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Echoes of rising tuition in students' borrowing, educational attainment, and homeownership in post-recession America *



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ABSTRACT

State public college tuition and fees have risen sharply in recent decades. In this paper we investigate how young Americans absorbed this increase and how it affected their post-schooling financial behaviors. Exploiting state-cohort variation in tuition increases, we find that recent student cohorts accommodated tuition shocks not by forgoing college education, but instead by amassing more debt. The rise in tuition and student debt in turn contributed to a sharp decline in homeownership which was concentrated in suburban and urban areas, especially in the US Northeast and West, and in higher-priced housing markets and locations in which younger adults make up a bigger share of the residential population. Thus tuition-hiking states can expect to see a response not through a decline in workforce skills, but through weaker future spending and wealth accumulation among young consumers.

The circumstances of young American consumers have undergone three unprecedented changes since the start of the twenty-first century. First, student loan balances and the prevalence of student borrowing have reached new heights, with the nominal aggregate student debt reflected in the New York Fed's Consumer Credit Panel (CCP) growing from roughly \$360 billion in 2004 to \$1.2 trillion in 2016, and the prevalence of student borrowing by age 25 rising from 25% in 2004 to nearly 45% by 2016. Second, homeownership rates among young consumers fell drastically following the Great Recession, with age 30 homeownership dropping from 31% in 2004 (and 32 percent in 2007) to 21% by 2016.¹ Finally, the share of young consumers living with parents or similar elders has climbed dramatically. While 33.5% of 23 and 25-year-olds lived with parents or similar elders in 2004, 44.9% lived with parents or similar elders by 2015.

Given the evidence, and the usual life-cycle timing of student and mortgage borrowing, one might wonder what the relationship is among the cost of education, student borrowing, and subsequent housing choices.² Public and private college costs have grown alongside student borrowing. Fig. 1 depicts enrollment-weighted mean tuition and fees at four-year public colleges and universities for each state from 2001 to 2009.³ The figure demonstrates the steep growth in college costs over the period: the mean across states of enrollment-weighted state

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¹ These homeownership rates are measured in the CCP data at the level of the individual fileholder. Household-level homeownership rates are slightly higher, but experienced a similarly sharp decline.

² Brown, Stein, and Zafar (2015) analyze and find no connection between *parents*' home price (and home equity) changes and their children's subsequent student debt accumulation.

³ Throughout the paper we emphasize the tuition growth from 2001 to 2009, though of course data are available for more recent years, and some are presented in Figure 1. The 2001-2009 tuition increase is one segment of a much longer trajectory. See, for example, College Board (2016) on the steady growth of real tuition and fees from the 1970s through 2010. The cohorts in college from 2001-2009 are those whose recent homeownership choices, from 2007 to 2015, we study below. Current cohorts of students and very recent tuition growth are certainly of interest, but we have no evidence yet on these cohorts' graduation rates and post-schooling experiences.



average tuition and fees per school year increased by \$3843, or 81%, from 2001 to 2009. It also demonstrates a substantial increase in dispersion across states in enrollment-weighted average annual tuition and fees, with the range of state averages increasing from \$2788–\$12,893 in 2001 to \$3671–\$20,466 in 2009. To the extent that the cost of a given human capital investment has increased, younger cohorts might be expected to experience some disadvantage in the shared housing market. Moreover, to the extent that student debt repayment struggles are increasingly prevalent, and mortgage underwriting is tighter following the Great Recession, young consumers who manage increased college costs by borrowing might be expected to experience decreased mortgage access.^{4,5} Student-debt induced mortgage rationing is also likely to constrain the demand for owner-occupied housing (Rosenthal et al. 1991).

This paper asks how the rapid increase in college costs has affected recent youth cohorts' student borrowing, educational attainment, and post-schooling consumption. As the price of higher education grows, do students choose to forego schooling or to meet the higher price of schooling with the aid of student debt? If the latter, what relationship do **Fig. 1.** State enrollment-weighted mean public college & university tuition and fees, 2001–2013.

Note: Annual public four-year college and university tuition from 2001 to 2013, weighted by full-time first-time student enrollment. *Source: Integrated Postsecondary Educational Data System (IPEDS).*

we observe between such tuition-induced debt and young Americans' lives after college? 6

Given the evidence of the challenges inherent in measuring student loan dollars in a survey context that we present in Brown et al. (2016), along with evidence of a strong negative association between students' ability to report balances and their subsequent homeownership, we turn to the Equifax-sourced New York Fed Consumer Credit Panel (CCP) for administrative data on the college borrowing and later homeownership decisions of nine recent cohorts of young American consumers. The CCP is valuable in this context for its ability to provide administrative data on student borrowing at age 24 and, four to six years later, homeownership at ages 28, 29 and 30 for nine distinct birth cohorts. Homeownership measures are drawn from 2007 to 2015, representing the recession and post-recession period. The CCP's large sample size and fine geography allow us to track local borrowing and homeownership patterns at individual ages - homeownership at 28, 29, and 30, for example - rather than in age bands. These can be measured in sufficient sample sizes across all fifty states throughout the estimation window.

The primary limitation we encounter with the CCP is its lack of education measures, a feature of credit reports in general. To analyze behavioral responses in educational attainment we draw on individuallevel American Community Survey (ACS) data from the Integrated Public Use Microdata Series. In addition to college enrollment and Bachelor's degree attainment, it includes the total years of post-high school education for each individual in the ACS data belonging to the same 1979–1987 birth cohorts we study in our CCP-based analysis.

