Credit Supply and the Rise in College Tuition: Evidence from the Expansion in Federal Student Aid Programs*

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June 2015

Abstract

When students fund their education through loans, changes in student borrowing and tuition are interlinked. Higher tuition costs raise loan demand, but loan supply also affects equilibrium tuition costs, for example, by relaxing students' funding constraints. To resolve this simultaneity problem, we exploit detailed student-level financial data and changes in federal student aid programs to identify the impact of increased student loan funding on tuition. We find that institutions more exposed to changes in the subsidized federal loan program increased their tuition disproportionately around these policy changes, with a sizable passthrough effect on tuition of about 70 percent. We also find positive passthrough effects on tuition of Pell Grant aid and the unsubsidized federal loan program, although these are economically and statistically not as strong. The subsidized loan effect on tuition is most pronounced for expensive, private institutions that are somewhat, but not among the most, selective.

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1 Introduction

A key question in finance is to what extent greater access to credit affects asset prices and may contribute to the emergence of pricing "bubbles" (Kindleberger, 1978). In recent years, much attention has been devoted to this question in the context of the housing market, for which credit is central, in an attempt to establish whether the U.S. housing boom of 2002-6 and the ensuing bust can be explained by those years' fluctuations in mortgage rates and loan availability to subprime borrowers (see, for example, Mian and Sufi, 2009; Adelino, Schoar, and Severino, 2012; Favara and Imbs, 2015). From a finance perspective, the market for postsecondary education has shared several features with the housing market in the past few decades, despite the fact that student loans fund a capital investment (Becker, 1962) while mortgages fund an asset. First, credit plays a key role in U.S. postsecondary education; student loans outstanding are now second only to mortgages as a household liability, (New York Fed, 2015). Second, student loans, much like housing finance, are often originated through government-sponsored programs, and these originations have been growing at a very sharp pace. Yearly student loan originations grew from $53 billion to $120 billion between 2001 and 2012, with about 90% of originations in recent years occurring through federal student aid programs (Figure 1). Against this backdrop of increased borrowing, average sticker tuition rose 46% in constant 2012 dollars between 2001 and 2012, from $6,950 to $10,200 (Figure 2), resembling the twin house price and mortgage balance booms. In this paper we attempt to address this question: What, if any, has been the effect of the student loan credit expansion on the cost of postsecondary education?

This issue has been at the forefront of the policy discussion for many years. Even the more muted tuition and student aid trends in the 1980s, prompted the then-Secretary of Education William Bennett (1987) to argue that "[...] increases in financial aid in recent years have enabled colleges and universities blithely to raise their tuitions, confident that Federal loan subsidies would help cushion the increase," a statement that came to be known as the "Bennett Hypothesis." Exploding tuition costs and loan balances in recent years have similarly attracted much policy attention (for example, Obama, 2013). Despite the importance of this issue, little empirical evidence exists on the link between student loans and college tuition. The key identification challenge is a standard simultaneity issue: a positive correlation between student funding and tuition costs may indicate that an increase in the availability of student credit has caused increases in tuition, that increases in tuition costs have caused increases in student loan balances, or that some other variable has caused an increase in both student loans and tuition. The main contribution of this paper is to propose an identification strategy to isolate a causal effect of student loan credit

on tuition.

Our identification approach exploits changes in the maximum disbursable amounts of per-student federal aid in federal student aid programs (collectively known as "Title IV" programs). We focus on the two largest such Title IV programs: subsidized and unsubsidized loans under the William Ford Federal Direct Loan Program (known as the Federal Family Education Loan Program prior to July 2010) and Pell Grants. Despite our interest in credit, we study Pell Grants because they are economically significant and experienced changes, which partially overlapped with those on the federal loan programs. These program changes were legislated through three separate initiatives that passed Congress between February 2006 and April 2008 and went into effect between the 2007-08 and 2010-11 school years.[1] We first show that surrounding the passage of these bills, the portfolio of stocks of publicly traded postsecondary institutions displayed cumulative abnormal returns of nearly 10%, consistent with the hypothesis that federal aid supply boosted demand at these postsecondary education institutions.

To identify the tuition impact of this credit expansion, we exploit a rich dataset from the Department of Education (DOE), known as NPSAS, containing student-level funding and family income information for a representative sample of postsecondary institutions in the US. This dataset reveals that while program cap changes technically applied to all institutions, certain institutions had many more students who would be able to take advantage of these increases, due to variation in eligibility and participation. We use this variation to construct an instrument for student loan credit by interacting the shift in federal aid supply and the "exposure" of an institution to each shift, as measured by the ex-ante fraction of students borrowing at a particular policy cap. This approach is analogous to the one commonly used in labor economics to analyze the impact of labor demand shocks (Bartik, 1991; Blanchard and Katz, 1992).

Our approach leads to three separate first stage regressions for (yearly changes) in subsidized loans, unsubsidized direct loans and Pell Grants. The point estimates imply that the effect of these cap increases is to raise dollar-for-dollar the amount of loans or grants disbursed to the students "exposed" to a policy cap change. In other words, students at the program caps display an extremely elastic demand for these loans and grants. Using data from the NY Fed CCP/Equifax panel, we confirm this high elasticity by examining the distribution of student loan origination amounts around the subsidized program cap change, and find that the pre-/post-distributions display a shift in the mass points of the

[1]The maximum subsidized federal loan amount for freshmen rose in the 2007-08 academic year from $2,625 to $3,500, and for sophomores from $3,500 to $4,500; unsubsidized loan maximums rose by $2,000 in the academic year 2008-09. Finally, federal aid in the form of Pell Grants rose gradually between the 2007-2008 and 2010-2011 school years.

loan distribution from the old caps to the new ones.[2]

The strength of this identification lies in our ability to not only observe eligibility, but also past participation rates in the affected student aid programs in NPSAS, except for the case of unsubsidized loans to dependent undergraduates. Dependent undergraduates became eligible for unsubsidized loans through the policy change, so participation is unobserved ahead of the policy. We construct a shadow participation rate using the fraction of dependent students that borrowed the maximum amount of subsidized loans they were eligible for.[3] While superior as a participation proxy than a simple eligibility criterion in terms of dependent status, this measure will likely still overstate actual participation since it assumes that any student who borrowed their full amount of subsidized loans will also borrow the full amount of unsubsidized loans. Consistently, the coefficient on this instrument is about .6, while the coefficients we estimate where we are able to observe actual participation are statistically not different from 1.

From the second stage, when we control for all forms of aid, we find that each additional Pell Grant dollar to an institution leads to a roughly 55 cent increase in sticker price tuition. For subsidized loans, we find a somewhat larger passthrough effect of about 70 percent. We also find a loading of tuition on unsubsidized loans of 30 percent. All of these effects are highly significant and are consistent with the Bennett Hypothesis. We further control for changes in other revenue sources at the institutional level, and the possibility that certain institutional characteristics may be correlated with both these changes and with tuition changes. We find that the subsidized loan effect is quite robust across specifications both in magnitude and significance, while the Pell Grant and unsubsidized loan effect are less so.

We focus our attention on sticker-price tuition rather than net tuition, which varies across students because it subtracts institutional grants, because data on sticker tuition is reliably available at a yearly frequency. However, we also show that in the medium run, changes in sticker price are largely reflected in the net tuition of all students, though the changes are smaller for those who receive high amounts of institutional grants. Finally, we find that the passthrough of subsidized loan aid to tuition is highest among relatively expensive, mostly private, four-year institutions with relatively high-income students but with average selectivity, as measured by their admittance rates.

We also use the same instrument to examine whether the student aid expansion increased

[2]The CCP panel does not include information on whether the loans are issued under the Federal Direct Loan program, but the caps for subsidized loans prior to the policy change are relatively irregular amounts (e.g. $2,625), permitting an indirect inference through the amounts.

[3]The rationale for this instrument is that a student that is eligible for subsidized loans but does not take those funds will not accept unsubsidized loans because the latter are more expensive.

in the short-run access to postsecondary education by looking for differential growth in enrollments around these policy changes. We find an effect only for changes in Pell Grant availability, which may be due to the fact that Pell Grants, which are available only to low-income students, may be affecting those most likely to be on the margin of enrolling, and because unlike the federal loans we study, they do not require any sort of principal repayment.

This paper contributes to three main strands of the literature. First, it builds on the expanding financial literature studying the role of credit supply on real allocations and asset prices. While in a strict Modigliani-Miller world the supply of credit does not influence asset valuations, theoretical and empirical work is at odds with this classical view. Geanakoplos (2010) and Brunnermeier and Pedersen (2009) present theories wherein cyclical variation in leverage and funding influence asset prices. As noted above, a large literature has also studied empirically the role of credit supply, in the context of the recent US housing cycle. Our paper, provides complementary evidence on the role of credit in affecting the cost of higher education.

This paper also contributes to the economics of education literature studying the role of student aid in increasing the price of postsecondary education. Most of this literature has focused only on grant aid, and in particular Pell Grants: for example, Singell and Stone (2007) show that increases in Pell Grants are captured by increased tuition at private universities and out-of-state tuition at public universities, while Turner (2012) uses a regression discontinuity approach and finds that institutions alter institutional aid (scholarships) as a means of capturing the federal aid provided through the federal Pell Grant program. Cellini and Goldin (2012) find evidence that for-profit universities that are eligible for any student federal aid (Title IV) programs, including loans, charge tuition that is about 75 percent higher than comparable institutions whose students cannot apply for such aid. We add to this study by attempting to specifically isolate the role of student loans using the natural experiments provided by federal aid policy changes. We also consider a different sample of institutions, as for-profit institutions represent a small fraction of the institutions sampled by the NPSAS data that we use.

Finally, this paper is related to the public economics literature on tax incidence (Kotlikoff and Summers, 1987), which studies how the burden of a particular tax is allocated among agents after accounting for partial and general equilibrium effects. In our setting, the student aid expansion is a disbursement of a public benefit. While one would expect this expansion to improve the recipients' welfare, for example, through lower interest payments and a relaxation of borrowing constraints, the subsidized loan expansion possibly resulted in lower welfare because of the sizable and offsetting tuition effect. We discuss in the

paper's conclusions, however, the role of these programs in expanding access to secondary education.

The remainder of the paper is organized as follows. We discuss major tuition and funding trends in the next section and data sources in Section 3. In Section 4, we describe our empirical method and changes in student aid policies. Section 5 discusses the main results in the paper, while Section 6 presents results on enrollments and institutional grants. This section also studies the attributes of institutions with the highest pass-through for the subsidized program. In Section 7, we discuss our natural experiment in the more general context of the tuition trends and also study the longer-term empirical relation between tuition, enrollment and aid before the policy changes. Finally Section 8 concludes and discusses evidence for for-profit institutions, which, despite having received much attention in the policy debate, are heavily underrepresented in the data that we use for our main results.

2 The postsecondary education industry and student funding

This section provides basic facts about the postsecondary education industry. It then describes the Federal Student Aid Programs; changes in these programs are the key identification strategy in this paper to study the effects of credit expansion on college tuition. As we discuss in this section, credit extended under these programs have also been a key contributor to the run up in overall student loan balances.

2.1 College tuition and programs

As shown in Figure 2, average undergraduate per student tuition nearly doubled between 2001 and 2012, from about $6,950 to more than $10,000 in 2012 dollars, corresponding to an average real rate increase of 3.5% per year. This trend has drawn much attention by media and policy makers alike (see, for example, Obama, 2013) and has driven major recent policy initiatives, such as the free community college program (White House, 2015).

These overall trends in college tuition mask significant variation within the postsecondary education sector. Tuition at postsecondary educational institutions vary widely depending on the type of degree the institution offers (four-year bachelor's degrees, two-year associate's degrees, or certificates generally requiring less than two years of full time study) and by the type of governance it operates under (for example, non-profit or for-profit).

In the 2011-2012 school year, there were 10.7 million undergraduate students enrolled at four-year institutions, and 7.5 million students enrolled at two-year institutions (see Figure 3). Four-year institutions also enrolled an additional 2.8 million graduate students, though we focus mainly on undergraduate loan amounts and tuition in this paper. Four-year institutions, which include public state universities (60% of enrollment in 2012), private non-profit research universities and liberal arts colleges (29%), and private for-profit institutions (11%), rely on a combination of revenue sources, from government appropriations to tuition revenue to other revenue (mostly private endowments and gifts).

The two-year sector is almost entirely dominated by public two-year colleges, also known as community colleges, which enroll about 95% of all two-year students. Tuition at these colleges is low, averaging just $2,600 in 2012, largely due to the large share of revenue that is funded through government sources (70%).

