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**Attendance Spillovers between Public and For-Profit Colleges:
Evidence from Statewide Changes in Appropriations for Higher
Education**

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**Attendance Spillovers between Public and For-Profit Colleges:
Evidence from Statewide Changes in Appropriations for Higher Education**

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Abstract

Between 2000 and 2010, U.S. public postsecondary schools experienced widespread and uneven changes in funding from state and local appropriations. We estimate that statewide funding cuts lead to a decrease in public attendance that is offset by an increase in for-profit attendance, with no change in overall enrollment rates. We document a corresponding increase in borrowing, driven by both a shift in attendance toward a higher-borrowing sector and public institutions price-adjusting to offset losses in revenue. Finally, we examine potential channels underlying these results and detect meaningful changes in public universities' tuition, faculty, and competitive admissions slots.

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1. Introduction

Between 2000 and 2010, there was a dramatic shift in funding for public higher education. The state and local appropriations share of public colleges' balance sheets shrunk by nearly 10 percentage points, which was fully offset by an increase in the share of revenue from tuition.^{2,3,4} Against this backdrop, enrollment at for-profit colleges skyrocketed. Prior to 2000, for-profits enrolled just 3 percent of college-goers. By 2007, they accounted for 7 percent of the national market, and by 2010, they were nearly 10 percent (Figure 1).⁵ While the returns to a for-profit education are relatively low, there is evidence that, in some settings, students have substituted between public and for-profit colleges (Cellini, 2009; Darolia, 2013).⁶ However, the extent to which declines in statewide appropriations to public colleges induce students to attend for-profits is unknown.

This paper investigates the relationship between these phenomena (Figure 2). Between 2000 and 2010, public post-secondary schools experienced widespread and uneven changes in the support that they receive from appropriations.⁷ Over this period, appropriations to public post-secondary schools, on average, fell from 3 percent of state and local spending to 2 percent.⁸ This drop, much of which occurred prior to the Great Recession, is unrelated to educational demand; indeed, college-going rates were increasing during these years.⁹ Instead, it is part of an ongoing decline in state and local support for higher education that began decades

² Meanwhile, revenue per student at public institutions, which serve the majority of undergraduate enrollees, has held mostly flat over this period, suggesting that resources available to attending students were largely unchanged in an environment of declining appropriations.

³ Federal grant and lending programs have become more generous, contributing to this pattern but also improving access to college, more generally.

⁴ Revenue shares derived from the Delta Cost Project database.

⁵ About 70 percent of the for-profit sector's increase in presence took place prior to the Great Recession. The staggering growth flattened out only recently, as these institutions have faced increased scrutiny and threat of regulation.

⁶ Students attending for-profit institutions are more likely to borrow and much more likely to default on their loans than students attending schools in other sectors, as they also typically pay more for their education and experience smaller earnings gains (Looney and Yannelis, 2015; Cellini and Chaudhary, 2014; Kane and Rouse, 1995).

⁷ The median state (in terms of variability) experienced annual changes in appropriations that ranged from -8 percent to 10 percent between 2000 and 2010.

⁸ Government spending figures derived from published State Higher Education Executive Officer reports and Bureau of Economic Analysis tables from the Census of Governments.

⁹ Between 2000 and 2010, total college-going grew at 3 times the rate seen in the prior decade.

earlier, the majority of which has been attributed to rising entitlement obligations and the increasing portion of states' budgets that they occupy (Kane, Orszag, and Apostolov, 2005).¹⁰ Our goal in this paper is to leverage variation in statewide appropriations for higher education – which, as we will demonstrate, appear to affect the supply of public education – and examine whether we observe demand-side responses that could help explain the rise of the for-profits.

Our primary strategy links statewide attendance and borrowing patterns to the revenue public colleges receive from appropriations. We first tie appropriations changes to shifts in attendance. While decreases in such funding appear to have no effect on aggregate college-going across the public and for-profit sectors, they lead to significant declines in public attendance.¹¹ We find evidence that, in a flush funding environment, marginal college-goers are absorbed into community colleges. However, when resources are scarce, college-goers are squeezed out of the public sector entirely and into the for-profit sector. We estimate that for-profit attendance increases about 2 percent for every 10 percent cut in statewide appropriations.¹² Effects are similar when we restrict our analyses to years excluding the Great Recession and recovery (i.e., 2008-2010). Altogether, it appears that crowd-out in the public sector is inducing a considerable number of students to attend for-profits over our period of study, separate from other phenomena such as the rise of certifications or worker retraining programs.

We hypothesize that public schools price-adjust in response to appropriations cuts, which, together with a corresponding shift in attendance toward the higher-borrowing for-profit sector, will induce an increase in debt financing of education

¹⁰ Kane, Orszag, and Apostolov (2005) estimate that rising state spending to meet Medicaid obligations could explain about 80 percent of the decline in state spending on higher education between 1988 and 1998. Between 2000 and 2010, spending on public welfare, hospitals, and pensions grew from 23 percent of state and local spending to 26 percent.

¹¹ We generally focus on appropriations “cuts” or “decreases” (rather than “changes” or even “increases”) in order to tell a consistent story about how all of the mechanisms we present interact. The median annual change in appropriations is -1 percent.

¹² Further, we find that a 10 percent decrease in public funding generates a 0.7 percentage point increase in the for-profit market share of demand-elastic enrollment (i.e., enrollment at community colleges and for-profit institutions). The mean statewide for-profit market share of such enrollment over our period of study is about 20 percent. (The standard deviation of real statewide public appropriations is \$2.0 billion, 1.3 times its mean of \$1.5 billion.)

among students and their families.¹³ We document a significant inverse relationship between appropriated funds to higher educational institutions and borrowing, which is concentrated at for-profits: for every 10 percent decrease in appropriations, we estimate a 0.7 percent increase in borrowing across our two active sectors, but a 2 percent increase at for-profits (in lockstep with our attendance results and the very high borrowing rates at such institutions).¹⁴ The effects on borrowing are more pronounced when we restrict the focus to schools whose budgets are sensitive to appropriations changes.

For a causal interpretation of our estimates, we must assume that within our framework, statewide appropriations changes are exogenous to students' attendance and borrowing outcomes. We examine the validity of this assumption in five ways. First, even though our results are not *prima facie* consistent with unaccounted for changes in local economic conditions (i.e., we would expect overall enrollment to increase if appropriations cuts merely reflect poor economic conditions), we show that changes in state economic indicators (e.g. unemployment rates) are uncorrelated with changes in appropriations. Next, we test for effects on other educational outcomes (e.g., SAT scores) that should not be influenced by appropriations changes directly but could be influenced by an excluded variable that co-varies with appropriations, and we find none. Third, as a falsification exercise, we demonstrate that changes in appropriations in a subsequent year appear to have no effect on attendance and borrowing today. We also show that our main estimates are not sensitive to the inclusion of various controls (e.g., a lagged state unemployment rate to account for potential procyclicality in the determination of appropriations) or state-specific time trends, nor to changing the specification of appropriations changes to an enrollment-

¹³ The available toolkit by which a school can adjust prices includes published tuition, effective tuition charged, and even the time cost of waiting in a queue for core classes. At the conclusion of the paper, we extend our analyses to examine which margins of adjustment are operating.

¹⁴ Our analysis focuses on subsidized and unsubsidized borrowing through the Federal Direct Loan and Federal Family Education Loan programs, which make up about 70 percent of annual educational borrowing over the period we consider (College Board, 2014). For participation rates in these programs by sector, see the 2010 Digest of Education Statistics, Table 350.

scaled measure. Last, we provide an array of evidence suggesting that reverse causality does not pose a significant threat to our design.

As a final exercise, we investigate plausible channels through which a negative shock to appropriations could limit educational opportunities in the public sector. We consider bottlenecks posed by potential increases in prices or decreases in available resources. For the price dimension, we examine various tuition concepts, derived from either published sticker prices or gross tuition revenue collected by institutions. We find that in response to a 10 percent funding cut, the in-state full sticker price of flagship institutions increases around 1½ percent, and the average sticker price increases 1 percent. Then, to examine resources, we focus on capacity constraints that could result if schools scale back spending on instruction or in-state admission slots.¹⁵ We find that changes in revenue are associated with very small changes in faculty resources: for a 10 percent cut in appropriations, the share of faculty teaching only part-time increases by one-fourth of a percentage point (less than 1 percent of the mean). We also show that public flagship institutions are composed of fewer in-state freshmen when funding is cut. While our data do not allow us to directly test one potentially-important channel that would help generate the substitution effects we detect – i.e., that public sector classes become oversubscribed – our results are certainly consistent with that mechanism operating.

Our study links cutbacks in appropriations for public postsecondary education to growth in attendance and borrowing at for-profit institutions, contributing to early work investigating the historical interaction of the demand for higher education between these two sectors (Darolia, 2013; Cellini, 2009). The effects on students of being squeezed out of the public sector are significant.¹⁶ Current estimates on the return to education in each sector imply sizable income differentials: earnings gains from community colleges are about 3 percentage

¹⁵ Figlio (1997) documents that property tax limitations in the late 1970s and early 1980s considerably reduced spending on instruction at K-12 public schools. (By definition, tuition for K-12 public schools is fixed at zero and therefore cannot be utilized to offset drops in public funding.)

¹⁶ Cellini (2012) provides an overview of the social welfare implications of such spillovers.

points larger than those from for-profits (Cellini and Chaudhary, 2014; Kane and Rouse, 1995). There is also evidence that students who attend for-profits are viewed less-favorably by employers than students who pursue similar programs at other schools, and on par with students who pursue no postsecondary education at all (Deming et al., 2014; Darolia et al., 2014). Further, the corresponding changes in educational borrowing in response to a funding cut corroborate findings from prior studies, that students heavily discount future consumption for small differences in their consumption today (Cohodes and Goodman, 2014). Moreover, there is increasing concern that the mere presence of student loans on young households' balance sheets, independent of the quality of education received, affects decision making early in their life-cycles (i.e., homeownership, family formation, career choice), which could have long-lasting effects (e.g. Dettling and Hsu, 2014; Gicheva, 2014; Mezza, Sommer, and Sherlund, 2014).

The rest of the paper proceeds as follows: Section 2 motivates and reviews our setting and the conceptual framework governing the relationship between public sector institutions and for-profits; Section 3 describes our data and analytical framework; Section 4 estimates the effect of public funding cuts on the market for higher education; Section 5 estimates the intermediate price and quality dimensions along which an appropriations shock can affect the market for education; and, Section 6 contextualizes our main estimates and concludes.