Data drawn from the US Department of Education's Integrated Postsecondary Education Data System (IPEDS) reflect the cost of college faced by a state-cohort, by age 22. In the CCP, we measure the student debt accumulated by age 24, and the homeownership rates of 28-, 29-,

⁴ One mechanism by which student loan dollars may influence the transition to homeownership is through total debt-to-income (DTI) ratios used in mortgage underwriting (Acolin et al, 2016; Bhutta and Ringo, 2017; Kuttner and Shim, 2016). Recent reforms have aligned the underwriting standards of FHA and Fannie Mae to include the greater of the student loan payment or one percent of the outstanding loan in the DTI calculation made in underwriting a mortgage (see, for example, U.S. Department of Housing and Urban Development (2016), Mayotte (2016)). Each had stood at two percent at some point in the recent past, though the FHA had long disregarded student debt in its DTI calculation before the recession.

⁵ In addition, student debt arising from increased tuition may slow progress toward homeownership to the extent that it acts as a drag on saving for a down payment. Finally, previous research has demonstrated a substantial positive association between student borrowing and credit report evidence of repayment delinquencies (Brown *et al* 2015d). Such delinquencies preclude traditional mortgage borrowing for many of the relevant years in our sample. (We thank one referee for noting these comparatively important possible mechanisms.) For a more general discussion of impact of leverage on consumption, see Dynan (2012) and Dynan and Edelberg (2013).

⁶ Mezza, Ringo, Sherlund, and Sommer (2020) estimate the relationship between student debt and later homeownership in merged administrative data. See section 1.2 for a detailed comparison of Mezza et al. and the present study.

and 30-year-olds, for each individual belonging to the included birth cohorts.

While our analyses are based on individual-level data, the college tuition paid by a given youth at her chosen school is likely endogenous to her later homeownership. For causal inference we therefore rely on aggregate state- and cohort-level variation in tuition. After accounting for persistent difference across states and time, we treat remaining variation due to differences in the timing and magnitudes of tuition increases as plausibly exogenous. Furthermore, our estimated relationships account for broader state and time patterns, and data from additional outside sources inform the empirical model regarding the status of relevant time-varying economic circumstances in each location.

Hence, we use variation within and between U.S. states in the college tuitions faced by different schooling cohorts to relate both student borrowing and college attendance and educational attainment levels to college costs, and then to relate post-schooling homeownership to college costs and tuition-induced increases in student debt. Our estimates first address the question of how students respond to the rising cost of education: by dropping out, or by borrowing more?⁷ Our empirical model indicates that the per-capita \$3578 increase in states' mean enrollment-weighted public tuition per school year between 2001 and 2009 was associated with a \$1628 increase in per capita student debt among (all) 24-year-olds. However, we find no change in educational attainment, whether measured by years of post-secondary education, college enrollment or BA degree attainment by age 24 associated with this increase in tuition. These results suggest that American students' price elasticity of demand for higher education is quite low.⁸ As college costs increase, American students do not forego education, but instead amass more debt.

Following these same nine cohorts six to eight years past their (traditional) college years, and four to six years past the age 24 student loan comparisons, we examine the rate at which each cohort achieves homeownership by ages 28, 29, and 30. Relative to the 2001 age-22 cohort, the mean age 28-to-30 homeownership rates for the 2009 age-22 cohort is approximately 7.7 percentage points lower, on a base of 26.9%. Exploiting state-cohort level variation in tuition in a fixed effects specification, we estimate the response of homeownership at these ages to the \$3578 average tuition increase for the same cohorts between 2001 and 2009. According to our estimates, the 2001-2009 tuition increase can explain 0.84 percentage points of the 7.74 percentage point decline (or 11%). As discussed in more detail in Section 3, while we cannot exclude the possibility that the rise in tuition may have affected homeownership through channels other than increased student debt, the debt channel is likely to be predominant. When we adopt a standard instrumental variables (IV) approach that attributes all of tuition's impact on homeownership to its effect through student debt, the estimates imply a strong negative impact of student debt on homeownership, with a \$1000 increase in average student loan debt leading to a 0.48 percentage point reduction in the homeownership rate at ages 28 to 30. This estimate implies that the observed \$5707 increase in mean per capita student debt from 2003 to 2011 could explain 2.74 percentage points of the overall 7.74 percentage point, or 35% of the decline in homeownership at ages 28 - 30.

The large size of our estimation sample, and its comparatively recent set of cohorts, permit some novel heterogeneity analysis regarding the communities and housing markets most affected by past tuition growth. Our estimates indicate that, while older communities are relatively protected from the tuition effect on new homebuyers, communities in which younger adults make up a moderate or large share of the population show particularly substantial responses of age 28-to-30 homeownership to past tuition. The estimated effect of tuition on later homeownership is also greater in the northeastern and western states, in ethnically diverse neighborhoods, in more densely populated communities, and in housing markets subject to higher FHFA conforming loan limits. Finally, we observe a surprising degree of stability in the estimated relationship among tuition, educational attainment, and homeownership from pre- to post-recession cohorts.

