit CIP. CIP codes do not have a consistent mapping to programs. For instance, Psychology is identified by a 2-digit CIP code whereas Sociology is a 4-digit CIP code.

law, and chiropractic programs.[24] A complete list of programs and corresponding student characteristics and graduation rates can be found in Appendix B.

B. Analysis Samples

We construct three analysis samples to examine the effects of Grad PLUS on graduate program access, student success, and program prices, respectively. First, to analyze how access to additional loan aid from Grad PLUS affected graduate school enrollment—overall and among specific demographic groups—we construct a program-by-year dataset containing information on the number of entering students, their demographic characteristics, average loan amounts, and baseline (2006) cost of attendance. We focus on a balanced panel of programs that had enrollment in each of the 2004 through 2010 academic years and had at least 20 students per year who filed a FAFSA, on average, in 2004 through 2006.[25] Because we are especially interested in examining how expanded federal loan limits affected the enrollment of Black and Hispanic students, our main analysis sample also excludes programs in Historically Black Colleges and Universities (HBCUs). We show that our results are robust to relaxing each of these restrictions.

To study how the loan expansion affected the outcomes of enrolled graduate students, we construct a student-level panel data set. We follow Black et al. (2020) and focus on first-time, entering graduate students who borrowed and categorize students as "constrained" and "unconstrained" borrowers within entry cohorts that were more or less likely to gain access to Grad PLUS loans. Constrained borrowers are first-year entrants whose federal Stafford Loans were equal to the annual limit and unconstrained are first-year borrowers with federal Stafford Loans below this amount.[26]

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[24] Private schools in Texas are required to submit a different information to the Texas Higher Education Coordinating Board, which limits our nonprofit sample to these four program types. Graduates from these programs made up 22 percent of all graduate degrees granted by nonprofit institutions in 2006 and overall, we can identify programs for 82 percent of all graduate student degree recipients in 2006 (authors' calculations using IPEDS completions data).

[25] This program-level panel begins in 2004 because data for nonprofit institutions is first available in 2003. We want to consider students who are enrolling in their program for the first time and the way we determine this is by checking for enrollment in the year prior, hence the 2004 is the earliest year where we can determine if someone is enrolling in a program for the first time. We restrict our main analysis sample to programs with at least 20 FAFSA filers, on average, in the pre-period because a program's COA – our best measure of price – is only available in our data for students who filed a FAFSA.

[26] We adjust limits to account for part-year enrollment, but our results are robust to using the full-year limit for all students. We also take into account the higher limits for students attending specific health programs (see Hegji 2021).

Our final analysis sample is used to test whether expansions in loan access through Grad PLUS led to higher program prices. We construct a second program-by-year level data set but do not limit the underlying sample to first-time students; rather, we include all students enrolled in the program. The key outcome of interest is the price faced by students in a given program. Unfortunately, we do not observe tuition separately from other components of the overall cost of attendance (i.e., estimated cost of books and supplies and living expenses). We calculate the average cost of attendance for each program (as defined in the previous section) among enrolled students who submitted a federal student aid application.

The tuition component of cost of attendance can depend on the number of credits a student attempts, number of semesters enrolled during the academic year, and, for students in public institutions, whether they are classified as in-state or out-of-state. While the average cost of attendance among students in a given program and year likely is correlated highly with the program's tuition, this measure could also reflect differences in enrollment intensity and the extent to which students enroll in the fall, spring, and/or summer semesters across programs. Thus, we use a second cost of attendance measure – the predicted cost of attendance for a full-time, full-year student.[27]

C. Characteristics of first-time graduate students

Table 1 shows summary statistics for students enrolled in graduate school for the first time in the 2002 through 2006 academic years ("pre-Grad PLUS") and 2007 through 2010 academic years ("post Grad PLUS"). Most (58 percent) first-time graduate students are female mirroring similar gender ratios at the undergraduate level. Slightly over half of the students entering graduate school are white, 6 percent are Asian or Pacific Islander (API), 10 percent are Black, 16 to 17 percent are Hispanic, and 13 percent are international students. On average, new graduate students are approximately 30 years old and 77 percent are in-state students. The demographics of new graduate students do not change substantially before and after the start of Grad PLUS.

Around 70 percent of first-time graduate enrollees completed a degree within 6 years of entry. The 6-year completion rate grew from 67 percent in the pre-Grad PLUS cohorts to 74 percent for later cohorts, mirroring similar increases in undergraduate graduation rates (Denning

[27] To generate a predicted cost of attendance for full-time, full-year (FTFY) graduate students, we regress a student's COA on credits attempted in each semester, semesters of enrolled, and fixed effects for program and academic year. We use these estimates to predict the FTFY cost of attendance for each program.

et al. 2022). The most common broad areas of study are education (about 24 percent), business (about 15 percent), health (about 15 percent), and engineering (8 percent).

On average, 36 percent of new students borrowed in their first year of attending a graduate program and this fraction grew from 32 percent before Grad PLUS to 40 percent after. Total (inflation adjusted, unconditional) first-year student loan debt grew from approximately $5600 for pre-Grad PLUS cohorts to approximately $7500 for later cohorts. Around 10 percent of students borrowed at or above the Stafford Loan annual limit before the Grad PLUS program was created, while 16 percent did so in the post-Grad PLUS period. Entering graduate students faced an average (inflation-adjusted) cost of attendance of just over $26,000 prior to Grad PLUS and nearly $30,000 in later years.

4. Effects of increased loan limits on graduate program access

To examine the effects of higher federal loan limits on access to graduate education, we leverage variation in program prices before the creation of the Grad PLUS program as a measure of treatment intensity in a dose-response difference-in-differences framework. Prior to Grad PLUS, students could borrow federal loans up to the lesser of their program's cost of attendance and the Stafford Loan limit. Following Grad PLUS, a program's cost of attendance solely determined a student's borrowing limit. Thus, there was only a subset of programs for which prospective students could fully finance their attendance with just federal loans, i.e., programs that charged prices below the statutory Stafford Loan limit. Grad PLUS did not change access to these programs and thus, these programs will serve as our control group.

In contrast, prospective students interested in programs that charged prices higher than the Stafford limit would not have been able to fully finance these programs with existing federal loan options before the creation of Grad PLUS. As a result, students lacking access to other sources of financing, such as private student loans or savings, may have found it difficult to enroll in these programs. Grad PLUS increased borrowing limits for students attending such programs by allowing students to cover the difference between the Stafford Loan limit and cost of attendance (net of grants) through Grad PLUS loans. These programs are where we expect the effects of Grad PLUS-driven loan limit expansion to be most pronounced and are our "treated" group.[28] Approximately 71 percent of programs had baseline prices below the Stafford Loan

[28] To give a specific example, Grad PLUS should have larger effects on access to a program with a $40,000 COA at baseline than a program with a $20,500 COA (the post-Grad PLUS Stafford limit). The composition of students

limit. Among programs that would experience borrowing limit expansions based on pre-period prices, the average increase was approximately $6,000 with a standard deviation of $5,152.[29]

Although Grad PLUS increased effective loan limits for students enrolling in treated programs by the amount that the cost of attendance exceeded the Stafford limit, we classify programs based on their baseline (2006) cost to abstract from changes in program prices induced by higher loan limit.[30] We estimate models in which the variable of interest is the distance between the pre-period price and pre-period Stafford loan limit ("projected limit increase"). This "intent-to-treat" approach has the advantage of requiring fewer assumptions, but the disadvantage of not directly relating changes in enrollment to changes in actual loan limits. Instead, given the key identifying assumption that changes in other factors affecting access after the creation of Grad PLUS are uncorrelated with the projected limit increase, this approach will provide estimates of the effect of a $1,000 increase in *predicted* loan availability.

We also estimate instrumental variables models in which a program's actual loan limit is the endogenous regressor (because it may be affected by program price after 2006) and the excluded instrument is the projected limit increase. Estimates can be interpreted as the effect of a $1,000 increase in actual loan limits on outcomes. Under the additional assumption that the projected limit increase only affects student enrollment through effects on actual loan limits and student enrollment responses are monotonic, this approach will provide estimates of the causal effects of actual loan limits on graduate program access.

Let $LimInc_p = \max\{(COA_{p,2006} - Limit_p), 0\}$ represent the predicted increase in borrowing limits due to Grad PLUS (in $1000) for program p, based on the program's baseline (2006) COA and the annual Stafford Loan limit. We estimate event-study models of the following form:

$$Y_{pc} = \sum_{c \neq 2006} \gamma^c \left(LimInc_p * \mathbf{1}[Cohort = c]\right) + \theta_c + \theta_p + \varepsilon_{pc} \qquad (1)$$

enrolling in programs with COAs below the pre-Grad PLUS limit should not be as affected, as there was no increase in loan limits for students who enrolled in these programs.

[29] Appendix Table A.1 displays characteristics of control (i.e., zero predicted limit increase) and treatment (i.e., greater than zero predicted limit increase) programs before and after the creation of Grad PLUS.

[30] We later show that there was an increase in program prices at programs where more students were constrained by pre-Grad PLUS federal loan limits relative to programs where fewer students were constrained. This effect would reinforce our motivation for using pre-Grad PLUS prices to create a measure of the potential increase in limits that is not contaminated by endogenous pricing responses.

Where Y_{pc} is an outcome (e.g., the number of students or the fraction of students belonging to a given racial/ethnic group) for program p and entry cohort c, and θ_c and θ_p are entry cohort and program fixed effects, respectively. When estimating effects on the demographic composition of entering cohorts, we weight program-year observations by average pre-period enrollment. Although this approach uses both the extensive margin of the policy change and a continuous measure of exposure to the policy change as identifying variation, we show that our results are robust to discretizing our measure of treatment to weaken the identifying assumptions required for a continuous difference-in-differences design (Callaway, Goodman-Bacon, and Sant'Anna 2021).[31]

A. Main estimates

Point estimates of γ^c and corresponding 95 percent confidence intervals from equation (1) are displayed in Figure 1. Panel A shows that the predicted federal loan limit increase based on 2006 prices is quite predictive of the actual increase in borrowing limits.[32] Additionally, in programs with higher predicted federal loan limit increases, per-student Grad PLUS borrowing was significantly higher (Panel B).

We find no evidence that the size or composition of programs where Grad PLUS led to larger expansions in federal loan access was changing differentially before the program was created, providing support for the assumption of parallel trends in outcomes in the absence of Grad PLUS. Figure 1 also shows that in the years following Grad PLUS, neither overall enrollment (Panel C) nor the demographics of entering students (Panels D and E) in programs with larger projected loan limit increases changed differentially relative to unaffected programs.

To provide a summary of these effects, we estimate a more parsimonious model that replaces the indicators for specific cohorts in equation (1) with a single indicator for cohorts that entered after the Grad PLUS program was created, $Post_c$:

$$Y_{pc} = \beta\left(LimInc_p * Post_c\right) + \theta_c + \theta_p + \varepsilon_{pc} \qquad (2)$$

[31] Specifically, a stronger "parallel trends assumption" is required: that for all doses of treatment (i.e., magnitudes of the difference between baseline COA and the Stafford Loan limit), the average evolution in outcomes in the post-treatment period across all units if they had been assigned that amount of dose is the same as the average evolution in outcomes over time for all units that actually experienced that dose of treatment.

[32] What appears to be a significant pre-period trend in the federal loan limit, dependent variable is adjusted for inflation (2018$), and as a result, programs with a constant federal limit during this period in nominal terms appear to have a decreasing federal limit in real terms. There is no pre-trend when the dependent variable is the nominal limit.

Panel A of Table 2 displays estimates of β from equation (2). We again find small and statistically insignificant effects on enrollment in programs where entering students would have experienced a larger increase in effective borrowing limits. Specifically, a $1,000 increase in the difference between pre-period cost of attendance and the pre-period limit led to an approximately 1 student decrease in the size of entering cohorts. This represents an approximately 1 percent decrease relative to average program enrollment in the pre-period (131 students).

Columns 2 through 7 of Panel A display estimated effects on the composition of enrolled students, including the percentage of entering students who are Black, Hispanic, Asian and Pacific Islander (API), white. international students, or men. We find small *decreases* in the percent of entering students who were Black and Hispanic and negative insignificant effects on the percent of the entering cohort who was male or an international student.[33] In contrast, we find positive effects, albeit economically small, on the percent of entering students who were white or API. Specifically, a $1000 increase in projected loan limits led to a 0.39 percentage point increase in the percent of entering students who were white and a 0.05 percentage point increase in API students.