Finally, in addition to the 20.4 million students enrolled at degree-granting institutions (two-year and four-year institutions) in 2012, another 572,000 were enrolled at Title IV "less-than-two-year" institutions. These institutions are mostly vocational schools in fields such as technology, business, cosmetology, hair styling, photography and fashion. In contrast to the degree-granting institutions, the majority of these institutions are private for-profit institutions and tuition revenue makes up the majority of their funding. These institutions tend to be smaller and unfortunately they are heavily under-represented in our study because only a limited number of for-profit institutions are included in NPSAS. In addition, we focus only on Title IV-eligible institutions in this paper, but several for-profit institutions exist that are not Title IV-eligible. Cellini and Goldin (2012), after controlling for observables, exploit differences in this eligibility to estimate the impact of Title-IV programs on tuition.

2.2 Federal Student Aid Programs

We briefly overview federal student aid programs and discuss their importance in the student loan credit expansion of recent years.

Federal student loan and aid programs are governed by the 1965 Higher Education Act (HEA). The original HEA outlined six mandates directing federal funds to higher education, the most important of which is described under HEA's Title IV.[4] Title IV authorizes federal financial aid to support access to postsecondary education in the form of two key programs:

[4]In addition to Title IV, Title I funded continuing education programs, Title II allocated money for libraries, Title III provisioned money for underdeveloped higher education institutions, Title V strengthened the quality of teaching, and Title VI was dedicated to undergraduate education.

Federal Pell Grants and the William D. Ford Federal Direct Loan Program, which, prior to July 2010, was known as the Federal Family Education Loan (FFEL) Program.[5]

Pell Grants are direct grants awarded through participating institutions to low-income undergraduates. As discussed in the econometric identification section, the grant amount is based on the student's financial need and cost of attendance, but is capped at a program maximum, which has changed over time. The Federal Direct Loan program provides loans funded by the federal government to help both undergraduate and graduate students obtain low-cost financing for their education. Key features of these loans are that they may or may not require repayment while a student is still in school, offer a fixed interest rate that is typically lower than private loans or other sources of consumer credit, and do not require a credit record or cosigner. The program offers four types of loans: Direct Subsidized Loans, loans that are awarded based on financial need for which the government pays the interest while a student is enrolled in school; Direct Unsubsidized Loans, loans that are not awarded based on need but where the student is responsible for paying interest during all periods; Direct PLUS loans, which require borrowers to not have adverse credit histories and are awarded to graduate students and parents of dependent undergraduate students; and Federal Perkins loans, which are made by specific participating institutions to students who have exceptional financial need.

Interest rates, fees and loan amounts on federal student loans and Pell Grant amounts have been determined by Congress through amendments to the HEA, which requires a 5 year reauthorization. These amendments form the basis for our identification.[6]

As shown in Figure 1, loan originations in Federal Loan Programs have accounted for over 90% of all student loan originations since the 2009-2010 school year, and 75-80% in the years of our sample before the financial crisis. As shown by the red areas, the majority of these originations (about 65-70%) are for undergraduate education, and most of these are originated through the Direct Subsidized Loan and Direct Unsubsidized Loan programs, which have originated between $25 and $30 billion each in recent years, or about 85% of all federal student loans made to undergraduates. From the figure, it is also evident that a sharp rise in originations through these programs took place between 2008 and 2010, which were the years of the federal loan cap changes that we discuss in the next section.

[5]Prior to 2010, the subsidized, unsubsidized, and PLUS loans were made by private lenders and their performance was guaranteed by a guarantor that was reinsured by the Department of Education. The Health Care and Education Reconciliation Act of 2010 made the DOE the lender for all of these loans starting in 2011.

[6]These have occurred in 1968, 1972, 1976, 1980, 1986, 1992, 1998, 2005, and most recently in 2008. For example, most recently, under the Bipartisan Student Loan Certainty 2013 Act, student loan rates are tied to secondary market rates. Very recent student loan policy initiatives also contemplate alternative income-linked repayment methods and repayment time horizons.

In Figure 4, we show that Pell Grant disbursement averaged around $30 billion in recent years, compared to an average of about $70 billion for federal student loan originations to undergraduates, and also experienced large increases between 2008 and 2010. Given these coincident increases, and their large economic significance, we will be controlling for changes in Pell Grants in our empirical approach.

3 Data

We use data from three main sources from the Department of Education (DOE): Integrated Postsecondary Education Data System (IPEDS), Title IV Administrative Data from the DOE's Federal Student Aid Office (FSA), which we refer to as "Title IV" data, and the restricted-use student-level National Postsecondary Student Aid Survey (NPSAS) dataset.

IPEDS is a system of surveys conducted annually by the DOE's National Center for Education Statistics (NCES) with the purpose of describing and analyzing trends in postsecondary education in the United States. All Title IV institutions are required to complete the IPEDS surveys. These surveys cover seven areas: institutional characteristics, institutional prices, enrollment, student financial aid, degrees and certificates conferred, student retention and graduation rates, and institutional human resources and finances. We mainly use IPEDS for a panel of sticker price tuition and enrollment. Though IPEDS began in 1980, the survey covering sticker-price tuition was changed significantly in the 2000-2001 school year, so we begin our sample there. Following NCES convention, we refer to this year as the year 2001.

In our analysis, we are interested in measures of financial aid from all government and non-government. However, these measures in IPEDS, which are contained in the "Student Financial Aid" survey, have a number of issues that we believe make them less usable than the sticker-price tuition and enrollment surveys. First, the Student Financial Aid survey is considered by most educational administrators to be the most burdensome of the IPEDS surveys (Government Accountability Office (2010)). This is likely because it requires administrators to estimate the total amount of aid and number of recipients within a specific IPEDS-defined universe of students, ''full-time first-time degree-seeking undergraduates." Restricting to this universe may be difficult for some institutions depending on what data sources they pull from to complete the IPEDS surveys. Thus, this data are less reliable than those obtained from the less-burdensome collection of published tuition levels and enrollment numbers. Second, this universe is not necessarily representative of the entire undergraduate body. Third, until recently, IPEDS did not distinguish between federal

loans and other loans, and still does not distinguish between subsidized and unsubsidized loans.

For these reasons, we avoid the IPEDS survey measures of loans from the Student Financial Aid survey. Instead, for measures of federal loan awards at the institution level, we use the Title IV Program Volume Reports, which report yearly institutional-level total dollar amounts and the number of recipients for each federal loan and grant program. These are available beginning with the 1999-2000 academic year and include information on each form of federal grant or loan.

Merging FSA and IPEDS data, we obtain an annual panel of federal loan borrowing, Pell Grants, enrollment and sticker price tuition for the universe of Title IV institutions. Importantly, however, this panel does not contain information on institutional grants by institution, and this is why we focus attention sticked price in our main analysis.[7]

Finally, we supplement the IPEDS/Title IV panel with NPSAS, a restricted-use student-level dataset from NCES. The NPSAS data are obtained from a survey of a nationally representative sample of students from Title IV institutions. The primary objective of the NPSAS survey is to produce reliable estimates related to student financing of education. NPSAS surveys have been conducted approximately every four years starting in 1988. Because they are only conducted every four years and are a repeated cross-section of the institutions in IPEDS, we do not generally attempt to exploit the panel dimension of NPSAS. Instead, we use the 2004 NPSAS to document pre-policy cross-sectional variation that is only possible to observe with student-level data, since this data allows us to observe not just institutional-level loan and grant totals, but the number of students who are constrained by each of the policy maximums.

Of the 1340 institutions in the NPSAS 2004 wave, 1190 have sticker-price tuition data for at least one of our sample years in IPEDS, and of these, we are able to match 790 to their Title IV Program Volume Reports. Our final main regression sample is thus an unbalanced panel of 790 institutions over the 11 years between the 2000-2001 and 2011-2012 academic years.

[7]For the reasons discussed above, the data from the Student Financial Aid survey appears to be unreliable. Another option is to use data on institutional grant expenditures from the finance survey, but this does not separate the expenditures into undergraduate and graduate amounts, and is only available for about 60% of our sample.

4 Empirical Method

As discussed in Section 2, between 2001 and 2012, average college tuition rose 46% in real terms while aggregate student loan originations more than doubled. Absent any identification assumption these joint increases cannot be interpreted causally because of simultaneity issues. In this section, we describe a Bartik-like approach that we will use to isolate the impact of a credit expansion on college tuition by sorting universities ahead of the federal policy changes in terms of student-loan eligibility. Before doing so, we first discuss federal student loan and grant eligibility criteria and describe the policy changes.

4.1 Eligibility for Federal Student Aid Programs

Eligibility for federal student aid programs is subject to two main criteria. First, the institution that a student attends must meet certain qualifications to make it eligible for Title IV aid programs such as being licensed, accredited from a Nationally Recognized Accrediting Agency (NRAA), and meeting standards of administrative capacity and financial responsibility.[8] While public institutions automatically satisfy these eligibility criteria, other institutions may not. Cellini and Goldin (2012) use variation in this institution-level eligibility to identify effects of all Title IV programs (both grants and loans) on tuition. Beyond the institution-level eligibility to Title IV programs, the amount and types of aid that a student is eligible for are governed by program caps and by individual caps that are a function of the education cost and measures of family income and assets. We will exploit variation in each program cap to study the (separate) impact of federal student aid and loans on tuition.

Students who attend Title IV-eligible institutions can qualify for federal loans and grants by filling out the Free Application for Federal Student Aid (FAFSA).[9] The primary output from the FAFSA is the student expected family contribution (EFC), which represents the total educational costs that families are expected to contribute to a (dependent) student. This number is determined by a somewhat complex calculation, which has changed over time, and that takes into account family and student income and savings, family size, and living expenses. The EFC is forwarded to a student's prospective schools. Aid eligibility is then determined by the EFC along with the institution-specific costs and aid policies.

[8] This responsibility requirement set maximum student loan default rates of its graduates. For example, default rates of graduates in excess of 25% for three consecutive years are grounds for losing Title IV status. A one-year default rate in excess of 40% for recent graduates is also grounds for losing Title IV status.

[9] Eligible federal aid recipients must be registered with the Selective Service System; be a U.S. citizen, or eligible non-citizen; have a valid Social Security Number; have a high school diploma or GED; not owe refunds on federal grants; not be in default on a current federal student loan; and not have been been found guilty of sale or possession of illegal drugs while federal aid was being received.

Institutions determine a student's aid package through a hierarchical process starting with need-based aid, which includes Pell Grants and Direct Subsidized Loans, as well as Federal Work Study and Federal Perkins Loans. This form of aid is capped at a student's "financial need," which is the portion of the cost of attendance that is not covered by the EFC. The COA includes tuition, room and board, and other costs or fees. Maximum need-based aid is then:

$$\text{Pell Grant} + \text{Subsidized Loan} + \text{Other Need-Based Aid} \leq \text{Financial Need} = \text{COA} - \text{EFC}. \tag{1}$$

In addition, in order to be eligible for a Pell Grant, a student must have an EFC below a certain threshold, regardless of how large the specific COA and thus how much financial need they have. The Pell Grant amount offered also decreases with EFC. This is in contrast to subsidized loans, which do not depend on EFC, except through the need-constraint shown above. The hierarchical aid assignment is such that students who are eligible for a Pell Grant will be offered it to cover their financial need before any loan or other need-based aid.

Eligibility for non-need-based federal aid (which include Direct Unsubsidized Loans and PLUS loans) is determined by computing the portion of the COA that is not covered by federal need-based aid or private aid (e.g. institutional grants):

$$\text{Unsubsidized Loan} + \text{PLUS Loan} \leq \text{COA} - \text{Need-Based Aid} - \text{Private Aid}. \tag{2}$$

As discussed in more detail in the next section, at the intensive margin, changes in each program cap are the main supply-driven determinant of equilibrium federal aid amounts, but demand will also play an important role. First, changes in EFC and COA will affect financial need. But also importantly, while a student will always accept any Pell Grant amount that she is offered, she may fund a higher or lower portion of the COA than implied by the EFC by varying the utilization of loans or other non-grant aid.

4.2 Changes in Federal Student Aid Policies and Stock Market Response

To identify the impact of aid supply, we study institution-level responses to changes in federal aid program caps as legislated through three legislative amendments to the HEA between 2006 and 2008: subsidized loan caps were increased in the 2007-2008 school year, unsubsidized caps in the 2008-2009 school year, and Pell Grant amounts were raised gradually between 2007-2008 and 2010-2011. In this section, we discuss these policy changes in

more detail and also study the response of publicly traded (for-profit) institutions to their legislative passage.

Borrowing caps for the two largest federal student loan programs, subsidized and unsubsidized loans, were unchanged between the 1992 HEA amendments and the Higher Education Reconciliation Act (HERA) of 2005. The HERA was a component of Title VII of the Deficit Reduction Act. Interestingly, one of the HERA goals was to attempt to lower the amount of student borrowing through an increase in student loan interest rates. However, in addition to increasing rates on student loans, HERA also increased the yearly subsidized borrowing caps for freshman to $3,500 from the original $2,625 and to $4,500 for sophomores from the original amount of $3,500. Borrowing limits for upperclassmen remained unchanged at $5,500. Signed into law in February of 2006, the act took effect July 1, 2007, so that the change was in place and well anticipated prior to the 2007-08 academic year.