2. Institutional Background and Conceptual Framework

This section describes how colleges are funded, presents some background on for-profit colleges over our period of study, and offers a theoretical framework to motivate our empirical analyses.

a. Brief Primer on Public College Funding and the Economic Environment

Public colleges and universities receive a large portion of their revenues from tuition and from state and local governments. (The remaining revenue—which mostly comes from the Federal government, internal operations, investments, and gifts—represents a fairly static, minority portion of overall funding.) However,

most states face balanced budget requirements, so they are constrained in their funding for higher education. The rising burdens of state-funded entitlement programs (e.g. Medicaid, pensions) – which are determined by factors unlikely to be correlated with the demand for higher education (e.g., program generosity, legislative attitudes, cost inflation, pension performance) – and K-12 education expenses, imply that higher education institutions have had access to fewer funds from state sources, even as demand for education strengthened. To wit, appropriations to public post-secondary schools fell from 3 percent of state and local spending to 2 percent over the period we consider. Correspondingly, the share of public higher education revenues coming from state and local appropriations fell about 10 percentage points.¹⁷

State and local government funding arrives through two channels: appropriations, and grants and contracts. Both reflect budgetary health. However, of the two, appropriations represent the lion's share of an institution's budget and play the more substantial role in supporting expenses for instruction. By contrast, grants and contracts tend to support research activities, training projects, building expenses, and in some instances, student aid. Because of their relative import to higher educational institutions' core operations, in both size and purpose, we treat state and local appropriations as the component of revenue most directly tied to institutional functionality, and grants and contracts as a co-varying indicator of budgetary and economic health of the state. (We will show that our results are not sensitive to the exclusion of grants and contracts as a control.)

Funds available for appropriations are determined by a combination of government revenue projections (mostly of taxes and lotteries), spending already obligated to state entitlement programs, and state legislative priorities. Presumably within any one state, "excess revenue flows" (i.e. revenue beyond entitlement spending) vary more substantially over time than state priorities, so that, after accounting for the latter, fluctuations in appropriations are essentially random shocks to the total dollars on hand within a state's higher education

¹⁷ Revenue shares derived from Delta Cost Project database.

system.¹⁸ It is this exogenous variation in total dollars available in any given year that we will leverage to examine changes in student outcomes within a state.

When appropriations fall, one remedy to offset the loss of revenue and maintain functionality is tuition increases.¹⁹ Tuition increases can come through increases in published costs of attendance (sticker prices), decreases in the generosity of aid packages awarded to matriculating students (effective prices), or a combination of the two. Indeed, between 2000 and 2010, reliance on tuition revenue strengthened as appropriations declined. In fact, the 10 percentage point drop in the appropriations share of revenue that was noted earlier was entirely offset by a corresponding increase in tuition revenue. The interplay of falling appropriations and rising tuition has become a central topic of concern.

b. For-Profit Institutions between 2000 and 2010

Meanwhile, the for-profit sector was booming, accounting for almost 30 percent of the total increase in enrollment between 2000 and 2010. The rise of the for-profits was both puzzling and concerning. Still, the sector did not come under formal federal scrutiny until June 2010, when the Senate Committee on Health, Labor, Education, and Pensions (i.e., “the HELP Committee”) began a two-year in-depth investigation of the causes and consequences of its run-up. We first describe the peculiarities of these institutions and then summarize the lax regulatory environment that allowed them to flourish over this period.

For-profits typically operate unlike other higher education institutions. While their market for students resembles community colleges, in that for-profit enrollments tend to swell when cohorts are large and local labor markets are weak, they are a distinct class of institution that has historically offered very specialized programs of study and served a fairly small portion of enrollment, particularly among recent high school graduates (Turner, 2006; Deming et al,

¹⁸ Note that there may be non-random sorting of dollars to the institutions within a state’s public education system based on priorities and needs, but our analysis will focus on state-level variation and thus abstract from these types of endogenous decisions.

¹⁹ There is variation in the discretion state legislatures have to adjust their tuition as they balance their budgets. We will leverage these differences in our calculations at the end of the paper. See Bell (2008) for a discussion of the interplay between state politics, tuition, and appropriations.

2012; United States Department of Treasury, 2012). Courses at for-profits are designed to accommodate the schedules of part-time and older enrollees who juggle continued education with other work and family responsibilities. Further, students who attend these institutions are more likely to borrow and much more likely to default on their loans than students attending schools in other sectors; the sector as a whole is nearly fully supported by various federal student aid programs. Ultimately, students who attend for-profits pay more for their education, even though they experience smaller earnings gains and employers generally consider them on par with applicants without any post-secondary education at all (Cellini and Chaudhary, 2014; Deming et al., 2014; Darolia et al., 2014; Kane and Rouse, 1995; Looney and Yannelis, 2015).

The task of regulating for-profits over this period was spread across states, educational accrediting agencies, and the federal government, each of which was either not properly incentivized or properly equipped to scrutinize the sector's activities.²⁰ For instance, even though the federal government was funding the majority of the existence of for-profits through an array of student aid programs, the punitive measures designed to prevent institutions from abusing these programs were often out-manuevered by clever bookkeeping. In fact, of the three, states theoretically were in the best position to monitor and regulate the sector, as each school's operations were often contained within their boundaries and primarily served their constituents, but they also seemingly had the least incentive. For one, the federal government never set minimum requirements for state authorization of for-profits; therefore, for-profits created very little overhead for states beyond the cost of routine inspections that states themselves were responsible for defining and enforcing. On the other hand, states had to fund public colleges that offered a competing product. Moreover, even if states were motivated to regulate the for-profits, they generally did not have the funds or staff to do so. For these reasons, "many states [took] a passive or minimal role in

²⁰ The description of the regulatory environment in this paragraph draws heavily from the HELP committee's report on its investigation of for-profits (United States Senate HELP Committee, 2012).

approving institutions, reviewing and addressing complaints from students and the public, and ensuring that colleges [were] in compliance with state consumer protection laws” (United State Senate HELP committee, 2012). In other words, states took a rather consistent, laissez-faire approach to regulating the for-profit sector—by charging minimal operating fees, by staffing few auditors to review operations, or both—from the 1990s through the decade we consider. There is very little evidence of state legislation altering either standards for the approval or operation of for-profits or the regulatory environment over our period of study that would interfere with our analysis.²¹

c. How Appropriations Funding Could Influence Attendance Patterns

Against this backdrop, we observe that year-over-year swings in appropriated funds to higher educational institutions within a state appear to be intimately connected to changes in for-profit attendance in that same state (Figure 2). This relationship is slightly stronger when we restrict attention to the most extreme changes in funds (i.e., the top and bottom 5 percent) over this period. Here we outline how revenue declines in the public sector could reallocate students into the for-profit sector.

There is evidence that larger-than-usual cohorts and tuition increases can substantially reduce public college attendance (Bound and Turner, 2007; Fortin, 2005). Further, cohorts exposed to these negative conditions appear to experience profound and long-lasting consequences, generally reflective of overcrowding in the public sector (e.g. reduced graduation rates as in Bound, Lovenheim, and Turner, 2010). In light of these findings, the surge in college-going and the ongoing shift in the burden of college financing away from state and local governments (and toward the student), together with the consequences cohorts exposed to these negative conditions expectedly face, could drive marginal public

²¹ The earliest state actions of record took place when for-profits were first coming under fire from the federal government and popular press. Both Alabama and Tennessee enacted policies aimed at removing poorly-performing for-profits from operating in 2008, with Alabama closing schools as early as 2008 (National Consumer Law Center, 2011). Our findings are robust to removing 2008-2010 from the analysis.

attendees to pursue education elsewhere, even if returns from that education are lower or riskier.²²

A separate and growing body of work has evinced that for-profit schools compete with community colleges for students (e.g., Cellini, 2009; Chung, 2012; Darolia, 2013). Similar in spirit to the current study, Cellini (2009) studies the sub-baccalaureate education market in California counties that narrowly passed bond measures to fund community colleges between 1995 and 2003. To motivate her analysis, she provides a comprehensive theoretical framework of the interplay between the two institution types. Within this framework, she offers that, between the two, for-profits can more readily and easily absorb excess student demand, as they tend to be “relatively unencumbered by bureaucratic red tape.” Indeed, she finds that cross-sector enrollment is sensitive to changes in funding at community colleges, whereby for-profits act as safe havens to accommodate overflow between sectors. Moreover, for-profit schools appear to fully enter and exit in response to these market dynamics. We hypothesize that in our setting, amid broad declines in appropriations funding of public higher education and an ever-growing national for-profit presence over the last decade, we can expect that a substantial number of students were squeezed out of the public sector and into for-profits. The following discussion highlights the price and quality channels through which these relationships result.

Consumers have preferences over the education received in each sector, such that there is imperfect substitutability between the two sectors. The for-profit sector offers a differentiated (i.e., lower-quality or lower-valued, on average) product and can elastically absorb excess demand for education in the public sector. Because there is imperfect substitutability between the two sectors, excess demand for public education can flow to the for-profit sector, where any increase

²² The negative economic conditions associated with the Great Recession likely compounded existing trends, further swelling cohorts and constraining revenue from state and local governments. When Long (2015) examines this period directly, she finds that much of the recessionary crowding occurred among non-traditional or lower-ability students. Within our design, appropriations changes are uncorrelated with unemployment rates, and our core results are robust to the exclusion of the severe changes in economic conditions that occurred during the Great Recession.

in for-profit enrollment could be smaller than the decline in public enrollment since education in the two sectors is not valued equally. Demand in the public sector depends on the aggregate demand for education and the relative costs and benefits for each student at each type of school. If the marginal rate of substitution (MRS) between the two sectors is close to 1, shocks that occur in the public sector can generate large swings in demand for for-profit education. Assume that prices in the for-profit sector are fixed in the short run so that they do not respond to contemporaneous changes in demand that result from a shock to the public sector.²³

If a negative funding shock occurs in the public sector, there are two dimensions along which institutions can respond: (1) decreasing quality or (2) increasing price. When quality decreases, education in the for-profit sector will become relatively attractive: the downward shift in demand for a public education resulting from a quality decrease will be met with an upward shift in demand for a for-profit education. Alternatively, when the price of a public education increases, assuming education is a normal good, the amount of public education demanded falls. Again, there will be an upward shift in demand in the for-profit sector. In both cases, the quantity of public education demanded falls and the quantity demanded of for-profit education unambiguously rises.

