The Effect of State Funding for Postsecondary Education on Long-Run Student Outcomes*

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Abstract

Most public colleges and universities rely heavily on state financial support for operation. As state budgets have tightened over the past several decades, appropriations for higher education have declined substantially, especially at less-selective institutions that tend to serve students with lower levels of collegiate preparation. Despite concerns expressed by policymakers and scholars that the declines in state support have reduced the return to education investment for public sector students, little evidence exists that can identify the causal effect of these funds on long-run student outcomes. We present the first such analysis in the literature using new data that leverages the merger of two rich datasets: consumer credit records from New York Fed's Consumer Credit Panel (CCP) sourced from Equifax and administrative college enrollment and attainment data from the National Student Clearinghouse. We overcome identification concerns related to the endogeneity of state appropriation variation using an instrument that interacts the baseline share of total revenue that comes from state appropriations at each public institution with yearly variation in state-level appropriations per college-age resident. This "shift-share" instrument exploits the fact that a statewide change in appropriations for higher education will have larger effects on institutions that are more reliant on state funds. Our focus is on state appropriation shocks that occur when students are already enrolled in college, which allows us to abstract from extensive margin effects. We examine the effect of state appropriations among 25-30 year olds and 30-35 year olds, separately by whether students initially enrolled in a four-year or two-year institution. Our findings indicate that state appropriation shocks students experience in college have long-lasting impacts on their life outcomes into their mid-30s. Among students whose first college is a four-year institution, state appropriation increases during college lead to a lower probability of having any student loan debt, lower student debt balances, higher credit scores, and increased likelihood of owning a car and a home. For two-year students, state appropriations increases lead to higher credit scores, an increased likelihood of owning a car and a home, and higher auto and home mortgage loan balances. Our results underscore the importance of state support for higher education in driving the returns students experience to investing in college and highlight the role played by declining state appropriations in increasing inequality and stratification of outcomes in the postsecondary sector.

KEYWORDS: Postsecondary Education, State Appropriations, Student Loans, Returns to Education

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1 Introduction

The US higher education system is dominated by public institutions that rely heavily on state funding. In the 2014-2015 school year, state appropriations accounted for 23% of total expenditures among all public institutions; state appropriations covered 32% of expenditures in public two-year institutions and were 21% of expenditures in public four-year universities. In total, states spent $77 billion dollars in support of public higher education in 2014-2015, $65 billion of which was direct appropriations.[1] Understanding the importance of state financing of higher education has taken on increased importance in recent years due to significant reductions in such support. In 1990-1991, state appropriations covered 39% of total expenditures. This percent dropped to 33% by 2000 and to 26% by 2005. The declining state support of public higher education institutions is a particular concern for less-selective institutions as they tend to rely much more on state funding. These institutions also serve a disproportionate percentage of students from low-income and disadvantaged backgrounds.[2] Thus, over time, reductions in state appropriations have contributed to the increased stratification of resources in the postsecondary sector, wherein resources are increasingly concentrated in a small set of elite universities that serve the most academically-advanced students (Hoxby 2009; Bound, Lovenheim and Turner 2010).

Declining state support for higher education is of concern if it reduces the return to postsecondary investments made by students. This question has received very little attention in the research literature to date, likely owing to the difficulty in isolating exogenous variation in state appropriations and linking such variation to long-run outcomes. Institutions that rely more on state funding tend to have lower-resources and are less selective, and variation over time in state appropriations is likely to be correlated with the financial health of the state, the business cycle, funding priorities of voters in the state, and the need to fund other state programs. Furthermore, variation in state appropriations can affect resource levels of the university and tuition levels (Deming and Walters 2017), which can alter the composition of students attending each institution. Estimating the effect of state appropriations on the returns to education

[1] These tabulations come from the Digest of Education Statistics, Table 333.10. In addition to appropriations, states provide revenues to higher education institutions in the form of grants and contracts.

[2] See Figures 7 and 8 for direct evidence of these patterns in our data. These figures are discussed in Section 3.

thus requires both exogenous variation in revenues coming from the state as well as individual data on educational and labor market outcomes. A large body of work exists that suggests there is a substantial return to college quality both in terms of labor market outcomes (Brewer, Eide and Ehrenberg; Black and Smith 2004, 2006; Hoekstra 2009; Long 2010; Andrews, Li and Lovenheim 2016; Zimmerman 2016)[3] and in terms of educational attainment (Bound, Lovenheim and Turner 2010, 2012; Cohodes and Goodman 2014; Goodman, Hurwitz and Smith 2015; Chakrabarti and Roy 2017). One prevalent measure of college quality is per-student expenditures, which vary systematically with state appropriation (Deming and Walters 2017). What has received little attention in the literature, however, is whether changes in state higher education funding can directly affect student outcomes in the manner suggested by the returns to college quality research. The answer to this question has direct policy importance, since state appropriations is a policy tool that state policymakers can directly change through the budgeting process. Estimating the causal effect of state appropriations also is of interest because it provides additional evidence on how postsecondary spending affects the returns to college investment.

This paper provides one of the first analyses of the causal effect of state appropriations on student outcomes using an empirical method that can plausibly overcome the endogeneity of state funding decisions. It is the first to use such variation to examine long-run outcomes of students. One of the innovations of this analysis is to use novel data from a new data merger that links consumer credit records with postsecondary enrollment and attainment histories. These data are constructed by a merge of the New York Fed Consumer Credit Panel (CCP) sourced from Equifax with the National Student Clearinghouse (NSC). The CCP data consist of a 5% random sample of US individuals with credit files and all of the household members of those 5%. The panel follows individuals, and thus for over 5% of Americans with any credit, we observe the history of credit card debt, student debt, mortgage debt, and consumer durables debt (such as cars). We also can observe whether (and when) individuals have debt in delinquency, whether (and when) they have defaulted on any loan, and whether (and when) they have declared bankruptcy. Finally, the data contain a credit score, which is a useful

[3]Notable exceptions to the finding of a positive labor market return to college quality are Dale and Krueger (2002, 2014). However, they do find positive effects for students from low-income backgrounds.

summary measure of the ability to handle debt responsibly, is highly correlated with labor market outcomes, and is an indicator of future credit access.

These data have been merged with the National Student Clearinghouse data that contain term-by-term enrollment information as well as major and degree attainment. For each individual in the linked dataset, we can observe whether and where they attended college, for how long, and debt accumulation both in college and after. We also observe information on post-collegiate enrollment in graduate programs. Together, these data provide a level of detail on students and their financial outcomes previously unavailable to researchers. The dataset we construct spans 1986 through the fourth quarter of 2016. We primarily focus on outcomes among two age groups: 25-30 year olds and 30-35 year olds. This allows us to trace out the timing of any effects on former students through their mid-30s. Given the timing of our outcome data, our analysis uses information on birth cohorts 1975-1986 for the 25-30 year old analysis and on birth cohorts 1975-1981 for the 30-35 year old age group.

In order to overcome the endogeneity of state appropriations, we use an instrumental variables approach that follows the insights of the shift-share instrument first proposed by Bartik (1991) to study labor markets. Specifically, we exploit the fact that state-level changes in appropriations will affect institutions differently depending on how reliant they are on state funding. Thus, we specify a base year proportion of total revenues that come from state appropriations, and we multiply this state appropriation share by the annual level of overall state appropriations per college-age resident in each state. This instrument is valid as long as state decisions about how much money to allocate to higher education are uncorrelated with unobserved changes in the productivity of any specific college or university in the state. Given the large number of postsecondary institutions in most states, this assumption is plausible.

A recent analysis uses the same instrumental variables approach to examine the effect of state appropriations on college enrollment and completion using institution-level data from IPEDS (Deming and Walters 2017). They show that this instrument is highly positively correlated with per-student spending and that it induces changes along the extensive margin. That is, student enrollment at a given institution responds to exogenous shocks to state appropriations. The focus of our paper is on the effect of state appropriation changes among students who are already

enrolled in a given institution. We therefore characterize students according to the college in which they are enrolled as of their second (sophomore) year.[4] The shift-share appropriations change is then calculated as the average over 6 years of potential enrollment among four-year students and over 3 years of potential enrollment among two-year students. Because private colleges and universities do not receive state appropriations, we focus exclusively on public institutions.

Our main findings indicate that state appropriation shocks students experience in college have long-lasting impacts on their life outcomes into their mid-30s. We stratify the sample according to whether the first postsecondary institution attended by the students were in a four-year university or two-year college as of their sophomore year and examine models separately for these groups. Our focus in this analysis is on the reduced form effect of the state appropriations instrument on outcomes among two age groups: 25-30 and 30-35 year olds. For extensive margin outcomes, (e.g., the likelihood of having any student debt), we examine whether individuals have specific forms of debt by age 30 and 35, while for intensive margin outcomes we focus on average debt levels between ages 25-30 and 30-35. We first show that the state appropriations instrument is strongly related to actual state appropriations per student at the institutional level. Shocks to overall state appropriations have a larger impact on state revenues at institutions that historically rely more on state appropriations to fund operating expenditures. We then examine how variation in the shift-share instrument affects a range of longer-run outcomes available in the CCP and NSC data: student loan debt, credit scores, credit card debt, auto loans, home mortgage balances, and graduate school enrollment.

Among students whose first college is a four-year institution, our results indicate that positive state appropriation shocks during college lead to a lower probability of having any student loan debt for both age groups, lead to a lower student debt balance for 25-30 year olds, and have a positive effect on credit scores for 30-35 year olds. The last result is striking because credit scores are a strong summary measure of well-being later in life. We also find that state appropriation shocks increase the likelihood of owning a car (as measured by having any auto loan debt), the amount of auto loan debt, and the likelihood of having a home mortgage (as measured by having any home mortgage debt). These effects are most prominent for those who are 30-35,

[4]For ease of exposition, we will refer to students in their second year of enrollment (excluding summers) as sophomores.

which underscores the importance of examining longer term outcomes.

Results among the two-year sample are similar along many dimensions to those of their four-year counterparts. While still negative and statistically significant in most cases, we find less robust evidence of a link between state appropriations and student loan outcomes among two-year students. This likely reflects the fact that two-year students are more likely to enroll in graduate programs when they experience positive state appropriation shocks. Since graduate enrollment leads to higher debt levels (Looney and Yannelis 2015), debt outcomes are difficult to interpret for this sample. We find more consistent evidence of positive effects of state appropriation shocks on other long-run outcomes for this group. Increases in state appropriations when enrolled in college lead to higher credit scores among both age groups. Among 30-35 year olds, the likelihood of having both an auto and home loan and the amount of these loans also increase due to state appropriation increases. Together, the educational outcomes and long-run credit outcomes point to sizable increases in outcomes due to higher state appropriation levels in college that persist into the mid-30s.

The main contribution of this paper is to provide the first estimates of the causal effect of state appropriations on long-run financial and credit outcomes of college students. As discussed above, the large literature on the return to college quality is suggestive of such an effect, but most prior work has not been able to isolate the impact of changes in state appropriations, per se, or of institutional spending more broadly. Bound and Turner (2007) provide one of the only causal analyses of the effect of per-student institutional resources on academic attainment. They exploit the fact that state appropriations adjust slowly to changes in student demand, which motivates the use of college-age cohort size as an instrument for per-student spending. The findings indicate that college-age population increases reduce resources and subsequent degree production because of what the authors term "cohort crowding."[5] Our approach differs from theirs in using variation in state funding that is directly under the control of policymakers and that comes from the supply side rather than from the demand side of the market.

The paper most related to ours is Deming and Walters (2017), who use a similar shift-share instrument to estimate the effect of state appropriations on college enrollment and completion.[6]

[5]Bound, Lovenheim and Turner (2010) show the completion effects are robust to controlling for student background characteristics, including high school test scores.

[6]Goodman and Henriques (2018) also show that state appropriation declines are associated with a switch to for-profit institutions.