In the 2007-08 year, subsidized loan originations to undergraduates jumped from $16.8 billion to $20.4 billion, and consistent with the higher usage intensity, the average size of a subsidized loan rose from under $3,300 to $3,700 (Figure 5).

We provide additional evidence of the effect of the policy change on loan amounts using the Federal Reserve Bank of New York (FRBNY) Consumer Credit Panel. The panel is based on a data sample provided by the consumer credit reporting agency Equifax Inc, and provides panel information on household debt, including student loans, although without distinguishing between federal subsidized, unsubsidized and private student loans.[10] Figure 6 plots a histogram of student loan amounts in the year 2006 and again in 2007—or, more precisely, in 2006:Q3-07:Q2 and 2007:Q3-08:Q2—which is when the change in subsidized loan cap was implemented. The 2006 plot shows a large mass of borrowers concentrated on the unconventional amount of $2,625, the maximum amount of subsidized loans supplied to freshmen borrowers. In contrast, the 2007 plot shows the largest mass of borrowers concentrated at $3,500, the new amount of subsidized loans supplied to freshmen borrowers. The plots also show a large mass of borrowers at cap amounts established for upperclassmen before and after the policy change. This shift is evidence that there was a large and immediate effect of the policy change on loan amounts.

Turning to unsubsidized loans, prior to the 2008-2009 school year, dependent students were not eligible for federal unsubsidized loans, whereas independent students were eligible for as much as $5,000 ($4,000 for freshman and sophomores) in unsubsidized loan amounts, in addition to any subsidized loans they qualified for. The passing of the Ensuring Continued Access to Student Loans Act of 2008 provided an additional $2,000 in unsubsidized loans

[10] We use this alternative source because NPSAS data is only available in the years 2004, 2008, and 2012, and is a repeated cross-section rather than a panel.

to dependent and independent students. Figure 2 shows that undergraduate unsubsidized loan originations jumped from under $15 billion to $26 billion in one year. It is worth noting that the act was passed in anticipation of private student loans becoming more difficult to obtain due to the financial crisis, and so some or all of these new originations may have partly replaced private loans. Additionally, the act was passed in May of 2008, after many financial aid packages had already been sent out, so schools were told they could revise their offers to accommodate the new policies for the upcoming school year, which seems to have been often the case based on the data series. That said, due to the timing of the change, the full impact of the higher caps may have had real effects in more than a single year.

Finally, after four years of unchanged Pell Grant maximums, the Revised Continuing Appropriations Resolution of 2007 increased the maximum Pell Grant to $4,310 from $4,030 for the 2007-2008 school year, and the College Cost Reduction and Access Act, passed by Congress on September 9, 2007 scheduled more increases from $4,310 in 2007-2008 to $5,400 by the 2010-2011 school year. Pell Grant amounts below the maximum amounts available were increased proportionately.

We next discuss stock market responses of publicly traded for-profit institutions to the three legislative changes. Much attention has been devoted to the for-profit secondary education sector in the context of federal student aid programs, given their governance and the fact that a substantial fraction of their revenue (over 75% on average) comes through tuition funded through federal student aid programs. In light of this, one of the conditions for continued Title IV eligibility is that institutions satisfy the "90/10" rule, which stipulates that no more than 90% of a for-profit institution's revenue can come from federal aid. In recent years, several federal and state investigations have targeted these institutions amid allegations of them providing misleading information on graduation rates and job-finding rates. Corinthian Colleges Inc., once one of the largest for-profit secondary institutions, and the subject of several investigations, ceased operations at all of its campuses in April 2015.

However, despite the interest in this sector, our empirical analysis contains very limited information on these institutions, with only 40 for-profits in the NPSAS matched sample. To supplement our main analysis, Table 2 reports event studies for abnormal returns over 3-day windows surrounding the passage of the three legislative changes to the HEA. Fourteen for-profit education companies were publicly traded around at least one of these legislative changes (and eight across all changes), including Corinthian and other large conglomerates, such as Apollo Education Group, which operates the University of Phoenix, one of the largest providers of postsecondary education in the U.S. with about 470,000 enrollees as

of the end of 2009. The cumulative abnormal returns are computed as each stock's excess return to the CRSP index returns, summed over the 3-day event window. We then calculate the (market cap) weighted and unweighted average of the cumulative abnormal returns of the eight publicly traded for-profit institutions to the index.

In the top panel of Table 2, we see that average 3-day cumulative abnormal returns around the 2006 re-authorization of HEA, which increased the subsidized loan limits for freshman and sophomores, were 3.64% and 2.9% under the value- and equally-weighted market benchmarks, respectively. The abnormal returns are statistically significant and economically large. As shown in the middle panel, three-day cumulative abnormal returns surrounding the 2007 legislative passage that increased Pell Grant amounts were 2.17% and 2.22%, respectively. Finally, we consider two separate event windows for the passing of the Ensuring Equal Access to Student Loans Act of 2008 which increased unsubsidized borrowing amounts.[11] Depending on the exact window used, abnormal returns on the for-profit institution portfolio ranged between 4.8% and 3.3%.

In sum, we find evidence that the passage of three pieces of legislation were associated with sizable abnormal stock market responses for the portfolio of publicly traded for-profit institutions. The nearly 10% abnormal return is consistent with the fact that students at for-profit institutions rely heavily on federal student aid to fund their education. Moreover, as we will see in the next sections, the increased funding resulting from policy changes indirectly boosted institutions' revenues through higher tuition levels.

4.3 Empirical model

As a motivation to the empirical approach in this paper, we regress changes in sticker price tuition on changes in per-student federal aid in the IPEDS panel starting in 2001 and ending in 2012. As shown in the first column of Table 4, which exploits pooled variation, changes in tuition load positively on changes in subsidized and unsubsidized loans with coefficients of .12 and .1, respectively. As shown by the standard errors, which are clustered at the institution level and reported in square brackets, both of these estimates are significant at the 1% level. In contrast, the coefficient on changes in Pell Grants is both economically and statistically not different from zero. These results are largely unchanged when we include year fixed effects (column 2), but after including institution fixed effects (column 3), the

[11] On April 30, 2008 the Senate passed the Act, after already having received approval by the House. However, the Senate's approving vote included some changes that had to be subsequently ratified by the House. Thus, the bill essentially passed on April 30, 2008, but the changes made by the Senate were not voted on, and subsequently passed by the House, until May 1, 2008. For completeness, we estimate three-day abnormal returns around both event dates, though the two event window obviously overlap on one day.

coefficient on changes in unsubsidized loans drops in magnitude and becomes statistically insignificant. The coefficient on subsidized loans is unaffected both in magnitude (.125) and in its significance with the inclusion of the additional controls. Instead, the coefficient on changes in Pell Grants is now significant and larger in size (.11). Interpreting these point estimates in a causal sense would of course be subject to a number of issues. First, because of the joint determination of tuition and federal aid amounts as discussed in detail in the previous section, these coefficients could be grossly overstated. But also importantly a number of other factors will affect changes in tuition, which are omitted in this regression, as evidenced by the relatively low explanatory power of the aid measures. Depending on the correlation of these omitted factors with the federal aid measures, the impact of federal aid on tuition could be either over- or understated.

In order to identify the impact of a credit expansion on tuition, we analyze institution-level responses to changes in federal aid program caps discussed in the previous section. In principle, these changes affected students at all Title IV institutions. In practice, however, changes in program caps will have a differential effect because of differences in the eligibility and participation of the student population at each university. Our identification approach exploits these cross-sectional differences. We follow a standard labor economics approach to analyze the impact of labor demand shocks (Bartik, 1991; Blanchard and Katz, 1992), and instrument student loan credit at the university level with the interaction between the shift in federal aid and the pre-policy importance of this aid at each university. In other words, the logic of this instrument is that the increase in federal aid impacted institutions differently based on the pre-policy importance of this aid for each institution.

As discussed in 4.1, key determinants of federal student loan eligibility are students' income levels and a university's cost of attendance. However, using these as measures for the pre-policy importance of aid may raise concerns about the exclusion restriction, since it is likely that these measures are strongly correlated with other institutional features that could affect tuition during the years of the policy change.

To help address these concerns, we use the rich student-level dataset NPSAS to define a narrower and more precise identification criterion of the pre-policy importance of different types of aid at each institution. Consider first the case of subsidized loans. If a student's individual cap is below the program cap, she cannot qualify for that amount and is thus unaffected by changes in this cap. Additionally, some students may choose to borrow less than the amount they are eligible for, meaning that they will also be unaffected by changes in the program cap. Thus, changes in program caps only affect students who qualified for (their individual cap was greater than the program cap) and would accept the program cap. We thus define an institution's "exposure" to the subsidized loan policy change as the

fraction of undergraduate students who borrowed at the policy maximum in 2004, since this corresponds to approximately the fraction of students we would expect to be affected by the policy change.

For unsubsidized loans, since dependent and independent students are treated differently, we measure two exposures. For independent students, we again take the fraction of students who were borrowing at the independent policy maximum in 2004. For dependent students, who were previously ineligible for unsubsidized loans and became eligible through the policy change, we construct a shadow participation rate since we cannot observe past participation. This measure is the subset of eligible students, or the fraction of dependent students at each institution, that borrowed the maximum amount of subsidized loans that they were eligible for, including students who were not eligible for any subsidized loans (since as discussed in Section 4.1, subsidized loans are need-based, while unsubsidized loans are not, so it is possible to be eligible only for unsubsidized loans). The intuition for this rule is that a student that could, but did not, borrow in the subsidized program will not borrow in the unsubsidized program, as it is more expensive to do so, and should therefore not counted as a student constrained by the unsubsidized program cap. In this shadow exposure we cannot, however, measure those who borrowed the maximum in the subsidized program but would not borrow in the unsubsidized program once they became eligible, either because it is more expensive, because their bliss point was around their capped amounts, or because subsidized loan caps also increased after our observation of the pre-policy borrowing behavior and this increase may have been fulfilled their demand for additional funding. As a result, we would expect this exposure to overstate the actual exposure. Finally, for Pell Grants, changes in the maximum Pell Grant amounts shift the supply of grants for all grant recipients. Thus, the Pell Grant exposure variable is calculated as the percent of students at a given institution awarded any positive Pell Grant amount as of 2004. As we will see below, because the policy shift applies to all amounts –rather than just a certain threshold – Pell Grant exposure displays a fairly high degree of correlation with EFCs, which also may complicate identification.

In the first stage estimation, we regress the date t yearly change in institution i federal aid type j (subsidized direct loans, unsubsidized loans and Pell Grants) per full-time equivalent undergraduate student:

$$\Delta\text{FedAid}_{jit} = \sum_j \beta_j \, \text{ExpFedAid}_{jit} * \Delta\text{CapFedAid}_{jit} + \gamma X_{it} + \delta_i + \phi_t + \epsilon_{it} \qquad (3)$$

on a set of controls. The key explanatory variable is the interaction of institution i exposure to each federal aid program cap, ExpFedAid_{jit} and the yearly change in the program caps $\Delta\text{CapFedAid}_{jit}$. We include all three forms of federal aid in each regression to control

for possible correlations in the exposures and timing of the policy changes as well as to control for possible substitution effects. We also include in each regression time effects and institution fixed effects. Given that the variables are specified in yearly differences, these effects control for institution specific trends for each federal aid, as well as changes in federal aid that affect all institutions in a given year. Finally, we also control for a set of other controls X_{it}.

In the second stage regression we regress the date t yearly change in each institution i variable of interest T

$$\Delta T_{it} = \sum_j \beta_j \Delta\widehat{\text{FedAid}}_{jit} + \gamma X_{it} + \delta_i + \phi_t + \epsilon_{it}, \tag{4}$$

on the yearly change in each institution's per-student federal aid, $\Delta\widehat{\text{FedAid}}$, instrumented as in (3). As in the first stage, the regression includes institution and year fixed effects to control for institution level, and yearly aggregate, trends in the outcome variables, as well as a set of additional controls X_{it}, which we describe below. Outcome variables include levels of sticker-price tuition, per-student institutional grants as well as log-enrollments.