The size of the increase in for-profit education demanded will be different under the quality decrease than under a price increase. Both hinge on the size of the shock to the primary sector, the degree of substitutability between the two sectors, and the relative price of education across sectors. The degree of substitutability will change when quality in the public sector declines. If the price rises in the public sector, the MRS is not affected, but the cross-price elasticity impacts the individual's choice of sector. All else equal, a higher elasticity of substitution will generate a larger increase in the demand for for-profit education.

²³ Even though the two sectors compete for students, in the short-run, it is realistic to assume that for-profits do not price adjust to changes in demand brought on by public sector spillovers. For-profit tuition is mostly determined by the cost of instruction and the generosity of federal financial aid programs (Cellini and Goldin, 2014; Cellini, 2009 and 2010).

3. Data and Empirical Framework

This section outlines our data sources and the construction of our key variables. We then briefly describe our empirical strategy.

a. Data

Our primary analysis sample is drawn from the Delta Cost Project (DCP) longitudinal data made available on the Department of Education's website.²⁴ The database includes harmonized institutional data on postsecondary finance, enrollment, and staffing reported to the federal government through a series of mandatory annual surveys of higher educational institutions, compiled into IPEDS (Integrated Postsecondary Education Data System). The DCP compiles this publicly available data and attempts to reconcile changes in accounting standards and reporting formats over time to be more useful for longitudinal analysis of enrollment and financing.

The panel covers all reporting institutions for enrollment years 1999 through 2009, such that there are over 10,000 distinct institutions, serving as the basis for analysis. Of these, approximately 20 percent identify as public institutions, and 50 percent identify as for-profits.²⁵ Data are further adjusted for reporting issues²⁶ and are then collapsed to the state-academic year level for analysis.

Our key revenue measure is a combination of state and local appropriations at public institutions aggregated to the state-year. We use the DCP data to construct an array of outcomes for our analysis (i.e., enrollment in public colleges and for-profits, faculty staffing, and various tuition concepts) and a measure of state economic conditions (i.e., state and local grants and contracts to public colleges). Unless otherwise noted, enrollment data from the DCP are quantified in terms of

²⁴ See <http://nces.ed.gov/ipeds/deltacostproject/>.

²⁵ These data do not cover the full extent of the dramatic rise in for-profit enrollment, which continued a couple of years beyond the reach of the panel until regulatory actions began to constrain continued expansion of the sector.

²⁶ Specifically, we linearly interpolate our key variables for missing and imputed institution-years, so that changes in our state aggregates do not reflect spotty institutional reporting. A total of 932 for-profit institution-years (out of over 31,000) are affected by this interpolation. We interpolate funding and enrollment for 198 and 269 public institution-years (out of over 20,000), respectively.

full-time equivalent (FTE) students,²⁷ and financial data are real adjusted to 2013 dollars using the Higher Education Consultants Association (HECA) index.²⁸

To measure borrowing, we leverage federal loan volume reports by institution and academic year for loans disbursed through the Federal Family Education Loan (FFEL) and Direct Loan programs.²⁹ We create summary measures by state and academic year, which quantify the following: aggregate borrowing to attend public and for-profit institutions; borrowing to attend public and for-profit institutions where in-state residents make up over two-thirds of enrollment;³⁰ and borrowing by sector of attendance (i.e., public, private for-profit, and, as part of our robustness checks, private non-profit institutions). Data are real adjusted to 2013 dollars using the HECA index.

For each state-year observation, we also include a cohort measure, derived from intercensal statewide population estimates for either 17-year-olds in July of the prior year or 18- to 24-year-olds in July of the current year – whichever is most relevant for the outcome of interest – and a measure of economic conditions, an academic-year adjusted unemployment rate averaging the Bureau of Labor Statistics statewide data from June to May. Finally, we include aggregated state and local grants and contracts (both operating and non-operating) to proxy for unobserved fluctuations in state budgetary health that could correlate with appropriations revenue and the outcomes we consider.

²⁷ We rely on fall enrollment counts, which is somewhat at odds with concerns raised in earlier work that for-profit attendance derived from fall enrollment may miss a considerable amount of students attending less conventional and short programs (Deming, Goldin, and Katz, 2012). A 12-month FTE enrollment measure is only available in our sample beginning in 2004, missing a sizable portion of our period of study. Moreover, the less conventional students they describe are not the subject of our analysis, which seeks to investigate the paths of for-profit enrollees who, in a better funding environment, would have attended public schools and thus likely would have enrolled in the fall.

²⁸ The HECA index is a specially-prepared price index generated by the association of public colleges intended to track changes in the costs of inputs purchased by colleges.

²⁹ Data are available on the Department of Education Federal Student Aid (FSA) website at <https://studentaid.ed.gov/sa/about/data-center/student/title-iv>.

³⁰ The indicator for “over two-thirds in-state enrollment” was derived from IPEDS data identifying, for each institution in 2012, the percent of first-time undergraduate students who indicated on their college application a home residence in the same state as the institution. A crosswalk available from the National Student Clearinghouse was used to link IPEDS IDs to FSA IDs, by which the borrowing data are classified. For FSA IDs that linked to nonunique IPEDS IDs, the average of the IPEDS variable determined its inclusion in the restricted borrowing measure. For any non-linked IDs, the institution’s borrowing was included in the count.

Some aspects of the college-going decision cannot be captured by the DCP data. Most importantly, we do not observe students' state of residence prior to college enrollment. Our analysis with the DCP is conducted using the state in which an institution is located; therefore, our measurement omits a potentially-important enrollment margin—geography—that many college-going students have at their disposal. In addition, because of reporting inconsistencies over time, we measure for-profit attendance using FTE counts rather than first-time college-goers. Doing so potentially dilutes the impact of public funding on enrollment choice since overall measures include continuing students who are likely less responsive than freshmen and could confound counterfactual public enrollees with non-conventional college-goers and graduate students.³¹ To better understand the geographical allocation of students, and in particular freshmen, we supplement our main findings with migration data covering a subset of our primary analysis years for first-time students from IPEDS.³² We use these data to examine in broad terms how an enrollee's home state funding environment affects the sector and state in which she attends college, and whether competitive flagship institutions vary the composition of their enrolling class between in-state and out-of-state in response to changes in state funding.

b. Empirical Framework

Throughout our analyses, our estimating equation is:

$$y_{st} = \alpha + \beta_1 \times \ln(\text{appropriations})_{st} + \beta_2 \times \ln(\text{grants})_{st} + \mathbf{X}_{st}\boldsymbol{\theta} + \gamma_t + \gamma_s + \varepsilon_{st}, \quad (1)$$

where y_{st} is our outcome of interest³³ (for instance, a measure of for-profit enrollment) for state s in year t ; $\text{appropriations}_{st}$ is aggregated state and local

³¹ This is less a concern for the for-profit enrollment analysis as these students are less likely to move across state lines to attend a for-profit institution.

³² In even years, the IPEDS survey collects additional information from each reporting institution on freshmen state of residence. Using data from survey years from 2004 to 2010, we link counts of fall-enrolling freshmen by state of residence and sector of institution attended to statewide appropriations, grants, and contracts revenue.

³³ The functional form of the outcome variable follows a consistent rule of thumb: share variables are denoted as percent of 100 and are estimated in levels, while count variables are expressed in logarithms.

appropriations; $grants_{st}$ is aggregated state and local grants and contracts, operating and nonoperating;³⁴ X_{st} represents our population and unemployment rate controls; and γ_t and γ_s are academic year and state effects. Standard errors are clustered at the state level.

Our primary coefficient of interest is β_1 such that, when y is “ln(for-profit enrollment),” our estimate represents the percent change in for-profit attendance owing to a 1 percent change in appropriations. The inclusion of state and year effects identify β_1 from variation of funding within a state, abstracting from annual fluctuations in national college enrollment, pricing, funding, and interstate variation in legislative priorities. For a causal interpretation of the estimates, one must assume variation in statewide appropriations funding exogenously influences the outcomes we consider. We revisit the validity of this assumption after we present our main results.

State level summary statistics of the outcome and control variables, from each of our data sources, are presented in Table 1. In general, more students attend public schools—both community college and four-year—than for-profits, though for-profit attendance represents an increasing share of attendance over time (Figure 1). Moreover, while more borrowed dollars each year accrue to students at public institutions, on a per-student basis, borrowing is clearly concentrated within the for-profit sector. We also see that appropriation funds outstrip dollars coming from grants and contracts. There is considerable variation in statewide appropriations (and grants and contracts) over our sample, reflecting mostly the considerable differences across state budget and population sizes, but also changes within states over time. Between 2000 and 2010, average annual appropriations to higher education in California were \$12.6 billion (varying from a low of \$11.7 billion to a high of \$13.6 billion), whereas in Vermont, that same figure was about \$75 million (varying from a low of \$72 million to a high of \$81 million). Because of the wide range, for comparability across states, we will focus on the effects of percent changes in appropriated dollars within states. (The

³⁴ Following the literature (e.g., Fortin (2005), Bound and Turner (2007), Jaquette and Curs (2014)), we estimate models with log revenues as the primary explanatory variable.

median state, in terms of variability, experienced annual changes in appropriations that ranged from -8 percent to 10 percent between 2000 and 2010.) Finally, as a matter of semantics, we generally focus our discussion on appropriations “cuts” or “decreases” (rather than “changes” or even “increases”) in order to tell a clear story about how all of the mechanisms we present interact. The median annual change in appropriations across our sample is -1 percent.

4. Main Analysis

Earlier, we outlined a conceptual framework whereby appropriations cuts that affect revenue flows in the public sector could reallocate students into the for-profit sector. In this section, we provide empirical evidence that such reallocation is indeed occurring, and furthermore, over our period of study, appropriations cuts, on balance, led to real increases in educational borrowing.

a. The Effect of Appropriations on Attendance

This section investigates how funding shocks relate to attendance patterns, and whether there appears to be systematic evidence that limited educational opportunities in the public sector are inducing students to reallocate into the for-profit sector.

i. Attendance at Public Institutions

We begin our analysis of enrollment by estimating the overall effect of appropriations reductions on public attendance, which tells us broadly whether crowd-out is indeed occurring. Since many first-time students exist on the margin between a four-year and a two-year public school, we examine how public funding could generate reallocation between community colleges (which are relatively cheap and open admissions) and four-year colleges (which are relatively expensive and competitive admissions), particularly among freshmen. We consider several measures of freshmen enrollment at public schools: total public freshmen, flagship freshmen, and community college freshmen. We estimate equation (1) with these outcomes over the DCP sample and, in the analysis of freshman enrollment, use the 18-year-old population to measure cohort (Table 2).