Our analysis is distinguished from theirs, as well as from Bound and Turner (2007), along two important dimensions. First, we abstract from the extensive margin to focus specifically on the effect of state funding changes among students already enrolled in a given institution. Deming and Walters (2017) and Bound and Turner (2007) show that state funding shocks in the year prior to potential enrollment affect both enrollment and completion. Critically, these papers cannot distinguish between completion effects stemming from changes in enrollment versus changes in persistence. Our approach abstracts from the enrollment margin, such that any effects are driven by how state appropriation shocks impact already-enrolled students.

Second, we leverage the unique CCP-NSC linked data to estimate effects of state appropriations shocks when enrolled in college on long-run outcomes. College completion is a critical educational outcome, but examining longer-run effects of collegiate resources is important in order to understand the extent to which any completion effects persist into adulthood.[7] Furthermore, changes in state appropriations could affect human capital accumulation in ways that are not picked up by college completion. This is especially the case because college completion is a binary outcome that understates variation in human capital and because state appropriations may impact students who are not on the margin of dropping out of college. Our analysis is the first to be able to provide causal estimates of the effect of state appropriations on these longer-run outcomes, and the structure of the panel data also permits an analysis of whether any effects become smaller or larger with age.

Taken together, the results from our analysis suggest that state appropriations have positive long-run effects on student outcomes that not only are detectable but that grow over time into the mid-30s. That the effects we find are driven by variation during college enrollment is particularly relevant, as we are not simply picking up changes in whether or where students enroll. These are important findings because they indicate a large return to public spending on postsecondary education, which has been declining significantly over the last several decades. Our results predict that such declines have reduced the returns to postsecondary education for

This could lead to worse outcomes if these institutions are less productive, as suggested by prior work (e.g., Armona, Chakrabarti and Lovenheim 2018; Deming et al. 2016; Cellini and Turner 2016; Deming et al. 2012).

[7]Scott-Clayton and Zafar (2016) use CCP outcome data linked to administrative education data from West Virginia to estimate the effect of the West Virginia Promise Scholarship on long-run outcomes. They find that scholarship receipt leads to better long-run credit outcomes. Similarly, Bleemer et al. (2017) use CCP data to estimate how public university tuition increases affect education debt held by 24 year olds. They argue that tuition increases can explain upwards of 30% of debt increases held by 24 year olds between 2003 and 2011.

students attending institutions that rely more heavily on state appropriations to fund operating revenues. These students are more likely to come from a lower part of the academic achievement distribution, given the negative correlation between the reliance on state appropriations and college selectivity, and so an implication of our results is that reductions in state appropriations have likely helped exacerbate inequality and stratification of outcomes in the postsecondary sector.

The rest of this paper is organized as follows: Section 2 describes the unique CCP-NSC linked dataset we use in this analysis and Section 3 describes our methodology, including the construction of the state appropriations instrument. All results are shown in Section 4, and Section 5 concludes.

2 Data

The data we use in this analysis come primarily from three sources: the New York Fed Consumer Credit Panel (CCP), the National Student Clearinghouse (NSC), and the Integrated Post-Secondary Education Data System (IPEDS). We combine these three data sources, as detailed below, to create the dataset that we use in our analysis.

2.1 Measuring College Enrollment and Short-term Student Outcomes

The integral part of our dataset leverages a merger between two unusually rich datasets: the New York Fed Consumer Credit Panel (CCP) and the National Student Clearinghouse (NSC). The CCP includes individual level consumer credit records (discussed below) sourced from Equifax credit bureau, while NSC includes individual level postsecondary education records. This unique dataset allows us to observe financial outcomes as well educational enrollment and attainment over time for a random sample of 223,000 individuals. Since NSC coverage improved over the years, we consider cohorts starting from 1975 birth year. To maximize match between NSC and CCP, we exploited a stratified random sampling method based on the coverage of the NSC data where we oversampled cohorts starting from 1980 birth year.

When examining outcomes by age 30 and outcomes between ages 25 and 30, we restrict our sample to those born prior to or in 1986, as the 1986 cohort is the last cohort that we observe

through age 30. This enables us to use a balanced set of cohorts (1975-1986 birth cohorts) in the sense that we observe each of these cohorts up to age 30. Similarly, when examining outcomes by age 35, we restrict our sample to those born prior to or in 1981 (1975-1981 birth cohorts). Table 1 shows, for each time horizon at which we examine these different outcomes, the birth cohorts used in our analysis, as well as the mean and median sophomore age and sophomore cohort year of the individuals in that sample. Sophomore age and cohort are defined as the age and year, respectively, in which each individual was enrolled in their second year of college. Since we oversampled the 1980 and later birth cohorts to maximize data quality, the mean is higher than the median birth year included in each sample. We control for this variation in sampling in our analysis by including a dummy variable in our regressions that take a value of 1 for cohorts born in 1980 or after (see subsection 3.2). Because we are interested in the effect of state appropriation shocks, our current analysis focuses only on college-attendees.

For each student, we identify an institution based on the first college in which we see that student enrolled. The primary motivation for this is that transferring to a different college later in the student's educational career has the potential to be endogenous to state appropriation shocks that the student faced earlier in life. For example, a negative state appropriation shock occurring while a student is in school may drive up tuition (Demming and Walters 2017), making that institution unaffordable and forcing him or her to transfer to a different school (or drop out altogether). These transfer and completion behaviors are outcomes of interest, rather than exogenously determined characteristics of an individual. Hence, we focus here on the first school an individual attended.

From the NSC data, we also obtain variables relating to educational outcomes that could be affected by state appropriations shocks, including whether or not a student graduated from the first institution he or she enrolled in, whether a student transferred out of the first institution he or she enrolled in, and whether or not he or she eventually went on to enter a graduate-level program.

2.2 Measuring State Appropriations

We identify state appropriations faced by each student at her first college starting from her sophomore year.[8] Since pre-entry state appropriation may well affect college choice of students, we consider state appropriations that the student faced after he or she already enrolled in her first college, specifically starting from her sophomore year. For this purpose, we start by identifying for each individual the year he or she was a sophomore in her first college.[9] This year determines the sophomore cohort to which this student belongs. The left panel of Figure 1 shows the distribution of students by their sophomore cohorts while the right panel shows the distribution of students into institution-sophomore cohort cells. Cohorts range from 1993 to 2014, but are most populated between 2000 and 2013. The mean number of students in an institution-sophomore cohort is six (median is 4) and the distributions varies between two and seventy-two. We use this sophomore cohort to identify the state appropriation shocks the student would have faced in her first college. Since length of time actually spent in first college is a matter of choice and likely highly correlated with her or her unobserved attributes, we assume the student is exposed to state appropriations shock in her first college based on the level of the college (4-year or 2-year). We assume students spend 150% of the statutory degree time enrolled in college.[10] For a four-year (two-year) first college attendee, we determine the state appropriations faced by that institution for six (three) years starting from her sophomore year and we assume this is the total shock faced by the student in her first college. Institution level state appropriations per student constitutes our endogenous variable. Figure 2 presents the distribution of institution level state appropriations per student at baseline for 4-year and 2-year institutions respectively. As may be expected, state appropriations per student is higher in 4-year institutions than in 2-year institutions, but there is a considerable amount of variation in state appropriations per student in each sector.

To construct our Bartik instruments (see subsection 3.1), we use data on institution-year level

[8] We define sophomore year as the calendar year following the year a student entered a school except if the student enrolled in January, February, or March. If a student entered in one of those months, we code the sophomore year as the same calendar year as the initial enrollment year. Thus, the state appropriations shock is always coded such that students experience it after college entry. State appropriations shocks occur in late spring, so for a student who entered in the fall, the next shock will occur next spring in the following calendar year. For a student entering in Jan-March, the next shock will be the spring of that year, so the sophomore year is taken to be the same calendar year.

[9] Some students transfer between their first and second year. We continue to use the first college of enrollment to assign state appropriations in these cases even though we specify the sophomore year using enrollment timing in the second institution.

[10] Our results are not sensitive to this assumption. Estimates assuming 100% of statutory degree time are similar and are available upon request.

state appropriations that we aggregate to state-year level by college sector (four-year and two-year). We also use total enrollment, and total revenue at the institution-year level. We obtain these data from IPEDS from the 1986-87 academic year to the 2014-15 academic year. We focus on 2-year and 4-year public institutions, as these institutions rely most heavily on funding from state appropriations as compared with private non-profit and for-profit institutions.[11] We exclude less than two year public institutions because of some IPEDS data inconsistencies during the period of our analysis; this group of institutions constitutes less than 1% of all public sector enrollment (0.7% in 2000-01 academic year; 0.3% in 2014-15).

2.3 Long-Term Outcome Measures

In addition to educational outcomes from NSC, a major strength of our dataset is that we have extensive data on longer-term financial outcomes from the CCP. For each individual, we identify a variety of financial outcomes that come directly from the CCP data, including student loan status and balance, credit score, credit card balance, auto loan status and balance, and mortgage loan status and balance. Mortgage and auto loans respectively constitute our measures of homeownership and car ownership. Since all-cash home or car purchases are rare, especially among the relatively younger adults that constitute our focus group, these measures are reliable indicators of homeownership (Chakrabarti, Gorton and van der Klaauw 2017; Bleemer et al. 2017) and car ownership (Chakrabarti and Pattison 2016). For loan balances and credit score, we calculate the average balance or score between ages 25 and 30 as well as the average balance or score between ages 30 and 35. For indicators of homeownership, car ownership, and student loan holdings, we construct indicator variables that take a value of 1 if an individual ever bought a home or car or held student loans by age 30 as well as by age 35.

2.4 Zipcode Income and College Selectivity

We match zipcode level income data for the period 2001-2014 from the Treasury to our CCP-NSC matched data using individual level zipcode information from the CCP. Finally, we match Barron's selectivity rankings for 2001 four-year colleges to our CCP-NSC matched data. Based

[11] We also performed our analysis with IPEDs data from the Delta Cost Project and found similar results. However, because the Delta Cost Project groups some institutions under a single parent institution, eliminating some variation in state appropriations faced by individual institutions, our primary analysis uses IPEDs data.

on institutional characteristics such as acceptance rate, median entrance exam (SAT, ACT), GPA for the freshman class, and percentage of freshmen who ranked at the top of their high school graduating classes, Barrons ranks colleges into six categories (1-highest, 6-lowest). We group the lowest two categories into a single category (group 5). All community colleges are grouped in a separate category (group 6).

2.5 Descriptive Statistics

Tables 2 and 3 present descriptive statistics for the 25-30 year old (1975-1986) and 30-35 year old (1975-1981) samples, respectively. Each table presents the mean, standard deviation and median of all analysis variables, separately for two- and four-year students. Selection across sectors is evident, as those who begin college in the four-year sector have higher credit scores, are more likely to own a car and a home, and have higher mortgage and credit card balances. The two groups have similar auto loan balances, however. Furthermore, four-year students have higher student loan debt, which likely reflects the fact that four-year enrollment is much more expensive than two-year enrollment. Student loan balances grow over time as well, which is due to graduate school enrollment and the fact that some individuals are enrolled in college when we observe their outcomes in their late 20s and early 30s. All of the credit balance outcomes show that there is an extensive amount of variation: the standard deviations tend to be higher than the mean. For example, the mean student loan balance among 30-35 year olds who began college in the four-year sector is $19,940 with a standard deviation of $38,615. Mean mortgage balance for this group is $7,080, and the standard deviation is $9,238.

3 Methodology

3.1 Construction of the Instrument

The goal of our analysis is to identify the causal effect of state appropriations changes while in college on long-run outcomes. The main identification concern is that state appropriations are negatively correlated with college quality in the cross section, and within-institution variation in state funding over time is highly correlated with the business cycle, state funding priorities, and other funding obligations. As a result, even a fixed effects panel regression at the institution-

year level is likely to be biased, however it is unclear in which direction the bias would go. To overcome this problem, we use an instrument based on the shift-share approach pioneered by Bartik (1991) and used previously by Deming and Walters (2017) that leverages the fact that state-wide changes in appropriations for higher education will have different effects on postsecondary institutions based on their underlying reliance on state funds. For example, 18% of revenue at the University of Michigan comes from state appropriations, while 46% at Western Michigan University comes from the state. A reduction in state appropriations should therefore have a larger impact on Western Michigan than on University of Michigan students.