Before turning to the regression results, we briefly characterize the exposure variables. As shown in the top panel Table 5, 30 percent of all undergraduate students borrowed at the subsidized program cap as of 2004, with the fraction increasing to about 45 percent by 2012. The fraction of students at the unsubsidized cap amount were lower at 15 (25) percent for dependent (independent) students as of 2004 and also rose gradually through 2012. As discussed before, because the unsubsidized dependent program did not exist in 2004, this cap is a shadow measure. Finally about 40 percent of students received a Pell Grant amount. As shown in the top panel, the cross-NPSAS wave persistence in the fraction of students at the subsidized and dependent subsidized cap is fairly high at about 75 percent, but lower for unsubsidized independent cap (50 percent) and for Pell Grant recipients (60 percent). Finally, the fraction of students at the subsidized cap, unsubsidized cap and Pell Grant recipients are correlated among themselves, and we therefore include all controls in each first and second stage. Despite the fact that eligibility for federal grant and loans depends on the cost of attendance and students' income, we see that the correlation of the exposure variables with the average EFC, tuition (and admittance rate) at each institution is rather limited owing to the nonlinearities in the eligibility requirements. That said, because the Pell Grant exposure includes all recipients (and not just those at the maximum), it is rather highly correlated to EFC.

5 Main empirical results

5.1 First stage: Impact of changes on in federal aid caps on aid amounts

We report regression estimates of the first stage regression in Table 6. The instruments are the product of the yearly change in each program cap (only varies over time) and the fraction of students at each institution that, based on the data prior to any policy change, qualify for (and are likely to accept) the increased student aid amounts. Each regression includes year and institution fixed effects, and standard errors are clustered at the institution level. The estimation sample starts in 2001 and ends in 2012.

As shown by the first column of Table 6, yearly changes in Pell Grant amounts at the institution level load on the grant instrument with a coefficient of 1.03, which is significantly different from zero at the 1% level but not different from one at conventional statistical levels. In contrast, when explaining changes in Pell Grants, the subsidized and unsubsidized instruments enter with small negative coefficients that are statistically not different from zero (with the exception of dependent unsubsidized that has a rather precisely estimated coefficient of -.03). One would expect the elasticity of Pell Grant demand to be infinite as any student should accept grant amounts as this form of aid is not subject to any form of repayment. A coefficient of one means that an increase in Pell Grant availability results in a one-for-one increase in the equilibrium grant amount disbursed. The fact that the coefficients on the unsubsidized and subsidized loan instruments are essentially zero implies that a greater availability of these other sources do not displace Pell Grants.

Moving on to the subsidized (column 2) and unsubsidized (column 3) loan results, it is useful to keep in mind that although subsidized loans require a principal repayment, interest on this principal is paid by the DOE while a student is in school, making elasticity of demand for these loans likely high as well. The demand elasticity for unsubsidized loans could be in principle lower, and should depend on whether borrowers are constrained as well as the interest rate differential on these loans relative to those on other alternatives. From the point estimates we see that coefficients on both subsidized and unsubsidized loans for independent students on their respective instruments are close to one (.98 for subsidized and 1.02 for unsubsidized independent, respectively) suggesting a very high elasticity of demand for these form of aid as well. As discussed previously, due to measurement issues, the coefficient on the dependent unsubsidized exposure is lower (about .6), as we need to proxy for these program students at the cap with students that were eligible and maxed out of subsidized loans. Interestingly, the Pell Grant instrument enters each loan regression with a negative and statistically significant sign, suggesting that a greater availability of Pell Grants displaces these other forms of aid. This crowd-out effect may be the result of

a lower demand or reduced eligibility as implied by equations (2) and (1). The crowd-out effect is also consistent with Marx and Turner (2015) who find that increases in Pell Grant aid lowers student loan borrowing using a kink regression discontinuity design. Finally, we report at the bottom of each regression the first-state F-statistic for testing the hypothesis that the instruments do not enter the first stage. As shown in the table, all of these statistics are above 20.

5.2 Second stage: Effect of aid expansion on tuition

Regression estimates for the second stage of the IV regression are reported in the top panel of Table 7. We first regress (columns 1 to 3) changes in sticker price tuition on each form of student aid separately, where each aid measure is instrumented by the product of the change in the corresponding program cap times the ex-ante institution exposure to the change. Each regression includes institution and year fixed effects, and standard errors are clustered at the institution level. Changes in sticker-price tuition have a coefficient of 0.40 on the change in Pell Grant amounts (column 1) and this effect is significant at the 5% confidence level. The economic magnitude of this coefficient is large and implies that a dollar increase in Pell Grants going to an institution is associated with a higher sticker price tuition of about 40 cents. The effect of an increase in subsidized loan amounts is higher, at about 63 cents on the dollar, and this effect is estimated to be statistically significant at the 1% confidence level. Finally, we see the effect of a change in unsubsidized loan amounts on sticker price tuition to be smaller at about 25% but still highly significant. When we include all regressors in the same regression model, we see that the coefficients on Pell Grants, subsidized and unsubsidized loan amounts are estimated to be somewhat larger (0.58, 0.66 and .3 respectively) and remain significant at the 1% level. These results, which are identified through cross-sectional exposures to the changes in student federal aid programs between 2007 and 2010, provide support to the Bennett Hypothesis. The point estimates suggest that the passthrough of increased student aid supply to tuition is around 50 cents on the dollar, on average, although with some heterogeneity.

As noted in Section 4, a key advantage of our identification strategy is that exposures to changes in federal aid caps are constructed using detailed student-level data, which, up to time variation in these exposures, can pinpoint the fraction of students at each institution that will be exposed to the policy changes. While we measure these exposures as of 2004, the fact that the loadings in the first stage are close to one support the view that we are identifying the pre-policy exposures fairly well. That said, the fraction of students subject to the policy caps in each program could be correlated with other characteristics of the student population. For example, as shown in the bottom panel of Table 5, the fraction of

students exposed to each of the policy changes are correlated with other characteristics of the student population such as income (as measured by the expected family contribution), a university admission rate, and the level of tuition as of 2004. To the extent that these institutional characteristics affected tuition across all years, their effect would be absorbed by the institutional fixed effects that we include in the regressions. In contrast, if universities with, for example, lower admission rates grew their tuition more during the years of the policy changes our point estimates may overstate the passthrough effect because of a violation of the exclusion restriction. We attempt to address these concerns next by expanding the set of controls to include interactions of each of the four policy cap changes with a set of additional cross-sectional institution-level characteristics (Table 8). We first include the 2004 level of tuition, EFC and admission rate, which when multiplied by the 4 caps result in 12 additional regressors. These characteristics proxy for differences in the average cost of an institution, the average income of its student population, and institutional quality. As shown in column 2 of Table 8, the coefficient on subsidized loans is roughly unchanged (column 1 reports baseline results without controls) and remains statistically significant at the 5% level. The coefficient on Pell Grants is essentially the same, however the coefficient is no longer significant when including the 12 additional controls. This may be because Pell Grants and EFC display a fairly high correlation of about (negative) 70 percent. Finally, changes in unsubsidized loans do not enter significantly in the regression with these additional controls and the coefficient drops to zero. This would suggest that the strength of the result for unsubsidized loans when excluding controls may have been driven by omitted factors, which is perhaps not too surprising given the difficulties in instrumenting this measure that we discussed.

Another concern for our identification is the heterogeneity in the types of programs included in our sample that vary between 4-year, 2-year, and less-than-2 year degree granting institutions (Figure 3). Our point estimates could, for example, be biased to the extent that community colleges offering 2-year degrees experienced a boost in demand, and consequently increased tuition, amid the high unemployment levels experienced during the great recession. When we include a program-dummy variable (column 3), both the subsidized loan and the Pell Grant coefficients are essentially unchanged from the baseline, and if anything are stronger for subsidized loans (.8). Once again, unsubsidized loans become insignificant. Next we turn our attention to controlling for differences in sources of funding. As shown in Figure 3 and discussed in Section 2, aside from tuition, universities fund their operations from non-tuition sources of revenue such as government appropriations and other sources, including private donations. In column 4, we control for contemporaneous variation in these other revenue sources. While we lose about six percent of our sample, the coefficients on Pell Grants (.46) and subsidized loans (.74) are somewhat stronger and

remain highly significant. In this case we see the unsubsidized loan effect to stay significant with a coefficient of .2. Finally we attempt to control for all of these variables at once, for a total of 28 different controls (column 5). In the smaller resulting sample, we lose significance in the Pell Grant coefficient and the point estimate is essentially cut in half. The coefficient on unsubsidized loans becomes economically and statistically insignificant. The t-statistic on subsidized loans also drops to about 1.5; however, the point estimate is essentially unaffected by the inclusion of this larger set of controls.

In sum, we find a passthrough of federal aid in the form of Pell grants and subsidized direct loans and a much weaker effect on unsubsidized loans. This weakness may be due to limitations to our identification approach as well as other factors such as the contemporaneous contraction in the private student loan market over the year in which the cap change was implemented. The results on subsidized loans are new to the literature. We find a sensitivity of changes in tuition to changes in subsidized loan amounts on the order of about 60-70 cents on the dollar, with estimates that are highly significant in essentially all of the specifications considered. Consistent with our results, Singell and Stone (2007) show that increases in Pell Grants are captured by increased tuition at private universities and out-of-state students at public universities. The result on Pell Grants is not as robust, both in terms of point estimates and significance, and ranges between about 25 cents and 50 cents on the dollar.

6 Additional empirical results

6.1 Institutional grants and enrollment

Using the empirical methods of the previous section, in this Section we study the impact of changes in federal aid on changes in per-student institutional grants and growth of undergraduate enrollment. In the previous section we focused on sticker-price tuition, because this measure is available from IPEDS at a yearly frequency. However, one potential concern with the findings of the previous section could be that despite the impact on sticker price, changes in student sticker price may not affect the actual tuition paid by students (the "net tuition"), because sticker price changes could be offset by systematic tuition rebates to students in the form of higher institutional grants.

Unfortunately, as discussed in Section 3, there are data limitations to studying changes in institutional grants. While some IPEDS measures such as total revenues, costs or sticker prices may be fairly well reported as they come from annual reports, other per-student estimates can be noisy. Indeed, we relied on official Title IV data for information on

disbursed federal loan and grant amounts as the dependent variable in the first stage. Unfortunately, no such data exists for institutional grants. The closest is the IPEDS financial data, which does not distinguish between undergraduate and graduate students, is only available for some institutions, and may still suffer from some survey data difficulties. While NPSAS data contain detailed information on each student's tuition and institutional grant amount, the data are only available every four years. Because of these limitations, we use here two alternative (imperfect) approaches to study institutional grants: first, we analyze the pass-through of changes in sticker price to net tuition using NPSAS data between 2004 and 2008. Second, we run yearly change regressions using the noisy grant measure.

In Table 9, we form four portfolio quartiles of students for each of the institutions that appears in both the 2004 and 2008 NPSAS samples by sorting students within each institution and year by their net tuition, or the difference between sticker tuition and institutional grants.[12] We then regress the 2004 to 2008 change in net tuition for each portfolio bucket on the (single) university 4-year change in sticker tuition. As shown in Table 9, changes in net tuition in the top quartile load with a coefficient of about 0.95 on changes in sticker tuition. The loading drops uniformly through the lower quartiles to a pass-through of about 0.35 in the bottom quartile. Intuitively, these results mean that changes in the sticker price of tuition pass-through nearly one-for-one to students in the top quartile of net tuition — those that receive the fewest institutional grants, but less so for the lower quartiles — those that receive more institutional grants. Overall, however, these estimates suggest the effect of sticker price tuition on net tuition is sizable.

Our second approach to analyzing whether institutional grants undo increases in sticker tuition utilizes the noisy institutional grant data from IPEDS. We regress changes in institutional grants per student on instrumented changes in federal aid (Table 10, column 2). As shown in the bottom of the panel the sample size is reduced by 40 percent. We see that changes in Pell Grants have a negative coefficient of about 0.5, while changes in unsubsidized and subsidized loans do not have a significant effect. The results for Pell Grants are consistent with Turner (2012), who, using a regression discontinuity approach, finds that institutions alter institutional aid to capture increases in Pell grants. Adding the effect of Pell Grants on sticker price from the previous section (repeated in column 1) and on institutional grants, we find an almost dollar-for-dollar offset in net tuition. That said, as noted in the previous section, the Pell Grant effect on sticker tuition is not extremely robust to the inclusion of additional controls, and, in unreported results, we find this to

[12] Because of differences in credits or in-state versus out-of-state status, sticker tuition can display within-university variation. Because NPSAS is a repeated cross-section in this exercise we simply define sticker price as the average sticker price tuition in each university.

also be the case for institutional grants.

Finally turning to enrollments, in the last column, we report regression estimates of log-changes in enrollment on changes in federal aid. Studying the effects of increased supply in aid on enrollments is important because expanding access to postsecondary education, especially to lower-income students, is one of the stated goals of the Title IV programs. A large literature exists attempting to answer the question of whether or not, and to what degree, decreases in price influence college attendance and college choice (see for example the review of Deming and Dynarski (2009)).[13] As shown in the Table, we find a positive and statistically significant coefficient on Pell Grants but an economically and statistically insignificant coefficient on loans. This would suggests that only grants, but not loans, raise enrollments. Importantly, however, this regression only measures short-run changes in enrollments while it may take time for institutions (many of which have closed enrollments) to expand their capacity. We return to this point below, as we study changes in funding/aid over the years preceding the policy changes that we have discussed thus far.