Public funding is directly related to attendance at public institutions (column 1), holding cohort size constant, such that drops in funding reduce overall public attendance. In other words, as expected, the public sector shrinks as funds wane. Moreover, we detect a clear crowd-out effect among freshmen (column 2), particularly at community colleges (column 4), such that statewide reductions in appropriations alter considerably many students' educational plans. Finally, we note that there is interesting within-sector nuance in how the two funding streams affect attendance: holding cohort size constant, appropriations reductions shrink community college attendance, but do not significantly affect freshman enrollment at flagships. However, grants and contracts may slightly increase capacity at public research universities, seemingly drawing in students on the margin of four-year and two-year schools.

Consistent with prior literature (Bound and Turner, 2007), we generally find that as cohorts grow, the size of the public sector expands. The sector is reasonably elastic and accommodates excess students brought on by larger-than-usual populations, even holding funding constant. Looking within the sector, the size of the freshman class enrolled at more-competitive flagships (column 3) does not expand with the cohort, given fixed levels of statewide funding. Instead, the expansion we recovered in the first column appears to mainly occur in the more supply-elastic community college sector.

We separately find that freshmen students, who presumably are the most geographically sensitive to changes in higher education conditions in their home state, do not, on average, respond to appropriations cuts by pursuing education out of state (Appendix 1). This finding – that a student's home state funding environment does not appear to affect the state in which she attends college – supports our examination of within-state enrollment responses to changes in funding. Moreover, all of the results, taken together, suggest that in a flush funding environment, college-goers are absorbed into community colleges, but when resources are scarce, they are squeezed out of the public sector entirely.

ii. Reallocation Across Sectors

We have shown that declines in appropriations shrink entrance into the public sector. Now we investigate how enrollment shifts across sectors, with a focus on the for-profit sector, vary with these funds. In conjunction with our findings thus far, and the theoretical discussion in Section 2, we expect the for-profit sector to grow as funds flowing to public schools wane.

We first estimate (1) for total attendance at institutions whose budgets, according to Section 2, are most sensitive to the funding variation we consider—i.e., either directly, at public colleges, or indirectly, at for-profits. The coefficient we obtain will tell us whether aggregate changes in appropriations funding influence college-going rates, or whether such changes are systematically linked to an omitted variable that coincides with college-going. Next we consider three measures of y to capture for-profit attendance resulting from funding shocks to the public sector:

- (a) the share of enrollees at “demand-elastic” institutions (public one- and two-year institutions and for-profits) who attend a for-profit school,
- (b) the share of enrollees at “budget-sensitive” institutions (all public and for-profits) who attend a for-profit school, and
- (c) log enrollment at for-profit institutions.

In understanding shocks to market share specifically, we consider the coefficient on appropriations for (a) to be the preferred measure. This parameter pertains most closely to the pool of potential for-profit enrollees, since most college-goers are likely not on the margin of choosing between a four-year public school and a for-profit institution. Still, this measure is an upper-bound when there is “infra-marginal” switching between the four- and two-year public schools in response to funding changes. Thus, the second outcome offers a lower bound for the effect of funds on for-profit enrollment allocation across all budget-sensitive institutions. The third outcome is our key measure of how appropriations affect for-profit attendance as it imposes the least functional form restrictions on the relationship between public and for-profit attendance.³⁵ Note that any

³⁵ The measure does not take into account the sector’s relative market size when quantifying growth; thus, large percentage changes in for-profit attendance captured by this measure could

unobserved changes in higher education market conditions that differentially affect for-profit college attendance (such as marketing campaigns targeting low-wage employees) that were correlated with changes in appropriations would result in our overestimating the true parameter of interest.

We do not detect an effect of appropriations on college attendance (Table 3, column 1), resulting in two key takeaways. Overall college-going is not influenced by statewide appropriations, even though, as we have shown, public enrollment is influenced. In addition, appropriations cuts do not appear to be systematically linked to changes in state economic conditions that would induce broad-scale changes in college-going. This suggests that the relationship between changes in appropriations and college-going outcomes by sector can be interpreted causally. At the end of the section, we further evaluate the validity of this interpretation.

Across the board, it appears changes in public funding are inversely related to for-profit enrollment; estimated β 's are all negative and statistically significant at conventional levels. Our estimates for the increased market share of the for-profit sector range from 0.3 percentage point to 0.7 percentage point, given a 10 percent drop in funding (Table 3, columns 2 and 3). In these first sets of regressions, the impact of the college-aged cohort is positive, though not statistically significant. This is the direction we would expect and expands the literature investigating the impact of cohort size on enrollment, as larger cohorts can also create additional competition for slots at constrained public institutions. It further supports a crowd-out story at public institutions, where excess enrollment cannot be accommodated and flows to for-profit schools, a more easily accessed sector and one that is less constrained. Turning to the final column, we estimate that for-profit enrollment is negatively associated with increases in log revenues. From a 10 percent drop in appropriations, we can expect a 2 percent increase in attendance.

reflect a very small sector at time zero and vice versa. We examine the robustness of this coefficient, and similar constructions of borrowing, to the growing for-profit market presence using state-specific time trends.

The full set of results is consistent with the framework in Section 2: there is a large degree of substitution between the public and for-profit sectors. In our sample, the average number of for-profit students in a state-year is roughly 21,000, such that our point estimate implies 413 extra students in the for-profit sector resulting from a 10 percent cut in appropriations. The average number of public students is about 186,000, so that a same-sized cut applied to our point estimate from Table 2 would imply a loss of 487 students from the public sector. Together, these results suggest that for a 10 percent cut, public sector losses are about offset by for-profit sector gains, with an MRS of 0.85.

b. The Effect of Appropriations on Borrowing for Education

Earlier, we theorized that appropriations cuts effectively decrease the amount or quality of a public education a student can consume at some fixed price. Because college students may heavily discount future earnings and debts in relation to nearer-term experiences, in our environment, we might be concerned that students are willing to borrow large sums to offset the negative shocks to their educational consumption brought on by appropriations cuts today. Indeed, we are unable to detect any changes in the overall college-going rate in response to a cut. Instead, we show that appropriations changes affect students' attendance decisions along a different margin, squeezing students out of the public sector and into for-profits, where about twice as many students borrow, and average annual borrowing is more than 1½ times as high among those who take out loans.³⁶ In contrast to the many sources of revenue that support operations in the public sector we outlined earlier, the business model of the for-profit sector relies heavily on the federal lending programs for revenue, and reportedly, many for-profits offer a battery of services to facilitate student loan applications and receipt. For these reasons, we might expect exogenous shocks to institutional revenue in the public sector, and the resulting spillover growth in attendance in the for-profit sector, to translate into substantially increased financial burden on students and

³⁶ See https://nces.ed.gov/programs/digest/d12/tables/dt12_387.asp.

their families, and specifically the amount of debt they use to finance students' education.

Over the period we consider, lending to students more than doubled in real terms, and as such, educational borrowing has independently become a policy parameter worthy of attention. Broadly, educational borrowing reflects a combination of the generosity of available lending programs, attendance rates, college pricing, and financial need. Our analytical framework abstracts from national trends in the generosity of lending at any given time,³⁷ as well as underlying economic conditions that correlate with, and thus proxy for, financial need. While these are important channels informing the rise in aggregate borrowing (which we leave for future work), any shifts in borrowing we detect generally reflect only changes in attendance rates and cost.

The extent to which we expect changes in appropriations to directly affect cost borne by students varies by educational sector. Thus, to motivate our analysis, we wed our attendance results from earlier to this inter-sector variation in price sensitivity. Only public institutions rely on state and local appropriations for revenue; therefore, prices in such institutions might, in theory, respond to changes in funding. As a result, any appropriations-induced borrowing changes we detect are the net result of pricing adjustments and changes in attendance, and within our construction, the two are empirically inseparable. The estimated effect on borrowing in the public sector is slightly positive but indistinguishable from zero (Table 4, column 1), consistent with the array of attendance and pricing estimates we obtain. First, we found that public attendance rises with appropriations increases; however, the increase in attendance was concentrated at community colleges (where tuition and borrowing are relatively low). We will show in the next section that public sector tuitions – measured by both sticker prices and effective prices charged – decrease with appropriations increases. These two

³⁷ For these analyses, we will concentrate on the two major federal lending programs—Federal Family Education Loan (FFEL) and Direct Loan—through which the bulk of educational loans originate.

relationships, taken together, could then offset each other to result in little change in public sector borrowing.

For-profit institutions, however, do not rely on state and local appropriations as a major source of revenue so that to a first order approximation, prices should not directly respond to changes in this type of funding; thus, any appropriations-induced shifts in borrowing at such institutions should reflect only changes in attendance patterns.³⁸ In the second column, we see that given a 10 percent appropriations cut, borrowing increases about 2 percent, in lockstep with attendance growth. Were students not reallocating across sectors, we would not expect appropriations cuts that shock revenue in one sector to stimulate borrowing in another. Therefore, the more fitting narrative for the patterns we observe is that revenue shocks in the public sector are squeezing students into the for-profit sector, where they ultimately rely on a considerable amount of borrowing to cover the cost of attendance. Moreover, given that between 80 and 90 percent of for-profit attendees borrow for their education, our estimate is very much in line with the corresponding increase in attendance we estimate.

As a final exercise, we examine aggregate borrowing across the public and for-profit sectors, which will yield an estimate of the net effect on students and families of revenue-induced shifts in the college-going and college-pricing landscapes. Specifically, if we think of borrowing increases as a transfer of cost burden from governments to families, this estimate approximates the size of that transfer. We find that a 10 percent cut in appropriations generates a 0.7 percent increase in borrowing. Because some institutions draw a large portion of their student body from outside the state, we also restrict the model to borrowing at schools where over two-thirds of the student body draws from residents of that state.³⁹ This restriction enables us to crudely examine institutions where we would expect pricing and attendance decisions to be the most sensitive to state funding,

³⁸ As part of the validity checks at the end of this section, we find that there are no detectable corresponding shifts in borrowing to attend private non-profits, where we do not anticipate either price or attendance responses to an appropriations cut.

³⁹ About 75 percent of the schools in our sample draw at least two-thirds of their students from within the state. The share is a bit higher – closer to 90 percent – among for-profits, and higher still – between 90 and 95 percent – among publics.

in comparison to those that compete nationally or regionally for students who would be less affected by state funding. In the final column, we see that a 10 percent cut in appropriations induces a 1 percent increase in borrowing at this class of institutions.

c. Validity

In this section, we examine the validity of our identifying assumption—that changes in appropriations are not systematically correlated with changes in our error term—so that we may reasonably interpret our estimates as causal. We do this in a few ways: we test for a correlation between appropriations changes and other education and economic outcomes, we alter our main estimating equation (i.e., by including additional controls, varying our specification of appropriations changes, and restricting our sample period to omit the Great Recession and recovery), we perform a falsification exercise, and we explore the potential for reverse causality.