Policy inferences arising from our quasi-experimental evaluation, in the absence of a behavioral model in which to draw welfare conclusions, must be tempered. That said, our evidence is consistent with the claim that American students have absorbed substantial college tuition shocks, without lowering their human capital investment, through an increasing reliance on the U.S. student loan system. Those who might respond to news of greater aggregate student debt, and of ubiquitous student loan delinquency and default, by reducing students' access to loans should consider this evidence. Contained within it is the suggestion that, absent recourse to student loans, young Americans might at last respond to rising college tuitions by purchasing less education.⁹

Assuming stability in our student loan system, others might infer that, because the estimated response to tuition hikes appears in the form of student borrowing and not in the form of declining schooling, the de-funding of public higher education has been a success. States are spending substantially less, per taxpayer, on higher education, and yet the skill of the workforce remains unaltered. Our homeownership estimates suggest that the de-funding of higher education has not been costless, at least in the context of one spending channel. Moreover, homeownership represents an important means of wealth accumulation, with housing equity being the principal form of wealth for most households. Further, Coulson and Li (2013) find significant external benefits of ownership in the form of higher neighborhood home prices. On the other hand, recent work demonstrates negative effects of homeownership on entrepreneurship (Bracke et al., 2018) and on labor markets (Blanchflower and Oswald 2013). Henderson and Ioannides (1983) provide a measured analysis of both sides of the ownership choice. To the extent that homeownership early in the life cycle benefits the individual through wealth accumulation, and the community via local house prices, our results suggest that states that increase the cost of education therefore may pay a price not in the form of declining workforce skill, but instead through muted housing-related spending and lower wealth accumulation among younger consumers in the years to come. To the extent that early homeownership is costly as it restricts labor market and entrepreneurial opportunities, the ownershipdeterring aspect of recent cohorts' student debt experiences may be less damaging.

The paper proceeds as follows. In section 1, we discuss the economic developments that characterize our estimation period in more detail, including trends in U.S. college costs, student borrowing, co-residence with parents, and early homeownership. We then summarize the related literature. Section 2 turns to administrative data on student borrowing and homeownership drawn from the CCP. It describes the construction of the estimation sample, along with additional empirical sources. Section 3 details our empirical approach, and summarizes findings regarding the relationship among college cost, student borrowing, educational attainment, and early homeownership.

⁷ Other means of accommodating a tuition hike are available. As the price of education rises, students will consume less of it and spend more on it, in some combination. Nonborrowing means of spending more include working more while in college and extracting more financial support from families.

⁸ A literature on information about the cost of attending universities similarly finds students' and families' relative insensitivity to the cost of higher education in their university enrollment decisions (e.g. Bettinger *et al* 2012, Bleemer and Zafar 2018).

⁹ Recent research by Black, Denning, Dettling, Goodman, and Turner (2020) fails to find evidence of an effect of increased student loan *availability* on housing markets. In fact, their estimates indicate positive effects of loan availability on academic and professional achievement and student loan repayment. Hence it appears that rising education costs, and not the loans that help students meet them, may create obstacles to homeownership.



Fig. 2. Troubled borrowers by school-leaving balance (as of 2014Q4), CCP 2009 school-leaving cohort.

Note: The proportion of main Consumer Credit Panel sample members who were age 22 in 2007 who were "troubled borrowers" in various ways by the fourth quarter of 2014, by age-24 student debt balance. "Ever default" indicates borrowers who have defaulted on at least one student loan; "ever 120+" indicates borrowers who had not defaulted but who had been more than 120 days behind payment on at least one student loan; and "balance higher than 2009" indicates borrowers who had not been delinquent but who owed higher student loan balances in 2014 than they owed in 2009.

Source: New York Fed Consumer Credit Panel / Equifax.

1. Context: economic developments and related literature

1.1. Developments from 2001 to 2015 in young Americans' college costs, student borrowing, and living arrangements

The three unprecedented changes in the circumstances of young Americans over the early 21st century that we describe in the introduction are reflected in young Americans' balance sheets. From 2003 to 2015, we observe a modest overall decline in the debt held by 30-year-olds in the CCP. But more striking is their reallocation of debt over that time. In real terms, the credit report of a representative 30-year-old in 2015 shows 28% less home-secured debt, 6% less auto debt, and 36% less credit card debt than that of a 30-year-old in 2003. It shows 174% more student debt.¹⁰ Today's young Americans exhibit a radically different relationship to both housing and consumer debt markets than that of young Americans only twelve years ago. Importantly, this change does not represent a broader pattern in American consumer behavior. Older Americans are borrowing more from nearly all standard sources: the credit report of a representative 65-year-old in 2015 includes 47% more housing debt, approximately identical credit card debt, 29% more auto debt, and more than an eight-fold growth in student debt when compared with a representative credit report for a 65-year-old in 2003.¹¹ As older Americans have borrowed more from (almost) all sources, younger Americans have both borrowed less and shifted their borrowing aggressively toward the student loan market.