6.2 Attributes of tuition-increasing institutions

Results presented thus far indicate that changes in the sticker price of tuition are, on average, sensitive to changes in the supply of subsidized loans, Pell Grants and on unsubsidized loans, with a particularly robust subsidized loan effect. In this section we further investigate the breadth of the subsidized loan effect by estimating a series of IV regressions that characterize the attributes of institutions that displayed the largest passthrough from changes in loan policy to tuition.

A natural starting point is to sort institutions by program type: four-year (college), two-year (community colleges), and less-than-two-year (vocational) institutions. To do so, we create indicator variables for institutions in each of the three categories. In a two-stage least-squares setting, we instrument for the interaction of the program-type indicators with subsidized loan amounts using the subsidized loan policy exposure variable interacted with the program-type indicators. The resulting coefficients essentially trace the subsidized loan result, allowing us to identify those institutions where the subsidized result is most

[13] They conclude that most studies of federal aid find that additional grant aid is associated with significant increases in attendance (e.g. Seftor and Turner (2002) for Pell Grants; Angrist (1993), Stanley (2003), Bound and Turner (2002) for GI Bills; Dynarski (2003) for Social Security student benefit program), though, for Pell Grants the evidence is mixed, as (Hansen (1983) and Kane (1995) find no significant increase in attendance following the introduction of Pell Grants). Many fewer studies look at federal loan aid; one exception is Dynarski (2002) who finds a very small effect on attendance and a larger effect on college choice. In general, this literature is focused on student-level choices, and does not necessarily address the question of whether institutions facing increased demand will correspondingly raise enrollments.

concentrated. In each specification we again control for institution and year fixed effects. The coefficients reported in Panel A of Table 11 indicate that changes in sticker tuition in response to loan policy changes were concentrated at four-year institutions. This result is perhaps not too surprising given that four-year institutions charge higher tuition, on average, resulting in higher dependence on external funding.

We next sort within four-year institutions to identify further attributes of those institutions that pass-through the most. We sort into quartiles based the average level of 2004 tuition, the average EFC of students attending the institution in 2004, and 2004 admittance rates. Having sorted institutions into their respective attribute-based quartiles, we create indicator variables for the bottom quartile (the *low attribute indicator*), the 25th-75th quartiles (the *mid attribute indicator*), and the top quartile (the *high attribute indicator*). As in Panel A, we instrument for the interaction of the attribute indicators with subsidized loan amounts using the subsidized loan policy exposure variable interacted with the attribute indicators. Panel B of 11 presents the results.

The results indicate that meaningful differences exist in tuition-loan sensitivities as a function of additional institution attributes. First, tuition-loan sensitivities are highest among the top-quartile tuition institutions. This result is consistent with students relying more heavily on subsidized loans at higher-tuition universities. Second, tuition-loan sensitivities are strongest at institutions with students that have the highest ability to pay, as measured by average EFCs. This is consistent with the high tuition result given that students with the highest EFCs attend institutions with the highest tuition, on average. Finally, our estimates indicate that tuition-loan sensitivities are most pronounced among mid-tier admittance-rate institutions.

The results just discussed identify the attributes of institutions that increased tuition more aggressively in response to the subsidized loan policy change. In order to provide more visibility into the nature of these results, we present summary statistics of institutions that fall into the categories most associated with large tuition increases for a given change in instrumented subsidized loans. In order to summarize the average characteristics of these institutions, we group institutions that fall into the intersection of high 2004 tuition, high 2004 EFC, and the middle bucket of 2004 admittance-rate institutions. We refer to these institutions as high subsidized sensitivity institutions and report summary statistics of characertistics of these institutions in Panel A of Table 12. For the purposes of comparison we summarize the complement of the high subsidized sensitivity institutions in Panel B.

Institutions most sensitive to the loan policy changes are primarily private (93%), report average 2004 tuition of over $22,000 annually, enroll students with average 2004 EFCs of over

$18,000, and admit 74% of applicants, on average. In contrast, low sensitivity institutions are predominantly public institutions (60%), charge lower average tuition ($10,825), enroll students with lower ability to pay (EFC = $9,124) and have slightly higher admittance rates (83%). Panels C and D report summary statistics of high and low sensitivity institutions for private institutions only. Panel C confirms that a large fraction of the high-sensitivity institutions are private.[14] Panel D indicates that among the low sensitivity institutions, private schools are similar along most dimensions to their public counterparts except that they charge higher tuition and have slightly lower acceptance rates, on average.

Taken together, the summary statistics indicate that the sample of institutions most prone to raising tuition in response to the subsidized policy change are expensive four-year institutions, mostly private, with students from families with a high ability to pay. However, the high tuition-loan sensitivity institutions do not appear to be the most academically elite institutions, given that tuition-loan sensitivities are more pronounced in middle-admittance rate institutions.

7 Pre-policy change evidence

Thus far we have exploited changes in federal student aid caps as means to identify the impact of a credit expansion on tuition. However, changes in aid caps occurred only between 2008 and 2010, and, as we discuss in the Appendix, affected about 25% of all subsidized borrowers. As shown in Figure 2, the trend in tuition is present throughout the 2001-2012 sample period. Thus while these policy changes may be a useful identification device, they cannot explain the lower frequency tuition pattern. This is not to say that the simultaneous increase in tuition and loan balances only reflected non-credit-related tuition factors that drove loan demand. Indeed while our identification exploits changes in the programs, the existence of the student loan program could be a key contributing factor to the tuition trend, for example through increased enrollments. In Table 4 we regressed yearly tuition changes on federal aid, finding significant coefficients on subsidized loans and Pell Grants of about 0.1. As discussed in Section 4, these estimates should not be interpreted in a causal sense. Here we discuss, a simple alternative approach to evaluate the importance of federal aid to loan balances, tuition and enrollments, by comparing 2004-08 trends as a function of the importance of federal aid as of 2003. While this approach is superior to a simple OLS estimation, it remains less identified than the IV method.

The results of this analysis are shown in Table 13. Drawing an analogy to the identification

[14] Sample sizes in each panel of Table 12 are rounded to the nearest 10, per NPSAS non-disclosure policy. Thus, while the sample sizes of Panel A and Panel C are both reported as 40, the number of institutions in Panel A exceeds the number of institutions in Panel C.

strategy that we used before, we first construct a measure of sensitivity to subsidized loans (top panel), unsubsidized loans (middle panel) and Pell Grants (bottom panel) from the fraction of total students using each of the three aid programs as of 2003. We then regress the subsequent four year change in each aid measure, in log-enrollment, and tuition. Each regression controls for the original tuition level, enrollment and includes program fixed effects. As shown in the first columns, universities that were, as of 2003, more reliant on each type of federal aid experienced a sharper increase in each respective aid measure, although the Pell Grant effect is not significant at conventional levels. As shown in the second column, institutions that were most exposed to the aid measures as of 2003 experienced larger increases in enrollments. For example, going from zero to 100% of subsidized borrowers implies an incremental enrollment growth rate of about 23% over four years. If students attending institutions that rely heavily on federal aid could only do so because of the existence of these aid programs, then joint increases in enrollments and per-student aid at these more-dependent institutions may have only taken place thanks to their existence. As a result, these institutions also experienced higher growth in sticker tuition, although these effects are not very significant.

8 Concluding remarks and the for-profit sector

We exploited a Bartik-like identification approach around large policy changes in the maximum amounts of Federal Student Aid Programs between 2008 and 2010 to identify the effect of increased loan supply on tuition. We find that institutions that, ahead of the policy changes, were most exposed to the increase in policy amounts experienced disproportionate tuition increases. We find a pass-through effect on tuition of Pell Grants and subsidized direct loans of about 55 and 65 cents on the dollar, respectively. We find the effect of greater availability of unsubsidized loans on tuition to be about 30 percent in our baseline, however, it is not very robust to the inclusion of the additional set of controls that we consider. This may be related to the difficulty to assess participation in this program for dependent students as it did not exist ahead of the policy changes.

From a welfare perspective, these estimates suggest that, while one would expect a student aid expansion to benefit recipients, the subsidized loan expansion could have been to their detriment, on net, because of the sizable and offsetting tuition effect. Pell Grants also seem to have driven tuition higher, but the net cost of attendance for a student declined because the passthrough was less than one and grants do not require a repayment of principal. This is not to say that the student aid programs hurt the student population at large, for example, because of their impact on participation and a gap between the cost of education and its social or private benefit that is generally perceived to be positive (Moretti, 2004).

While the literature disagrees on the exact magnitude of the returns to higher education (Card, 1999; Avery and Turner, 2012), the "college wage-premium" has been rising over the past two decades. Reflecting this premium, U.S. wage inequality has been raising as the demand for skilled workers may have outpaced its supply (Goldin and Katz, 2009). To the extent that greater access to credit increases access to secondary education, as stated in the HEA, and that the college premium is significant, student aid programs may help lowering wage inequality by boosting the supply of skilled workers.[15] While we find a limited short-term impact of the policy cap changes in terms of enrollment as it may take time for institutions to expand capacity, we showed that in the 2004-07 sample, institutions with a larger fraction of federal aid recipients experienced significantly larger growth in enrollments. This suggests that over longer horizons, student aid could indeed be boosting access to higher education.

While we presented evidence of large abnormal stock market responses for a portfolio of all publicly traded for-profit institutions to the legislative passage of the aid increases, our data contains limited information on these institutions. Since the 1972 HEA re-authorization made for-profit institutions eligible to receive federal student aid, the market share of for-profit institutions has grown substantially (Coleman and Vedder, 2008). This growth reflects in part federal aid, with over 76.7% of for-profit revenues funded through Title IV programs. Given the differential governance of this sector relative to other education institutions, and their heavy dependence on federal aid, we compare in Table 14 changes in grants and federal direct loans between for-profit (panel a) and other institutions (panel b) in our sample period. For each type of institution (and panel) we regress yearly changes on year dummy variables (reported at the top of each panel and with the year 2002 serving as the omitted year) as well as on a policy year dummy variable which is equal to one for the 2008, 09 and 10 academic years when the federal aid changes went into effect (reported at the bottom of each panel). As shown in the bottom section of the panels, for-profit institutions experienced significantly larger increase in disbursed aid over the years of the aid cap changes. Correspondingly, these institutions also displayed sticker tuition increases of about $180, on average, as compared to $56 for non for-profit institutions. These larger tuition increases are consistent with the results in the paper and the heavy reliance of for-profit institutions on federal student aid. This raw comparison has obvious limitations, such as, separating effects of the different forms of aid. Given the recent policy initiatives directly targeting aid for students attending for-profit institutions, a better understanding of the role of federal borrowing and grants for these institutions remains a fruitful area of research.

[15] Lochner and Monge-Naranjo (2011) develop a theoretical model to analyze students' borrowing decisions as a function of the returns to college education.

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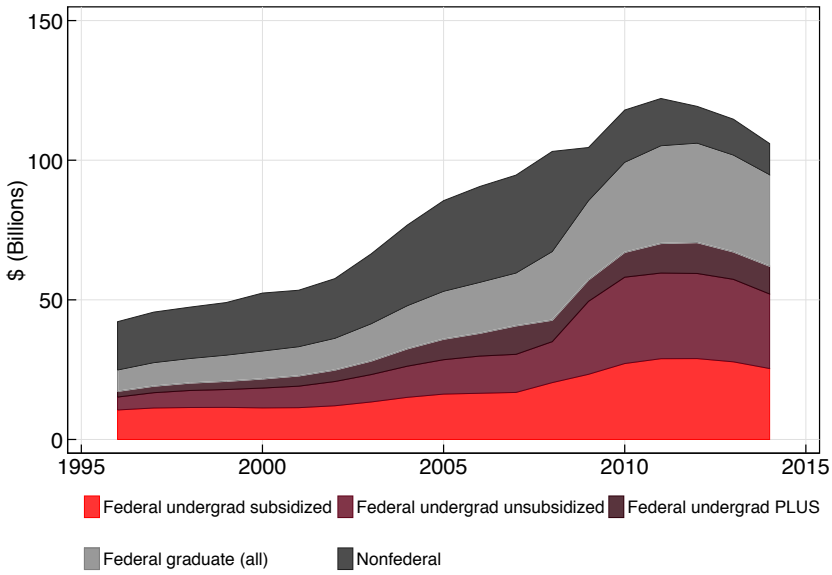
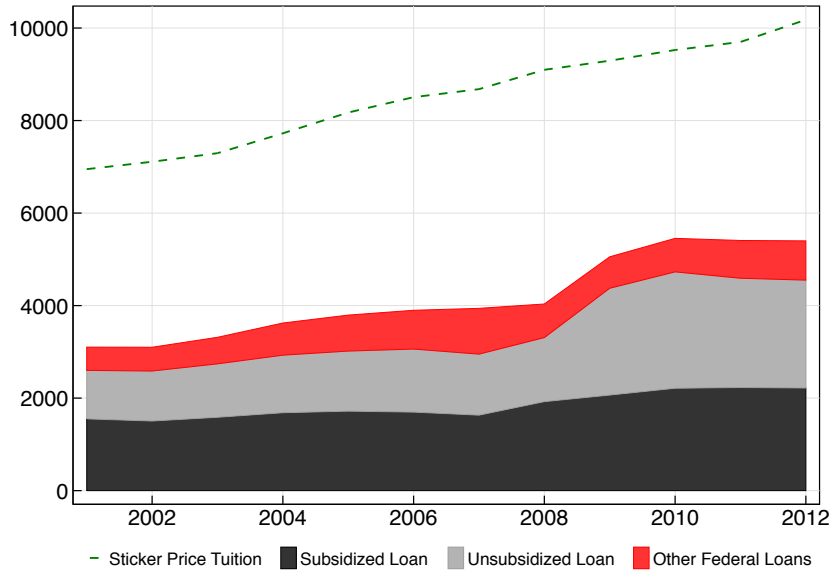
Figure 1: **Aggregate Student Loan Originations** This figure shows the time-series evolution of aggregate student loan originations by program type. Amounts shown are in nominal terms.