Panel B displays estimates from IV models in which we instrument for a program's realized limit increase with the projected limit increase. The first stage coefficient is approximately 1.08. IV estimates are quite similar to OLS estimates and quite precise—we can rule out effects larger than a 1.4 student increases in enrollment (1 percent relative to the baseline mean), suggesting that Grad PLUS did not lead to higher enrollment in programs that had larger expansions in federal loan limits. Upper bounds of estimated 95 percent confidence intervals rule out essentially any positive effect of $1000 increase in loan limits on the share of entering students who were Black or Hispanic. Altogether, these estimates suggest that increases in borrowing limits that were caused by Grad PLUS did not expand graduate program access.

B. Robustness

Our estimates are robust to alternative specifications and sample definitions (Appendix Table A.2). First, to avoid issues with continuous differences in differences designs (Calloway et al. 2022), we use a discrete version of the treatment variable equal to an indicator for having above median pre-period prices (Panel A). Second, we estimate models using an alternative measure of

[33] Absent program capacity constraints, we would not expect changes in international student enrollment because students in the group are not eligible for federal student loans.

a program's cost of attendance – the average COA from 2004 through 2006 (versus 2006 in our main specification); results are in Panel B. This has the advantage of more data being used to calculate the cost of attendance; however, given trends in tuition, earlier years may be less predictive of future prices than 2006 alone. Third, we use the predicted program price for full-time, full-year students (Panel C). Since we calculate prices using an average of students we observe, the projected limit increase could be biased by differences in students' enrollment intensity if these differences also vary with baseline prices. Predicting the cost of attendance for a full-time, full-year student addresses this concern.

We also estimate models of effects on composition that do not weight observations by baseline program size (Panel D). We expand the years used in estimation to go until 2013 to test for effects on access over a longer time horizon (Panel E). We change the requirement to only have an average of 10 students in the pre-period to see if our restriction to programs with at least 20 entering students in the pre-period influences our results (Panel F). This allows us to use smaller programs but also makes our cost of attendance average more sensitive to outliers. We show our estimates are robust to including HBCU programs in the analysis sample (Panel G). In Panels H and I, we vary the definition of academic programs based on different thresholds of terminal master's degrees granted. In all cases, our estimates are very similar to those produced by our main specification. Finally, Denning and Turner (2023) show that access to programs that typically lead to high earnings was not affected by expansions in loan limits due to Grad PLUS.

C. New programs and school-level estimates

An additional possibility that our results thus far cannot account for is expansions in access due to the creation of new graduate programs. This is because our identification strategy relies on using pre-Grad PLUS prices to predict loan limit increases and we do not observe this measure for programs that did not exist prior to Grad PLUS. To explore this possibility, we estimate an institution-level version of equation (2). Because Stafford limits and prices vary within institutions, we calculate the effective limit and projected limit increase for each student who submitted a financial aid application (and thus observe their cost of attendance). We then take the average of these measures across all students in the institution. This approach will capture both changes in enrollment in programs that existed before and after Grad PLUS and increases in enrollment within newly created programs, but at the expense of losing within-institution

variation. Appendix Table A.3 contains these estimates, which are quite similar to the program level estimates shown in Table 2.

Our results speak to an often-referenced potential benefit of Grad PLUS—increasing access to programs. We find no such benefit overall. Similarly, we find no effect in the composition of entering graduate students suggesting that binding credit constraints were not the determinative factor for graduate students' ability to enroll in graduate school prior to the advent of Grad PLUS, even among students that are traditionally underrepresented in graduate school. While our main estimates are restricted to programs that existed before the start of Grad PLUS and thus, abstract from expansions to access through the creation of *new* programs, to the extent that any new programs would be priced relatively similarly to existing programs, estimates from school-level regressions provide suggestive evidence that this was not the case.

Our finding that Grad PLUS did not increase enrollment or student composition in programs where students would have experienced the largest loan limit increases is also important for our subsequent analyses. If student enrollment had responded to Grad PLUS, the sample of students in graduate school would be endogenously affected by the program's creation, thus complicating analysis using students who enrolled after the policy. However, because we find no evidence that enrollment or observable student characteristics changed, we are able to estimate effects on both students who were enrolled when Grad PLUS was created and those who entered after Grad PLUS led to higher loan limits.

5. Effects on student academic and labor market success

We next focus on estimating the effect of increased liquidity due to Grad PLUS on students' educational attainment and labor market outcomes. Classic models of credit constraints predict that increased access to loans for human capital investment should increase constrained students' borrowing, human capital investment (e.g., graduate school enrollment and completion), and earnings. We test these predictions in our setting by comparing changes in the outcomes individuals who are likely to be credit constrained to those who are likely unconstrained.

We follow a similar approach to Black et al. (2020) and classify students who borrowed the maximum amount available from Stafford Loans in their first year of the program as "constrained students" and classify those who borrowed less than the maximum amount as

unconstrained.[34] We compare the outcomes of constrained and unconstrained students who entered in cohorts that were more and less affected by the Grad PLUS increase in borrowing limits and estimate:

$$Y_{ipc} = \beta(Cons_i * Post_c) + \mathbf{X_i}\boldsymbol{\beta_x} + \theta_c + \theta_p + \varepsilon_{ipc} \qquad (3)$$

Where Y_{ipc} is an outcome such as degree completion or annual earnings for student *i* who belonged to entry cohort *c* and first enrolled in program *p,* $Cons_i$ indicates whether a student is classified as constrained (borrowing at Stafford maximum in their first year, accounting for half-year enrollment), and $Post_c$ indicates whether a student belonged to an entry cohort that was potentially affected by Grad PLUS and thus would have gained access to higher federal loan limits due to the establishment of the Grad PLUS program. $\mathbf{X_i}$ is a vector of baseline student characteristics (e.g., age, and indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and main effects for constrained status), θ_c and θ_p are entry cohort and entry program fixed effects, respectively. Standard errors are clustered by entry program.

Under the key identifying assumption that the outcomes of constrained and unconstrained students would have evolved similarly in the absence of loan limit increases due to the establishment of Grad PLUS, estimates of β will represent the causal effect of access to additional federal loans for constrained graduate students. While this assumption is fundamentally untestable, we provide evidence in its support by (1) using event-study models to test for parallel trends in outcomes for cohorts that entered early enough that they would presumably have left graduate school before Grad PLUS existed and (2) testing for differences in baseline demographic characteristics between constrained and unconstrained students for cohorts that were and were not "treated" by the Grad PLUS program.

Following Black et al. (2020), we restrict the sample to enrolled students who borrowed in their first year to enable comparisons between similar students who had demonstrated a need to borrow. We observe first-time graduate students starting with the 2002 entry cohort for public institutions and the 2004 entry cohort for private nonprofit institutions. Focusing on students who made their initial enrollment and borrowing decisions before Grad PLUS loans were available would avoid any possibility of endogenous selection into the sample due to treatment. Given that

[34] Appendix Table A.4 displays average characteristics of "constrained" and "unconstrained" graduate student borrowers, before and after Grad PLUS was created.

many graduate programs are two years and our need to condition on first-year borrowing, this restriction would limit us to one year of "post" data for such programs. As discussed in Section 4, we find no evidence that programs in which students would have experienced relatively larger increases in loan limits saw increases in enrollment or changes in student characteristics after Grad PLUS. Thus, we also include cohorts of students who entered a graduate program after the implementation of Grad PLUS but before the start of the Great Recession in our analysis sample and we maintain the assumption that differences in unobservable characteristics of constrained and unconstrained borrowers before and after Grad PLUS are, on average, the same.[35]

A second complication involves identifying *which* entry cohorts were treated by access to higher loan limits. For instance, the 2005 cohort did not gain access to Grad PLUS Loans in their first two years of graduate school but if they remained enrolled, they would be treated in their third year. Similarly, the 2004 cohort was untreated for its first through third years of graduate school but students who enrolled for a fourth year would be treated. We test the extent to which earlier entry cohorts gained access to Grad PLUS loans by estimating event study models—similar to equation (3) except $Post_c$ is replaced with a set of entry cohort indicators—in which the dependent variable is cumulative Grad PLUS loans:

$$Y_{ipc} = \sum_{c \neq \underline{c}} \beta^c (Cons_i * \mathbf{1}[Cohort = c]) + \mathbf{X_i}\boldsymbol{\beta_x} + \theta_c + \theta_p + \varepsilon_{ipc} \qquad (4)$$

To determine the last control cohort (which will also serve as the omitted category, $\underline{c}$) we estimate equation (4) and find the cohort in which constrained students did not see significant larger increases in Grad PLUS loans compared to unconstrained students, relative to earlier cohorts. Figure 2 displays point estimates and corresponding 95 percent confidence intervals from models in which the 2004 entry cohort serves as the reference group. These estimates suggest that constrained students in the 2005 through 2008 cohorts saw significant increases in cumulative Grad PLUS loans relative to earlier cohorts. Thus, we classify cohorts that entered before 2005 as untreated and cohorts that entered in 2005 and later as treated.

We first test for differential changes in students' baseline characteristics, including race, gender, age, parental education, Texas residency, and EFC. To avoid over-rejecting the null due

[35] We exclude the students who appear to enter graduate school in the first year of available data (2001 for publics and 2003 for nonprofits) to make sure we identify entering students and need at least one year of data to identify if people have enrolled in graduate school previously. Our main analysis sample excludes cohorts who entered after the start of the Great Recession, although our results are robust to including these later entry cohorts.

to multiple hypothesis testing, we also create an index of baseline characteristics equal to the probability of receiving a graduate degree within 10 years of entry as a function of these characteristics. Estimates from these placebo analyses can be found in Appendix Table A.5. We find small, statistically insignificant differences in all baseline characteristics except for EFC, which is negative. Reassuringly, we find no evidence of significant changes in the predicted graduation rate.

Figure 3 shows that effects of Grad PLUS access on cumulative borrowing from all sources were smaller than the increase in Grad PLUS loans and we find no effect on cumulative loans from all sources for the 2005 entry cohort. We investigate the potential reasons for this difference by estimating the more parsimonious equation (3) and breaking out total loans into Grad PLUS, total federal loans (PLUS and Stafford), and a combined category of state and private loans, results are shown in Table 3. We find that access to Grad PLUS loans led to significant increases in constrained students' cumulative federal borrowing in treated entry cohorts and significant decreases in cumulative nonfederal loans. Specifically, 6 years after entry, constrained students borrowed an additional $5,772 in Grad PLUS loans (Panel A), while cumulative federal loans increased by $6,159. However, some of the increase in federal borrowing was offset by a $2,578 reduction in state and private loans. Taken together, constrained students who gained access to Grad PLUS experienced significant increases in cumulative total student loans by approximately $3,596.

Thus, Grad PLUS appears to have increased total borrowing while also shifting some existing borrowing from private to federal loans, a result consistent prior estimates based on nationally representative credit bureau data (Bhole 2017). Federal loans, including PLUS loans, may offer better terms than private loans, especially for students with low credit scores or those lacking a long credit history. Additionally, federal borrowers generally have access to a wider variety of repayment options compared to what is offered by private lenders.

We next consider the effects on educational attainment outcomes. We find that constrained students were no more likely to persist after they gained access to additional federal loans in any year after entry (Table 4, Panel A). Estimated effects on cumulative credits attempted, shown in Panel B, are statistically significant (but economically small) in students' second through tenth years after entry. By the end of our 10-year panel, estimates indicate that constrained borrowers attempted approximately 1.6 additional credits when they gained access to Grad PLUS loans,

which is a 3 percent increase from the baseline mean. Finally, we find no evidence of significant increases in graduate degree receipt (Panel Table 4, Panel C and Figure 4). Estimates are small and statistically insignificant – the estimate 95 percent confidence interval excludes effects larger than a 2.7-percentage point increase. Similarly, we find no evidence of significant effects on specific degrees (Appendix Tables A.6 through A.8). So, while constrained students borrowed more when they gained access to Grad PLUS loans, the additional debt did not appear to lead to any meaningful increases in their human capital.

Finally, we examine whether access to additional student loans affected constrained students' labor market outcomes. We first estimate effects on the probability of having any earnings during the academic year.[36] As shown in Panel A of Table 5, we find some evidence that constrained students in affected entry cohorts saw small increases in the probability of having any earnings in UI-covered employment in Texas in their second through sixth years after entry. However, by the seventh year after entry, we find no evidence that the probability of working in Texas was affected, and this null result persists through the tenth year after entry. These results simplify the interpretation of earnings results and suggest that Grad PLUS did not have large differential effects on the probability of working in Texas for constrained versus unconstrained students.