Repayment proves challenging for the majority of student borrowers, in one way or another. Fig. 2 describes the repayment experiences of the 2009 school-leaving cohort as of the end of 2014.¹² Here we see that the prevalence of explicit repayment failures, in the sense of default or delinquency exceeding 120 days, is highest for the smallest balance borrowers, at 51%. From there, the rate of repayment failure first declines and then eventually flattens as student debt balances increase. Further, if one includes not having paid down a dollar of the 2009 school-leaving balance by the end of 2014, the prevalence of repayment problems takes on a U-shape. Repayment struggles are very common among low-balance borrowers, at 59% among the \$1000–5000 2009 balance group, and among high-balance borrowers, at 57 and 54% among the \$50,000–\$100,000 and \$100,000+ groups, respectively. The most successful repayers are those with 2009 balances between \$10,000 and \$25,000, but even among those 48 percent have defaulted, been severely delinquent, or not repaid a dollar as of late 2014.

Looney and Yannelis (2015) describe the relationship of this surprising negative delinquency association to the post-college earnings of large and small borrowers. We find this discussion to be of substantial value to the literature, and here add the observation that, where small borrowers struggle with delinquency, large borrowers manage to remain nominally current and yet fail to repay. Perhaps most importantly, something about the repayment experience leaves 48% of even the most successful repayment group, the mid-range borrowers, struggling.¹³

As reliance on the U.S. student loan system advanced, younger Americans' residential circumstances also underwent a transformation. Fig. 3 shows homeownership rates at ages 28, 29 and 30 by age-22 cohort. We infer homeownership based on the presence of home-secured debt, whether mortgage or home equity-based loans, on the sample member's credit report. The presence of home-secured debt on the

¹⁰ This evidence is based on the authors' calculations using the CCP, and appears in Brown et al., 2020. Related evidence can be found in Demyanyk and Kolliner (2015) and Brown and Caldwell (2013).

 $^{^{11}}$ These comparisons are made in 2015 dollars. Average home-secured debt at 30 fell by \$8,195, or 28%; at 65 it increased by \$11,191, or 47%. Average credit card debt at 30 fell by \$1,121, or 36%; at 65 it fell by \$11, which rounds to 0%. Average auto debt at 30 fell by \$292, or 6%; at 65 it grew by \$1102, or 29%. Average student debt at 30 grew by \$6,912, or 174%; at 65 it grew by \$857, or 886%.

¹² Fig. 2 was first published in Brown et al (2015c). The school-leaving cohort is determined based on the last quarter in which we observe student borrowing for the consumer in the CCP.

¹³ It is worth noting that the 2009 school-leaving cohort demonstrates somewhat worse five-year repayment outcomes than those shortly preceding it, for obvious reasons. The relative CCP five-year cohort default rates of the 2005, 2007, and 2009 school-leaving cohorts give some idea of the magnitude of the business cycle contribution to the prevalence of repayment troubles. Brown et al (2015b) find these rates to be 20, 21, and 26 percent, respectively.



Fig. 3. Annual Homeownership by Age.

credit report is a particularly reliable proxy for homeownership at young ages, and its absence a reliable proxy for non-homeownership, as very few 28–30-year-old homeowners in the U.S. own their homes outright.¹⁴ We find that homeownership among 28-year-olds declined steadily from 24.4% in 2007 to 16.0% in 2015, an approximate 0.94 percentage point annual decline. We see a similar decline for homeownership at age 29 (0.91 percentage point annual decline) and a slightly smaller decline at age 30 (0.74 percentage point annual decline).

Finally, as homeownership declined, young Americans increasingly chose to live with their parents or with similar elders. Fig. 4 depicts the proportion of U.S. 23-25-year-olds living with "parents" in the CCP from 2004 to 2015. For 23–25 year old CCP sample members, we observe an increase in the rate of co-residence with parents or similar elders from 33.5% in 2004 to 44.9% in 2015.¹⁵ Note that this pattern is free of life-cycle effects, as we measure co-residence with parents for the cross-section of CCP sample members who are 23 and 25 years old in each year. This substantial growth in living with parents is approximately monotonic over the period, and proceeds at a steady pace from 2004 to 2015.

1.2. Related literature

A number of studies have investigated whether and to what extent the observed empirical relationship between student debt and homeownership represents a causal relationship. Such an investigation is complicated by the presence of confounding factors: individual- and household-level attributes and circumstances that influence both the amount of student debt taken out as well as directly affecting subsequent home purchase decisions. Perhaps foremost amongst these is the education itself for which the debt was incurred. Those with positive and larger amounts of student debt are likely to have attained a higher level of educational attainment, in quantity or quality, than those with no or less debt, resulting in higher subsequent earnings, wealth and home ownership. Parental income and academic ability similarly are factors likely to both influence student debt and homeownership. Several confounding factors, such as ambition, preferences and parental support, may be hard to measure. A failure to adequately account for such confounding factors is then likely to result in invalid inferences.

In the face of such challenges in empirically identifying a causal relationship, one fruitful approach might be simply to ask student borrowers whether their loans have affected their homeownership choices. A number of post-recession surveys provide decisive evidence that young consumers feel their progress toward ownership is slowed by their student debt. In a 2011 Pew Research Center survey of a nationally representative sample of American adults, 48% of student borrowers responded that student debt made it harder to pay other bills, and 25% said that student debt has made it harder to buy a home (Pew Research Center 2011). The National Association of Realtors (NAR) publishes the results of an annual survey of homebuyers regarding market conditions and their experiences. Among buyers aged 18-35, 44% held student debt at the time of the homebuyer survey, with a median outstanding balance of \$25,000. Further, 53% of buyers in this age group reported that they had been delayed by student debt in purchasing a home (National Association of Realtors, 2016). In a 2013 (American Student Assistance, 2013) survey of 259 young professionals, 75% reported that student debt had affected their ability to purchase a home (ASA 2013). Additionally, 59% of those with student debt reported difficulty making student loan payments, 60% reported confusion with student loan repayment paperwork, and 69% reported confusion regarding repayment options. Finally, the third annual America at Home survey in 2015, a national telephone survey fielded by NeighborWorks America (2015), showed an increase in the rate at which respondents reported that student loan debt is "at least somewhat of an obstacle to buying a home". Fifty-seven percent of respondents agreed with this statement in 2015, up from 49% in 2014.