We construct the instrument in two ways. The first is to use a rolling shock measure, where we use the 3-year lagged state appropriations share as the baseline share measure. This allows the base share to update each year. The rolling appropriations shocks are calculated as:

$$\widetilde{SA}_{jst} = \frac{SA_{js,t-3}}{REV_{js,t-3}} * \frac{SA_{st}}{College\_Age\_Pop_{st}}, \tag{1}$$

where $SA_{js,t-3}$ is per-student state appropriations received by institution j in state s in year $t-3$, REV is total per-student revenue received by the institution in that year, and SA_{st} is total state appropriations in the state in year t, and $College\_Age\_Pop$ is the number of people aged 18-44 in state s and year t. We take an expansive definition of the college-age population due to the increasing prevalence of older, non-traditional students. In addition to rolling shocks, we also construct a cumulative shock measure, with 1986 as the base year:

$$\widetilde{SA}_{jst} = \frac{SA_{js,1986}}{REV_{js,1986}} * \frac{SA_{st}}{College\_Age\_Pop_{st}}, \tag{2}$$

where $\frac{SA_{js,1986}}{REV_{js,1986}}$ is the share of total revenue from state appropriations in institution j in 1986. We favor the rolling shock measure because it provides more variation, but we show estimating using both below. In general, the results are quite similar across the two different measures of state appropriation shocks.

Tables 2 and 3 present means of base shares, state appropriations and enrollment by birth cohort and first sector of postsecondary attendance across individuals in our analysis samples, while Figures 3-6 show distributions of the state appropriation instrument and its constituent

parts across institutions.[12] Most public colleges and universities rely heavily on state appropriations for operating revenue: on average, those attending public institutions enroll in universities that receive between 35 and 45 percent of their revenues from state appropriations. The means mask a considerable amount of heterogeneity, however. Figure 3 presents the distribution of baseline shares across institutions using both rolling baselines (top row) and the fixed 1986 baseline (bottom row) in the first analysis year. In both the 2-year and 4-year sectors, many institutions receive over half their revenues from the state, with community colleges relying more on state funding than four-year universities. Furthermore, the distributions using the rolling versus the fixed share are similar. This helps explain why our findings using the two methods are align closely with one another.

Figure 4 shows the distribution of the second part of the instrument: overall state appropriations per college-age resident in the state in the baseline year. In the top row, we show the raw data, while in the bottom row we demean by the overall state average over our analysis period to more clearly show the distribution of within-state changes. The four-year and two-year sectors differ because the overall state appropriations are sector-specific. The top row highlights the large amount of variation in state support for higher education, which is \$330-\$344 per college-age resident on average in the four-year sector and \$97-\$100 per college-age resident on average in the two-year sector (see Tables 2 and 3). Some states provide very little support per resident, while others are quite generous. The bottom row of Figure 4 shows that the overall distribution does not just reflect cross-sectional heterogeneity. There are large changes in appropriations per capita within states over time. Interestingly, the changes in the four-year sector tend to be positive,[13] while those in the two-year sector tend to be negative.

Figures 5 and 6 show the distribution across institutions of the instruments given by equations (1) and (2), with means across individuals shown in Tables 2 and 3. In Figure 5, we present the distributions of the shocks pooled across years. The top panel presents the rolling shocks while the bottom presents cumulative shocks; the left hand side of each panel relates to 4-year schools and the right hand side to 2-year schools. Each panel reveals a large amount

[12] Tables 2 and 3 provide averages across individuals while the figures present distributions across institutions. They thus show somewhat different descriptive statistics related to the distribution of the instrument.

[13] The positive changes in the four-year sector are not inconsistent with declining state support because overall expenditures are growing rapidly. Thus, even though states are putting more money towards higher education in some cases, on average the share of spending being paid for by state revenues is shrinking.

of variation, though as may be expected there is larger variation among four year universities for both types of shocks. The average shock in the baseline is lower for two-year colleges even though they have a higher base share, reflecting lower state appropriations per student in two year schools (see Tables 2 and 3). Comparing across the panels, we see that changing the baseline share measure has little effect on the distribution. Figure 6 shows quartiles of the shift-share instruments by year. The shocks have grown in magnitude over time, most of which is driven by the top quartile. The bottom three quartiles exhibit relatively stable magnitudes of state appropriation changes over time, but institutions can move across quartiles in different years.

One of the core identification concerns in this analysis is driven by the fact that baseline state appropriation share is negatively correlated with institutional quality. This pattern is illustrated in Figure 7, which presents the distribution of base shares by college selectivity using the Barron's rankings categories to measure selectivity. Category 1 is the most selective, and all community colleges are in group 6. There is a clear increase in base share as selectivity declines, though the distributions overlap across categories. In addition to college quality, baseline share is negatively correlated with student income as shown in Figure 8.[14] The figure presents the relationship between state appropriations share and zip code income of students in the first year in which students are observed in the data. We see a clear negative relationship: institutions that rely more on state appropriations also typically serve students from more disadvantaged backgrounds. The shift-share instrument we employ is designed to account for any bias stemming from the correlation of state appropriation share with institutional quality and student background characteristics.

As discussed above, we want to abstract from the extensive margin in order to focus on the effect of state appropriation shocks among students already enrolled in college. In this way, we are identifying the effect of funding changes among existing students that are not coming from altering where students initially enroll. Institution j is defined as the college or university in which a student is enrolled in her sophomore year. Similarly, each student's cohort is defined as the year in which he is enrolled in his sophomore year in college. We then average the

[14]Because lower-income students tend to select into lower-quality colleges and universities, Figures 7 and 8 reflect the same underlying selection process.

shocks over six years of potential enrollment for four-year students and three years of potential enrollment for two-year students.[15]

$$\widetilde{SA}_{ijst}^{4yr} = \frac{SA_{js,t-3}}{REV_{js,t-3}} * \frac{\sum_{\tau=t}^{t+5} SA_{js\tau}}{\sum_{\tau=t}^{t+5} College\_Age\_Pop_{s\tau}} \tag{3}$$

$$\widetilde{SA}_{ijst}^{2yr} = \frac{SA_{js,t-3}}{REV_{js,t-3}} * \frac{\sum_{\tau=t}^{t+2} SA_{js\tau}}{\sum_{\tau=t}^{t+2} College\_Age\_Pop_{s\tau}}. \tag{4}$$

Equations (3) and (4) are the average state appropriations a student can expect based on prior institutional reliance on state appropriations and changes in overall state funding for higher education in the period of expected enrollment. We show these equations using 3-year rolling baseline share, but we also calculate them using the fixed 1986 baseline shares.

3.2 Empirical Model

We use the instruments shown in equations (3) and (4) to overcome the selection problems associated with state appropriation variation. The reduced form model on which we focus is as follows:

$$Y_{ijsac} = \beta_0 + \beta_1 \widetilde{SA}_{ijc} + \beta_2 \frac{SA_{jc}}{REV_{jc}} + \beta_3 College\_Age\_Pop_{sc} + \beta_4 1(yob \geq 1980) + \gamma_{ac} + \phi_j + \epsilon_{ijsca} \tag{5}$$

where Y is outcome of individual i who was a sophomore at institution j in state s when she was age a in sophomore cohort c. Thus, c indexes the calendar year in which a student was in her sophomore year, and a indexes the age the student was in her second year of postsecondary enrollment. When Y is per-student state appropriations, equation (5) represents the first stage effect of the instrument on actual state appropriations. We include fixed effects for age at sophomore year interacted with sophomore cohort year (γ) in the model. Because our outcomes are stratified by age as well, the age-cohort fixed effects also account for calendar year effects.[16] We also include controls for college population in the state during one's sophomore year and a dummy variable that takes a value of 1 for 1980 and later birth cohorts as our stratified random sampling method used to match the CCP data to NSC oversampled cohorts born in 1980 and

[15] Estimates are similar when we use 100% of enrollment time, but the long time to BA degree among public university students suggests the 150% measure is more appropriate (Bound, Lovenheim and Turner 2012).

[16] The reason for this equivalence is that calendar year in which outcomes are measured can be calculated knowing an individual's current age, his age in sophomore year and the calendar year in which the student was a sophomore.

after (see section 2).

Equation (5) controls for institutional fixed effects and base share used to calculate the instrument as well. The baseline share variable is important to include because when we employ the rolling state appropriations shock measure, the base share changes over time. If these within-institution changes are correlated with unobserved attributes of students that relate to long-run outcomes, they could bias our estimates. Directly controlling for the baseline share accounts for such changes. We show results below with and without institution fixed effects. Institution fixed effects are desirable in this context, but they are difficult to implement given the structure of the data because about 25% of the sample attends college with few if any other CCP panel members. This is shown in the right panel of Figure 1, which contains the distribution of institution-cohort counts. Most institutions have fewer than 5 individuals from the merged CCP-NSC sample in them. Thus, including institutional fixed effects weights the sample towards those who attend larger institutions. Without institution fixed effects, controlling for the baseline share accounts for cross-sectional heterogeneity in institutional characteristics correlated with such share. One can view this control as a parameterized version of institutional fixed effects, whereby the baseline share acts as a summary measure of unobserved cross-sectional heterogeneity. When we use the cumulative shock measure in models with institution fixed effects, the fixed effects account for the baseline share and so this variable is excluded. In the models in which institution fixed effects are not included, however, we directly control for 1986 share.

The coefficient of interest in equation (5) is β_1, which shows the effect of a change in state appropriations during one's potential time enrolled in college differentially by baseline share on outcomes at a given age. The main assumption underlying the identification of equation (5) is that state-level changes in state appropriations are uncorrelated with potential outcomes of students at colleges that rely differentially on state funding. For example, if state appropriations are declining in states in which the students at more state-reliant institutions are entering college with lower achievement levels, this would bias our estimates. Put differently, bias stems from secular trends in unobserved student ability that are correlated both with changes in overall state appropriations and with the base share. There are several reasons we argue our estimates are robust to such secular variation. First, despite the overall downward shift in state

appropriations over time, most institutions experience both positive and negative shocks to state funding over our sample period (see Figure 4). Unidirectional secular trends should not present a bias in our estimates. Rather, a concern is that unobserved shocks at the institution level are correlated with the baseline share and with the timing, magnitude and sign of aggregate state appropriation shifts. There is little reason to believe such unobserved shocks are systematically present in the data.

A second argument for why our estimates are not seriously influenced by changes in unobserved student characteristics is that we examine state appropriation shocks among students already enrolled in a specific institution and who persist to their sophomore year. This is an important sample to consider in its own right, as these students are the ones who are most likely to finish and who might be the most affected by persistent changes in collegiate resources. While students can transfer, they are not making initial enrollment decisions based on the state appropriations shocks we assign to them since they already have made the enrollment decision. This distinguishes the parameter we identify relative to Bound and Turner (2007) and Deming and Walters (2017). These analyses allow for state appropriation shocks to influence the extensive margin, which they show to be an empirically relevant margin of student response. The way in which we specify the instrument does not allow for such extensive margin adjustments; students can transfer in response to state appropriation changes, but this is a mechanism underlying the results rather than a source of bias.

We estimate equation (5) separately for those initially enrolling in two-year and four-year institutions. For two-year students, transferring to a four-year college is an important outcome that can be influenced by state appropriation changes. However, our approach does not lend itself to examining the separate effects of state appropriation changes in two- and four-year institutions among those who enroll in both. We therefore only consider the sector and institution in which students first enroll. Because the instrument varies by sophomore cohort and state, we cluster standard errors at the cohort-state level throughout the analysis.