Other Outcomes

We first provide suggestive evidence that appropriations changes are not picking up an excluded variable that is unobservable but that is broadly driving changes in the educational landscape (Table 5a). Specifically, we use equation (1) to examine the effects of appropriations changes on average SAT scores, a measure of academic achievement and college readiness that we would not expect to be affected by variations in the revenue available to public colleges, but that would be affected by, for instance, large-scale reforms (or funding shortages) in publicly-provided education. Effects are indistinguishable from zero (column 1). Next, we consider the effect of appropriations changes on borrowing in the private non-profit sector. While this sector represents between 30 and 40 percent of borrowing nationally over our period of study, as a whole, we would not expect such schools to be particularly revenue-sensitive to appropriations, either directly because they do not receive any of their funding from appropriations or indirectly

because they are fairly insusceptible to changes in in-state attendance patterns.⁴⁰ Thus, we would expect any omitted but important changes in the borrowing landscape, or in broad college-going and college-pricing patterns, that we may be omitting to also induce changes in private sector borrowing. The estimate is again indistinguishable from zero (column 2).

We also test whether the economic controls that we include to increase the precision of our main estimates vary contemporaneously with appropriations. If they did, we might be concerned that our results are driven by economic conditions that underlie appropriations changes, rather than the appropriations changes themselves. Neither the unemployment rate nor grants and contracts vary systematically with appropriations, suggesting that it is, in fact, appropriations changes that are driving the changes in borrowing and attendance we detect (columns 3-4).

Variants on Our Main Specification

We next attempt to rule out other forms of endogeneity by examining the robustness of our main estimates to five variants of our main specification (Table 5b). First, we include state and local budget measures available from annual surveys of U.S. state and local government finances.⁴¹ Specifically, we add controls for changes in tax revenue, pension spending, and spending on health and hospitals for the years these measures are available (i.e., 2000, 2002, 2004-2010). Our results are not sensitive to this inclusion (row 1).

Then, we introduce an accounting for potential procyclicality of appropriations owing to state balanced budget requirements (Clemens and Miran, 2012). The literature finds that state government spending tracks the business cycle with a lag of about one year; therefore, we add a control for the state's lagged unemployment rate. Our estimates are robust to this change (row 2).

Third, because we might be concerned that appropriations determinations today are directly linked to changes in public sector enrollment last year, we

⁴⁰ The average private non-profit institution draws over 40 percent of its student body from outside the state.

⁴¹ U.S. Census Bureau.

include a control for lagged public sector enrollment. Our estimated effects on for-profit attendance and borrowing across publics and for-profits are fully robust to this inclusion, but the effect on for-profit borrowing is smaller and no longer statistically significant, partially due to a reduction in power and a resulting increase in the standard error (row 3).

Fourth, we consider another measure of appropriations changes, whereby we scale by public enrollment in a prior year. This measure is intended to capture changes in dollars allocated per student, which arguably better approximates a resource measure. However, to mitigate concerns that appropriations changes are linked to current enrollment levels or even one-year-prior levels, we scale by a twice-lagged measure of enrollment, and consequently sacrifice two years of data from our analyses. Results are extremely similar to our main estimates (row 4).

Finally, prior findings in this area suggest that for-profit institutions are self-propagating once they draw a critical mass of students to fund their existence (Cellini, 2009). To examine whether there are underlying trends within states that we are not capturing in our analysis (e.g., states that already have a relatively high-growth for-profit sector are more likely to cut appropriations), we re-estimate our main outcomes including state-specific time trends. We note the caveat that these models can overwhelm our statistical power because our analysis relies on just 11 data points for each state; still, our core results are generally robust to their inclusion (row 5).

In the appendix, we present results examining the robustness of the interplay between the public and for-profit sectors to the omission of the unique economic conditions and changing college funding landscape during the Great Recession and the recovery (Appendix Table 2). Additional federal funding was provided to support states' higher education spending as part of the American Recovery and Reinvestment Act of 2009 (ARRA), which we cannot fully isolate in our data. Most significantly, the State Fiscal Stabilization Fund (SFSF) allocated \$48.6 billion to help alleviate substantial budget shortfalls states faced during the recession. For the purposes of our analysis, the ARRA funding can be viewed as an exogenous shock to public funding that could potentially contaminate the

measure we use of funds available to institutions in the 2009 enrollment year.⁴² The first columns demonstrate that our results are not particularly sensitive to the exclusion of that year. Also of potential concern, is whether the Great Recession itself is creating sweeping and rapid changes in the college-going and funding landscape that are driving our results. We might be concerned, for instance, that the recessionary increase in workers who claim to be marginally attached to their industries (i.e., pushing people into vocational training programs when they are not fully unemployed) could drive up for-profit enrollment in ways we do not fully capture in our main equation. The final columns demonstrate that while the effect on public and for-profit borrowing in aggregate is about half the size of our main estimate and no longer statistically significant—partially due to a reduction in power and a resulting increase in the standard error—fully excluding the three recession years from our analysis does not materially change our estimates of spillover activity in the for-profit sector.

Falsification and Reverse Causality

As a falsification test, we test for feedback between our key outcomes and appropriations (Table 5c). For each of our main outcome variables, the estimated effect of appropriations changes tomorrow on changes in conditions today is indistinguishable from zero (columns 1-3). This non-effect helps affirm the timing in how appropriations changes and attendance patterns interact implied by our specification.

Finally, we might be concerned that reverse causality is introducing bias into our analysis if, say, statewide appropriations for higher education are determined at least partially by enrollment in the public sector. At first pass, the relationship between appropriations funding and public sector enrollment that we detect is indeed consistent with this scenario. However, when we take into account our full

⁴² Funds were allocated based on states' relative college-aged and overall populations, and in general, were to be used to restore state support to the budgeted amount for the 2008 or 2009 fiscal year. States were given discretion as to how to allocate their ARRA funds across fiscal years 2009, 2010, 2011, and potentially 2012. ARRA funds made up between 2 and 3 percent of higher education revenue in 2010 and 2011. Very little of the funds were distributed to institutions in fiscal year 2009. See www.deltacostproject.org/sites/default/files/products/Trends2011_Final_090711.pdf.

set of results, it seems unlikely that reverse causality poses a threat to our design, at least in a simple model of higher education funding and enrollment. First, from Table 5b, our estimates are generally not sensitive to the inclusion of lagged public enrollment as a control variable, and, from Table 5c, enrollment changes today do not appear to be correlated with funding changes tomorrow. In addition, the association between overall and public sector enrollment, conditional on our other control variables, is extremely significant and near 1. Thus, if enrollment changes are important determinants of appropriations changes, we would expect higher funding to not only be mechanically correlated with higher public sector enrollment, but also higher enrollment overall. However, we find no effect on the latter. Second, reverse causality would imply that lower for-profit enrollment must be associated with higher public sector enrollment, yet a regression of for-profit sector enrollment on public sector enrollment, again conditional on our other control variables, is insignificant. Moreover, if we take a worst case scenario, namely that the bottom of the 95% confidence interval for this insignificant estimate is the true association between the two sectors of enrollment and calculate the implied effect on for-profit enrollment using our estimated effect of appropriations on public enrollment (0.026), we recover a coefficient that is an order of magnitude smaller than our main estimate. As a final exercise, because enrollment changes this year cannot mechanically induce appropriations changes last year, we instrument appropriations changes today with changes in the prior year, and results are extremely similar (available upon request). With this body of evidence, it is unlikely that reverse causality poses a substantial threat to our design.

5. The Effect of Appropriations on the Supply of a Public Education

The potential for spillover effects to the for-profit sector hinges on funding cuts having a detrimental effect on the baseline education at a public college. We posit that, all else equal, public college systems have two broad ways to adjust their ledger for a shortfall in state funds: (1) increase prices or (2) reduce available resources for students. Adjustments along either margin could induce enrollment

frictions, generating the spillovers to borrowing and attendance we detect. In this section, we investigate these intermediate dimensions along which a funding shock could have affected the public sector and, in turn, students' enrollment decisions.

a. Tuition

A clear margin of adjustment to a revenue shortfall is to increase the cost of college. Thus, we re-estimate equation (1) over several concepts of tuition.⁴³ The first is enrollment-weighted tuition at community colleges—i.e., gross community college tuition paid (either by or on behalf of students) divided by the number of community college attendees. To the extent community colleges and for-profits compete for students, changes in the average price a student must pay to attend a community college will have the most direct influence on her enrollment decision.

This measure best targets our population of interest but conflates several educational decisions likely affected by price changes. First, in a low-pricing environment, some community college students may instead elect to attend a four-year public college, and in a high pricing environment, students along this margin may attend a community college and extensive margin students may opt out of schooling (or the sector) entirely; in all cases, student entry and exit will conflate enrollment counts across pricing environments. Second, unlike four-year colleges where tuition is fixed by level and intensity of enrollment, community college students can elect the number of credits to pursue, subject to the cost of a credit. Community college students have been shown to strategically respond to the amount of credits they pursue in a semester when the price of a class changes (Marx and Turner, 2015), and a model of economic behavior does not deliver an unambiguous prediction for the direction of that effect. Thus, our first measure reflects an additional choice on the part of an attending student—the amount of education to consume—which we cannot distinguish from the true price.

⁴³ College price (at large research universities) is historically insensitive to cohort size (Bound and Turner, 2007), which suggests tuition does not respond to changes in demand for education. If this is the case and we estimate tuition increases in an environment of changing funding, changes in price are likely to be driven by a supply-side factor, rather than a tertiary variable from the demand-side.

We offer a second measure—the flagship sticker price (i.e., tuition and fees) for in-state students—which more cleanly reflects a state’s pricing environment. Compared to any other measure, flagship tuition is not influenced by enrollment mix and most accurately reflects the true intensity of enrollment; however, it also does not precisely capture the typical sticker price faced by our population of interest (unless the flagship price moves in lockstep with the rest of publicly provided higher education in a state).

The third and fourth measures—enrollment-weighted average sticker price and enrollment-weighted average tuition—link the pricing environment in the second measure to tuition revenue in the first measure. Note that reported sticker prices at community colleges are benchmarked to a fixed number of credits in order to be apples-to-apples with four-year institutions. Because of this, we might anticipate a tighter link between average tuition and appropriations than between average sticker prices and appropriations.