Source: IPEDS/DOE.

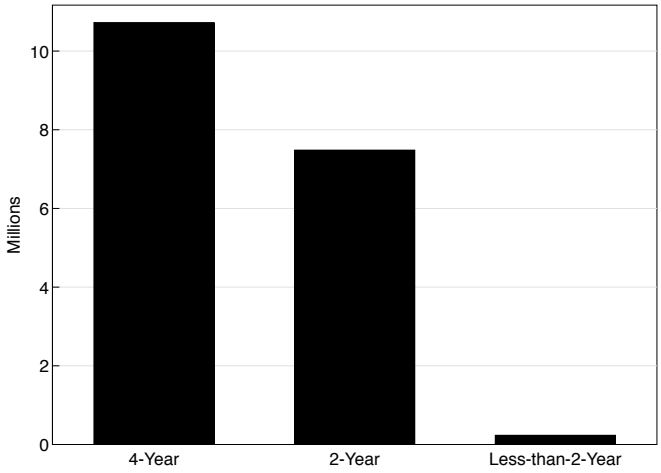
Figure 2: **Sticker Tuition and Per-student Federal Student Loans** This figure plots average undergraduate sticker-price tuition and average federal student loan amounts per full-time-equivalent student. Amounts shown are in 2012 dollars



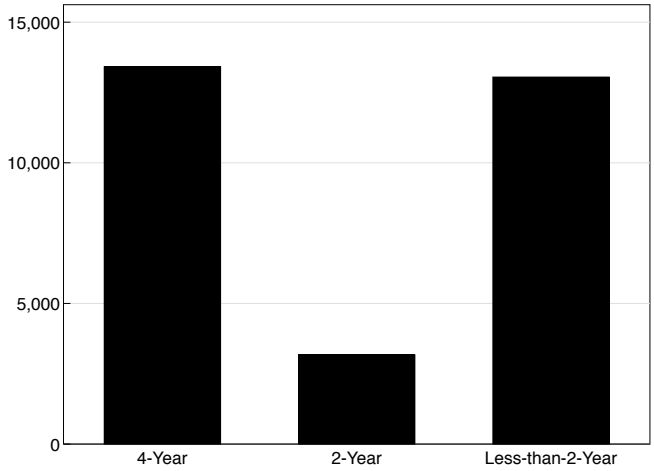
Source: IPEDS/DOE.

Figure 3: **Enrollments, Sticker Tuition and Revenue by Program Type** These figures plot total enrollment, average sticker price, and average revenues per student for institutions, depending on the type of program offered in the 2011-2012 school year.

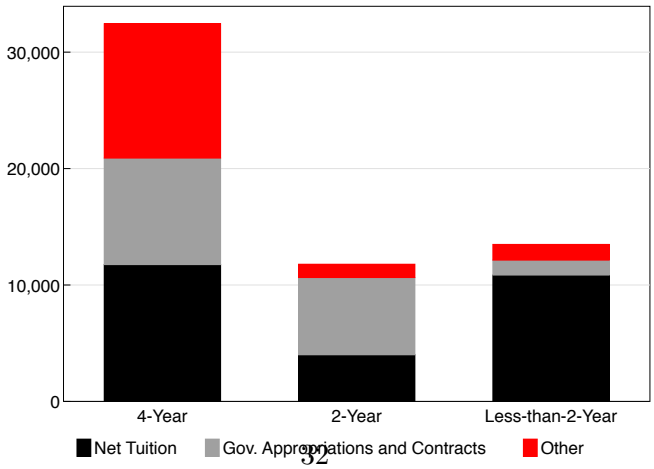
(a) Total undergraduate enrollment by institution program type (millions)



(b) Average sticker price by institution program type

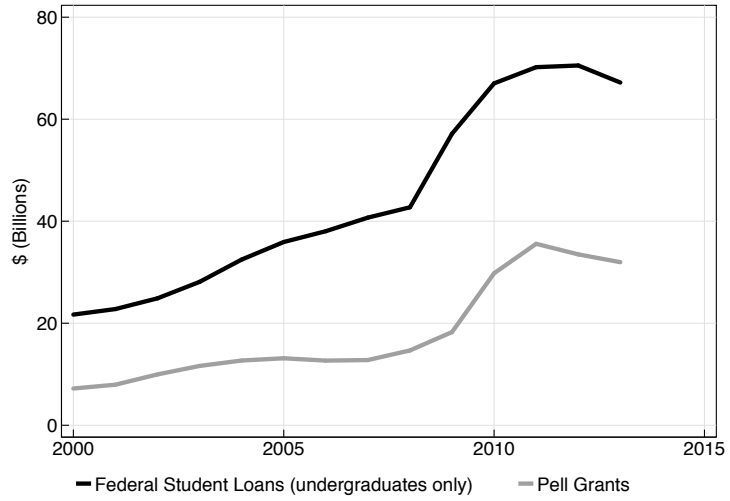


(c) Average revenues by institution program type



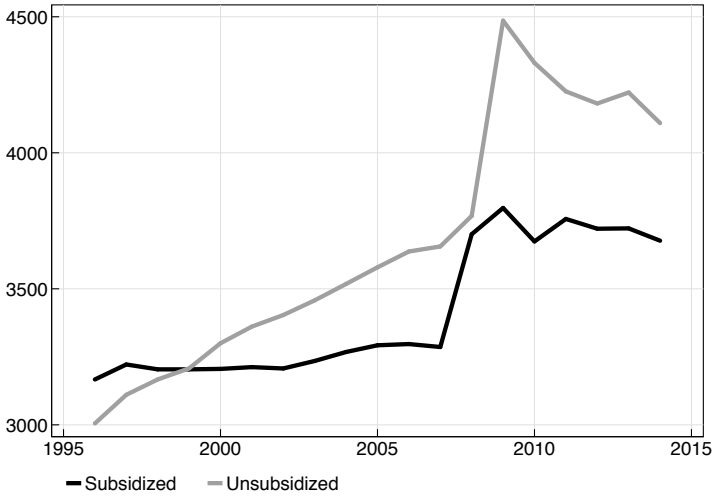
Source: IPEDS.

Figure 4: **Aggregate Pell Grant and Federal Loan Amounts** This figure plots Pell Grant disbursements by year as compared to total undergraduate federal student loan originations.



Source: DOE.

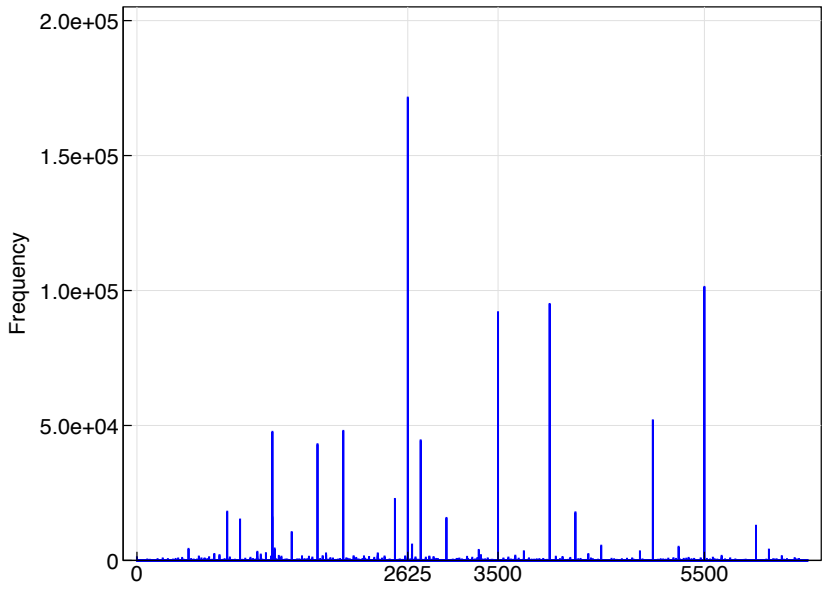
Figure 5: **Per-student Subsidized and Unsubsidized Federal Student Loan Amounts** This figure shows changes in the average borrowed amounts in the subsidized and unsubsidized Federal Direct Loan programs.



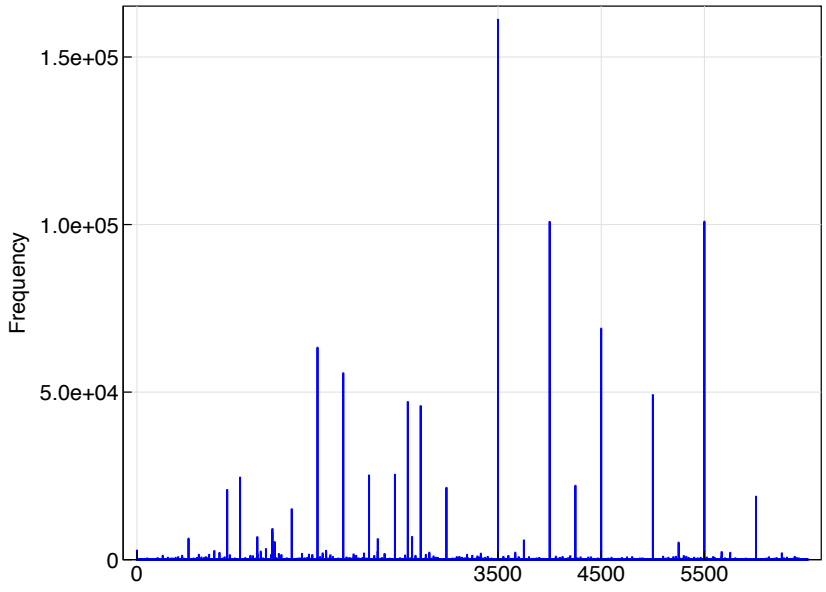
Source: CollegeBoard/DOE.

Figure 6: **Distribution of Student Loan Amounts** These figures plot the distribution of student loan amounts in the NY Fed CCP/Equifax panel before and after the change in the subsidized loan maximum. The maximums are marked on the x-axis for each academic year.

(a) Student Loan Amount in 2006-2007



(b) Student Loan Amount in 2007-2008



Source: NY Fed CCP/Equifax.

Table 1: **Changes in Title IV Federal Aid Program Caps** This table shows changes to the caps (reported as dollar amounts) of the Federal Direct Loan and Pell Grant Program. Y1, Y2, Y3, Y4, Grad are respectively caps for undergraduate freshmen, sophomores, juniors, seniors and graduate students. (D) and (I) refers to dependent and independent students. See Section 4.2 for more detail.

	Subsidized Loans				Unsubsidized Loans				Pell Grants
Year	Y1	Y2	Y3/Y4	Grad	Y1-Y4(D)	Y1/Y2(I)	Y3/Y4(I)	Grad	Y1-Y4
2004	2625	3500	5500	8500	0	4000	5000	10000	4050
2005	2625	3500	5500	8500	0	4000	5000	10000	4050
2006	2625	3500	5500	8500	0	4000	5000	10000	4050
2007	2625	3500	5500	8500	0	4000	5000	10000	4050
2008	3500	4500	5500	8500	0	4000	5000	12000	4310
2009	3500	4500	5500	8500	2000	6000	7000	12000	4731
2010	3500	4500	5500	8500	2000	6000	7000	12000	5350
2011	3500	4500	5500	8500	2000	6000	7000	12000	5550
2012	3500	4500	5500	8500	2000	6000	7000	12000	5550

Source: Higher Education Act and subsequent amendments.