4 Results

4.1 First Stage Estimates

First stage estimates that show how the predicted state appropriations instrument relates to actual state appropriations are reported in Table 4. We examine outcomes among two primary age groups: 25-30 year olds (1975-1986 birth cohorts) and 30-35 year olds (1975-1981 birth cohorts). Odd columns of the table include age-sophomore cohort fixed effects, baseline state appropriations share, and college-age population, while even columns add institution fixed effects. The first two columns of Table 4 show estimates for 25-30 year olds and columns (3) and (4) show estimates for 30-35 year olds whose first enrollment was at a four-year institution. Columns (5)-(8) have the same relative layout for those first attending a two-year college. Panel A presents estimates using 3-year rolling state appropriations shocks. A $1 increase in state appropriations per college-age student leads to between a $19.21 and $26.28 increase in appropriations per student when the 3-year lagged state appropriations share of revenue is 1 percentage point higher.[17] An increase of 10 percentage points in the share of revenues constituted by state appropriations thus leads to an increase of $192-$263. This effect is significant at the 1% level using standard errors that are clustered at the sophomore cohort-state level and varies little across columns when we add institution fixed effects and when we alter the age group.

Estimates in the two-year sector are somewhat smaller than those in the four-year sector, but they still are large, positive and significant at the 1% level. An increase in predicted state appropriations of $1 leads to a $13.20-$19.44 increase in per-student state appropriations at the institution level. Again, these estimates vary little with additional controls or across age groups. Indeed, in both the two-year and four-year sectors, the effects are larger when we add institution fixed effects, although they are qualitatively similar. These results indicate that the state appropriations instrument is strongly and robustly related to actual state appropriations at the institution level when we use a rolling baseline share.

[17] These estimates are much larger than one because of the way we have scaled the instrument and the endogenous independent variable. The former is in terms of total state appropriations per resident aged 18-44, while the later is per student in that level of the institution (2-year of 4-year). Since there are many more residents aged 18-44 than there are college students at either 2-year or 4-year institutions, the scale of the instrument is smaller than the scale of per-student state appropriations at the institution level. Tables 2 and 3 present means that show the differences in scale between the instrument and per-student state appropriations.

In Panel B, we show first-stage estimates using a constant base share from 1986. The state appropriations shocks thus are cumulative relative to 1986 rather than rolling relative to a 3-year lagged base. The effect in Panel B is very similar to the one in Panel A in the four-year sector: a $1 increase in state appropriations per college-age student in the state leads to between $15.39 and $22.57 increase in state appropriations per student when baseline state appropriations share is 1% higher. This is also the case in the two-year sector, where a $1 increase in predicted state appropriations leads to a $12.15-$17.19 increase in appropriations per student. Across panels, we see that the state appropriations instrument is highly correlated with actual state appropriations and is relatively unaffected by the addition of institutional fixed effects. In results not reported here we also introduce state fixed effects or Barron's ranking group by state fixed effects instead of institution fixed effects. The results continue to be statistically significant at the 1% level and remain qualitatively similar.

4.2 Reduced Form Estimates

We focus on reduced form effects of the shift-share state appropriations instrument on a range of adult outcomes among 25-30 and 30-35 year olds. The outcome tables are organized similarly to Table 4, with even-column estimates including institution fixed effects, columns (1)-(2) showing estimates for either continuous outcomes for 25-30 year olds or binary outcomes by age 30 among those attending a four-year university, and columns (3)-(4) showing estimates for either continuous outcomes for 30-35 year olds or binary outcomes by age 35 among those who attend a four-year university. Columns (5)-(8) are organized similarly for the two-year attendee sample. Panel A presents results using the rolling state appropriations shock, while Panel B provides results for the cumulative shock. Throughout, predicted state appropriations are in units of $100 per college-age student in the state, and all standard errors are clustered at the state-sophomore cohort level.

Table 5 shows estimates of the effect of state appropriations shocks on the likelihood of ever having any student debt by ages 30 and 35 respectively. The estimates for four-year students indicate that for both age groups, increases in state appropriations per student reduce the likelihood of originating student debt. In the first two columns, $100 per college-age student

higher state appropriations reduces the likelihood of student debt by age 30 by 4.1 percentage points for each 1 percentage point increase in baseline state appropriations share. This is 6.2% of the mean shown in Table 2. While the estimate in column (1) is significant at the 1% level, the estimate in column (2) is no longer significant even though it is almost of identical magnitude. This reflects the demanding nature of institutional fixed effects in this context, and the pattern is repeated in many of the results below: including institution fixed effects has a large effect on the standard errors but little influence on the point estimates. A similar effect is evident for student debt by age 35, where an additional $100 of state appropriations leads to a 6.0 percentage point decline in the likelihood of having student debt when baseline share is 1% higher. Relative to the mean in Table 3, this is an impact of 7.9%. The estimate is larger in column (3), at 10.1 percentage points (13.3%), and it is significant at the 10% level. Using cumulative shocks leads to similar conclusions. The estimates among 30 year olds align closely with the rolling shock results in sign, magnitude and statistical significance. Among 35 year olds, however, the estimates are attenuated and the result using institutional fixed effects no longer is statistically different from zero. Because of the demanding nature of institution fixed effects with respect to power, we also estimate alternative specifications for all results in this paper where we include Barron's selectivity group by state fixed effects.[18] Estimates remain qualitatively similar in all cases, and in many cases they are more precise.

Results among those attending two-year colleges are larger in absolute value and are statistically significant for both age groups when we do not include institutional fixed effects. However, inclusion of these controls renders the estimates much closer to zero and not significant. Thus, we find suggestive but less robust evidence of an effect of state appropriations among two-year students. Among 35 year olds, there is more consistent evidence across models of a negative effect, with an impact of -12.9 percentage points (16.7%) in Panel A without institution fixed effects and an effect of -4.8 percentage points (6.3%) when we include these fixed effects. Together, the results in Table 5 point to declines in the likelihood of originating student debt by the mid-30s if students face positive state appropriations shocks when enrolled in college.

We examine the effect of state appropriations on student debt balance in Table 6. The dependent variable in the table is outstanding student debt balance for those in the different age bins

[18] While not reported here, these results are available on request.

(including zeros). Any changes in loan balances could reflect an effect of state appropriations on loan origination amounts in college, but they also could reflect labor market outcomes that lead students to pay back loans more or less quickly. For 25-30 year olds in the four-year sector, state appropriation increases lead to a large reduction in outstanding student loan balances. The point estimates are $1,459 and $4,009 in Panel A, which represent 9.9% and 27.3% of mean outstanding student debt for this age group, respectively. When we include institutional fixed effects, the estimate grows in absolute value substantially and remains significant at the 5% level. Estimates in Panel B show a similar pattern, with a somewhat smaller effect in column (2) of -$2,976 (20.3%). Effects among 30-35 year olds who first attended a four-year university are also negative, but they are not statistically significant at even the 10% level and are smaller in absolute value than the estimates for the younger group when we include institution fixed effects. This pattern may reflect increased repayments by the early 30s. Still, there is suggestive evidence that the negative effect of state appropriations on student debt balance remains among students in their early/mid 30s.

The impact of state appropriations shocks on outstanding student debt balance of two-year students is less clear. When we exclude institution fixed effects, the estimates are negative. They are significant at the 5% level for 25-30 year olds as well. Adding institution fixed effects to the model reverses the sign of the estimates, however. While sizable, the point estimates tend not to be significantly different from zero. This is an unexpected result, but as we show below these students are much more likely to enter a graduate program in response to state appropriation shocks. It is likely that at least some of these higher debt levels reflect continued schooling.

We now turn to the effect of state appropriation shocks on outcomes that reflect choices and behavior post-college: credit score, credit card balance, car ownership and home ownership. Credit scores are of interest because they are a summary measure of financial health of the household. Furthermore, credit scores are often used directly by banks and potential employers to check individual credentials. Table 7 presents intent-to-treat (ITT) estimates with credit score as the dependent variable. For the 25-30 year old four-year sample, there is a negative and statistically significant effect that becomes much smaller in absolute value when institutional

fixed effects are controlled for. Among 30-35 year olds, there is more consistent evidence that state appropriation increases increases credit scores, but the estimates are not statistically significant at conventional levels. Taking the point estimates at face value suggests that for each $100 increase in state appropriations per college age student, credit scores increase by between 5.8 and 11.3 points when the baseline share is 1 percentage point higher. This represents between a 0.8 and 1.6 percent increase relative to the mean, so these effects are relatively modest.

Effects among 2-year students are larger and are more robust to changes in the specification. Among 25-30 year olds there is an increase of 11.3-16.1 in credit scores per $100 increase in per-capita state appropriations when baseline share is 1 percentage point higher. This is between a 1.8 and 2.6 percent increase relative to the mean, and all but one of the estimates is significantly different from zero at the 1% level. A similar pattern holds among 30-35 year olds whose first college is a 2-year college. Here, the effects double or triple when institution fixed effects are controlled for, such that a $100 increase in state appropriations increases credit scores by about 28.5 points (4.4%) when the baseline share of revenue coming from state appropriations is 1 percentage point higher. These estimates are all significant at either the 5 or 10 percent level.

While we find pretty consistent evidence that state appropriations lead to higher credit scores, especially for two-year students, the evidence is less consistent for credit card debt. Results using this dependent variable are shown in Table 8. The institutional fixed effects estimates tend to have a different sign from those without such controls, which renders these estimates rather inconclusive. In the models with institution controls, there is an increase in credit card balances among the four-year sample due to state appropriation shocks when in college, and the effect sizes are large relative to the mean credit card debt of $3,355 and $3,668 among 25-30 and 30-35 year olds, respectively. The estimates for the 2-year sector are much smaller in magnitude and are not significantly different from zero. Thus, among the 2-year students that experience sizable impacts on their credit scores, credit card balances are not strongly influenced by state appropriation shocks.

One reason why state appropriations may increase credit scores later in life is because they make it more likely consumers engage in purchases that help them build credit. Auto and

home loans are the two purchases that can lead to higher credit scores if the loans are paid back on schedule. Table 9 shows the effect of state appropriation shocks while in college on whether individuals have an auto loan by age 30 or 35. This is a strong proxy for owning a car, more so for young adults in their late 20s or early 30s, but some individuals may own a car without having a loan. For 30-year-olds whose first college is a 4-year college, there is a 2 percentage points (3%) higher probability of originating an auto loan due to a $100 state appropriations shock at a university that has a 1% higher baseline state appropriations share, although this effect is not statistically significant at conventional levels when we include institution fixed effects. For 30-year-olds whose first college is a 2-year college, we find a 1-2 percentage points (1-3%) higher probability of owning a car; this effect also is not statistically significant. However, state appropriations do increase the likelihood of owning a car by age 35. The impact is starkest for students whose first college is a 4-year college; they are about 8 percentage points (10.5%) more likely to have such a loan due to a $100 state appropriations shock at a university that has a 1% higher baseline state appropriations share. The estimates among former 2-year students are similarly-sized but are not significantly different from zero at even the 10% level.

Table 10 shows that state appropriations shocks increase the value of auto loans for both the 25-30 and 30-35 age groups. Higher auto loan debt could reflect individuals purchasing more expensive cars, individuals paying auto loans back more slowly, or individuals financing a higher proportion of the purchase price. Our data allow us to separate between the first two mechanisms as we observe origination amounts and repayments; in ongoing work we are trying to disentangle these factors. In the 4-year sector, state appropriation shocks lead to an increase in auto loan balances of $689-$727 (about 13% relative to the baseline mean) among 25-30 year olds in models that do not include institutional fixed effects. These estimates are significant at the 1% level. When institution fixed effects are included, the point estimates are slightly attenuated but the standard errors more than double, rendering the estimates not significantly different from zero. A similar pattern emerges among 30-35 year olds, except here the estimates including institution fixed effects are slightly larger. The estimates of $884-$915 represent about a 10% increase relative to the mean auto loan.

Effects among those who are sophomores at two-year colleges are smaller than those among their four-year counterparts, and they are not significantly different from zero. Still, almost all of them are positive and among 30-35 year olds the point estimates are of a similar magnitude to those in the four-year sector when institution fixed effects are controlled for; they are very imprecisely estimated, however. We interpret these results are providing clear evidence of a positive effect of state appropriations shocks on auto loan balances among four-year students, while in the two-year sector such effects are more suggestive.