Research on the effect of student debt on post-schooling outcomes using more conventional survey data and methods has generated mixed results. This heterogeneity in findings is likely to reflect at least in part cross-study variation in the effectiveness of approaches to account for confounding factors. Findings from several studies using survey data appear to suggest modest or no effects of student debt. Using the Consumer Expenditure Survey, Kurtz and Li (2015) find that the likelihood

Note: The annual proportion of 28- to 30-year-olds who own a home, as measured in the main Consumer Credit Panel sample. *Source: New York Fed Consumer Credit Panel / Equifax.*

¹⁴ Similar results obtain where we track the rate of ever owning over the full course of the panel. The potential difficulty with this measure is that the look-back window available in the CCP lengthens as the panel progresses, creating time dependence in the quality of the measure of homeownership.

¹⁵ As in Bleemer et al (2017), we adopt the phrase "living with parents" to describe youth living with parents or with one of the variety of responsible elders captured by our co-residence measure, which defines co-residence as residing at the same street address as at least one individual who is between 15 and 45 years older.

Co-residence trends among 23 & 25-year olds



Fig. 4. Proportion living with parents among 23-25 year olds in the CCP, 2004-2015.

Note: The proportion of 23- to 25-year-olds who reside with their parents, as measured in the main Consumer Credit Panel sample. See text for the definition of parental coresidence.

Source: New York Fed Consumer Credit Panel / Equifax.

of purchasing a vehicle is, in fact, increasing in the ratio of student debt to income. Exceptions appear for the cases of student borrowers with very high balances, and for the case of cash purchases of new vehicles. Akers and Chingos (2014), using a long series of waves from the Survey of Consumer Finances (SCF), find that the homeownership rates of student borrowers relative to those of non-borrowers have waxed and waned over the years, and, further, that the debt payments that SCF household heads report that student borrowers actually make constitute, at the median, roughly 3-4% of monthly income. They conclude that the payments that student borrowers are making are not burdensome relative to their incomes, which reflect the returns to their educational investments.¹⁶ Houle and Berger (2015) study homeownership rates in the NLSY's 1997 cohort. They find a modestly lower homeownership rate among student borrowers than among non-borrowers, but no significant association between student loan balance and homeownership. Instead, they find that sociological markers of the transition to adulthood are substantially positively associated with homeownership.

While the aforementioned studies find little evidence of large impacts of increased student debt, Gicheva and Thompson (2015), using the SCF, find significantly higher rates of binding credit constraints and bankruptcy following schooling for student borrowers than for non-borrowers, and some evidence of lower homeownership among student borrowers. Gicheva (2016) finds a negative association between student debt and subsequent first marriage rates in a survey of registrants for the Graduate Management Admissions Test, controlling for other relevant factors. Cooper and Wang (2014), using the Panel Study of Income Dynamics, find that student debt is associated with a lower likelihood of homeownership by age 30 for a group of individuals who attended college during the 1990s. Further, Cooper and Wang observe a fairly strong negative association between student loan debt and wealth for a group of households who have at least some college experience and a household head aged 40 or younger.

In a related paper, Bleemer et al. (2020) study student borrowing and later homeownership in the National Longitudinal Survey of Youth's 1997 cohort. Its 1997 adolescents reached age 30 between 2010 and 2014, which provides us the opportunity to study post-recession homeownership at age 30 among five consecutive birth cohorts, whose education, family background, financial resources and choices, academic ability, and post-schooling experiences have been meticulously documented from the age of 12–16 forward. Among our findings in the paper, perhaps the most novel and the most relevant to the analysis here pertains to survey data quality and the role of students' financial awareness. Conditioning on measures of ability, diligence, background, family supportiveness, final educational attainment, and a host of other relevant characteristics, we estimate that, among student borrowers able to report loan balances, \$10,000 in additional student debt accumulated during school is associated with a 1.49 percentage point decline in the probability of homeownership at age 30. At the same time, we find that a substantial minority of student borrowers fail to report balances, and that student borrowers who cannot report their loan balances have similar homeownership rates to borrowers who report \$36,000 of cumulative borrowing. This amount is roughly three standard deviations above the mean cumulative balance among student borrowers.¹⁷

These findings suggest that inferences based on survey data involving student loan balances should be treated with caution, given the apparent importance of limitations in respondents' ability to report

¹⁶ A potential criticism to this conclusion relates to low reported payment amounts potentially reflecting a high fraction of borrowers participating in various income-driven repayment plans or being delinquent in repaying their loans. In addition, many young student debtors are not yet household heads, and hence are not SCF respondents. They may be captured in the SCF indirectly if at all, and their household heads may not be aware of their debt levels.