Given that we found no effects on human capital accumulation, it is unsurprising that we find little evidence of effects on long-run earnings (Figure 5). Panel B of Table 5 shows that although constrained students who gained access to Grad PLUS loans had significantly higher earnings one year after entry, estimated effects in all subsequent years are insignificant at the five percent level (Panel B). That said, effects on earnings should be interpreted with some caution as by the end of our panel, we only observe 60.5 percent of the sample with any annual UI-covered earnings in Texas. The national labor force participation rate for individuals with a post-baccalaureate degree is between 70 and 80 percent, suggesting substantial mobility out of the state (even if the rate of out-migration is not correlated with treatment).[37]

6. Effects on program prices

Finally, we turn to examine the effects of the increase in federal loan availability and borrowing on graduate program prices. Universities, recognizing that students have more ability

[36] We align quarters with academic years, i.e., for AY 2010, we sum earnings from 2009-Q4 through 2010-Q3.
[37] See, for instance, https://www.bls.gov/spotlight/2017/educational-attainment-of-the-labor-force/home.htm.

to pay when loan limits are increased, may try to capture some of the additional funding through higher prices. Ideally, to determine the pass-through of federal loan generosity to institutions, we would compare increases in borrowing to increases in prices. However, realized changes in borrowing after Grad PLUS will be a function of the price increase. Thus, we employ an approach in the spirit of Lucca et al. (2019) and estimate reduced form models in which we compare changes in prices for graduate programs that had a high share of students borrowing at the limit before the Grad PLUS program to changes in prices for graduate programs where few students borrowed were constrained by the statutory limit in earlier years.[38] The intuition for this strategy is that programs in which more students were constrained by federal loans limits should see the largest increase in borrowing after these constraints are lifted and will have the most scope to raise prices and see increases in tuition revenue.[39]

Our estimating equation is:

$$Y_{pc} = \beta\left(Pct_{p,pre} * Post_c\right) + \theta_c + \theta_p + \varepsilon_{pc} \qquad (5)$$

Y_{pc} is a component of program price such as the cost of attendance, average institutional grants, or average tuition waivers. $Pct_{p,pre}$ represents the average percentage of students borrowing at the pre-Grad PLUS federal loan limit in the pre-period (2003 through 2006), and the other variables are defined as in equation (2).[40]

Our main analysis sample includes a balanced panel of programs with enrollment in every year between 2003 to 2010 and we weight program observations by the average number of students for whom we observe cost of attendance in the pre-period. Further, we limit our main analyses to programs in which the average number of students submitting financial aid information in a given year in the pre-period is at least 20 to avoid relying on variation from

[38] Our methods differ from Lucca et al. (2019) in that we use population data (versus survey data) to measure exposure to loan limit increases at the program (versus institution) level, examine effects on price levels (versus year-to-year price changes), estimate effects on both list and net price, and test for price discrimination.

[39] We only observe a program's cost of attendance (COA), of which tuition is only one component. Our implicit assumption in using COA as a measure of price is that incentives for schools to change the other components of COA were unaffected by changes in loan limits and borrowing because spending on these other components does not go to the school. Specifically, we assume that the living expense allowance in COA is changing similarly for programs that were more and less exposed to Grad PLUS-driven increases and thus is differenced out.

[40] We define the percent constrained by the number of students who are borrowing from the federal government at or above the Stafford maximum accounting for partial year enrollment. However, we show that our results are robust to using a measure that considers both federal and nonfederal borrowing in defining which students are at the limit or not accounting for partial year enrollment.

small programs, which will be measured with more noise.[41] On average, 15 percent of first-year borrowers were constrained, but there is substantial variation in this measure of exposure across programs: in programs within the bottom quartile, less than 3 percent of students were constrained, in programs in the top quartile, more than 18 percent of students were constrained, and 10 percent of programs (weighted by enrollment) had more than 60 percent of students constrained at baseline. Appendix Table A.9 provides average characteristics of programs in the main analysis sample, before and after Grad PLUS. Standard errors are clustered at the institution level.

Figure 6 shows estimates from an event study model in which $Post_c$ in equation (5) is replaced with indicators for event time (i.e., years before/after 2006). In the years preceding Grad PLUS, program prices trended similarly for programs with low and high shares of students who were constrained by federal loan limits, providing support for our identifying assumptions. After Grad PLUS, however, programs with a higher percentage of students who were constrained at baseline show significantly larger increases in average cost of attendance. Estimated effects are of a similar magnitude to the estimated effects on average Grad PLUS loans received by students in a program.[42]

Table 6 presents estimated effects on average student loans. Programs that were more exposed to Grad PLUS experienced significantly larger increases in average per-student Grad PLUS and Stafford loans than programs with a lower share of students who were constrained at baseline. The point estimate for Grad PLUS loans implies that a 1 percentage point increase in the share of students who were constrained by loan limits at baseline resulted in a $79 increase in average annual Grad PLUS borrowing per student. In total, annual federal loan aid per student increased by $54, suggesting that average Stafford Loans taken out by students may have decreased after Grad PLUS although the point estimates not statistically distinguishable from estimated effects on only Grad PLUS loans.[43] Some of the increase in federal borrowing was

[41] We later show the results are robust to relaxing these enrollment-based sample restrictions.

[42] In theory, average Grad PLUS loans per student should be $0 for all programs in the pre-period. However, the THECB collected PLUS and SLS loans in the same field. This results in a very small number of students having SLS/PLUS loans in the pre period.

[43] Although students are required to exhaust their Stafford Loan eligibility before borrowing through the Grad PLUS program, these two results are not necessarily inconsistent. An increase in Grad PLUS borrowing and a decrease in Stafford borrowing could be explained by a change in the composition of students who borrow, with fewer students taking out federal loans overall but those who borrow taking on larger amounts.

offset by the significant $33 decrease in average private student loans per student, while state loan aid was unaffected. A standard deviation increase in baseline percent constrained (21 percentage points) corresponds to an approximately $1745 increase in average Grad PLUS loans, $1195 increase in average federal loans, negligible effects on state loans, and a $728 decrease in average private loans following the creation of Grad PLUS.[44]

Next, we estimate effects on prices; Table 7 contains these results. Programs with a higher share of constrained students at baseline see significant increases in the average cost of attendance following the creation of Grad PLUS. A percentage point increase in constrained students at baseline corresponds to an approximately $60 increase in average cost of attendance after Grad PLUS. Taken together with the results in Table 6, these estimates suggest that prices increased by $0.75 per $1 increase in average per-student Grad PLUS loans and more than dollar for dollar with increases in total federal student loans. When we examine effects on the predicted cost of attendance for a full-time, full-year student (column 2), we find significant effects that are of a similar magnitude.

While Grad PLUS led to relatively larger increases in prices for programs in which students experienced the largest scope for borrowing increases, average grant aid received by students in these programs also increased. We find that approximately half of the increase in cost of attendance was offset by a $23 increase in institutional grants per 1 percentage point increase in share constrained (Table 7, column 3). This is consistent with colleges engaging in price discrimination: programs' sticker prices increased but students also received more grant aid. Aid received in the form of tuition waivers was unaffected. Taking the offsetting effects on list price and grant aid into account suggests a more modest degree of crowd-out: $0.64 increase in net price per $1 of average Grad PLUS loans (Table 7 column 5 estimates scaled by Table 6 column 1 estimate) or $0.64 net price increase per $1 increase in federal loans (Table 7 column 5 estimate scaled by Table 6 column 2 estimate).

We confirm these back-of-the-envelope calculations by estimating IV models in which total federal loan aid is the endogenous regressor and $Pct_{p,pre} * Post_c$ serves as the excluded

[44] These estimates are not directly comparable to the estimates of Lucca et al. (2019) for the effect of exposure to undergraduate loan limit increases as Lucca et al. (2019) use a first differences model in which treatment is the interaction between the percent constrained exposure measure and the statutory increase in borrowing limits, separately for subsidized and unsubsidized loans.

instrument.[45] Under the assumption that the baseline percent of students who were constrained only affected prices in the post period through changes in per-student federal loans, this specification provides an estimate of the extent to which prices changed per $1 increase in federal loans. Estimates suggest that $1 increase in federal loans resulted in a significant $1.10 increase in a program's list price and a $0.64 increase in net price (Table 8).

We test the robustness of these results to the construction of the analysis sample, how exposure to Grad PLUS is measured, and weighting by baseline enrollment. Changing the minimum program size required for sample inclusion to 10 or 30 produces very similar results (Appendix Table A.10, Panels A and B). Results are also quite similar when we use alternative cut-offs to distinguish between academic and professional master's degree programs (Panels C and D). We explore several alternative measures of exposure to Grad PLUS. First, we replace $Pct_{p,pre}$ – the average percent constrained between 2003 and 2006 – with the percent of students who are constrained in 2006 alone (Panel E). This measure may have more measurement error in the true fraction constrained because less students are used to calculate it, but it is temporally closer to treatment. Second, we construct three additional measures of the baseline percent constrained: federal borrowing at the Stafford Loan annual maximum not accounting for partial year enrollment (Panel F), total borrowing at the Stafford maximum not accounting for partial year enrollment (Panel G), and federal borrowing at the Stafford maximum accounting for partial year enrollment (Panel H). Our results are similar across all these measures of treatment intensity. We obtain similar (albeit less precise) estimated effects on borrowing, COA, and grants from a specification that discretizes the continuous measure of the percent of students constrained at baseline into a binary measure of above/below median baseline percent constrained to avoid issues with continuous differences in differences (Panel H). Finally, results in Panel I show that our findings are similar when we do not weight observations by baseline program size.

While prices may have gone up in response to the policy change, all students may not have borne the burden of tuition increases equally given institutions' ability to price discriminate by offering discounts through grants and tuition waivers. We investigate this by creating a new data

[45] Total loans or Grad PLUS loans alone could also serve as the endogenous regressor in IV models. We focus on pricing responses to total federal loans because it is the most policy relevant measure of treatment – both Stafford and PLUS Loans are determined by the federal government, whereas private loans may adjust endogenously to these policy decisions.

set at the program-by-year-by-group level, where group is defined by baseline student characteristics such as Pell Grant receipt as an undergraduate or race/ethnicity. Ex ante, it is not clear how price discrimination will work in graduate school, and while we observe income and assets for students (and their spouse, if present), this information will only be relevant for need-based (versus merit-based) aid. We consider several groups of students that may have experienced differential price discrimination. Groups are defined by student race (white, Black, Hispanic, API), parental education (parents with a college degree versus first-generation college students), Pell Grant receipt as an undergraduate in Texas, and the federal government's measure of need (above versus below median).[46]

Table 9 presents estimates by student race/ethnicity. We find some evidence of heterogeneous borrowing responses to Grad PLUS: Black students' federal loans increased by $91 per 1 percentage point increase in baseline percent constrained, Hispanic and white students' loans increased by $80 and $67 respectively, and Asian and Pacific Islander (API) students saw a $50 increase in average Grad PLUS loans. In contrast, we find the largest increase in average grant aid among white students, $34 per 1 percentage point increase in baseline percent constrained. Grant aid increased by $27 for Hispanic and API students and $15 for Black students. These differences in grant aid translate into differences in net price. Black students saw their net price increase by $36 per 1 percentage point increase in baseline exposure and Hispanic students see a $15 increase. Increases in average net prices faced by white and API students were $7 and $8, respectively. None of the estimated effects on net price are statistically significant at conventional levels but are suggestive that pricing responses to Grad PLUS were not equally experienced by students of different races/ethnicities.

Next, we examine whether there is heterogeneity in borrowing, grant, and price effects by measures of socioeconomic status (SES). Table 10 contains these results. Implied increases in grant aid are larger for non-Pell Grant recipients, students with a college educated parent, and students with above median need, but differences between groups are smaller than those implied by estimated effects by race/ethnicity.

Taken together, the estimates in Tables 9 and 10 suggest that increases in grant aid were not targeted to underrepresented students or students from less advantaged backgrounds. We

[46] The federal government calculates a student's Expected Family Contribution (EFC) to determine need. EFC is based on a number of inputs (e.g., income, assets, family structure) that students provide on their FAFSAs.

formally test whether increases in grants per $1 increase in federal loan aid were significantly larger for underrepresented groups by comparing the estimates from IV models. Table 11 contains these results. To compare effects on grants by race/ethnicity we combine Black and Hispanic students into a single category and white and API students into a second grouping. Estimates imply that average grants increased by $0.69 per $1 increase in federal loans for white and API students but only by $0.41 for Black and Hispanic students. The difference between these estimates is significant at the 10 percent level. Estimated effects by Pell Grant receipt, parental education, and EFC are not statistically distinguishable.