All measures of tuition are inversely related to public funding (Table 6). Unsurprisingly, a funding decrease drastically affects tuition collected at community colleges and sticker prices at flagship institutions. In response to a 10 percent funding cut, the price of a public education rises 2 and 1½ percent, respectively. In addition, we see a slightly muted but still positive impact of a funding cut, on the order of 1 percent, on each of the full pricing environment and tuition revenue measures.

b. Resource Reductions

Resource reductions can occur through two channels, either by: dropping expenditures, or increasing the ratio of out-of-state students to in-state students. The first is a simple byproduct of a fixed budget, when one source of revenue falls and other revenue-raising activities are restricted or unavailable. For instance, in the K-12 educational environment, public schools do not charge an explicit cost of attendance, so tuitions cannot be used to raise revenue amidst budgetary shortfalls; instead, spending on instruction has been shown to decrease (Figlio, 1997). The second is a specific lever available to cash-strapped, selective public

postsecondary institutions. There, because public tuitions are higher for out-of-state students than for in-state students, all else equal, an out-of-state student generates more revenue than an in-state student. When there are funding shortfalls, such schools may vary the composition of in- and out-of-state students they admit to make up for lost revenue, resulting in a statewide reduction of admissions slots available to in-state students. Both of these channels could constrain capacity from the perspective of an in-state enrollee.

Schools' payrolls are likely sensitive to the amount of revenue on hand. The number of faculty, and the hours they are expected to work, represent a large portion of such spending. Further, if additional faculty hours translate into increased time available for students and instruction, increased spending in this area may also reflect the resources and quality of education provided by an institution to its students.⁴⁴ We consider three measures of staffing decisions as they pertain to spending on faculty. The first is the total number of full-time faculty members. The second is the total number of part-time faculty members. Part-time hires are cheaper than full-time faculty, but of course come at the expense of faculty hours available to students. Still, adding part-time staff, unless it is at the expense of full-time staff, is not necessarily going to reduce expenses, so the impact of a funding reduction on part-time hires is theoretically ambiguous. The third measure—the fraction of all public school faculty who are part-time—relates to these concepts, and of the three, most directly captures constraint. Struggling institutions might substitute part-time for full-time staff, either by actually replacing expensive faculty members with cheaper ones or, more conceptually, by retaining current staff but reducing their hours to part-time. In either case, the third measure should be unambiguously negatively correlated with funding, which is borne out by our analysis.

Finally, using the information available in the freshmen migration sample, we investigate the extent to which flagship institutions, which generally have

⁴⁴ Research on the effect of the replacement of tenure-track faculty with adjuncts is mixed (Figlio, Schapiro, and Soter, 2015; Bettinger and Long, 2010; Carrell and West, 2010), though it is unlikely that students are dissuaded in their enrollment decisions by higher faculty-student ratios, or more faculty hours per student.

admissions discretion, vary the composition of their student body in response to different funding environments. Most students can become state residents by their second year of school, so from the institution's perspective, only an out-of-state freshman is more revenue-generating than any other student. Jacquette and Curs (2014) find that the elasticity of non-resident freshmen enrollment to state appropriations is negative and significant at public research institutions. When institutions focus on increasing out-of-state enrollment, in-state students might lose admissions slots.

We estimate each faculty outcome following equation (1) over the DCP sample and flagship admissions over the freshmen migration sample (Table 7). Full-time faculty counts are positively associated with funding shocks, whereas part-time faculty counts are negatively associated, though neither is statistically significant (columns 1-2). As expected, the fraction of public school faculty members who are part-time employees is inversely tied to such shocks (column 3). The point estimates suggest that the share of faculty on part-time status increases about three-tenths of a percentage point from a 10 percent decline in public funds.

We also find some evidence that public four-year institutions vary their composition (column 4), such that a 1 percent increase in funding produces a larger share of in-state students on the order of 0.1 percentage point, a small percent of the mean.⁴⁵ On average, 79 percent of the freshmen class at a four-year institution are from the state in which the school is located.

Finally, while our data do not allow us to directly test one potentially-important channel that would help generate the substitution effects we detect – i.e., that public sector classes become oversubscribed – our results are certainly consistent with that mechanism operating. Our results show that capacity constraints for in-state students, measured by faculty resource reductions and increased enrollment of out-of-state students, are important byproducts of state

⁴⁵ These findings are consistent with Jacquette and Curs (2014), as they do not find a significant elasticity of resident freshmen enrollment to appropriations, implying the share of in-state freshmen would be positively correlated with appropriations.

appropriations cuts, the effects of which would likely be amplified without a for-profit sector to absorb some students.

6. Discussion and Conclusion

We find evidence that the uneven fluctuations in state and local appropriations to higher education that took place between 2000 and 2010 induced both statistically and economically significant shifts in attendance and borrowing patterns. We estimated that every 10 percent cut in appropriations statewide generated a 2 percent rise in for-profit enrollment, owing entirely to students who, in a better funding environment, would have attended a public institution. Our results suggest that for a 10 percent cut, public sector losses are about offset by for-profit sector gains, with an MRS of 0.85. We hypothesize that public schools price-adjusting in response to an appropriations cut that, together with a shift in attendance toward a higher-borrowing sector, would induce an overall increase in debt financing of education among students and their families. We recover a corresponding increase in annual borrowing across the two sectors of 0.7 percent, driven by the for-profit sector. In the remainder of the paper, we present suggestive evidence that funding cuts indeed produced substantial bottlenecks for prospective students with respect to both public tuitions and the resources available to students in the public sector. As a result, students were squeezed out of the public sector and into the for-profit sector, where they proceeded to accumulate large amounts of debt to finance their education. The funding-driven reallocation of students across sectors over these pivotal years contributes to the run-up in for-profit enrollment and borrowing that challenges policymakers today.

We conclude by considering questions of interest that arise from our main findings, but that our core research design does not address. First since our estimation strategy relies on variation within states and years, the borrowing and attendance effects we identify are, by design, rather immediate responses to changes in appropriations funding. It may very well be the case that in reality, school pricing and spending decisions take time to fully adjust to funding shocks, or that students' attendance and borrowing decisions partially rely on school

performance-based metrics that themselves take time to adjust to funding. Indeed, the cumulative effect of appropriations changes on our main outcomes when we include two lagged terms is magnitudinally, but not statistically, larger than our main results. In the event that the demand side response is more gradual than the one our estimation strategy allows for, our estimates should be interpreted as a lower bound estimate of the full effects of a funding cut. Future work could explore the medium-run effects of appropriations cuts and allow for a more dynamic treatment of the relationship between public sector funding and demand-side responses.

As a final exercise, we offer a suggestive derivation of the elasticity of enrollment in the for-profit sector with respect to conditions in the public sector. In our main analyses, we found tuition to be a particularly important channel, both in its responsiveness to funding cuts and its causal role in reallocating students across sectors. In Appendix 2, we relate the change in for-profit attendance to funding-driven variation in two of our price measures—flagship tuition (which we argue, owing to its relative responsiveness, is the first line of defense public college systems employ against a funding cut) and average tuition (the price faced by a typical public school attendee). For some estimates, we derive additional variation from the extent to which a state can use college prices to offset changes in other revenue streams. Results generally suggest a cross-price elasticity of for-profit attendance between 1 and 1.5.⁴⁶

⁴⁶ Because our results throughout the paper suggest that a number of other supply-side mechanisms are also operating, the estimate this exercise yields is likely an upper bound of the true relationship.

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Table 1: Descriptive Statistics

Delta Cost Project Data			
	<i>N</i>	mean	sd
For-Profit Allocation			
for-profit/(for-profit+cc)	550	20.4	12.8
for-profit/(for-profit+public)	550	8.0	7.3
for-profit enrollment	550	21,284	40,764
Public Allocation			
enrollment in public schools	550	185,995	213,530
freshmen enrollment in public schools	550	30,324	29,182
flagship freshmen	550	4,813	3,374
community college freshmen	550	12,427	14,373
Faculty Resources			
full-time faculty	550	8,556	8,261
part-time faculty	550	7,118	8,792
share of faculty that are part-time	550	41.0	10.3
Tuition			
flagship sticker price (real\$)	550	6,726	2,412
enrollment-weighted tuition (real\$)	550	6,743	2,587
enrollment-weighted community college tuition price (real\$)	550	3,730	1,419
enrollment-weighted sticker price	550	4,935	1,844
Revenue, Borrowing, and Controls			
appropriations (billions real\$)	550	1.62	2.01
grants (billions real\$)	550	0.36	0.48
borrowing, private nonprofit (billions real\$)	550	0.367	0.525
borrowing, for-profit (billions real\$)	550	0.212	0.526
borrowing, public (billions real\$)	550	0.521	0.473
borrowing, public and for-profit (billions, real\$)	550	0.733	0.818
borrowing, public and for-profit, >2/3 in-state-attendees (billions, real\$)	550	0.595	0.710
unemployment rate	550	5.2	1.8
college-aged population	550	575,987	642,486
18-year-old cohort	550	83,632	92,780
Freshmen Migration Data			
(public _{stay_in_state})/(for-profit+public)	204	78.8	10.9
(flagship _{in_state})/(flagship)	204	71.3	15.9
appropriations (billions real\$)	204	1.53	1.99
grants (billions real\$)	204	0.31	0.44
unemployment rate	204	6.1	2.2
18-year-old cohort	204	85,011	97,340

Table 2: Effects of Appropriations on Public Attendance

	log(public enrollment)	log(public freshmen)	log(flagship freshmen)	log(community college freshmen)
log(appropriations)	0.026** (0.011)	0.048*** (0.016)	0.019 (0.024)	0.148** (0.062)
log(grants)	-0.021* (0.012)	-0.004 (0.015)	0.030 (0.020)	-0.075* (0.042)
UR	0.011*** (0.003)	0.010** (0.005)	0.003 (0.008)	0.049*** (0.017)
log(18-24 year olds)	0.300*** (0.090)			
log(18 year olds)		0.727*** (0.143)	0.137 (0.142)	1.241*** (0.325)
constant	7.638*** (1.035)	1.040 (1.745)	5.836*** (1.744)	-6.56 (4.661)
N	550	550	550	550

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2000–2010 (inclusive). Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Effects of Appropriations on Attendance Patterns and For-Profit Enrollment

	log(overall enrollment)	(for-profit enrollment)/ (for-profit enrollment + community college enrollment)	(for-profit enrollment)/ (for-profit enrollment + public enrollment)	log(for-profit enrollment)
log(appropriations)	-0.005 (0.024)	-7.113*** (1.616)	-3.154** (1.292)	-0.196*** (0.060)
log(grants)	-0.02 (0.015)	-0.486 (1.332)	-0.174 (0.716)	-0.083 (0.081)
UR	0.011** (0.004)	-0.317 (0.426)	0.014 (0.223)	0.027 (0.022)
log(18-24 year olds)	0.454** (0.224)	4.443 (14.854)	7.191 (11.566)	-0.120 (0.672)
constant	6.368* (3.358)	121.738 (219.708)	-15.481 (176.715)	15.993 (9.608)
N	550	550	550	550