We now turn to a similar set of estimates for home mortgages. We first examine the effect of state appropriations on whether individuals have a home mortgage by the ages of 30 and 35 in Table 11. We see little effect of state appropriations on home ownership among 30 year olds.[19] Among 35 year olds, state appropriation increases lead to higher home ownership rates. In the four-year sector without university fixed effects, home ownership increases by about 6-7 percentage points for every $100 increase in state appropriations per college-age student when state appropriations share is 1 percentage point higher. This is 10.2-11.9% relative to the mean, and the estimates in both panels are significant at the 1% level. When we control for institution fixed effects, the estimates become somewhat smaller but are qualitatively similar. In the two-year sector, the effect size grows when we add college fixed effects, and in Panel A the estimate remains significant at the 10% level. Only 45% of former two-year students own a home by age 35, so the effect sizes shown in Table 11 for this sample are large.

Table 12 presents estimates of the effect of state appropriation shocks while in college on average mortgage balances at 25-30 and 30-35. As with auto loans, home mortgage balances can change because of how much of the home price is being financed, the price of the home being purchased, and the rate at which the loan is paid back. In ongoing work using the CCP-NSC matched data we are trying to parse out these mechanisms. Looking at mortgage balances, we do not find consistent evidence of an effect of state appropriations shocks on mortgage balances among students whose first college is a 4-year college. The estimates switch sign when institution fixed effects are included in the model, and the estimates are very imprecise. In the two-year sector, there are large, positive effects in models without institution fixed effects

[19] As Table 2 demonstrates, home ownership among 30 year olds is not ubiquitous at just 31%-38%. The likelihood of owning a home grows substantially by age 35 (Table 3), but it still is under 60% in the four-year sector and under 50% in the two-year sector.

for both age groups. A $100 increase in state appropriations per college-age student increases the mortgage balances by between 8.0 and 11.3 thousand dollars when the baseline share is 1 percentage point higher among 25-30 year olds, and the effect is between 11.9 and 21.6 thousand dollars among 30-35 year olds. All of these point estimates are significant at the 1% level. When we include institution fixed effects, the estimates are smaller among 25-30 year olds and no longer are significant, while among 30-35 year olds the point estimates change little while the standard errors double. Thus, we interpret the evidence in Table 11 as indicating a positive effect of state appropriations shocks on the mortgage balances of former two-year students when they are in their early 30s.

Finally, we present estimates on how state appropriations affect later postsecondary investments. In particular, we focus on the likelihood of enrolling in a graduate program that offers a degree higher than a BA. This is one of the mechanisms underlying some of the long-run credit outcomes we examine as there is likely a labor market return to graduate training, and enrolling in graduate school can delay labor market entry and thus affect credit outcomes. Table 13 shows estimates of how our state appropriations instrument affects graduate program entry. These estimates rely only on the NSC data that provide enrollment information. There is no effect among four-year students in any model. However, among two-year students there is a large, statistically significant effect. An additional $100 of state appropriations per college-age student increases the likelihood a two-year student later enrolls in a graduate program by between 2.7 and 3.9 percentage points in the models that include college fixed effects. These estimates are significant at the 1 or 5 percent levels and suggest that one of the drivers of enhanced credit outcomes from state appropriations shocks among two-year students is through inducing more educational attainment. That we find such a large impact on graduate enrollment for this group also suggests state appropriation shocks affect subsequent BA receipt.[20]

[20]The NSC data are not well equipped to examine degree receipt as this information is missing for a large percentage of students. We thus do not examine this outcome directly, though Deming and Walters (2017) show large effects on BA completion of the type of state appropriations shocks we examine here.

5 Conclusion

This paper presents the first analysis in the literature on how changes in state appropriations while students are enrolled in college affect long-run financial outcomes. We contribute to existing research along two dimensions. The first is the use of an instrument for state appropriations that exploits variation in how state-level funding variation differentially impacts institutions depending on their historic reliance on state revenues. This shift-share approach has been used recently by Deming and Walters (2017), but we extend it to examine long-run outcomes and to focus on variation occurring after students have made initial enrollment decisions. The second contribution is to use a new dataset that combines administrative postsecondary enrollment records from the National Student Clearinghouse (NSC) with credit data from New York Fed Consumer Credit Panel (CCP). The latter dataset comes from a 5% sample of all individuals with credit reports in the US, sourced from Equifax. A random sample of these data constituting 223,000 individuals has been matched with the NSC data. Together, the data provide a level of detail regarding postsecondary enrollment behavior and long-run financial outcomes that are not available in other datasets.

Our findings indicate that state appropriation increases when students are enrolled in college have large, positive impacts on their long-run outcomes into their mid-30s. We first show that the instrument is highly correlated with actual per-student state appropriations. Then, for both students whose first college is a 4-year college or 2-year college, we examine a range of their outcomes when they were between the ages of 25-30 and 30-35. Our estimates point to a strong, positive relationship between state appropriation shocks in college and long-run outcomes. In the four-year sector, increases in state appropriations lead to a lower likelihood of having student loan debt and lower student debt balances, particularly for 25-30 year olds. Credit scores increase among 30-35 year olds, and in this age group there is a positive effect on having a car loan and the size of the car loan. Furthermore, 30-35 year olds are more likely to have a home mortgage due to state appropriation increases during college.

For students who were in a community college during their second year of postsecondary enrollment, we also find positive long-run effects of state appropriation shocks. Unlike the four-year sector, we do not find consistent evidence of student loan reductions, but we argue

a reason for this is that state appropriation increases induce two-year students to enroll in graduate school. Such enrollment increases student debt, which causes these estimates to be less conclusive. There is clearer evidence that state appropriations lead to better financial outcomes more broadly for this group, however. An increase in state appropriations during college has positive effects on credit scores for both age groups, and among 30-35 year olds it causes an increase in whether individuals have auto and mortgage loans and the value of these loans.

The results from our analysis have several policy implications. First, they suggest that state appropriations have a large effect on the return to postsecondary investments made by young adults that last into later adulthood. State appropriations are under the direct control of policymakers, and so our results are relevant for those making state budgeting decisions in supporting expenditures on higher education. Furthermore, our estimates relate more generally to the question of whether increased spending affect postsecondary outcomes. The results we present suggest this is indeed the case, and although we examine revenues from one source – state governments – there is no reason to believe that revenues from different sources would have different impacts on students. Lastly, our estimates relate to ongoing policy concerns regarding inequality in postsecondary education. Resources and outcomes have become increasingly stratified in higher education in the past several decades (Hoxby 2009; Bound, Lovenheim and Turner 2010). Lower-resource and lower-selectivity schools are most reliant on state appropriations; the sensitivity of long-run student outcomes to state appropriations suggests that continued declines in state support for higher education has and will continue to exacerbate this stratification.

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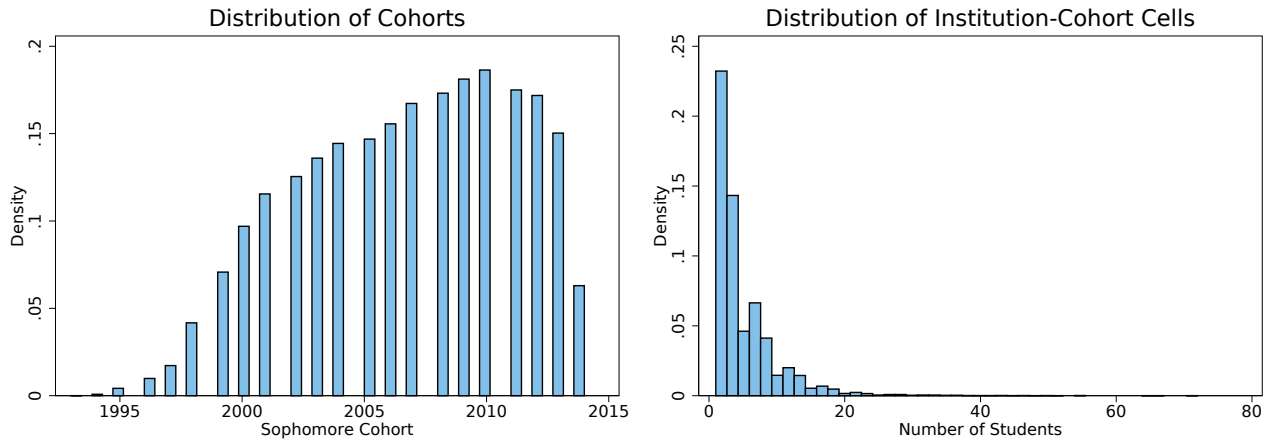
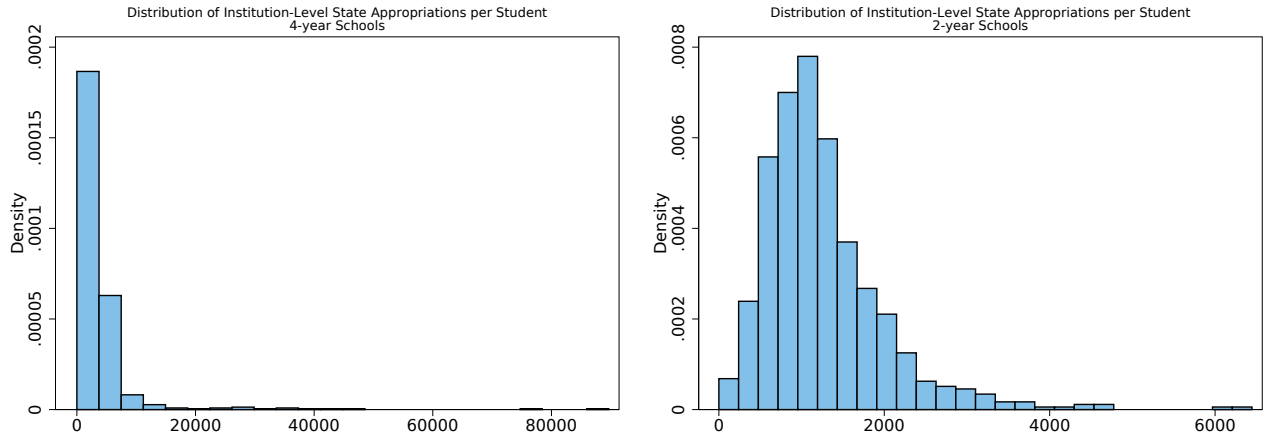
Figure 1: Sample Statistics: Cohort Populations