Overall, our results demonstrate that schools do in fact respond to increased loan access by increasing tuition, and it appears that this burden is not born disproportionately by higher-SES students nor were benefits targeted to students in groups that have been historically underrepresented in graduate school. While we test for heterogeneity in compensating increases in grant aid along dimensions of representation and need, we do not observe pre-graduate school academic preparation (such as GRE scores) or other measures upon which merit-based aid might be based, which in the case of graduate education, may be the most relevant dimension for price discrimination.[47]

7. Discussion and Conclusion

This paper explores the comprehensive effects of a large expansion in federal student loans for graduate school due to the creation of the federal Grad PLUS Program. Grad PLUS increased graduate student loans and shifted graduate borrowing from private to federal sources. However, the increase in federal loan limits did not increase access to graduate programs overall or for underrepresented students.

We find little evidence of economically significant short- or longer-run effects on the human capital accumulation of students who were or would have been constrained by federal borrowing limits in the absence of Grad PLUS, even though cumulative debt significantly increased for these students when they gained access to Grad PLUS loans. This suggests that access to additional liquidity was not the deciding constraint for graduate student borrowers' human capital investments prior to the implementation of Grad PLUS. We also find little evidence of an impact on later earnings, consistent with no change in human capital accumulation.

[47] Another relevant factor affecting changes in grant provision could be field of study, but our sample is too small to estimate heterogeneity along this dimension.

However, Grad PLUS-driven increases in federal student loans significantly increased prices. This provides confirmatory evidence for the Bennett Hypothesis. In addition to raising prices, we provide evidence that schools engaged in price discrimination more after the increase in student loan availability by increasing grant aid. As a result, increases in federal borrowing led to smaller increases in net prices than in the listed price. We find suggestive evidence that the increases in grant aid was larger for white and API students than for Black or Hispanic students, but otherwise did not vary by SES.

Our results are relevant for policy. The implementation of Grad PLUS loans seems to have benefitted students very little in terms of human capital accumulation. This contrasts with the large human capital and earnings returns to higher loan limits among constrained undergraduates (Black et al 2020), who face relatively low federal borrowing limits and may have limited access to private student loans. Our results raise important questions about the utility of essentially uncapped government-backed loans for graduate school.

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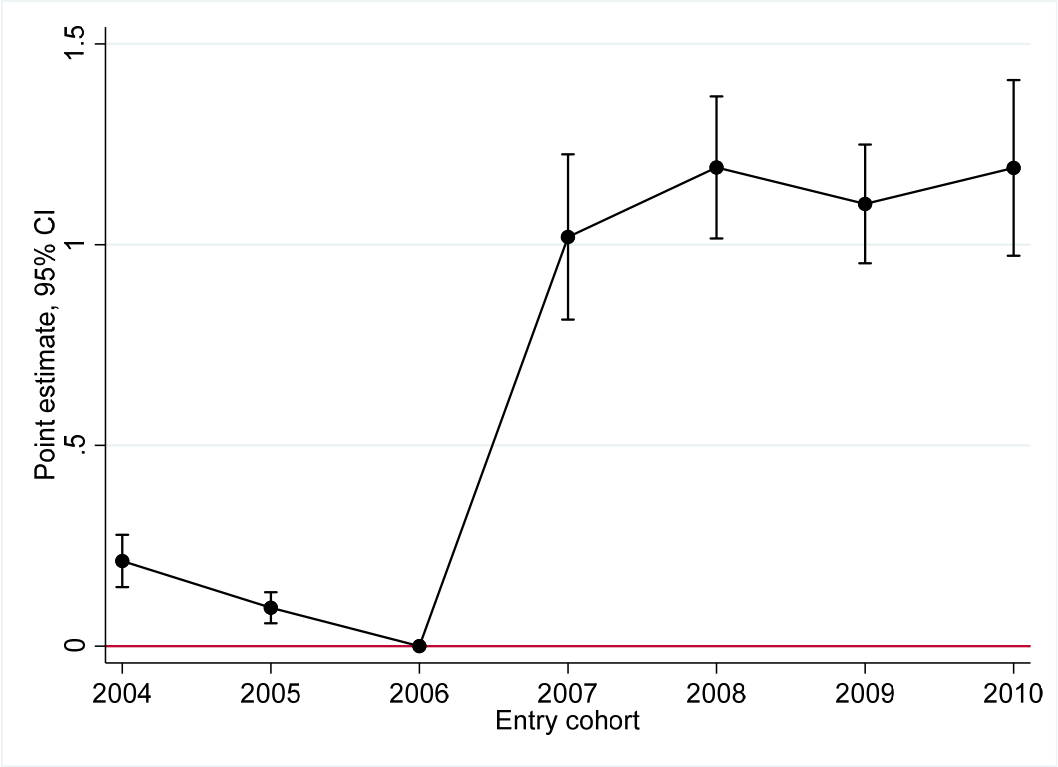
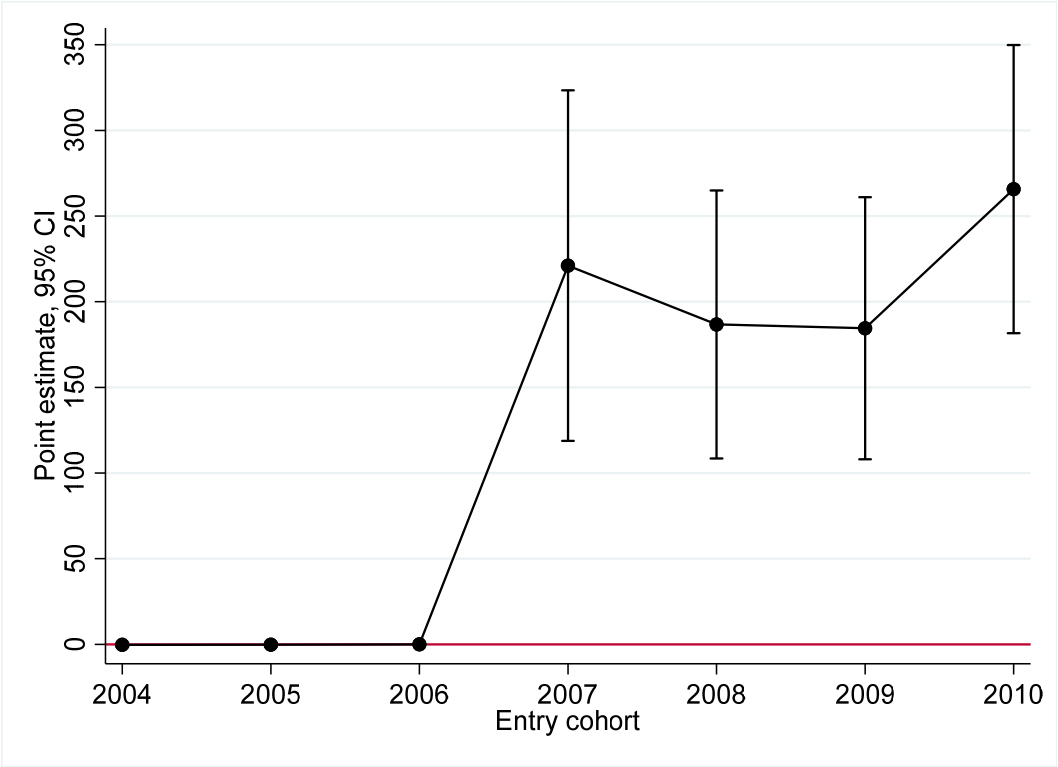
Figures and Tables