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. Enrollment measured as FTE students. Overall enrollment includes all students enrolled at any public institution or for-profit institutions. All regressions include state and year effects. The estimation sample is all 50 states, over academic years 2000–2010 (inclusive). Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Effects of Appropriations on Borrowing

	log(borrowing at public schools)	log(borrowing at for-profit schools)	log(borrowing at public and for-profit schools)	log(borrowing at public and for-profit schools with >2/3 in-state attendance)
log(appropriations)	0.006 (0.030)	-0.196** (0.094)	-0.069** (0.034)	-0.099*** (0.036)
log(grants)	0.052 (0.036)	-0.123 (0.159)	0.044 (0.036)	0.039 (0.036)
UR	0.029*** (0.008)	0.054** (0.027)	0.030*** (0.010)	0.034*** (0.009)
log(18-24 year olds)	-0.025 (0.232)	-1.312 (0.803)	0.068 (0.361)	0.448 (0.342)
constant	18.538*** (3.317)	39.857*** (10.830)	19.186*** (5.185)	14.646*** (4.891)
N	550	549	550	550

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2000–2010 (inclusive). Data indicate there was no for-profit borrowing in Mississippi in 2000. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 5a: Validity Checks, Omitted Variables

	the effect of appropriations on other outcomes			
	average SAT Score	log(borrowing at private non-profit schools)	unemployment rate	log(grants)
log(appropriations)	-11.465 (7.828)	-0.026 (0.069)	-1.135 (0.810)	-0.120 (0.179)
log(grants)	1.792 (3.576)	-0.042 (0.044)	-0.392* (0.207)	
UR	1.948 (1.546)	0.043 (0.026)		-0.051 (0.031)
log(18-24 year olds)	-70.485** (0.019)	0.582 (1.083)	5.169*** (1.657)	0.198 (0.585)
constant	2159.532*** (395.235)	12.407 (14.557)	-30.979 (24.406)	18.512** (7.764)
N	550	550	550	550

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2000–2010 (inclusive). Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 5b: Validity Checks, Alternative Specifications

	log(borrowing at public and for- profit schools)	log(borrowing at for-profit schools)	log(for-profit enrollment)	N
including controls for state and local budget (i.e., log(tax revenue), log(pension spending), log(health and hospital spending))	-0.062* (0.035)	-0.197** (0.091)	-0.203*** (0.062)	550
allowing for a lag in the business cycle (i.e., UR _{t-1})	-0.623* (0.034)	-0.175** (0.086)	-0.177*** (0.060)	550
including lagged public enrollment (i.e., log(public) _{t-1})	-0.078** (0.030)	-0.131 (0.102)	-0.174*** (0.061)	500
scaling key appropriations measure by lagged public enrollment (i.e., log(appropriations _t /public _{t-2}))	-0.103*** (0.027)	-0.168* (0.095)	-0.182*** (0.066)	450
adding state-specific time trends	-0.062** (0.028)	-0.229** (0.090)	-0.173* (0.100)	550

Notes: Each cell reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header and the perturbation of the main estimating equation is denoted by the row title. All regressions include state and year effects, as well as controls for the unemployment rate, the cohort size, and state and local grants and contracts to public universities. The estimation sample is all 50 states, academic years 2000–2010 (inclusive) in rows 1, 2, and 5, academic years 2001–2010 (inclusive) in row 3, academic years 2002–2010 (inclusive) in row 4. Data indicate there was no for-profit borrowing in Mississippi in 2000. State and local budget controls for row 1 are unavailable for 2001 and 2003: they are coded to zero and the regression includes a control for whether the budget data are missing. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 5c: Validity Checks, Falsification Exercise

the effect of next year's appropriations on key outcomes this year			
	log(borrowing at public and for-profit schools)	log(borrowing at for-profit schools)	log(for-profit enrollment)
log(appropriations _{t+1})	-0.041 (0.044)	-0.151 (0.106)	-0.113 (0.079)
log(grants)	0.046 (0.037)	-0.125 (0.150)	-0.082 (0.079)
UR	0.034*** (0.012)	0.073** (0.031)	0.041* (0.023)
log(18-24 year olds)	0.056 (0.350)	-1.189 (0.770)	-0.082 (0.654)
Constant	18.720*** (5.092)	37.331*** (10.140)	13.139 (9.501)
N	500	499	500

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2001-2010 (inclusive). Data indicate there was no for-profit borrowing in Mississippi in 2000. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Effect of Appropriations on Tuition

	log(enrollment-weighted tuition at community colleges)	log(flagship sticker price)	log(enrollment-weighted sticker price)	log(enrollment-weighted tuition)
log(appropriations)	-0.222*** (0.043)	-0.134*** (0.039)	-0.074* (0.041)	-0.110*** (0.023)
log(grants)	-0.035 (0.038)	-0.021 (0.022)	-0.002 (0.019)	0.016 (0.032)
UR	0.000 (0.010)	0.010 (0.009)	0.010 (0.007)	0.004 (0.007)
log(18-24 year olds)	-0.055 (0.166)	-0.020 (0.228)	-0.096 (0.186)	-0.063 (0.143)
constant	14.127*** (2.443)	12.135*** (3.070)	11.195*** (2.538)	11.505*** (1.900)
N	550	550	550	550

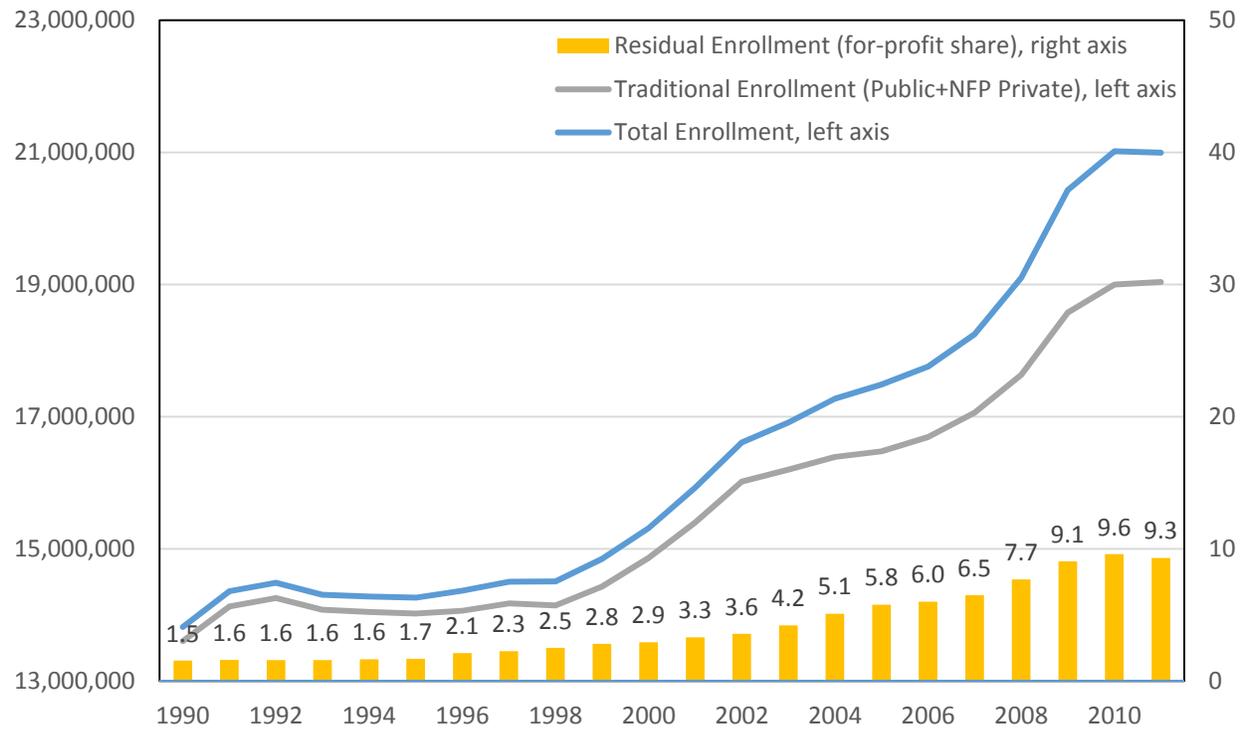
Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2000–2010 (inclusive). Enrollment-weighted tuition is derived by aggregating gross tuition and fees revenue (i.e. tuition and fees collected from the student plus scholarships applied to tuition and fees) from each institution to the state-year and dividing by aggregate FTE enrollment. The sticker price is the lowest of in-state and in-district sticker prices for tuition and fees reported by the school to the Department of Education, weighted by distribution of enrollment within a state-year where relevant. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Effects of Appropriations on Resources

	log(full-time faculty)	log(part-time faculty)	% faculty who are part-time	flagship composition
log(appropriations)	0.018 (0.026)	-0.106 (0.069)	-2.452* (1.233)	8.226*** (2.892)
log(grants)	0.004 (0.026)	-0.063 (0.056)	-1.517 (1.393)	2.342 (1.917)
UR	-0.002 (0.006)	0.014 (0.021)	0.373 (0.424)	0.437 (1.195)
log(18-24 year olds)	0.071 (0.214)	0.578 (0.650)	3.284 (9.202)	
log(18 year olds)				-1.838 (3.995)
constant	7.279*** (2.987)	3.961 (7.752)	72.108 (134.091)	-124.930*** (37.131)
N	550	550	550	204

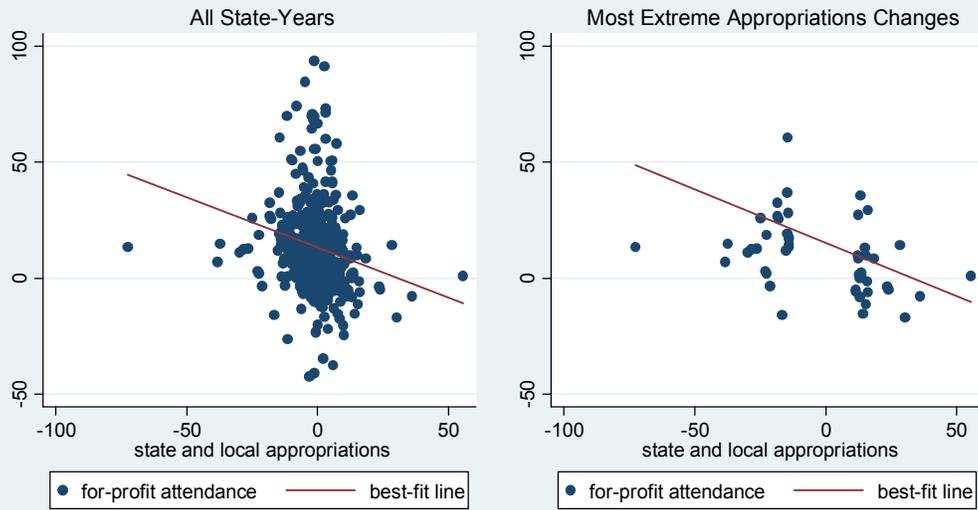
Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects. The estimation sample is all 50 states, academic years 2000–2010 (inclusive). Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Figure 1. Fall Enrollment in Degree-Granting Institutions



Source: U.S. Department of Education, Digest of Education Statistics 2012, Table 223.