Table 2: **Stock Market Reactions to Changes in Federal Aid Policy** This table reports 3-day cumulative abnormal returns for a portfolio of 14 publicly traded for-profit universities surrounding dates of legislative passage to changes in Federal Aid Policy. Returns are computed in excess of the CRSP index on a value-weighted and equal-weighted basis.

Event	Date	Mkt Weights	Policy	Event Window	Mean Cum. Abnormal Ret.	Z score
Congress reauthorized the Higher Education Act	2/1/2006	v	Sub. Loans	(-1,+1)	3.64%	(3.216)
Congress reauthorized the Higher Education Act	2/1/2006	e	Sub. Loans	(-1,+1)	2.90%	(2.545)
College Cost Reduction and Access Act Passes Congress	9/7/2007	v	Pell Grants	(-1,+1)	2.17%	(2.204)
College Cost Reduction and Access Act Passes Congress	9/7/2007	e	Pell Grants	(-1,+1)	2.22%	(2.242)
Ensuring Equal Access to Student Loans Act of 2008 is passed by the Senate	4/30/2008	v	Unsub. Loans	(-1,+1)	4.86%	(2.570)
Ensuring Equal Access to Student Loans Act of 2008 is passed by the Senate	4/30/2008	e	Unsub. Loans	(-1,+1)	4.80%	(2.480)
Ensuring Equal Access to Student Loans Act of 2008 is passed by Congress	5/1/2008	v	Unsub. Loans	(-1,+1)	3.30%	(1.752)
Ensuring Equal Access to Student Loans Act of 2008 is passed by Congress	5/1/2008	e	Unsub. Loans	(-1,+1)	3.62%	(1.933)

Table 3: **Summary Statistics** This table presents summary measures for the variable included in the main regression sample (Table 7). Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies. Avg EFC is from NPSAS, all other measures from Title IV and IPEDS.

(a) Levels

	Mean	SD	Min	Max	Count
Sticker Tuition	14,492	8,661	812	44,070	7610
Institutional Grants per FTE	3,801	4,104	0	2,1518	4620
Subsidized Loans per FTE	1,491	913	3	4,881	7610
Unsubsidized Loans per FTE	1,588	1,313	1	19,915	7610
Pell Grants per FTE	1,038	683	0	4,672	7610
Avg EFC	10,252	5,019	0	29,639	7610
Admit Rate	0.81	0.21	0.05	1.00	7530
Enrollment (FTE)	7,938	11,285	21	204,519	7180
State Funding per FTE	4,694	5,891	0	185,578	7180
Federal Funding per FTE	1999	4,524	0	5,3217	7180
Private Funding per FTE	3,415	11,216	-110,992	167,775	7180

(b) Yearly Changes

	Mean	SD	Min	Max	Count
ΔStickerTuition	790	691	-2,610	3,512	7610
ΔInstGrants	282	425	-907	2,123	4390
ΔPellGrants	87	191	-1,429	1,004	7610
ΔSubsidizedLoans	71	161	-633	782	7610
ΔUnsubsidizedLoans	103	292	-3,398	1,487	7610
ΔLog(Enrollment)	2	7	-42	49	7130
ΔStateFunding	-18	2,063	-121,265	64,981	7180
ΔFederalFunding	54	852	-23,019	22,836	7180
ΔPrivateFunding	48	11,777	-185,623	208,313	7180

Table 4: **OLS Regression Estimates for Changes in Sticker Tuition on Federal Aid Measures** This table reports OLS regression estimates of changes in sticker price tuition on changes in subsidized loan amounts, unsubsidized loan amounts, and Pell grant amounts per full-time equivalent undergraduate. Sample starts in 2002 and ends in 2012. Standard errors clustered by institution are reported in brackets. Significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

	ΔStickerPriceTuition$_{it}$		
	(1)	(2)	(3)
ΔSubsidizedLoans$_{it}$	0.121***	0.117***	0.125***
	[0.040]	[0.044]	[0.048]
ΔUnsubsidizedLoans$_{it}$	0.101***	0.076***	0.010
	[0.021]	[0.024]	[0.027]
ΔPellGrants$_{it}$	0.011	-0.002	0.112**
	[0.041]	[0.051]	[0.056]
Adj. R2	0.00	0.00	0.07
Obs.	32595	32595	32595
FEs?	No	Year	Year, Institution

Table 5: **Summary Measures for Institution Exposure Measures** This table presents summary measures for institution exposures as measured by the fraction of students that are subject to the change in student aid maximums for the subsidized loan, unsubsidized independent loan, unsubsidized dependent loan and Pell grant program. The 2004 fractions are used in the instrumented regressions. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

(a) Cross-year comparisons

	Averages			Correlations	
Years	04	08	12	04-08	08-12
SubLoanExp	.30	.36	.44	.77	.79
IndUnsubLoanExp	.25	.32	.39	.52	.57
DepUnsubLoanExp	.15	.17	.21	.75	.72
PellGrantExp	.39	.41	.53	.61	.55
Observations	1340	1680	1450	710	780

(b) Cross-sectional correlation as of 2004

Variables	SubLoanExp	IndUnsubLoanExp	DepUnsubLoanExp	PellGrantExp
SubLoanExp_04	1.000			
IndUnsubLoanExp	0.733	1.000		
DepUnsubLoanExp	0.766	0.496	1.000	
PellGrantExp	0.139	0.060	-0.093	1.000
EFC	0.040	0.110	0.276	-0.713
AdmitRate	-0.251	-0.230	-0.350	0.275
StickerTuition	0.419	0.354	0.554	-0.378
Observations	950			

Table 6: **First stage regression results** This table reports OLS regression estimates for the first stage regression. The unit of observation is an institution and year. Sample starts in 2002 and ends in 2012. The dependent variables are annual changes (between year t and $t-1$) in per institution $ amounts of Pell Grants, subsidized loans, and unsubsidized loans per full-time equivalent undergraduate student. The explanatory variables are the product of the cross-sectional institution exposure variables, which measure the fraction of students exposed to the policy change, times the time series of the change in each program cap. Standard errors clustered by institution are reported in brackets. Significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

	ΔPellGrants$_{it}$	ΔSubsidizedLoans$_{it}$	ΔUnsubsidizedLoans$_{it}$
PellGrantExp$_i$ $\times$ ΔPGCap$_t$	1.029***	-0.203***	-0.315***
	[0.074]	[0.058]	[0.108]
SubLoanExp$_i$ $\times$ ΔSLCap$_t$	-0.078	0.977***	0.239
	[0.063]	[0.076]	[0.167]
IndUnsubLoanExp$_i$ $\times$ ΔIULCap$_t$	-0.038	-0.026	1.020***
	[0.039]	[0.067]	[0.149]
DepUnsubLoanExp$_i$ $\times$ ΔDULCap$_t$	-0.028***	-0.001	0.594***
	[0.011]	[0.023]	[0.069]
Year FEs	Yes	Yes	Yes
Institution FEs	Yes	Yes	Yes
First-stage F-statistic	21.0	20.5	20.7
Adj. R2	0.58	0.14	0.29
Number of Institutions	800	800	800
Observations	7610	7610	7610

Table 7: **IV regression estimation results** This table reports IV regression estimates of the effect of changes in federal loans and grants on sticker price tuition. The dependent variable is the annual change in sticker price tuition. The sample begins in 2002 and ends in 2012. Observed changes in federal grants and loans per enrolled student are instrumented by exposures multiplied by policy changes, as described in the text and in the previous table. We control for year fixed effects and institutional fixed effects. Standard errors clustered by institution are reported in brackets. Significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

	ΔStickerTuition$_{it}$			
	(1)	(2)	(3)	(4)
ΔPellGrants$_{it}$	0.403**			0.577***
	[0.172]			[0.198]
ΔSubsidizedLoans$_{it}$		0.633***		0.657**
		[0.242]		[0.270]
ΔUnsubsidizedLoans$_{it}$			0.262***	0.300***
			[0.099]	[0.101]
Year FEs	Yes	Yes	Yes	Yes
Institution FEs	Yes	Yes	Yes	Yes
Number of Institutions	790	790	790	790
Observations	7600	7600	7600	7600

Table 8: **IV regression estimation results with additional controls** This table reports the IV regression estimates of the previous table when additional controls are added. We control for contemporaneous changes in different types of funding to an institution, and also include various controls that control for the possibility that additional institutional characteristics may be correlated with these policy changes. These controls are created by multiplying institutional characteristics measured in 2004 by $\Delta\mathbf{Caps}_t = \langle \Delta\text{PGCap}_t, \Delta\text{SLCap}_t, \Delta\text{IULCap}_t, \Delta\text{DULCap}_t \rangle$. Standard errors clustered by institution are reported in brackets. Significance: $^{*}\, p < 0.1$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

	$\Delta\text{StickerTuition}_{it}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta\text{PellGrants}_{it}$	0.577***	0.536	0.528***	0.455**	0.260
	[0.198]	[0.401]	[0.196]	[0.208]	[0.428]
$\Delta\text{SubsidizedLoans}_{it}$	0.657**	0.640**	0.797***	0.740**	0.628
	[0.270]	[0.313]	[0.308]	[0.295]	[0.434]
$\Delta\text{UnsubsidizedLoans}_{it}$	0.300***	0.045	0.140	0.220**	-0.043
	[0.101]	[0.123]	[0.125]	[0.097]	[0.148]
$\text{Tuition}_{i,2004} \times \Delta\mathbf{Caps}_t$	No	Yes	No	No	Yes
$\overline{\text{EFC}}_{i,2004} \times \Delta\mathbf{Caps}_t$	No	Yes	No	No	Yes
$\text{AdmitRate}_{i,2004} \times \Delta\mathbf{Caps}_t$	No	Yes	No	No	Yes
$\text{Level}_i \times \Delta\mathbf{Caps}_t$	No	No	Yes	No	Yes
$\Delta\text{StateFunding}_{it}$	No	No	No	Yes	Yes
$\Delta\text{FederalFunding}_{it}$	No	No	No	Yes	Yes
$\Delta\text{PrivateFunding}_{it}$	No	No	No	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Institution FEs	Yes	Yes	Yes	Yes	Yes
Number of Institutions	790	770	790	730	710
Observations	7600	7520	7600	7170	7100

Table 9: **Changes in net tuition and sticker price tuition** This table reports OLS estimates of a regression of 4-year changes in average net tuition on sticker tuition interacted by a net-tuition bucket indicator. These buckets are formed in each school and year by sorting students in quartile portfolio based on the net-tuition level. Portfolio Q4 is the highest net tuition student bucket. The index i refers to an institution and the index q for a quartile within that institution. To be included in the sample, a school must be in both the NPSAS 04 sample and the NPSAS 08 sample. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

	Δ^4AverageNetTuition$_{q,i,08}$	
Δ^4StickerTuition$_{i,08} \times \mathbb{I}_q$ (Q1)	0.368***	[0.035]
Δ^4StickerTuition$_{i,08} \times \mathbb{I}_q$ (Q2)	0.574***	[0.038]
Δ^4StickerTuition$_{i,08} \times \mathbb{I}_q$ (Q3)	0.773***	[0.040]
Δ^4StickerTuition$_{i,08} \times \mathbb{I}_q$ (Q4)	0.944***	[0.038]
Observations	910	

Table 10: **IV regression estimation results for additional dependent variables** This table reports the estimates of IV regressions as above, where the dependent variables are the annual changes in the sticker price of tuition, institutional grants per student, and enrollment (in logs). Standard errors clustered by institution are reported in brackets. Significance: $^{*}\, p < 0.1$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

	ΔStickerTuition$_{it}$	ΔInstGrants$_{it}$	Δ100*Log(Enrollment$_{it}$)
ΔPellGrants$_{it}$	0.577***	-0.377*	0.015***
	[0.198]	[0.204]	[0.004]
ΔSubsidizedLoans$_{it}$	0.657**	0.003	0.006
	[0.270]	[0.271]	[0.006]
ΔUnsubsidizedLoans$_{it}$	0.300***	0.117	-0.002
	[0.101]	[0.093]	[0.002]
Year FEs	Yes	Yes	Yes
Institution FEs	Yes	Yes	Yes
Number of Institutions	790	490	730
Observations	7600	4360	7120

Table 11: **Sensitivity of Subsidized Loan Exposure to Institution Attributes** This table documents the results of IV regressions in the manner of the previous tables, except we allow the coefficient to vary across different buckets of various institutional characteristics (tuition, admission rate, and average EFC, as measured in 2004). For each of these characteristics, we take the bottom 25%, middle 50%, and highest 25%, and interact indicators for an institution belonging to each of these buckets with changes in subsidized loans, instrumented by the corresponding exposures. The dependent variable is sticker price tuition, as before. Standard errors clustered by institution are reported in brackets. Significance: $^{*}\, p < 0.1$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$. Sample sizes are rounded to the nearest 10 in compliance with NPSAS nondisclosure policies.