Figure 1: Effect of a $1000 increase in loan limits on graduate program access

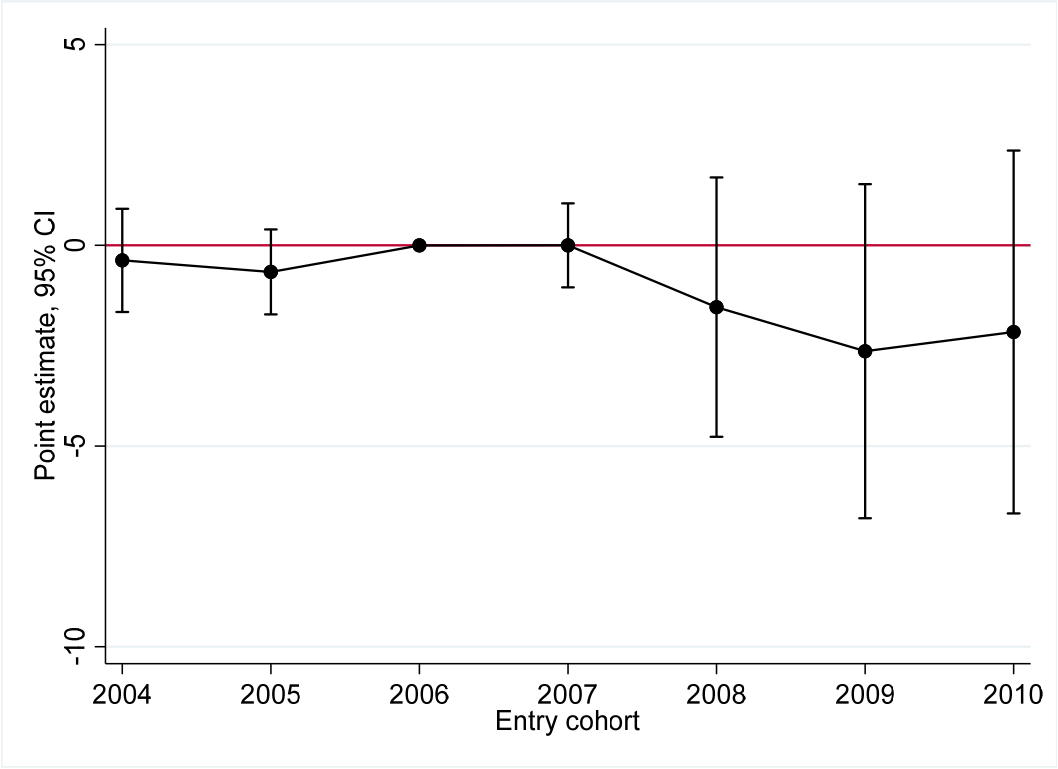
A. Federal borrowing limit



B. Grad PLUS loans



C. Number of students in entry cohort



D. Percent (0-100) of entering students who are Black, Hispanic, or Native American

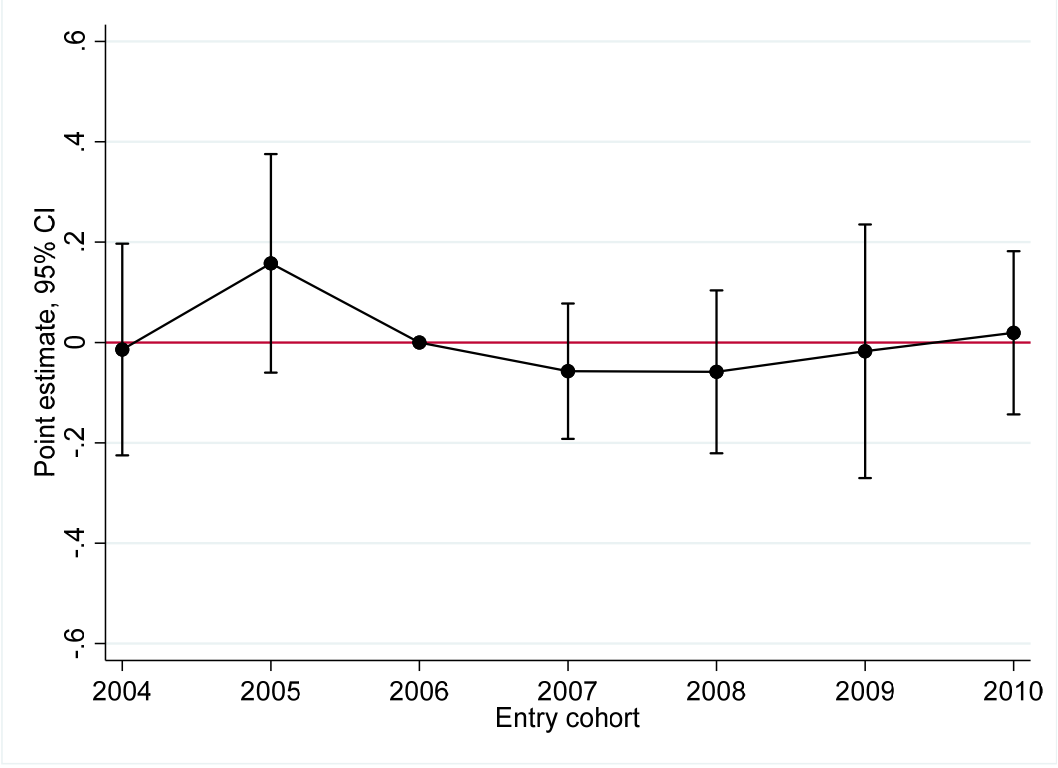
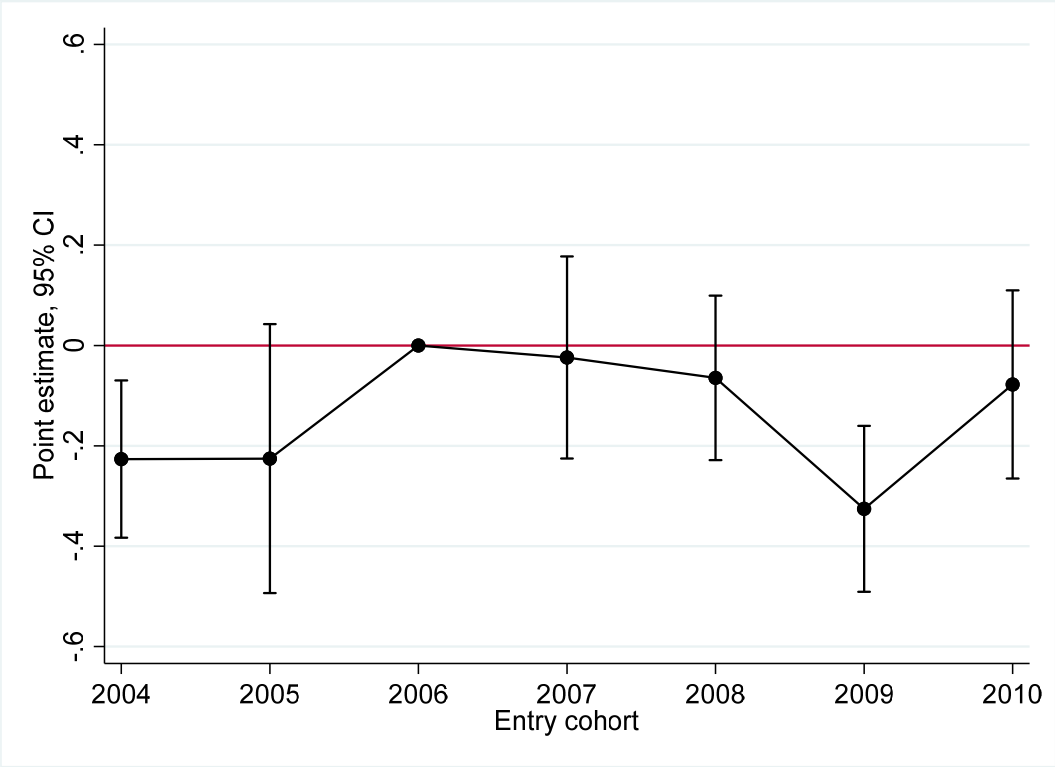


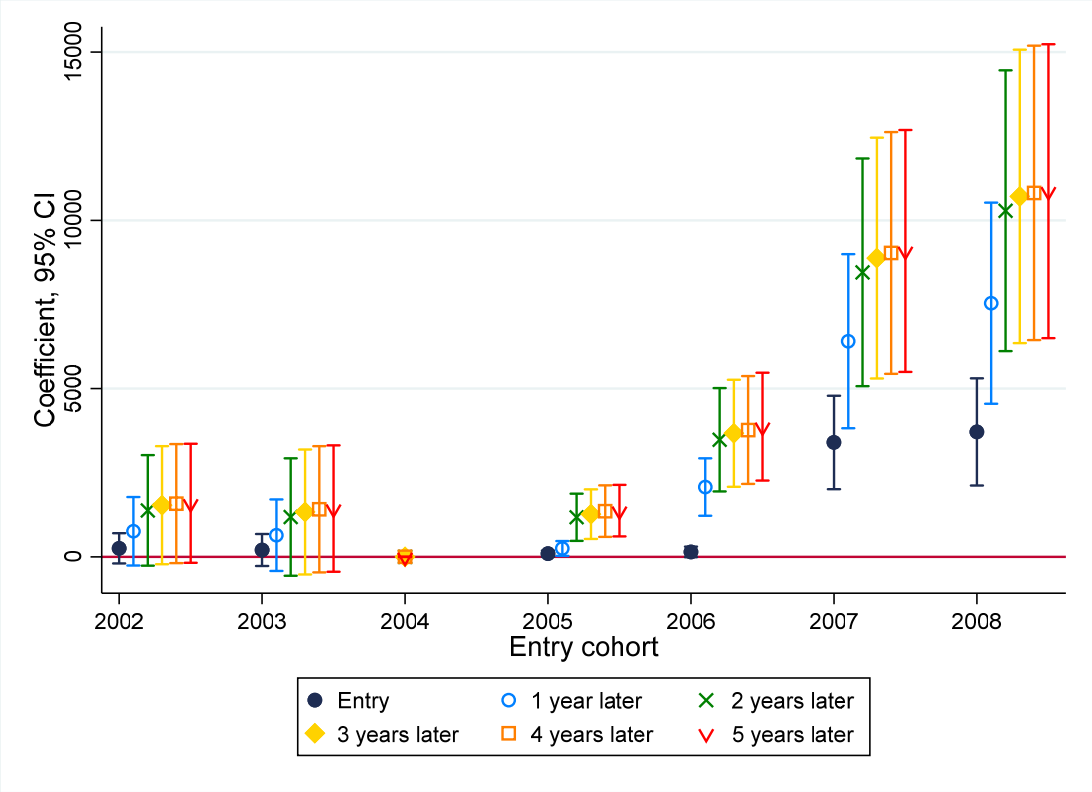
Figure 1, continued

E. Percent (0-100) of entering students who are men



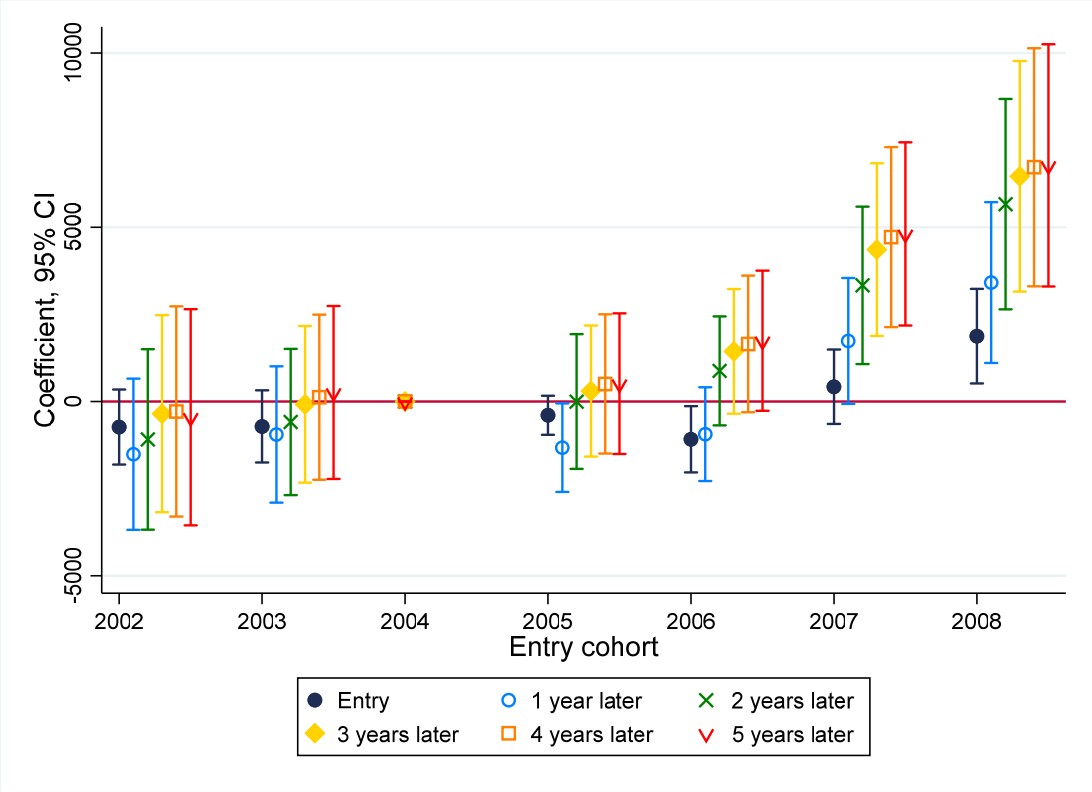
Notes: The sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006. Point estimates and 95% confidence intervals from regressions of federal loan limits (Panel A), average Grad PLUS loans per student (Panel B) first-year enrollment (Panel C) or percent (0-100) of entering students who were Black, Hispanic, or Native American/Alaskan Native (Panel D), or men (Panel E) on an interaction between entry cohort and the projected federal loan limit increases (see text for details). Regressions also include entry cohort and program fixed effects. Standard errors are clustered at the program level.

Figure 2: Effects on constrained students' cumulative Grad PLUS loans by entry cohort



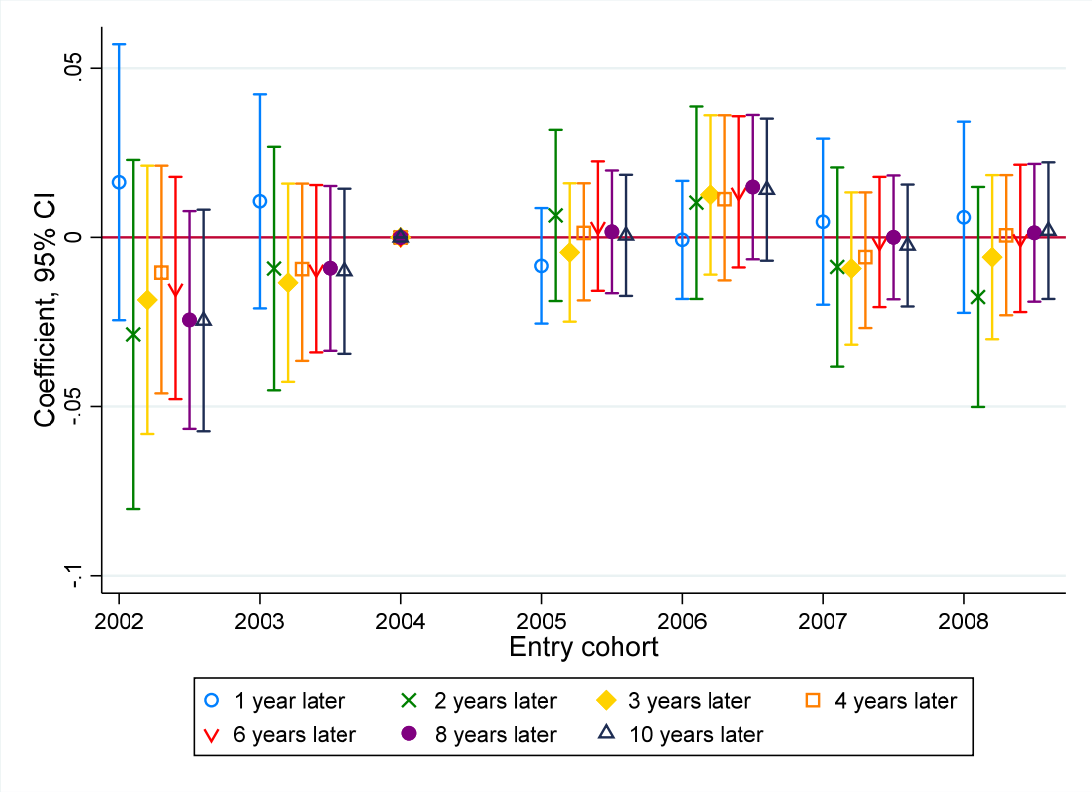
Notes: The sample includes first-time graduate students who borrowed in their first year of enrollment. Point estimates and 95% confidence intervals from regressions of cumulative Grad PLUS loans at the specified number of years since entry on an interaction between entry cohort and an indicator for being constrained (borrowing at the federal Stafford Loan limit). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Standard errors are clustered at the program level.