Figure 2: Appropriations and For-Profit Attendance
Year-over-Year Percent Changes



Notes: Graphs plot the year-over-year percent change in appropriations against year-over-year percent change in for-profit attendance for 50 U.S. states (2001-2010).
Right figure restricts to top and bottom 5% of appropriations changes, only.
Outliers are removed from picture but not fit measure. Fit coefficients are -0.434 and -0.460, respectively.

For Online Publication

Appendix 1: Geographic Allocation

The enrollment analyses link student enrollment decisions to funding conditions in a student's state of attendance. This presumes most students are geographically constrained in their educational decisions, such that a drop in a state school system's available funding primarily operates by squeezing students into other sectors within that same state. We would have preferred to evaluate whether changes in public funding within a state's public school system potentially limit the opportunities of students within that state. According to the Digest of Education Statistics, about 20 percent of freshmen attend school in a state other than their home state.⁴⁷ Thus, there exists a potentially important geographic channel through which the allocation of students could adjust in response to changes in funding. If, on the whole, college-goers do not appear to pursue education in another state in response to funding cuts, funding conditions in the student's state of attendance are a reasonable proxy for funding conditions in a student's state of residence, which is an important check of our main identifying assumption that students are fairly geographically constrained with respect to the funding conditions in their home state.

Here we investigate how initial college-going decisions are affected by shifts in public funding. In other words, we estimate the enrollment response to funding conditions in a student's home state.⁴⁸ We focus on freshmen college-goers since migration is best measured for this group. State of residence, by which migration is measured, is not a meaningful concept after the first year of school.⁴⁹ Further, compared to non-freshmen enrollees—i.e., retained students, transferring students, or returning older students who might be less mobile and/or are pursuing a particular program of study—an incoming freshman's attendance decision is likely most sensitive to school resources.

⁴⁷ See http://nces.ed.gov/programs/digest/d10/tables/dt10_232.asp.

⁴⁸ Our sector analyses link student enrollment decisions to funding conditions in their state of attendance: if student attendance decisions are instead driven by funding conditions in their state of residence, and that is a distinct concept from the state in which they attend school, we would need to account for that in our main analyses.

⁴⁹ All of this said, of for-profit full-time undergraduates, 17.5 percent are freshmen, compared with 23 percent of public full-time undergraduates; as a result, estimates from these analyses likely overstate the extent to which geographic responses to public funding offset sectoral shifts. See http://nces.ed.gov/programs/digest/d10/tables/dt10_203.asp and http://nces.ed.gov/programs/digest/d13/tables/dt13_326.30.asp to derive freshmen share of fall enrollees (in 2008).

We estimate equation (1) with the fraction of students from state s attending a public school in state s on the left-hand side, again using the number of 18-year-olds in a state as our cohort measure to best capture at-risk freshmen. The coefficients suggest that a very small portion of students—an amount indistinguishable from zero—geographically respond to changes in funding in their home state (Appendix Table 1).

Appendix 2: Cross-Price Elasticity of Demand for a For-Profit Education

The analyses in the text provide suggestive evidence on channels through which funding cuts are likely to operate to reallocate students across sectors, but do not directly link changes in supply-side metrics to demand outcomes. We now attempt to isolate the causal impact of our most responsive channel – price at public institutions – on for-profit attendance. The framework we consider follows two stage least squares (2SLS) setup, where we allow appropriations funding to serve as an instrument for our endogenous measure, price.

First stage:

$$\ln(\text{tuition})_{st} = \alpha_1 + \alpha_2 \times \ln(\text{appropriations})_{st} + \mathbf{X}_{st}\boldsymbol{\theta} + \gamma_t + \gamma_s + \varepsilon_{st}$$

Second stage:

$$\ln(\text{for} - \text{profit enrollment})_{st} = \beta_1 + \beta_2 \times \ln(\widehat{\text{tuition}})_{st} + \mathbf{X}_{st}\boldsymbol{\theta} + \gamma_t + \gamma_s + \mu_{st}$$

We consider both the enrollment-weighted posted tuition at all public schools and the sticker price at flagships as endogenous price measures with β_2 as our key parameter. Based on our inspection of the underlying data, we observe potential time trends within states in their pricing, even after we remove national trends. Therefore, we present only specifications that include state-specific time trends and year effects. (Recall that our baseline regressions were robust to the inclusion of such trends.) Taken at face value, our estimates suggest that for every funding-induced percent increase in tuition, there will be a commensurate enrollment increase of around 1.5 percent in the for-profit sector (Appendix Table 3).

Note that our work throughout this paper would imply that the exclusion restriction we need to identify causality in this setting is violated. Other intermediate supply-side outcomes respond to funding changes and could potentially affect demand for for-profit education, and thus will be contained in μ_{st} . Thus, this exercise is merely a suggestive derivation of a cross-price elasticity of demand, ignoring the other channels.

Still, it seems plausible that a tuition increase is the first-best response to a funding cut from an institution's perspective. For a number of reasons, it is conceivable that states and schools would rather shift the burden of educational financing to the federal government and families than damage their educational quality. Taking this further, we leverage additional variation in tuition-setting flexibility, which will proxy for the extent to which states must offset appropriations cuts with quality reductions. In other words, if we isolate state systems that can

systematically adjust tuition, we are less concerned that the 2SLS estimates are confounded by other key intermediate outcomes of a funding cut.

Every few years, state legislatures report on the primary body responsible for setting public tuition in a state.⁵⁰ Using this information, we classify states into two groups according to how centralized they report their tuition-setting practices to be, under the assumption that more uniform systems are more likely to systematically offset appropriations decreases with price increases. We interact centralized authority with changes in state funding, so the first-stage equation becomes

$\ln(\text{tuition})_{st} =$

$$\alpha_1 + \alpha_2 \times \ln(\text{appropriations})_{st} + \alpha_3 \times \ln(\text{appropriations})_{st} \times \text{central} + \mathbf{X}_{st}\boldsymbol{\theta} + \gamma_t + \gamma_s + \varepsilon_{st}.$$

The estimated effect is thus partly determined by how responsive we expect tuition to be to changes in funding in states with centralized tuition-setting practices. In the first-stage estimate, we find a significant, negative impact of centralized tuition on the relationship between funding and tuition, as expected. Results from the 2SLS estimation are slightly strengthened and qualitatively similar compared with the previous models (Appendix Table 3).⁵¹ Results indicate a cross-price elasticity of for-profit attendance between 1 and 1.5.

⁵⁰ This information is gathered through surveys fielded by the State Higher Education Executive Officers (SHEEO). Additional information can be found at www.sheeo.org/resources/publications/state-tuition-fees-and-financial-assistance-policies.

⁵¹ Because of potential concerns with endogeneity of appropriations for non-centralized tuition-setting states, we re-estimated the 2SLS results only using state-year observations that had centralized practices. Results are consistent with what we report here.

Appendix Table 1: Effects of Appropriations on Freshmen Migration

	[in-state public freshmen/(all public and for-profit freshmen from state)]
log(appropriations)	0.364 (0.921)
log(grants)	0.064 (0.833)
UR	0.137 (0.318)
log(18 year olds)	-17.267 (10.798)
constant	256.440** (121.377)
N	204

Notes: Table reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. Regression includes state and year effects. The estimation sample is all 50 states, even academic years 2004–2010 (inclusive). Data indicate there was no for-profit borrowing in Mississippi in 2000. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Appendix Table 2: Effects of Appropriations on Borrowing and Attendance, Sensitivity Analyses

	the effect of appropriations on key outcomes, excluding key ARRA year (i.e., Academic Years 2000–2009)			the effect of appropriations on key outcomes, excluding the Great Recession and Recovery (i.e., Academic Years 2000–2007)		
	log(borrowing at public and for- profit schools)	log(borrowing at for-profit schools)	log(for-profit enrollment)	log(borrowing at public and for- profit schools)	log(borrowing at for-profit schools)	log(for-profit enrollment)
log(appropriations)	-0.051 (0.036)	-0.222* (0.117)	-0.212*** (0.067)	-0.036 (0.054)	-0.230** (0.104)	-0.153* (0.100)
N	500	499	500	400	399	400

Notes: Each column reports coefficients from an OLS regression, where the outcome of interest is denoted by the column header. All regressions include state and year effects, as well as controls for the unemployment rate, the cohort size, and state and local grants and contracts to public universities. The estimation sample is all 50 states, academic years 2000–2009 (inclusive) and 2000–2007 (inclusive). Data indicate there was no for-profit borrowing in Mississippi in 2000. Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Appendix Table 3: LATE Estimates of Funding-Driven Price Effects on For-Profit Enrollment

	flagship sticker price	enrollment-weighted sticker price
	baseline	
log(tuition)	1.367*	1.229*
	(0.729)	(0.693)
first-stage F statistic	40.6	25.2
	accounting for centralization	
log(tuition)	1.437**	1.283*
	(0.735)	(0.712)
first-stage F statistic	19.7	13.5

Notes: Each panel reports coefficients from the second stage of a 2SLS regression, where the outcome of interest is log(for-profit enrollment), the endogenous tuition concept is denoted by the column header, and the instrument is log(appropriations). The bottom of each panel reports the first-stage F statistic. The panel header denotes an additional restriction imposed on the estimating equation. All regressions include state and year effects, state-specific time trends, and state-year controls for unemployment rate, log(college-aged cohort) and log(state and local grants and contracts). The estimation sample is all 50 states, over academic years 2000–2010 (inclusive). Standard errors clustered at state level in parentheses. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.