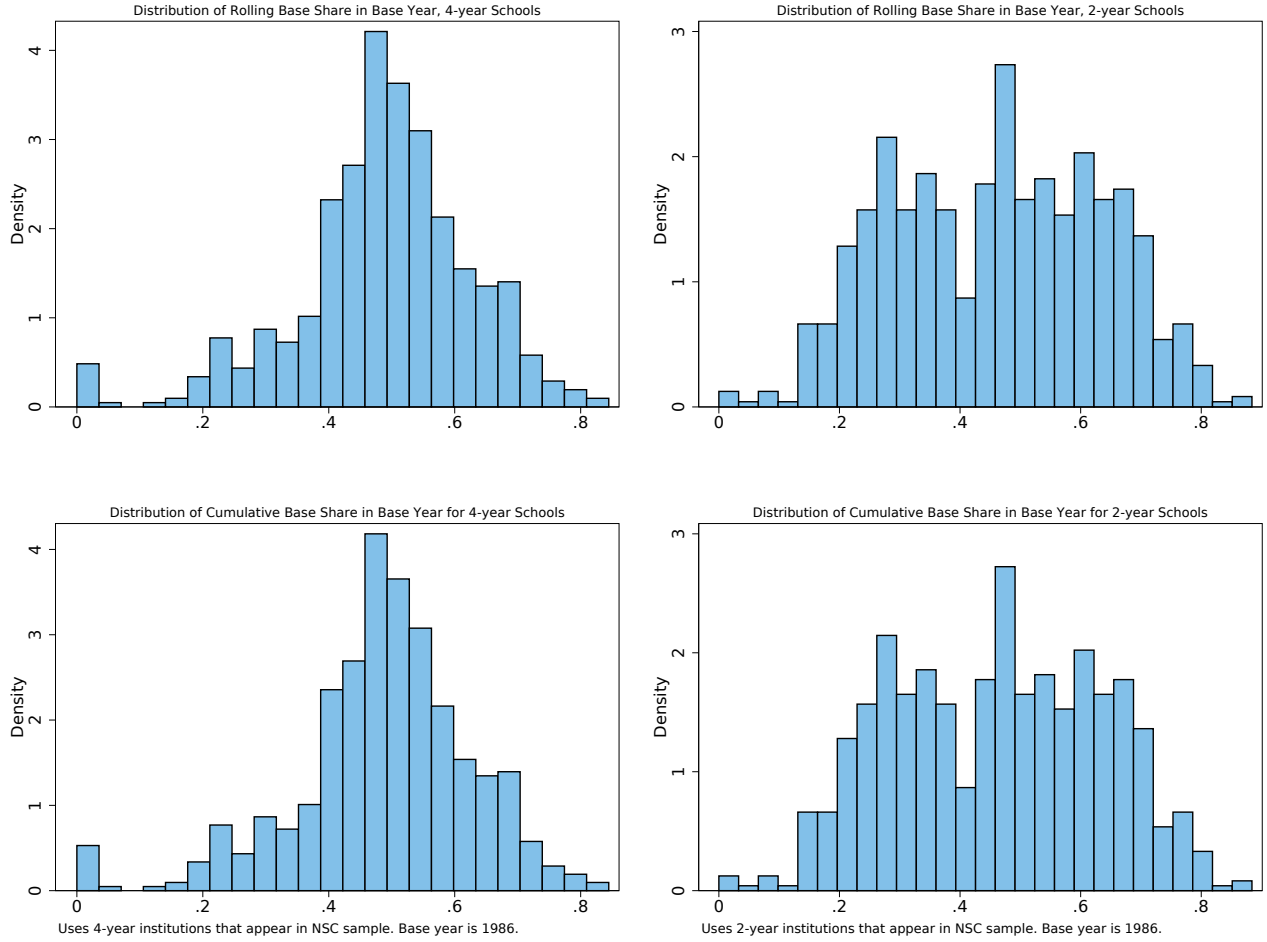
Source: Linked CCP-NSC data as described in the text. The left panel shows the distribution of students by their sophomore cohorts while the right panel shows the distribution of students into institution-sophomore cohort cells.

Figure 3: Distribution of Institution-Level State Appropriations per Student (Base Year)



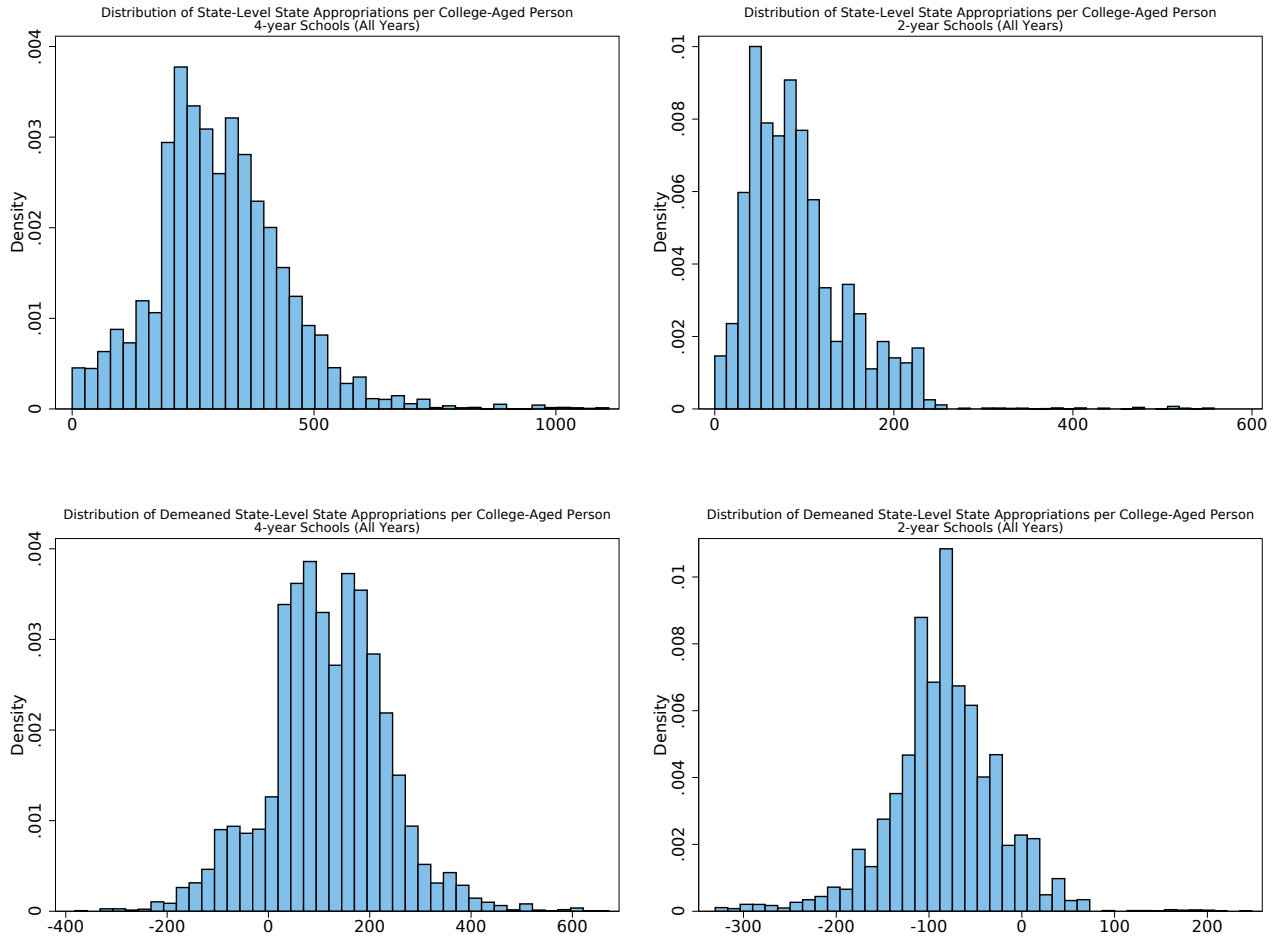
Source: Linked CCP-NSC data as described in the text. Each panel shows the distribution of per-student state appropriations in the base year at the institution level.

Figure 5: Distribution of Baseline Share (Base Year)



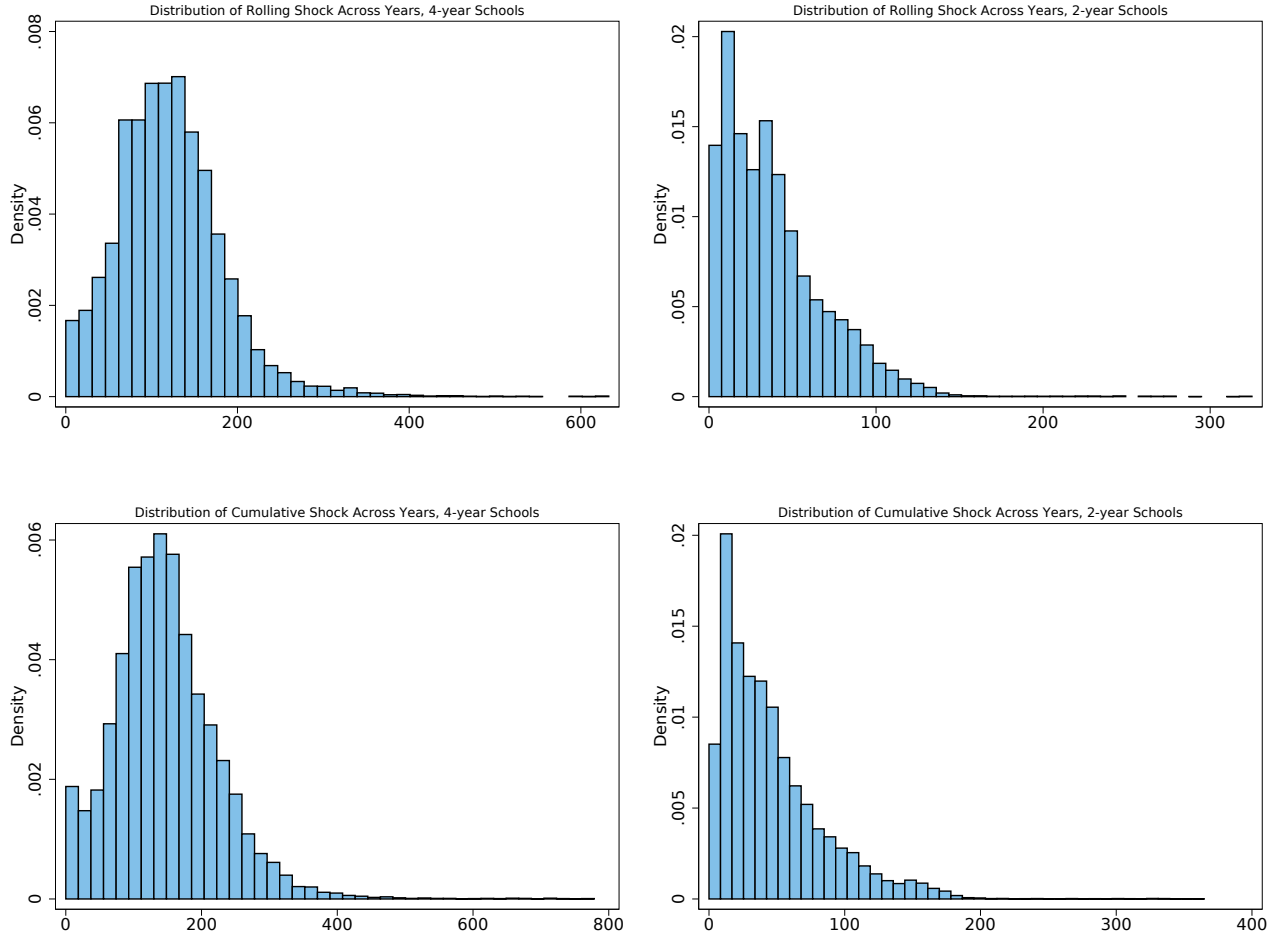
Source: Linked CCP-NSC data as described in the text. Each panel shows the distribution of the baseline share of revenues constituted by state appropriations at the institution level. The top row shows rolling baseline share distributions in years t-3, while the bottom row shows the baseline share distribution from 1986.