Figure 3: Effects on constrained students' cumulative student loans from all sources



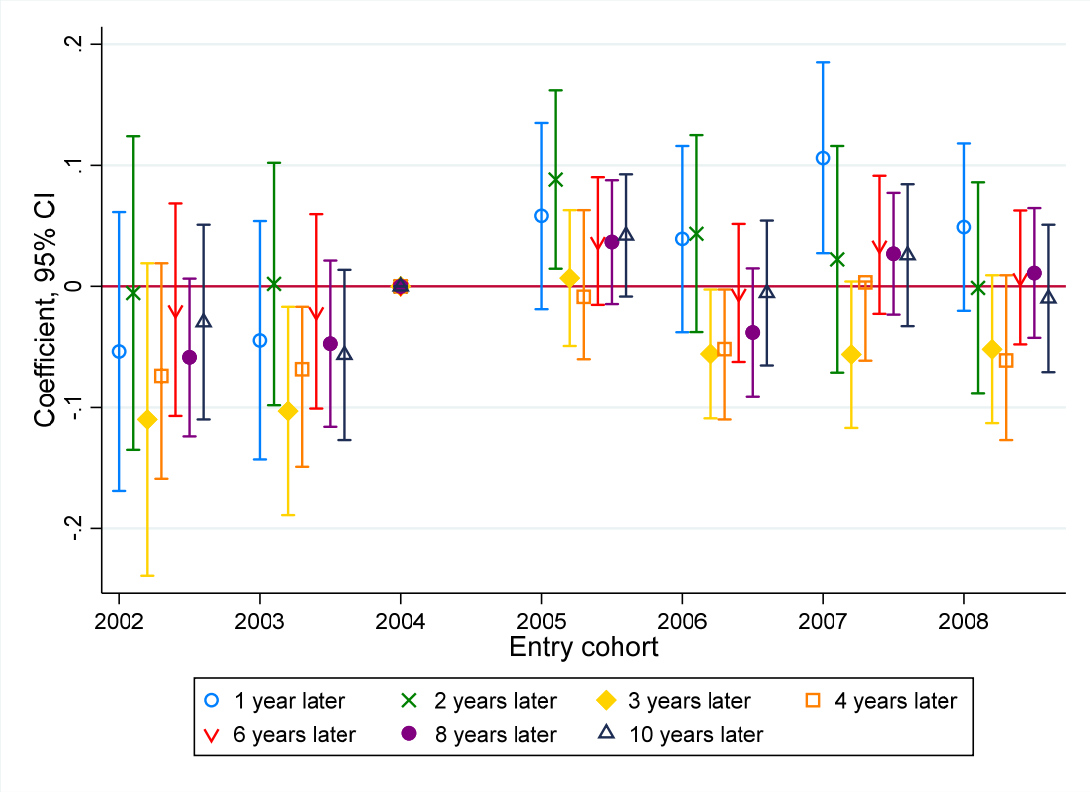
Notes: The sample includes first-time graduate students who borrowed in their first year of enrollment. Point estimates and 95% confidence intervals from regressions of cumulative student loans at the specified number of years since entry on an interaction between entry cohort and an indicator for being constrained (borrowing at the federal Stafford Loan limit). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Standard errors are clustered at the program level.

Figure 4: Effects on constrained students' degree receipt by entry cohort



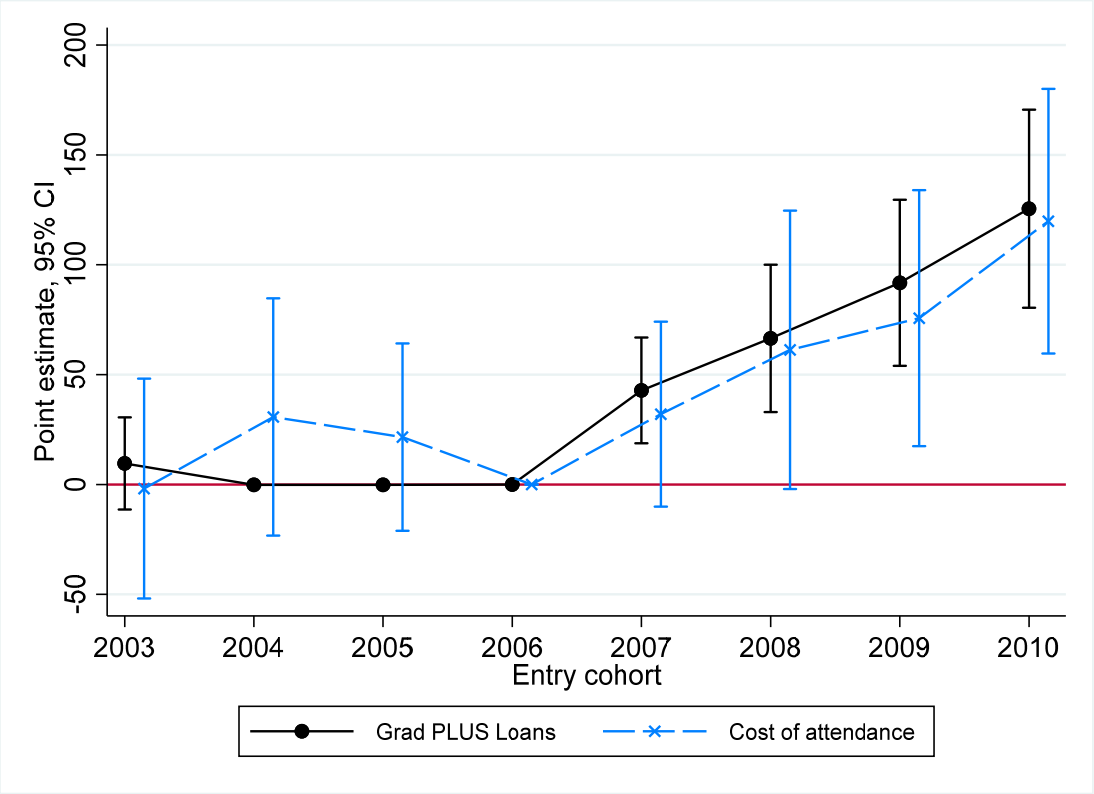
Notes: The sample includes first-time graduate students who borrowed in their first year of enrollment. Point estimates and 95% confidence intervals from regressions of the probability of any graduate credential receipt as of the specified number of years since entry on an interaction between entry cohort and an indicator for being constrained (borrowing at the federal Stafford Loan limit). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Standard errors are clustered at the program level.

Figure 5: Effect on constrained students' earnings by entry cohort



Notes: The sample includes first-time graduate students who borrowed in their first year of enrollment. Point estimates and 95% confidence intervals from regressions of ln(annual earnings) at the specified number of years since entry on an interaction between entry cohort and an indicator for being constrained (borrowing at the federal Stafford Loan limit). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Standard errors are clustered at the program level.

Figure 6: Effect of a 1 percentage point increase in baseline percent of students who are constrained by Stafford Loan limits on program-level borrowing and prices



Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates and 95% confidence intervals from regressions of average Grad PLUS loans per student (dark solid markers) or average cost of attendance (light Xs) on interactions between academic year indicators and the percent of students who were constrained at baseline (see text for definition). Regressions also include academic year and program fixed effects. Standard errors are clustered at the program level.

Table 1: Characteristics of first-time graduate students

	(2) Pre (2002-2006)	(3) Post (2007-2010)
Observations	245,875	212,606
Race/ethnicity/nativity[1]		
Asian	0.06	0.06
Black	0.10	0.10
Hispanic	0.16	0.17
White	0.56	0.53
International	0.13	0.13
Age (in yrs.)	30	29
	(9)	(9)
Texas Resident[2]	0.77	0.77
Degree receipt within		
2 years	0.44	0.51
4 years	0.62	0.69
6 years	0.67	0.74
8 years	0.69	0.75
Broad field of study[3]		
Education	0.25	0.23
Business	0.14	0.16
Health	0.14	0.16
Engineering	0.08	0.08
Law	0.05	0.05
Computer science	0.03	0.03
Psychology	0.03	0.02
Social services	0.03	0.04
Library sciences	0.02	0.02
Academic doctoral	0.17	0.15
Borrowers	0.32	0.40
Constrained borrowers	0.10	0.16
Amount borrowed (2018$)		
Federal Stafford	$5,240	$6,567
	(9,428)	(10,014)
Federal PLUS loans	$13	$597
	(407)	(3,746)
Federal Perkins	$82	$49
	(650)	(480)
State	$17	$50
	(409)	(894)
Private and other	$289	$198
	(2,393)	(2,072)
Total loans	$5,640	$7,461
	(10,402)	(12,063)
Total grants (2018$)	$735	$1,551
	(2,690)	(4,658)
Cost of Attendance (2018$)[4]	$26,064	$29,940
	(13,071)	(19,691)

Notes: Sample is limited to first-time graduate students who enrolled in the 2002 through 2010 academic years. Constrained borrowers are students who borrowed the maximum available Stafford Loan amount for the academic year. Standard deviations for continuous variables under means in parentheses.

1. Among those in one of the listed race/ethnicity/nativity categories (pre N = 238,348; post N = 194,378).
2. Among those with nonmissing residency information (pre N = 213,429; post N = 171,922).
3. Among those with nonmissing field of study in entry year (pre N = 211,184; post N = 179,193).
4. Among those with nonmissing COA (i.e., who filed a FAFSA) (pre N = 82,729; post N = 109,315).

Table 2: Effect of projected and realized increases in federal loan limits on enrollment and the composition of entering graduate students

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
A. OLS estimates							
Projected limit increase ($1k) x Post	-1.2	-0.04	-0.03	0.05	0.39	-0.15	0.03
	(1.5)	(0.05)	(0.05)	(0.04)	(0.144)**	(0.159)	(0.074)
B. IV estimates							
Federal loan limit ($1k)	-1.3	-0.04	-0.03	0.05	0.38	-0.14	0.03
	(1.4)	(0.04)	(0.05)	(0.04)	(0.118)**	(0.14)	(0.07)
95% CI	[-4.1 ,1.5]	[-0.12 ,0.04]	[-0.12 ,0.06]	[-0.02 ,0.12]	[0.15 ,0.61]	[-0.42 ,0.13]	[-0.11 ,0.16]
C. Pre-Grad PLUS mean	131.3	8.2	16.8	5.8	53.9	12.9	40.8

Notes: The sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006 (N = 2,345). Panel A displays point estimates from regressions of first-year enrollment or percentage of entering students (0-100) with the given demographic characteristic on an interaction between post-Grad PLUS entry cohort and the projected federal loan limit increases (see text for details). Panel B displays point estimates from instrumental variables models in which the interaction between the projected limit increase and the indicator for post-Grad PLUS serves as the excluded instrument for the realized federal loan limit (F-stat = 171). Panel C displays the mean of the dependent variable in 2004-2006. All specifications also include entry cohort and program fixed effects. Columns (2) through (7) estimates weighted by the size of the entering cohort. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 3: The effect of Grad PLUS on constrained students' cumulative borrowing

Years since entry =	0	1	2	3	4	5	6
A. Federal PLUS loans							
Constrained x treated cohort	1796	3860	5404	5622	5702	5752	5772
	(358)**	(781)**	(1122)**	(1152)**	(1153)**	(1152)**	(1151)**
Dep var mean (const, pre-period)	$12	$14	$19	$88	$133	$171	$226
B. Federal loans (Stafford + PLUS)							
Constrained x treated cohort	1054	2870	5338	5909	6099	6144	6159
	(397)**	(814)**	(1188)**	(1342)**	(1401)**	(1433)**	(1460)**
Dep var mean (const, pre-period)	$23,254	$42,038	$53,282	$56,729	$58,331	$59,401	$60,196
C. State and private loans							
Constrained x treated cohort	-504	-1587	-2417	-2595	-2592	-2581	-2578
	(235)*	(544)**	(770)**	(837)**	(834)**	(832)**	(831)**
Dep var mean (const, pre-period)	$2,226	$4,399	$5,489	$5,609	$5,653	$5,673	$5,682
D. Total loans							
Constrained x treated cohort	575	1347	2926	3325	3519	3579	3596
	(344)+	(629)*	(860)**	(956)**	(1011)**	(1034)**	(1058)**
Dep var mean (const, pre-period)	$25,704	$46,958	$59,607	$63,258	$64,924	$66,020	$66,829

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of cumulative student loans at the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for bellowing to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 4: The effect of Grad PLUS on constrained students' educational attainment

Years since entry =	1	2	3	4	5	6	7	8	9	10
A. Cumulative years enrolled										
Constrained x treated cohort	0.010	0.022	0.026	0.041	0.048	0.053	0.054	0.053	0.051	0.048
	(0.006)	(0.017)	(0.023)	(0.028)	(0.033)	(0.036)	(0.039)	(0.041)	(0.043)	(0.044)
Dep var mean (const, pre-period)	1.88	2.48	2.69	2.80	2.89	2.96	3.02	3.06	3.10	3.14
B. Cumulative credit hours attempted										
Constrained x treated cohort	0.345	0.98	1.142	1.32	1.469	1.572	1.593	1.605	1.605	1.588
	(0.425)	(0.496)*	(0.630)+	(0.667)*	(0.690)*	(0.715)*	(0.734)*	(0.750)*	(0.761)*	(0.766)*
Dep var mean (const, pre-period)	32.80	41.08	43.39	44.79	45.79	46.55	47.17	47.66	48.06	48.40
C. Any graduate degree receipt										
Constrained x treated cohort	-0.005	0.005	0.005	0.006	0.008	0.009	0.011	0.012	0.012	0.011
	(0.013)	(0.012)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Dep var mean (const, pre-period)	0.280	0.675	0.769	0.799	0.813	0.822	0.827	0.831	0.835	0.837

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of cumulative years of enrollment (Panel A), cumulative credit hours attempted (Panel B), or the probability of any degree receipt (Panel C) as of the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for bellowing to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$, + $p < 0.1$.