¹⁷ Alternatively, the estimates show borrowers unable to report balances to be 5.4 percentage points less likely to own homes at age 30 than otherwise comparable nonborrowers. The estimated relationship between age 30 homeownership and the inability to report student loan balances is as strong as or stronger than all other estimates in the paper that describe the relationship between student loan history and later homeownership. This evidence is in line with the results of a comparison of administrative and survey data on U.S. student debt balances in Brown et al (2015a), in which the aggregate student loan balance implied by borrower-reported survey data was estimated to be, at most, 75 percent of the aggregate balance implied by lender-reported administrative data.

balances. This observation motivates our use of administrative data in the present study, as lender-reported balances avoid any limitations affecting borrowers' financial awareness and willingness to report.

One recent study of the causal impact of student borrowing on later homeownership uses comprehensive administrative data merged from credit bureau, Department of Education, and other sources. As we do in our paper, Mezza et al. (2020) turn to tuition-induced variation in student debt across time and states to analyze the relationship between student debt and homeownership. They have assembled a powerful data resource, merged from several administrative sources, that includes not only student and housing debt histories following schooling, but also detailed educational histories for the 33,435 young Americans, who were 24 to 31 years old in 2004, that constitute their estimation sample. Their administrative records allow them to add a further dimension to their state-cohort tuition variation: they compare students who attended public and non-public colleges and universities. Their estimates indicate that a \$1000 increase in student debt leads to a 1.8 percentage point decrease in the probability of homeownership among public 4-year college-goers in their mid-20s.

The two studies, Mezza et al. and the current paper, inform each other. Though we lack the merged administrative data on educational and personal characteristics that make the Mezza et al. study uniquely informative, we are able to address the question of the relationship among college enrollment and costs, student borrowing, and subsequent homeownership for more recent cohorts, including several post-recession cohorts; to estimate homeownership responses at somewhat older ages; to estimate using a sample of millions of American youth; and, owing to the size and timing of our sample, to build important evidence on the contexts in which college costs are most consequential for homeownership. We distinguish the influence of tuition on homeownership between housing markets populated by younger and older residents; between more and less densely populated areas; among the run-up to the Great Recession, the recession, and the recovery; by the predominant race or ethnicity of the youth's (geographically fine) neighborhood; between locations in which higher education is and is not the norm; by region of the country; and, in a placebo exercise, between samples in which youth do and do not borrow for college.

While much of the literature takes the approach of relating accumulated student debt to later homeownership, we take an approach that differs from previous studies by focusing more directly on the role of rising college cost as a cause of increased student debt.¹⁸ Observed changes in student debt levels reflect changes in consumer demand for education (quantity as well as quality), application behavior and admission policies, available family resources, financing options, needs and costs. Our analysis will focus on changes in the price of education as a specific primitive cause of increased student debt, and address the following policy questions: How do students respond to the rising cost of education: by not enrolling in college or dropping out, or by borrowing more? What impact, if any, did the sharp rise in college costs have on educational attainment as measured by college attendance, BA degree attainment and total years of education? How much of the observed growth in student debt is attributable to the increase in college costs as measured by state tuition levels? And to what extent is the sharp decline in homeownership among younger Americans attributable to the rise in college costs, and the associated increase in student debt?

Given its focus on the price of a college education, our analysis is informative about the causal impact of policy-induced shifts in the financing of college education away from state and federal governments towards students and their families. Thus, instead of trying to assess what the homeownership rate would be in the absence of the student loan program, or of analyzing the impact of variation in student debt irrespective of its source, we consider what we take to be the more relevant policy question of what the homeownership rate of younger Americans would have been if average college tuition (and associated student debt) had not grown or grown by a different amount in recent years.

2. Data sources and measurement

2.1. Administrative debt data: The FRBNY Consumer Credit Panel

The New York Fed Consumer Credit Panel is a longitudinal dataset on consumer liabilities and repayment. The data include individual account-level information on all mortgages, home equity lines of credit, and student loans, as well as information on all credit card and auto loan debt. The panel is built from quarterly consumer credit report data collected and provided by Equifax Inc. Data have been collected quarterly since 1999Q1, and the panel is ongoing.¹⁹ Sample members have Social Security numbers ending in one of five arbitrarily selected, randomly assigned pairs of digits. Therefore the sample comprises 5% of U.S. individuals with credit reports (and Social Security numbers). The CCP sample design automatically refreshes the panel by including all new reports with Social Security numbers ending in the abovementioned digit pairs. Therefore the panel remains representative for any given quarter, and includes both representative attrition, as the deceased and emigrants leave the sample, and representative entry of new consumers, as young borrowers and immigrants enter the sample.²⁰

While the sample is representative only of those individuals with Equifax credit reports, the coverage of credit reports (that is, the share of individuals with at least one type of loan or account) is nearly complete for American adults. Aggregates extrapolated from the data match those based on the American Community Survey, Flow of Funds Accounts of the United States, and SCF well.²¹ However, because we focus on young people's student borrowing and homeownership decisions, we restrict our dataset to 24- to 30-year-olds, who have lower coverage than later ages; CCP coverage over 2003–2013 of the Census-estimated, age-specific population ranges between 83.4% and 93.9% for 25-year-olds and between 91.0 and (approximately) 100% for 30-year-olds, increasing from 2003 to 2007 and decreasing from 2007 to 2013.²²