Figure 7: Distribution of State-Level Appropriations per College-Age Resident (All Years)



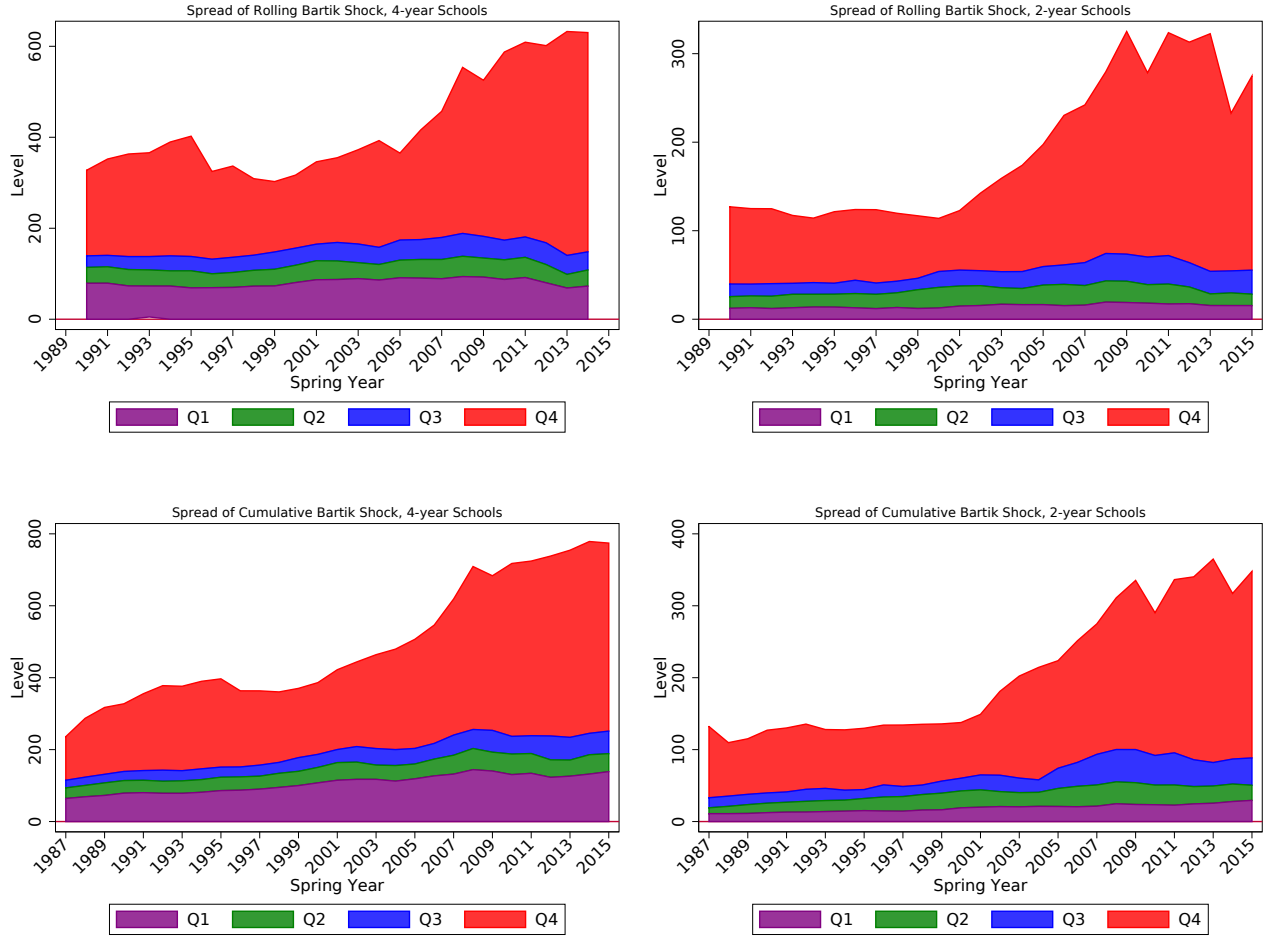
Source: Linked CCP-NSC data as described in the text. Each panel shows the distribution of state-year level appropriations in dollars per college-age resident (aged 18-44). The top row shows raw distributions, while the bottom shows distributions relative to the state-level mean over the analysis period.

Figure 9: Distribution of State Appropriations Instrument, Pooled Across Years



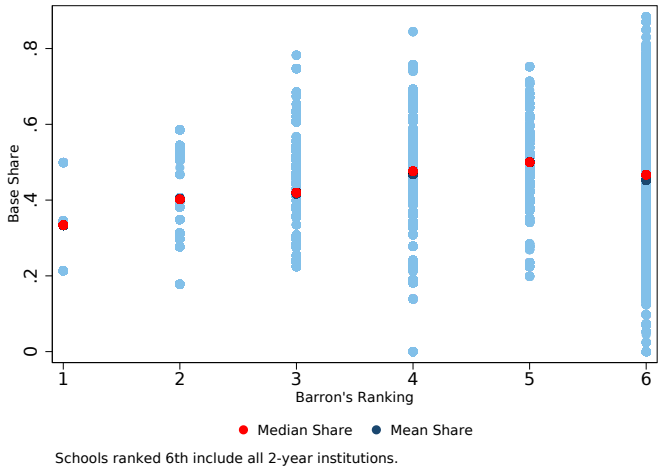
Source: Linked CCP-NSC data as described in the text. Each panel shows the distribution of the shift-share appropriations instrument in dollars per college-age resident pooled across analysis years. The top row shows the distributions of the rolling shock and the bottom row shows distributions of the cumulative shock.

Figure 11: Distribution of the Shift-Share State Appropriations Instrument, by Year



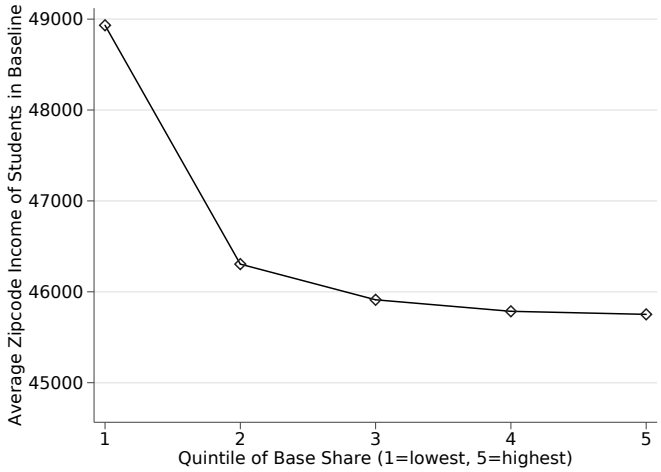
Source: Linked CCP-NSC data as described in the text. Each panel shows quartiles of the shift-share appropriations instrument in dollars per collage-age resident. The top row shows the distributions using a rolling base share and the bottom row shows distributions using the fixed 1986 base share.

Figure 13: Distribution of Base Share by Institution Selectivity



Source: IPEDS data as described in the text and Barron's College Rankings of four-year institutions. Barron's rankings are from most selective (ranking=1) to least selective (ranking=6). Groups 5 and 6 are pooled together into one group (group 5). We group all community colleges together into group 6. Only public institutions are included in this figure.

Figure 14: Average Baseline Income by Base Share Quintile



Source: IPEDS data, CCP data and Treasury data, as described in the text. We match 2001 zip code income from Treasury data to the zip code at which we first observe each person in CCP. We plot the relationship between average baseline zip code income and baseline share quintile. Group 1 includes institutions that relied the least on state appropriations in the base year.

Table 1: Cohorts Studied

Age at Outcome	**Birth cohorts**	**Sophomore Age**	**Sophomore Year**
25-30	1975-1986	21.02 [19.00]	2003.38 [2003.00]
30-35	1975-1981	22.56 [21.00]	2001.86 [2000.00]

Source: Merged FRBNY/Equifax Consumer Credit Panel and National Student Clearinghouse data as described in the text. Mean value in cells; median value in brackets. The table reports birth cohorts corresponding to outcomes for age groups 25-30 and 30-35 as well as mean and median sophomore age and calendar years when they were sophomores in their first college.

Table 2: Summary Statistics: Birth Years 1975 - 1986

	4-year Schools			2-year Schools		
Variable	**mean**	**std. dev.**	**median**	**mean**	**std. dev.**	**median**
Sophomore Cohort	2003	3	2003	2004	4	2003
Birth Cohort	1982	3	1983	1982	3	1983
Student Loan Outcomes						
Mean student loan balance b/w ages 25 and 30	17,473.67	31,441.31	5,057.70	8,185.58	19,078.23	30.77
Held student debt by age 30	0.68	0.47	1.00	0.54	0.50	1.00
Mean student loan balance b/w ages 25 and 30, cond. on > 0	27,184.44	35,692.80	15,207.48	16,264.25	24,327.50	8,399.48
Car Ownership Outcomes						
Owned car by age 30	0.68	0.47	1.00	0.69	0.46	1.00
Mean auto loan balance b/w ages 25 and 30	5,334.89	7,103.14	2,749.04	5,478.49	7,602.64	2,496.44
Mean auto loan balance b/w ages 25 and 30, cond. on > 0	8,289.71	7,342.02	6,434.19	8,684.62	7,986.38	6,624.78
Home Ownership Outcomes						
Owned home by age 30	0.38	0.48	0.00	0.31	0.46	0.00
Mean mortgage balance b/w ages 25 and 30	33,664.57	60,898.86	0.00	24,843.74	53,170.91	0.00
Mean mortgage balance b/w ages 25 and 30, cond. on > 0	91,603.89	69,168.44	79,037.41	84,776.80	67,576.97	71,617.09
Credit Card Debt Outcomes						
Mean credit card balance b/w ages 25 and 30	2,792.62	4,238.06	1,246.00	2,094.92	4,054.25	669.42
Mean credit card balance b/w ages 25 and 30, cond. on > 0	3,150.19	4,374.31	1,571.67	2,640.73	4,390.69	1,185.00
Credit Score Outcomes						
Average Credit score b/w ages 25 and 30	671.50	88.52	695.75	630.07	88.17	625.31
State Appropriations Variables, Institution Level						
State Appropriations	136,227,147.87	125,724,913.88	84,716,384.00	22,433,740.75	20,441,516.92	16,215,073.00
State Appropriations per Student	6,171.58	4,728.69	5,325.44	2,041.47	1,032.00	1,920.49
Rolling Shock	127.35	53.45	126.14	37.89	27.07	34.51
Cumulative Shock	164.42	67.32	164.16	50.24	35.48	44.00
Base Share, Cumulative	0.45	0.13	0.46	0.45	0.16	0.47
Base Share, Rolling	0.35	0.11	0.37	0.35	0.14	0.35
Total Enrollment, Institution Level	20,066.75	12,687.77	17,953.00	11,985.48	9,530.39	9,303.00
State Appropriations Variables, State Level						
State-Level State Appropriations	1482253657.34	1275082316.72	1064144640.00	668,191,595.17	736,843,024.78	336,155,616.00
State-Level State Appropriations per College-Age Population	344.43	96.37	339.18	99.57	48.48	92.88
State College Age Population	4,631,811.87	4,027,990.33	3,234,765.00	6,303,144.00	5,127,716.56	4,229,112.00
Total Enrollment, State Level	220,627.80	159,785.22	171,182.00	406,000.32	477,075.97	190,194.00

Source: Merged Consumer Credit Panel, National Student Clearinghouse, and IPEDS data as described in the text. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and by age 30 outcomes. All tabulations are done at the individual-level rather than at the institutional level.

Table 3: Summary Statistics: Birth Years 1975 - 1981

	4-year Schools			2-year Schools		
Variable	**mean**	**std. dev.**	**median**	**mean**	**std. dev.**	**median**
Sophomore Cohort	2001	4	2000	2003	4	2001
Birth Cohort	1979	2	1980	1979	2	1980
Student Loan Outcomes						
Mean student loan balance b/w ages 30 and 35	19,939.85	38,614.76	3,539.88	9,756.37	21,629.50	0.00
Held student debt by age 35	0.69	0.46	1.00	0.57	0.50	1.00
Mean student loan balance b/w ages 30 and 35, cond. on > 0	33,167.89	45,185.03	17,678.06	19,743.16	27,379.05	10,419.52
Car Ownership Outcomes						
Owned car by age 35	0.80	0.40	1.00	0.78	0.41	1.00
Mean auto loan balance b/w ages 30 and 35	7,080.33	9,238.10	3,929.81	6,540.81	8,930.86	3,180.17
Mean auto loan balance b/w ages 30 and 35, cond. on > 0	10,322.55	9,537.07	7,831.58	9,975.42	9,347.85	7,424.58
Home Ownership Outcomes						
Owned home by age 35	0.59	0.49	1.00	0.45	0.50	0.00
Mean mortgage balance b/w ages 30 and 35	74,869.50	99,082.81	28,329.35	44,057.56	77,015.45	0.00
Mean mortgage balance b/w ages 30 and 35, cond. on > 0	136326.38	97,456.49	118995.86	112586.04	86,268.79	95,767.23
Credit Card Debt Outcomes						
Mean credit card balance b/w ages 30 and 35	4,138.27	8,314.77	1,818.04	2,846.98	5,807.30	808.91
Mean credit card balance b/w ages 30 and 35, cond. on > 0	4,679.25	8,697.29	2,285.12	3,581.20	6,308.22	1,470.40
Credit Score Outcomes						
Average Credit score b/w ages 30 and 35	691.66	94.84	719.88	638.13	94.86	633.19
State Appropriations Variables, Institution Level						
State Appropriations	132,466,208.82	123,131,097.76	84,096,592.00	22,199,481.61	20,797,609.87	15,825,837.00
State-Level State Appropriations per College-Age Population	6,221.76	5,708.44	5,255.56	2,032.06	1,048.00	1,895.09
Rolling Shock	125.29	52.13	125.31	37.31	26.81	34.31
Cumulative Shock	159.29	63.29	159.18	48.96	34.31	43.37
Base Share, Cumulative	0.46	0.13	0.46	0.45	0.16	0.47
Base Share, Rolling	0.36	0.11	0.38	0.35	0.15	0.35
Total Enrollment, Institution Level	19,476.38	12,240.13	17,410.50	11,975.13	9,683.85	9,212.00
State Appropriations Variables, State Level						
State-Level State Appropriations	1406438634.49	1198319529.36	1007698368.00	644,964,607.68	708,374,231.65	319,803,808.00
State-Level State Appropriations per Student	329.91	93.96	324.44	96.78	47.13	92.88
State College Age Population	4,630,462.91	4,043,427.45	3,187,823.00	6,290,817.50	5,124,776.15	4,262,449.00
Total Enrollment, State Level	212,740.39	154,341.38	161,066.00	393,459.52	458,159.60	184,672.00

Source: Merged Consumer Credit Panel, National Student Clearinghouse, and IPEDS data as described in the text. The 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes and by age 35 outcomes. All tabulations are done at the individual-level rather than at the institutional level.