Table 5: The effect of Grad PLUS on constrained students' labor market outcomes

Years since entry =	1	2	3	4	5	6	7	8	9	10
A. Any earnings (N = 117,954)										
Constrained x treated cohort	0.012	0.020	0.016	0.015	0.015	0.015	0.012	0.011	0.012	0.013
	(0.009)	(0.008)*	(0.008)*	(0.007)*	(0.007)*	(0.008)+	(0.008)	(0.008)	(0.009)	(0.008)
Dep var mean (const, pre-period)	0.717	0.706	0.712	0.69	0.669	0.651	0.637	0.624	0.614	0.605
B. Ln(earnings)										
Constrained x treated cohort	0.086	0.038	0.009	0.003	-0.005	0.028	0.035	0.033	0.024	0.033
	(0.028)**	(0.035)	(0.024)	(0.025)	(0.020)	(0.020)	(0.019)+	(0.019)+	(0.017)	(0.022)
Dep var mean (const, pre-period)	9.67	10.01	10.57	10.81	10.89	10.95	10.99	11.03	11.08	11.09
Observations	87,587	85,519	88,277	86,146	84,122	82,424	80,816	79,539	78,309	77,347

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of the probability of having earnings in a UI-covered sector in Texas (Panel A) or ln(annual earnings) as of the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for bellowing to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses;
** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 6: Effect of 1 pp increase in baseline percent of students constrained by Stafford Loan limit on average per-student loans

	(1) Grad PLUS	(2) Total Federal	(3) State	(4) Private
% constrained*Post	79.3	54.3	3.3	-33.1
	(16.6)**	(28.8)+	(3.2)	(12.3)**
Observations	2,336	2,336	2,336	2,336

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates from regressions of average loans per student from the specified source on an interaction between post-Grad PLUS and the percent of students who were constrained at baseline (see text for definition). Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, + $p < 0.1$.

Table 7: Effect of 1 pp increase in baseline percent of students constrained by Stafford Loan limit on program prices and financial aid

	(1) COA	(2) FTFY COA	(3) Grants	(4) Tuit waivers	(5) Net price
% constrained*Post	59.6	62.7	23.0	1.8	34.8
	(21.1)**	(18.9)**	(13.7)+	(3.1)	(30.2)
Observations	2,336	2,336	2,336	2,336	2,336

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates from regressions of average prices or average aid per student (indicated in the column heading) on an interaction between post-Grad PLUS and the percent of students who were constrained at baseline (see text for definition). COA = cost of attendance. FTFY COA is the predicted program-level cost of attendance for a full-time, full-year student (see text for details). Net price equals COA minus grants and tuition waivers. Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, + $p < 0.1$.

Table 8: IV estimates of the effect of federal loans on program price

	(1) COA	(2) FTFY COA	(3) Net price
Federal loans	1.098	1.156	0.641
	(0.480)*	(0.5181)*	(0.355)+
Observations	2,336	2,336	2,336

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates from instrumental variables models in which average federal student loans per student is the endogenous regressor and an interaction between post-Grad PLUS and the percent of students who were constrained at baseline (see text for definition) is the excluded instrument. COA = cost of attendance. Net price equals COA minus grants and tuition waivers. Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$, + $p < 0.1$.

Table 9: Heterogeneity in the effect of exposure to Grad PLUS by race/ethnicity

	(1) Grad PLUS loans	(2) Total Fed. loans	(3) Grants	(4) Net price
A. Asian or Pacific Islander				
% constrained*Post	49.8	18.4	26.5	8.3
	(11.7)**	(17.7)	(15.2)+	(35.0)
Observations	1,770	1,770	1,770	1,770
B. Black				
% constrained*Post	91.4	55.4	15.1	35.5
	(20.0)**	(21.4)*	(28.6)	(40.7)
Observations	2,111	2,111	2,111	2,111
C. Hispanic				
% constrained*Post	79.5	13.2	26.6	14.8
	(18.7)**	(26.2)	(20.3)	(38.6)
Observations	2,240	2,240	2,240	2,240
D. White				
% constrained*Post	66.7	20.2	33.6	7.0
	(14.7)**	(15.5)	(17.4)+	(40.0)
Observations	2,286	2,286	2,286	2,286

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Programs without any students of the specified race/ethnicity are excluded. Point estimates from regressions of average loans, grants, or price per student on an interaction between post-Grad PLUS and the percent of students who were constrained at baseline (see text for definition). Net price equals COA minus grants and tuition waivers. Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 10: Heterogeneity in the effect of exposure to Grad PLUS by socioeconomic status

	(1) Grad PLUS loans	(2) Total Fed. loans	(2) Grants	(4) Net price
A. Received Pell Grant as undergrad				
% constrained*Post	103.7	66.5	19.2	18.7
	(23.0)**	(36.2)+	(20.2)	(32.4)
Observations	2,319	2,319	2,319	2,319
B. Did not receive Pell as undergrad				
% constrained*Post	85.3	70.1	25.5	33.1
	(18.0)**	(32.5)*	(15.5)	(33.9)
Observations	2,336	2,336	2,336	2,336
C. First generation college student				
% constrained*Post	94	75.6	24.8	36.9
	(20.4)**	(36.3)*	(19.7)	(35.4)
Observations	2,336	2,336	2,336	2,336
D. College educated parent				
% constrained*Post	103.3	75.4	27.8	29.7
	(20.2)**	(36.3)*	(18.5)	(35.5)
Observations	2,319	2,319	2,319	2,319
E. EFC < median				
% constrained*Post	100.1	81.3	26.6	37.4
	(21.4)**	(35.7)*	(18.6)	(35.3)
Observations	2,334	2,334	2,334	2,334
F. EFC > median				
% constrained*Post	89.6	65.8	26.5	13.8
	(19.4)**	(34.2)+	(17.6)	(28.7)
Observations	2,327	2,327	2,327	2,327

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Programs without any students of the specified category are excluded. EFC = expected family contribution (limited to students who filed an application for federal student aid). Undergraduate Pell Grant receipt only available for students who received an undergraduate degree from a Texas public higher education institution. Point estimates from regressions of average loans, grants, or price per student on an interaction between post-Grad PLUS and the percent of students who were constrained at baseline (see text for definition). Net price equals COA minus grants and tuition waivers. Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 11: Heterogeneity in the effect of federal borrowing on average grant aid received by students within demographic groups

	(1) URM (vs. White/API)	(2) Pell receipt as UG	(3) First gen student	(4) EFC > median
Federal loans				
x Has characteristic	0.407	0.289	0.369	0.402
	(0.535)	(0.400)	(0.374)	(0.405)
x Does not have characteristic	0.689	0.364	0.329	0.327
	(0.612)	(0.343)	(0.358)	(0.325)
Test of eq (p-val)	0.063	0.513	0.584	0.514
Observations	4,614	4,655	4,655	4,661

Notes: See Table 10 notes for sample. Programs without any students of the specified groups are excluded. EFC = expected family contribution (limited to students who filed an application for federal student aid). Undergraduate Pell Grant receipt only available for students who received an undergraduate degree from a Texas public higher education institution. Point estimates from regressions of average grant aid per student on average federal loans per student from IV models in which an interaction between post-Grad PLUS and the percent of students who were constrained at baseline serves as excluded instruments. Regressions also include academic year and program fixed effects. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Appendix A: Additional Tables and Figures

Table A.1: Characteristics of graduate programs by cost of attendance relative to Stafford Loan limit

Predicted limit increase =	*Zero*		*Greater than zero*	
	(1) Pre	(2) Post	(3) Pre	(4) Post
Unique programs	253	253	85	85
Percent (0-100) entering students who are:				
API	5.7	6.0	6.1	7.2
Black	9.1	10.0	5.8	6.3
Hispanic	19.6	20.8	9.2	9.9
White	53.9	50.0	52.8	52.3
International	9.8	10.0	22.3	20.8
Men	36.8	36.7	51.9	51.7
Average loans (2018$)				
PLUS	$9	$78	$14	$1,035
Stafford	$4,905	$5,874	$5,993	$6,058
State or private	$175	$224	$745	$254
Total	$5,088	$6,176	$6,751	$7,347
Federal loan limit (2018$)	$19,559	$20,912	$23,396	$29,913

Notes: The sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006 (N = 2345). Pre is 2004-2006, post is 2007-2010.

Table A.2: Robustness of estimated effects on program enrollment and composition

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
A. Binary treatment							
$Treat_p$ x Post	-8.7	-0.37	-0.52	0.93	3.38	-1.61	-0.05
	(12.7)	(0.33)	(0.39)	(0.38)*	(1.31)*	(1.37)	(0.70)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
B. Average COA 2004-2006							
Projected limit increase ($1k) x Post	-1.3	-0.05	-0.03	0.06	0.34	-0.13	0.04
	(1.3)	(0.04)	(0.04)	(0.03)+	(0.11)**	(0.12)	(0.06)
Observations	2,366	2,366	2,366	2,366	2,366	2,366	2,366
C. Predicted FTFY COA							
Projected limit increase ($1k) x Post	1.1	-0.39	-0.11	0.38	0.29	-0.18	-0.06
	(1.8)	(0.15)**	(0.24)	(0.17)*	(0.38)	(0.21)	(0.25)
Observations	2,338	2,338	2,338	2,338	2,338	2,338	2,338
D. Unweighted							
Projected limit increase ($1k) x Post	-1.2	-0.10	-0.08	0.14	0.12	-0.03	0.06
	(1.5)	(0.05)+	(0.13)	(0.05)**	(0.13)	(0.08)	(0.08)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
E. Expand post-period to 2013							
Projected limit increase ($1k) x Post	-0.8	-0.10	0.38	0.04	0.06	-0.12	0.01
	(1.5)	(0.05)+	(0.13)**	(0.07)	(0.14)	(0.12)	(0.08)
Observations	3,652	3,652	3,652	3,652	3,652	3,652	3,652
F. 10 student minimum							
Projected limit increase ($1k) x Post	-1	-0.04	-0.02	0.05	0.38	-0.14	0.01
	(1.2)	(0.05)	(0.05)	(0.04)	(0.14)**	(0.16)	(0.07)
Observations	2,947	2,947	2,947	2,947	2,947	2,947	2,947
G. Include HBCU programs							
Projected limit increase ($1k) x Post	0.5	-0.08	-0.05	0.03	0.09	-0.20	0.02
	(0.8)	(0.05)	(0.07)	(0.05)	(0.18)	(0.13)	(0.14)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
H. 80% terminal MA cut-off for nonacademic							
Projected limit increase ($1k) x Post	-1.4	-0.04	-0.03	0.05	0.39	-0.15	0.04
	(1.5)	(0.05)	(0.05)	(0.04)	(0.15)**	(0.16)	(0.07)
Observations	2,541	2,541	2,541	2,541	2,541	2,541	2,541
I. 75% terminal MA cut-off for nonacademic							
Projected limit increase ($1k) x Post	-1.4	-0.04	-0.04	0.06	0.37	-0.14	0.01
	(1.4)	(0.05)	(0.05)	(0.04)	(0.13)**	(0.15)	(0.10)
Observations	2,744	2,744	2,744	2,744	2,744	2,744	2,744

Notes: See Table 2 notes.