We construct an individual-level, pooled dataset from the CCP by first extracting observations for all individuals who are between 24 and 30 years old in each panel year between 2003 and 2015.²³ In total, using the full 5% CCP, we estimate with a pool of 3,872,274 individual-year observations between ages 28 and 30. Using the CCP's loan-level student debt balance data, we calculate the total student debt held by each 24-year-old in our pooled estimation sample. Since CCP student loan data begin with 2003, our student loan measures cover only birth cohorts that reached age 24 in 2003 or later. Note that the oldest cohort in our sample, then, reaches age 28 during 2007. Hence our age 28 to 30 homeownership outcome measures span the period of available data on homeownership for cohorts with valid student debt data, from 2007 through 2015. The measure of home ownership used in the estimates is an indicator for whether the fileholder holds any home-secured debt at the age in question (28, 29, or 30), as discussed above.

¹⁸ Note that Mezza et al. is the exception among the existing literature on this point, in that it does include "reduced form" estimates of the influence of tuition on homeownership. (See Mezza et al. Table 5.)

¹⁹ Student debt data are only available in the CCP starting in 2003.

²⁰ See Lee and van der Klaauw (2010) for details on the sample design.

²¹ See Lee and van der Klaauw (2010) and Brown et al. (2015a) for details.

²² Lee and van der Klaauw (2010) extrapolate similar populations of U.S. residents aged 18 and over, overall and by age groups, using the CCP and the ACS, suggesting that the vast majority of US individuals at younger ages have credit reports. Jacob and Schneider (2006) find that 10 percent of U.S. adults had no credit reports in 2006, and Brown et al. (2015c) estimate that 8.33 percent of the (representative) Survey of Consumer Finances (SCF) households in 2007 include no member with a credit report. They also find a proportion of household heads under age 35 of 21.7 percent in the 2007 SCF, 20.64 in the 2007Q3 CCP, and 20.70 from Census 2007 projections, suggesting good representation of younger households in the CCP.

²³ We use data for the fourth quarter of each year of the panel. See Brown, Grigsby, van der Klaauw, and Wen (2016) for additional detail on the extensive coverage of young consumers (in their case, consumers aged 18 to 28) in the 1999 to 2012 waves of the CCP.

2.2. Educational survey data: the American Community Survey

We also construct a time series of cross-sections of age-24 ACS survey respondents in order to estimate the relationship between public university tuition and educational attainment. In order to align our estimates of the tuition-student debt and tuition-homeownership relationships with those from the tuition-educational attainment model, we similarly construct samples from the 2003-2011 ACS of age-24 individuals belonging to the same 1979–1987 birth cohorts. We observe individuals' educational attainment as measured in three ways: an indicator for having completed at least one year of college, and indicator for having completed a Bachelor's degree, and a count of the number of years of completed education by age 24. We also observe state of residence and ethnicity. Because we do not directly observe respondents' state of residence at younger ages, we merge all contemporaneous local economic statistics using their age-24 state of residence. All analysis employs person-level sample weights.

2.3. Other data sources

Annual county-level employment data are drawn from the Bureau of Labor Statistics' (BLS) Quarterly Census of Employment and Wages (QCEW) program. The employment data are reported on a quarterly basis and cover a total of 3197 counties. In order to measure the employment-to-population ratio, we also draw annual county-level population data from the US Census's Population Estimates.²⁴ We calculate the youth unemployment rate at the state level using employment data from 18- to 30-year-old individuals drawn from the Current Population Survey (CPS), aggregated from months to quarters.²⁵ Average weekly county-level wage data for 3197 counties are also drawn from the BLS's QCEW program, and monthly county house price index (HPI) data are pulled from CoreLogic. The CoreLogic HPI uses repeat sales transactions to track changes in sale prices for homes over time, with the January 2000 baseline receiving a value of 100; we aggregate an annual index to avoid seasonal variation. Finally, we calculate versions of each of these measures for the county in which we observe each fileholder at age 22, and for the year in which the youth turned 18. This allows us to account for local conditions during or leading up to the time that the state tuition applicable to the cohort was determined.

The mean student debt per capita among 24-year-olds in our sample is \$6715 with a mean of \$3902 in 2003 rising to a mean of \$9603 in 2011.

At the center of the analysis below is a set of college tuition measures. We construct a series of state-cohort average sticker costs of public colleges by pulling cost data from IPEDS.²⁶ We define sticker cost as the sum of tuition and fees (excluding room and board) at US public colleges and universities. Costs are averaged across postsecondary public institutions by state, sector, and year, and weighted by undergraduate enrollment. The average across the pool of all state-cohorts in our sample of the mean state sticker cost of public college is \$6723 per school year, with a standard deviation of \$2794.²⁷ Our focus on tuition at public colleges and universities is motivated by the fact that time-variation in this measure is more likely to capture exogenous reflections of idiosyncratic political processes rather than market demand. Private tuitions instead are set by private universities, likely in response to changes in demand for their degrees (and tuition costs at public institutions). For similar reasons we prefer using the sticker price rather than a net cost price. Net tuition would reflect differences and changes in average household income levels (determining Pell grant eligibility), as well as potentially endogenous college enrollment choices and grant allocation decisions by public colleges and universities.