Table 4: First Stage Results: Birth Cohorts 1975-1986 and 1975-1981

Dependent Variable: State Appropriations ($100s) per Student								
Panel A: Rolling Shock	4-Year				2-Year			
Birth years	1975-1986		1975-1981		1975-1986		1975-1981	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	21.43***	26.28***	19.21***	25.79***	15.84***	19.44***	13.20***	18.79***
	(2.20)	(0.97)	(2.58)	(1.13)	(1.11)	(1.07)	(1.82)	(1.30)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16798	16775	6112	6072	22936	22898	7855	7739
R^2	0.05	0.99	0.04	0.99	0.52	0.91	0.50	0.91
Panel B: Cumulative Shock	4-Year				2-Year			
Birth years	1975-1986		1975-1981		1975-1986		1975-1981	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	18.36***	22.57***	15.39***	21.70***	12.78***	17.02***	12.14***	17.19***
	(1.80)	(0.96)	(1.99)	(1.33)	(0.97)	(0.92)	(1.46)	(1.12)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16525	16510	5954	5921	21333	21317	7316	7232
R^2	0.06	0.99	0.04	0.99	0.41	0.91	0.38	0.92

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. State appropriations is expressed in $100s per student and the state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 5: The Effect of State Appropriation Shocks on Ever Originating Student Debt by Early/Mid 30s

	Dependent Variable: 1(Remaining Student Debt)							
Panel A: Rolling Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-0.04***	-0.04	-0.06***	-0.10*	-0.12***	0.02	-0.13***	-0.05
	(0.01)	(0.03)	(0.02)	(0.05)	(0.02)	(0.04)	(0.04)	(0.07)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.01	0.07	0.01	0.11	0.02	0.09	0.02	0.14
Panel B: Cumulative Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	-0.04***	-0.03	-0.04**	-0.02	-0.09***	0.01	-0.11***	-0.07
	(0.01)	(0.03)	(0.02)	(0.05)	(0.02)	(0.03)	(0.03)	(0.06)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.01	0.07	0.01	0.10	0.03	0.08	0.02	0.13

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for by age 30 outcomes and the 1975-1981 birth year cohorts constitute the sample for by age 35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 6: The Effect of State Appropriation Shocks on Student Loan Balances

Dependent Variable: Student Loan Balance (Including Zeros)								
Panel A: Rolling Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-1458.84**	-4009.21**	-1653.51	-2768.85	-2611.90***	2415.12	-2135.00	3785.53
	(697.15)	(1627.93)	(1617.86)	(3545.67)	(757.64)	(1525.81)	(1624.54)	(2896.37)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.01	0.06	0.01	0.10	0.03	0.06	0.02	0.11
Panel B: Cumulative Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	-1236.88**	-2976.22**	-1333.41	-1311.68	-1683.14***	2450.08*	-1474.26	1742.22
	(534.52)	(1374.80)	(1223.59)	(2937.57)	(594.93)	(1290.34)	(1245.07)	(2363.56)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.01	0.06	0.01	0.09	0.02	0.06	0.02	0.10

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 7: The Effect of State Appropriations Shocks on Credit Score

Dependent Variable: Credit Score								
Panel A: Rolling Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-8.16***	1.33	2.59	11.30	13.38***	11.34	12.84*	28.91**
	(2.81)	(4.53)	(4.26)	(9.13)	(4.23)	(7.22)	(7.55)	(14.67)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16619	16594	6071	6030	22602	22565	7848	7736
R^2	0.03	0.18	0.03	0.21	0.05	0.13	0.04	0.17
Panel B: Cumulative Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	-7.57***	-2.11	-0.91	5.84	14.51***	16.14***	9.90*	28.55**
	(2.15)	(3.84)	(3.39)	(7.92)	(3.56)	(5.25)	(5.84)	(11.25)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16362	16346	5918	5884	22276	22257	7756	7679
R^2	0.03	0.18	0.03	0.20	0.05	0.12	0.04	0.16

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 8: The Effect of State Appropriation Shocks on Credit Card Balance

	Dependent Variable: Credit Card Balance (Including Zeros)							
Panel A: Rolling Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-280.24***	447.62**	-611.58	531.83	191.81	-126.96	-111.09	-45.10
	(100.50)	(223.68)	(392.76)	(773.12)	(155.57)	(383.61)	(323.74)	(722.19)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.02	0.07	0.02	0.08	0.02	0.08	0.02	0.12
Panel B: Cumulative Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	-218.93***	481.15**	-411.26	865.11	221.91*	-235.44	10.43	88.01
	(80.38)	(195.95)	(269.59)	(700.05)	(122.36)	(299.58)	(262.69)	(605.25)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.02	0.07	0.02	0.08	0.02	0.08	0.02	0.11

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 9: The Effect of State Appropriations Shocks on Car Ownership by Early/Mid 30s

Dependent Variable: 1(Own Car)								
Panel A: Rolling Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	0.01	0.02	0.03*	0.08*	-0.02	0.01	0.01	0.09
	(0.01)	(0.03)	(0.02)	(0.04)	(0.02)	(0.04)	(0.03)	(0.06)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.01	0.07	0.01	0.11	0.01	0.07	0.01	0.14
Panel B: Cumulative Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	0.02*	0.02	0.03**	0.08**	-0.01	0.02	-0.01	0.05
	(0.01)	(0.02)	(0.01)	(0.04)	(0.02)	(0.03)	(0.02)	(0.05)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.01	0.07	0.01	0.11	0.01	0.06	0.01	0.13

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. Auto debt constitutes our measure of car ownership. The outcome variable is whether the student originated any auto debt by age 30 or 35 respectively. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for by age 30 outcomes and the 1975-1981 birth year cohorts constitute the sample for by age 35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 10: The Effect of State Appropriations Shocks on Auto Loan Balances

Dependent Variable: Auto Loan Balance (Including Zeros)								
Panel A: Rolling Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	727.04***	555.15	883.95**	1124.58	393.68	185.73	55.32	972.54
	(212.74)	(495.43)	(401.44)	(941.12)	(375.85)	(651.27)	(702.67)	(1337.37)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.01	0.07	0.01	0.11	0.01	0.08	0.01	0.13
Panel B: Cumulative Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	689.47***	596.35	914.95***	1239.51	191.14	174.14	-141.52	1386.16
	(181.93)	(434.96)	(319.15)	(778.86)	(296.26)	(516.11)	(547.34)	(1132.57)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.01	0.07	0.01	0.11	0.01	0.07	0.01	0.12

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 11: The Effect of State Appropriation Shocks on Home Ownership

Dependent Variable: 1(Own Home)								
Panel A: Rolling Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-0.01	0.03	0.07***	0.05	0.06***	0.02	0.09***	0.11*
	(0.01)	(0.03)	(0.02)	(0.05)	(0.02)	(0.03)	(0.03)	(0.07)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.02	0.08	0.02	0.12	0.03	0.09	0.02	0.13
Panel B: Cumulative Shock	4-Year				2-Year			
	By Age 30		By Age 35		By Age 30		By Age 35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	0.01	0.03	0.06***	0.02	0.05***	-0.00	0.06**	0.08
	(0.01)	(0.02)	(0.02)	(0.04)	(0.01)	(0.03)	(0.03)	(0.06)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.02	0.08	0.02	0.11	0.02	0.08	0.02	0.12

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. Mortgage debt constitutes our measure of homeownership. The outcome variable is whether the student originated any mortgage debt by age 30 or 35 respectively. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for by age 30 outcomes and the 1975-1981 birth year cohorts constitute the sample for by age 35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 12: The Effect of State Appropriations Shocks on Home Mortgage Balance

Dependent Variable: Mortgage Balance (Including Zeros)								
Panel A: Rolling Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rolling Shock	-1618.20	1569.08	1585.48	-3852.23	11361.01***	593.97	21598.56***	19163.63*
	(1571.39)	(3385.08)	(4274.09)	(8440.56)	(2272.71)	(4766.21)	(5465.26)	(10833.66)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16806	16782	6112	6072	23205	23172	7996	7883
R^2	0.01	0.06	0.02	0.12	0.02	0.07	0.03	0.12
Panel B: Cumulative Shock	4-Year				2-Year			
Ages	25-30		30-35		25-30		30-35	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Shock	-1129.81	2426.99	242.74	-2296.30	8026.82***	596.75	11849.22***	14340.91
	(1217.23)	(2769.03)	(3447.44)	(6940.44)	(1927.44)	(3907.41)	(4536.33)	(9060.13)
Institution FE	N	Y	N	Y	N	Y	N	Y
Observations	16533	16517	5955	5921	22865	22850	7896	7819
R^2	0.01	0.06	0.02	0.12	0.02	0.06	0.02	0.11

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. The 1975-1986 birth year cohorts constitute the sample for age 25-30 outcomes and the 1975-1981 birth year cohorts constitute the sample for age 30-35 outcomes. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 13: The Effect of State Appropriation Shocks on Graduate School Enrollment

Dependent Variable: 1(Any Graduate Program Enrollment)				
Panel A: Rolling Shock	4-Year		2-Year	
	(1)	(2)	(3)	(4)
Rolling Shock	0.00	-0.02	0.01**	0.04**
	(0.01)	(0.01)	(0.01)	(0.02)
Institution FE	N	Y	N	Y
Observations	31945	31936	50382	50372
R^2	0.07	0.13	0.03	0.06
Panel B: Cumulative Shock	4-Year		2-Year	
	(1)	(2)	(3)	(4)
Cumulative Shock	0.00	-0.01	0.02***	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
Institution FE	N	Y	N	Y
Observations	30903	30895	47754	47749
R^2	0.07	0.12	0.03	0.05

Authors estimation of equation (5) using the linked CCP-NSC data described in the text. All regressions include cohort-by-age fixed effects as well as controls for baseline state appropriations share, age at sophomore year, state college-age population and a dummy for 1980 and later birth cohorts. Cohorts are defined as the year in which each individual was a sophomore in college, and college sectors (4-year/2-year) refer to the sector in which each individual was enrolled in sophomore year of his first college. The state appropriations shock is expressed in $100s per college-age resident in the state. Panel A uses a 3-year lagged rolling baseline state appropriations share as shown in equation (1) and Panel B uses a fixed baseline share from 1986 a shown in equation (2). Standard errors clustered at the state-by-cohort level are in parentheses: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.