Table A.3: Effect of projected and realized increases in federal loan limits on enrollment and the composition of entering graduate students, school-level estimates

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
A.OLS estimates							
Projected limit increase ($1k) x Post	-2.0	-0.05	-0.03	-0.002	0.02	0.12	-0.09
	(3.6)	(0.03)+	(0.02)	(0.02)	(0.10)	(0.09)	(0.04)*
B. IV estimates							
Federal loan limit ($1k)	-1.7	-0.05	-0.03	-0.001	0.02	0.1	-0.08
	(2.7)	(0.02)*	(0.02)+	(0.02)	(0.07)	(0.08)	(0.03)*
95% CI	[-7.0 ,3.6]	[-0.08, -0.01]	[-0.06, 0.002]	[-0.03, 0.03]	[-0.13, 0.16]	[-0.05, 0.25]	[-0.14, -0.01]
C. Pre-Grad PLUS mean	817.8	9.5	15.5	5.6	54.3	11.7	42.5

Notes: The sample includes public and nonprofit higher education institutions with graduate student enrollment in each of the 2004 through 2010 academic years (N = 428). Panel A displays point estimates from regressions of first-year enrollment or percentage of entering students (0-100) with the given demographic characteristic on an interaction between post-Grad PLUS entry cohort and the projected federal loan limit increases (see text for details). Panel B displays point estimates from instrumental variables models in which the interaction between the projected limit increase and the indicator for post-Grad PLUS serves as the excluded instrument for the realized federal loan limit (F-stat = 348). Panel C displays the mean of the dependent variable in 2004-2006. All specifications also include entry cohort and institution fixed effects. Columns (2) through (7) estimates weighted by the size of the number of entering graduate students at baseline. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table A.4: Characteristics of constrained and unconstrained borrowers by entry cohort

	Unconstrained borrowers		Constrained borrowers	
Entry cohort =	*2002-2004*	*2005-2008*	*2002-2004*	*2005-2008*
Demographics (measured at college entry)				
Gender = male				
Race/ethnicity				
API	0.06	0.07	0.05	0.06
Black	0.14	0.14	0.14	0.16
Hispanic	0.20	0.22	0.14	0.16
White	0.57	0.54	0.61	0.57
Texas resident	0.89	0.90	0.81	0.84
Age	27.6	27.6	28.1	28.3
Financial aid received in entry year (2018$)				
Grants	$2,059	$2,533	$2,126	$3,382
Federal Stafford loans	$13,501	$12,799	$23,165	$22,673
Federal PLUS loans	$47	$147	$23	$3,495
Federal Perkins loans	$279	$191	$207	$167
State and private	$305	$535	$2,467	$969
Total loans	$14,133	$13,672	$25,863	$27,304
EFC (2018$)	$5,826	$6,734	$9,831	$9,796
COA (2018$)	$22,842	$24,946	$34,461	$36,828
Broad field of study				
Health	0.25	0.24	0.15	0.18
Education	0.21	0.21	0.14	0.16
Academic	0.17	0.15	0.15	0.12
Law	0.03	0.03	0.32	0.28
Business	0.11	0.13	0.10	0.12
Social services	0.05	0.05	0.03	0.05
Psychology	0.05	0.05	0.01	0.01
Engineering	0.02	0.02	0.01	0.01
Number of students	54,878	24,774	23,633	14,669

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment.

Table A.5: Placebo estimates

	(1) API	(2) Black	(3) Hispanic	(4) URM	(5) Age
Constrained x treated cohort	0.002	0.005	0.009	0.013	0.010
	(0.004)	(0.006)	(0.006)	(0.009)	(0.118)
Dep var mean (const, pre-period)	0.052	0.131	0.137	0.274	28.03

	(6) Male	(7) College ed parent	(8) In-state	(9) EFC	(10) Index
Constrained x treated cohort	-0.002	-0.008	0.003	-1180	-0.001
	(0.008)	(0.009)	(0.018)	(497)*	(0.001)
Dep var mean (const, pre-period)	0.471	0.648	0.815	10,200	0.804

Notes: See Table 3 notes for sample and specification. URM = underrepresented minority. Index is a linear prediction from a regression of the probability of earning a graduate degree within 10 years of entry on all baseline characteristics.

Table A.6: Effects of Grad PLUS on constrained students' receipt of specific degrees

Years since entry =	1	2	3	4	5	6	7	8	9	10
A. Master's degree										
Constrained x treated cohort	-0.005	0.009	0.003	0.0004	0.0004	0.001	0.002	0.001	0.001	0.0003
	(0.014)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Dep var mean (const, pre-period)	0.271	0.438	0.488	0.509	0.519	0.526	0.530	0.534	0.538	0.540
B. Professional degree										
Constrained x treated cohort	‡	-0.006	0.001	0.004	0.006	0.006	0.006	0.006	0.007	0.007
	‡	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Dep var mean (const, pre-period)	‡	0.239	0.285	0.293	0.296	0.298	0.299	0.300	0.301	0.301
C. Doctoral degree										
Constrained x treated cohort	‡	‡	‡	‡	0.0017	0.0038	0.0045	0.0054	0.0052	0.0043
	‡	‡	‡	‡	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Dep var mean (const, pre-period)	‡	‡	‡	‡	0.013	0.017	0.020	0.023	0.026	0.029

Notes: See Table 3 notes for sample and specification.
‡ results suppressed

Table A.7: Effects of Grad PLUS on constrained students' receipt of specific degrees by field of study

Years since entry =	2	3	4	5	6	7	8	9	10
A. Law degree (JD)									
Constrained x treated cohort	-0.010	0.001	0.003	0.004	0.005	0.005	0.005	0.005	0.005
	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Dep var mean (cons, pre-2005 cohorts)	0.227	0.246	0.250	0.252	0.253	0.253	0.253	0.254	0.254
B. MBA									
Constrained x treated cohort	-0.010	-0.009	-0.008	-0.008	-0.008	-0.007	-0.007	-0.007	-0.007
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Dep var mean (cons, pre-2005 cohorts)	0.145	0.151	0.154	0.155	0.156	0.157	0.158	0.158	0.159
C. Education master's degree									
Constrained x treated cohort	0.004	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Dep var mean (cons, pre-2005 cohorts)	0.073	0.085	0.091	0.095	0.098	0.100	0.102	0.103	0.104
D. Other health master's degree (excl. MPH and nursing)									
Constrained x treated cohort	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dep var mean (cons, pre-2005 cohorts)	0.031	0.035	0.036	0.036	0.037	0.037	0.037	0.037	0.037
E. Accounting master's degree									
Constrained x treated cohort	0.0003	0.0002	-0.001	-0.0001	-0.0004	-0.0002	-0.0002	0.0001	0.00003
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Dep var mean (cons, pre-2005 cohorts)	0.027	0.028	0.028	0.029	0.029	0.029	0.029	0.029	0.029
F. Chiropractic degree									
Constrained x treated cohort	-0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dep var mean (cons, pre-2005 cohorts)	0.012	0.025	0.026	0.026	0.027	0.027	0.027	0.027	0.027
G. Nursing									
Constrained x treated cohort	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dep var mean (cons, pre-2005 cohorts)	0.021	0.023	0.024	0.024	0.024	0.024	0.024	0.024	0.025
H. Medical degree (MD or DO)									
Constrained x treated cohort	‡	‡	-0.001	-0.001	-0.001	-0.0004	-0.0004	-0.001	-0.001
	‡	‡	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	‡	0.013	0.013	0.014	0.014	0.014	0.015	0.015
I. Master's in Social Work									
Constrained x treated cohort	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.001)+	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)*
Dep var mean (cons, pre-2005 cohorts)	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
J. Other business master's degree (excl. MBA and accounting)									
Constrained x treated cohort	‡	-0.0003	-0.001	-0.002	-0.002	-0.002	-0.001	-0.002	-0.002
	‡	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.012
K. Engineering master's degree									
Constrained x treated cohort	‡	-0.001	-0.001	-0.0002	0.0002	0.0002	0.0002	0.0003	0.0004
	‡	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011

Notes: See Table 3 notes for sample and specification.
‡ results suppressed

Table A.8: Effects of Grad PLUS on constrained students' receipt of academic master's degrees

Years since entry =	2	3	4	5	6	7	8	9	10
A. Arts or humanities master's degree									
Constrained x treated cohort	0.002	0.003	0.003	0.004	0.004	0.004	0.005	0.004	0.004
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Dep var mean (cons, pre-2005 cohorts)	0.020	0.025	0.027	0.028	0.029	0.029	0.029	0.030	0.030
B. Social science master's degree									
Constrained x treated cohort	‡	0.002	0.0004	0.0002	0.0002	0.0004	0.001	0.001	0.001
	‡	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Dep var mean (cons, pre-2005 cohorts)	‡	0.013	0.015	0.016	0.016	0.017	0.017	0.017	0.017
C. Math or science master's degree									
Constrained x treated cohort	‡	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.002
	‡	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dep var mean (cons, pre-2005 cohorts)	‡	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013

Notes: See Table 3 notes for sample and specification.
‡ results suppressed

Table A.9: Graduate program prices and characteristics before and after Grad PLUS

	(1) Pre	(2) Post
Average enrollment		
All	937	918
FAFSA filers	427	522
Percent of students who are:		
Asian	0.07	0.06
Black	0.10	0.10
Hispanic	0.15	0.17
White	0.58	0.53
First gen	0.37	0.38
Average age	30.2	29.9
Average EFC	$6,431	$7,080
COA	$28,030	$30,695
FTFY COA	$21,303	$26,125
Net price	$26,644	$28,418
Percent with any loans	0.49	0.54
Average loans		
PLUS	$38	$987
Stafford	$10,754	$11,534
State or private	$515	$515
Total	$11,673	$13,166
Average grants	$1,214	$1,857
Average tuition waiver	$172	$420
Observations	1,168	1,168

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Pre is 2003-2006, post is 2007-2010.

Table A.10: Robustness of estimated effects on program-level loans and prices

	(1) Grad PLUS loans	(2) Total Fed. loans	(3) COA	(4) FTFY COA	(5) Grants	(6) Net price
A. Minimum program enrollment = 10						
% constrained*Post	79.3	54.5	60.0	63.4	23.0	35.2
	(16.5)**	(28.7)+	(21.1)**	(18.9)**	(13.6)+	(30.1)
Observations	3,104	3,104	3,104	3,104	3,104	3,104
B. Minimum program enrollment = 30						
% constrained*Post	79.4	54.5	59.3	62.4	23.0	34.5
	(16.6)**	(28.9)+	(21.2)**	(19.0)**	(13.7)	(30.3)
Observations	1,992	1,992	1,992	1,992	1,992	1,992
C. 80% terminal MA cut-off for academic program def						
% constrained*Post	79.3	54.1	59.0	62.1	23.1	34.1
	(16.6)**	(28.9)+	(21.1)**	(19.0)**	(13.7)+	(30.2)
Observations	2,576	2,576	2,576	2,576	2,576	2,576
D. 75% terminal MA cut-off for academic program def						
% constrained*Post	79.4	54.0	58.2	61.7	23.1	33.4
	(16.6)**	(28.9)+	(21.1)**	(19.0)**	(13.7)+	(30.2)
Observations	2,728	2,728	2,728	2,728	2,728	2,728
E. Percent constrained based on 2006 only						
% constrained*Post	69.6	50.9	52.7	53.7	19.5	31.8
	(15.3)**	(24.0)*	(20.2)*	(19.7)**	(11.6)+	(26.6)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
F. Constrained def does not account for partial year enrollment						
% constrained*Post	75.6	53.1	58.1	62.2	22.3	34.2
	(15.9)**	(27.0)+	(19.7)**	(17.7)**	(12.8)+	(28.0)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
G. Constrained def based on all loans, accounts for partial year enrollment						
% constrained*Post	84.7	56.7	65.5	68.1	25.5	37.5
	(18.0)**	(31.9)+	(23.2)**	(20.2)**	(14.8)+	(33.2)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
H. Constrained def based on all loans, not accounting for partial year enrollment						
% constrained*Post	82.1	56.4	64.4	67.0	24.5	37.5
	(17.1)**	(30.1)+	(21.9)**	(19.1)**	(14.0)+	(31.3)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
I. Discrete treatment (above median % constrained)						
Abv med*Post	1761.2	1097.3	938.7	1362.3	368.2	337.5
	(494.9)**	(742.6)	(912.3)	(808.2)+	(265.0)	(905.6)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
J. Unweighted						
% constrained*Post	57.3	22.1	49.3	59.8	13.0	34.1
	(13.1)**	(21.0)	(19.3)*	(17.5)**	(11.4)	(24.7)
Observations	2,336	2,336	2,336	2,336	2,336	2,336

Notes: See Table 6 notes for baseline sample and specification.