(a) By Program Type

	ΔStickerTuition$_{it}$	
$\mathbb{I}$(Four-Year) $\times\Delta$SubsidizedLoans$_{it}$	0.837***	[0.294]
$\mathbb{I}$(Two-Year) $\times\Delta$SubsidizedLoans$_{it}$	0.536	[0.329]
$\mathbb{I}$(Less-than-Two-Year) $\times\Delta$SubsidizedLoans$_{it}$	0.396	[0.308]
Number of Institutions	790	
Observations	7610	

(b) Four-Year Institutions Only

	ΔStickerTuition$_{it}$	
$\mathbb{I}$(Low Tuition$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	0.250	[0.547]
$\mathbb{I}$(Mid Tuition$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	0.638	[0.419]
$\mathbb{I}$(High Tuition$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	1.560***	[0.445]
$\mathbb{I}$(Low AdmitRate$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	0.941**	[0.412]
$\mathbb{I}$(Mid AdmitRate$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	1.214***	[0.446]
$\mathbb{I}$(High AdmitRate$_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	0.368	[0.471]
$\mathbb{I}$(Low $\overline{\text{EFC}}_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	0.611*	[0.345]
$\mathbb{I}$(Mid $\overline{\text{EFC}}_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	1.523***	[0.590]
$\mathbb{I}$(High $\overline{\text{EFC}}_{i,2004}$) $\times\Delta$SubsidizedLoans$_{it}$	2.529***	[0.598]
Year FEs	Yes	
Institutional FEs	Yes	
Number of Institutions	520	
Observations	5070	

Table 12: **Summarizing the Attributes of High Subsidized Loan Exposure Institutions** This table summarizes the attributes of institutions that load heavily on the subsidized loan exposure variable in Table 11. In Panel A we summarize the attributes of high subsidized sensitivity institutions, identified as high tuition, mid admit rate, and high EFC schools. Panel B summarizes the complement of these, and Panels C and D summarize subsets of these.

# Inst.	% Priv.	% Four-Year	Avg. Tuition	Avg. EFC	Avg. Admit Rate
Panel A. High Subsidized Sensitivity Institutions					
40	.93	1	$22,347	$18,132	.74
Panel B. Low Subsidized Sensitivity Institutions					
960	.40	.59	$10,825	$9,124	.83
Panel C. High Subsidized Sensitivity Institutions - Private Only					
40	1	1	$22,531	$18,178	.73
Panel D. Low Subsidized Sensitivity Institutions - Private Only					
390	1	.76	$15,042	$9,964	.75

Table 13: **Relationship of Pre-Policy Changes in Enrollment, Tuition, and Institutional Grants with Borrowing Behavior** This table reports the results of cross-sectional regressions (by institution) using the 4-year pre-policy change (2003-2007) in loans/grants, enrollment, tuition as dependent variables, and the fraction of students in each of the loan/grant programs as the independent variable. The regression also controls for program fixed effects as well as 2003 tuition and enrollment levels. Tuition and enrollment data is from IPEDS; loan amounts and number of borrowers are from Title IV. Robust standard errors are reported in brackets. Significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

(a) Subsidized Loans

	Δ^4SubLoans$_{i,07}$	Δ^4Log(Enroll$_{i,07}$)	Δ^4Tuition$_{i,07}$
SubLoanPct$_{i,03}$	676.926***	0.230***	345.253
	[153.169]	[0.052]	[219.464]
Program FEs	Yes	Yes	Yes
Tuition$_{i,03}$, Enroll$_{i,03}$	Yes	Yes	Yes
Adj. R2	0.01	0.02	0.48
Observations	2787	2804	2791

(b) Unsubsidized Loans

	Δ^4 UnsubLoans$_{i,07}$	Δ^4Log(Enroll$_{i,07}$)	Δ^4Tuition$_{i,07}$
UnsubLoanPct$_{i,03}$	1571.562***	0.317***	294.039
	[292.691]	[0.067]	[276.692]
Program FEs	Yes	Yes	Yes
Tuition$_{i,03}$, Enroll$_{i,03}$	Yes	Yes	Yes
Adj. R2	0.02	0.02	0.48
Observations	2787	2804	2791

(c) Pell Grants

	Δ^4 PellGrants$_{i,07}$	Δ^4Log(Enroll$_{i,07}$)	Δ^4Tuition$_{i,07}$
PellGrantPct$_{i,03}$	45.823	0.121**	57.961
	[105.322]	[0.053]	[187.588]
Program FEs	Yes	Yes	Yes
Tuition$_{i,03}$, Enroll$_{i,03}$	Yes	Yes	Yes
Adj. R2	0.01	0.01	0.48
Observations	2801	2804	2791

Table 14: **Years of Federal Loan, Pell Grant, and Tuition increases for For-Profit and Not-for-Profit institutions** These tables regress annual changes in federal subsidized and unsubsidized loans, Pell Grants, and sticker price tuition against year dummies, with institutional fixed effects. The omitted dummy is for the year 2002. The PolicyYear dummy is equal to one in 2008, 09 and 10, which is when then federal aid cap changes take effect.

(a) For-Profits

	ΔPellGrants$_{it}$		ΔSubLoans$_{it}$		ΔUnsubLoans$_{it}$		ΔStickerTuition$_{it}$	
$\mathbb{I}$(Year = 2003)	-72.6***	[17.6]	19.0	[15.7]	21.1	[34.2]	133.8**	[60.6]
$\mathbb{I}$(Year = 2004)	-195.7***	[16.0]	28.9**	[14.4]	4.5	[30.9]	-16.4	[49.7]
$\mathbb{I}$(Year = 2005)	-281.8***	[15.9]	-8.2	[14.0]	-18.2	[30.2]	25.4	[52.4]
$\mathbb{I}$(Year = 2006)	-296.4***	[15.3]	-9.3	[14.2]	27.9	[30.5]	60.1	[51.8]
$\mathbb{I}$(Year = 2007)	-190.8***	[16.4]	92.0***	[14.2]	-58.0*	[30.7]	45.1	[51.4]
$\mathbb{I}$(Year = 2008)	-71.1***	[15.7]	571.1***	[15.0]	120.6***	[30.8]	182.1***	[51.4]
$\mathbb{I}$(Year = 2009)	66.6***	[16.1]	-6.0	[14.9]	742.6***	[33.9]	217.2***	[53.2]
$\mathbb{I}$(Year = 2010)	446.7***	[17.0]	-130.6***	[16.7]	-167.7***	[32.3]	199.2***	[55.3]
$\mathbb{I}$(Year = 2011)	-38.1**	[19.4]	-8.2	[15.6]	-231.8***	[35.6]	41.9	[53.6]
$\mathbb{I}$(Year = 2012)	-478.8***	[19.6]	-94.2***	[16.2]	-76.4**	[32.7]	-118.2**	[53.9]
Constant	254.5***	[11.6]	43.9***	[10.4]	128.4***	[22.6]	526.8***	[45.9]
$\mathbb{I}$(PolicyYear)	318.4***	[8.0]	138.7***	[7.5]	267.8***	[15.0]	186.5***	[17.6]
Constant	59.0***	[2.4]	48.0***	[2.2]	83.1***	[4.6]	540.7***	[5.9]
Institutional FEs	Yes		Yes		Yes		Yes	
Obs.	10652		7495		9325		10293	

(b) Not-for-profits

	ΔPellGrants$_{it}$		ΔSubLoans$_{it}$		ΔUnsubLoans$_{it}$		ΔStickerTuition$_{it}$	
$\mathbb{I}$(Year = 2003)	-42.2***	[4.6]	66.4***	[6.3]	23.1***	[7.7]	140.3***	[13.0]
$\mathbb{I}$(Year = 2004)	-95.9***	[4.3]	97.3***	[5.4]	28.1***	[7.3]	226.6***	[13.3]
$\mathbb{I}$(Year = 2005)	-125.5***	[4.4]	38.5***	[5.6]	13.6*	[7.2]	195.4***	[13.8]
$\mathbb{I}$(Year = 2006)	-175.7***	[4.4]	-12.8**	[5.4]	11.5*	[6.9]	137.7***	[12.6]
$\mathbb{I}$(Year = 2007)	-133.7***	[4.4]	9.3*	[5.6]	-44.7***	[7.0]	162.8***	[13.8]
$\mathbb{I}$(Year = 2008)	-39.6***	[4.0]	197.5***	[6.1]	23.1***	[7.3]	216.9***	[13.3]
$\mathbb{I}$(Year = 2009)	21.8***	[4.4]	32.1***	[5.8]	458.6***	[10.4]	244.5***	[13.2]
$\mathbb{I}$(Year = 2010)	352.3***	[5.1]	66.3***	[6.0]	84.2***	[8.7]	215.3***	[14.7]
$\mathbb{I}$(Year = 2011)	97.5***	[5.0]	24.5***	[6.2]	-138.2***	[8.6]	200.9***	[13.9]]
$\mathbb{I}$(Year = 2012)	-163.8***	[5.3]	14.9**	[5.9]	-13.0	[8.1]	254.6***	[13.9]
Constant	129.3***	[3.0]	22.7***	[4.1]	77.9***	[4.8]	466.6***	[9.1]
$\mathbb{I}$(PolicyYear)	190.0***	[2.5]	67.9***	[2.6]	205.7***	[4.7]	56.7***	[6.7]
Constant	50.1***	[0.7]	52.5***	[0.7]	62.5***	[1.3]	634.5***	[1.9]
Institutional FEs	Yes		Yes		Yes		Yes	
Obs.	32651		24596		29388		33238	

A Appendix: Assessing the role of program cap changes in the growth of federal aggregate loan originations

In this Appendix we estimate the fraction of federal loan origination increase between 2004 and 2008 to the change in the subsidized loan cap. We then repeat a similar exercise for 2008-12 change in unsubsidized loan originations. In Table 15, we break down the growth in federal student loan originations attributable to supply factors by studying in NPSAS the total fraction of undergraduates constrained by program caps pre- and post-policy. For subsidized loans (top panel), borrowers are split into those who are eligible to borrow at the pre-policy program cap (i.e. their personal cap is larger than the program one), and those who are constrained by their personal cap rather than by the program cap. We further split these two categories into borrowers at each respective eligible amount and those below. To attribute the aggregate loaned amounts to each segment, we compute per-student amounts and obtain aggregates by re-scaling these estimates by IPEDS undergraduate enrollment. The majority of subsidized originations are from borrowers at the program cap (line 1), and of the $4.7B change ($19.25-$14.54) in originations we estimate between 2004 and 2008 (compared to the actual $5.3B change observed in FSA), $2B is due to these borrowers borrowing the higher amounts they are now eligible for because of the policy change. However, the rest of the change is due to either higher demanded amounts by those who are not borrowing the full amount they are eligible for, or to changes in personal caps (which may reflect changes in EFCs or COAs that are increasing these caps) and the number of borrowers borrowing at their personal cap. These types of trends may explain the increases in loan originations that we see in non-policy years. Thus over four years, about 40% of the increase in subsidized aggregate loan originations is attributable to the change in the subsidized program cap.

In the bottom panel, we show that the majority of the increase in unsubsidized loan originations we observe between 2008 and 2012 ($9.6B of the $14.4B increase we estimate) is due to dependent students becoming eligible for unsubsidized loans. For independent borrowers, we note that their average amount borrowed also increased, likely due to increase in program caps, but so did the fraction of students borrowing.

Table 15: **Pre- and Post-Policy Borrowing Patterns** These tables report the percentages of all undergraduates who are constrained by the caps discussed in the paper, as well as the percentages of undergraduates who are borrowing below the amount they are eligible for. To compute the ''Total $" column, we scale these NPSAS percentages by undergraduate enrollment from IPEDS (10.81M in 2004, 11.58M in 2008, 13.06M in 2012) and compare these totals to known FSA amounts.

(a) Subsidized Loan Borrowers

	Fraction of Students		Avg. $ Amount		Aggregate $ Amount	
	2004	2008	2004	2008	2004	2008
Personal Cap ≥ 2004 Cap						
Borrowing at Cap	.26	.24	3793	4547	10.67	12.64
Borrowing below Cap	.08	.13	2480	3011	2.14	4.53
Personal Cap < 2004 Cap						
Borrowing at Cap	.04	.05	2472	2652	1.07	1.54
Borrowing below Cap	.03	.02	2065	2333	0.67	0.54
Total					14.54	19.25
FSA Total					15.09	20.37

(b) Unsubsidized Loan Borrowers

	Fraction of Students		Avg. $ Amount		Aggregate $ Amount	
	2008	2012	2008	2012	2008	2012
Dependent borrowers	.10	.30	3273	3347	3.54	13.1
Independent borrowers	.13	.16	3997	5200	6.02	10.87
Total					9.56	23.97
FSA Total					14.67	30.49