Following Bleemer and van der Klaauw (2019), we use 2000 Census data to geographically categorize individuals by the racial make-up of each individual's age-22 Census block. Census blocks are the smallest regional designation used by the US Census; the average block has a population below 70 people, and is well-conceptualized as a literal city or suburban block. Blocks are characterized as white, Asian, Hispanic, or Black if at least 75% of residents of their age-22 block are members of that ethnicity, with about 25% of the sample characterized as 'no majority ethnicity' given the multiethnic nature of their residential block.

For our heterogeneity analysis, we also pull county-level population density information based on the 2014–18 American Community Survey (ACS) five-year estimates, county-level FHFA conforming loan limits from Fannie Mae (2020) (prior to 2008) and FHFA (2020) (2008 and onwards), and the block-level urban/rural status and the county-level proportion of the adult population between ages 25 and 44 (young adults) from the 2000 and 2010 US Censuses.

3. Empirical specifications and results

3.1. Estimation of student debt and graduation choices

Our administrative data include rich detail on a young consumer's location, age, and debt portfolio. They do not, however, offer the level of detail regarding human capital investment typical of survey data. Still, the present paper adds a new perspective that the survey-based analysis cannot. First, it permits estimation using student debt measures that are not affected by any shortcomings in student borrowers' willingness or ability to report balances. Second, the large sample and fine geographic data of the CCP allow us to place the student borrowing and homeownership choices that we observe in local economic and institutional context. Moreover, this context varies widely within our sample, owing to measures taken for millions of young consumers over a broad and detailed geography and a fairly long panel. Hence, while we cannot fix test scores or high school academic performance for sample youth in modeling the dependence of educational outcomes on tuition, and of homeownership on tuition and past student debt, we can compare the decisions of youth who are members of state-cohort groups who were subject to higher and lower college costs. Moreover, we can do so for youth who are experiencing expanding local economic conditions, as well as for those struggling through local recessions.

While our analyses are based on individual-level data, our main source of identifying variation in the tuition variable will operate at an aggregate state-cohort, rather than individual, level. We restrict our sample to cohort-year pairs in which the cohort making the housing choice in question is between 28 and 30 years old, with their student debt measured at age 24. For each of these cohort-year pairs, we assemble overall employment to population, mean wage, and other characteristics described above at the county level for the specific cohort-year combination.

Hence we begin by estimating the following fixed effects model of education outcomes – student debt, college attendance, years of education and BA degree attainment, each measured at age 24 – for a sample of ACS youth cohorts whose tuition is observed between 2001 and 2009, and whose education outcomes are observed between 2003 and 2011:

$$Y_{icl} = X_{iclt}\beta + E_{cs}\gamma + \delta_s + \tau_c + \varepsilon_{icl},\tag{1}$$

where Y_{icl} represents the age-24 education outcome of individual i of youth cohort *c* residing in county *l* in state *s*. Further, X_{iclt} represents a vector of covariates that includes the current (at time *t* and age 24)

 $^{^{\}rm 24}$ Data are from the 1990s Postcensal Estimates and the Vintage 2009, 2014, and 2015 estimates.

 $^{^{25}}$ This aggregated sample of the CPS (over all months from 2003 to 2015) includes 3.2 million respondents between age 18 and 30—19,333 of whom are missing labor force status information—though due to the sampling methodology of the CPS, some people appear in the dataset twice (in two different quarters). Data are aggregated using individual weights.

 $^{^{26}}$ IPEDS covers all 7,255 postsecondary schools in the United States, 5,126 of which provide enrollment and tuition data, accounting for 97.8 percent of enrollment in the dataset.

²⁷ Appendix Table A1 reports descriptive statistics for each variable used in the estimation, based on the state-cohort-year cells.

county employment-to-population ratio, state youth unemployment rate, the current county-level QCEW mean wage, and a classifier for the racial composition of the neighborhood of respondent *i*: majority Asian, majority Black, majority Hispanic, and no majority (holding out majority white).

Vector E_{cs} represents the IPEDS-sourced, enrollment-weighted mean school-year tuition and fees across all public colleges and universities for state *s* (the state in which we observe the respondent at the age of 22), measured when the respondent's cohort, *c*, reaches 22. This age-22 tuition is attached to the members of the state-cohort throughout the analysis.²⁸ It is our regressor of primary interest. Note that by including state fixed effects (for the location at which tuition is measured) we account for persistent differences across states in the quantity, quality and cost of education, while by including cohort fixed effects we account for common changes in these education measures over time. Moreover, we account for differences in current local economic conditions and racial composition of the neighborhood (Census block). Thus for identification we rely purely on remaining differential state-cohort variation in tuition, reflecting differences in the timing and magnitude of tuition increases across states.

The properties of error term ε_{icl} remain to be determined. While using individual-level data on educational outcomes, county- and Census block-level data on demographics, and county-level variation in local economic conditions, we rely on state-cohort-level tuition variation to estimate the relationship between tuition levels and educational outcomes. One may therefore want to adjust the standard errors to account for remaining state-level correlation, even after estimating both state and cohort fixed effects. In sections 3.4.2 through 3.4.4 below, we report estimates of expression (1) first clustering errors ε_{icl} by individual i's state-cohort (the level of state tuition variation), and second while clustering errors by individual i's state.

3.2. Estimation of the association between college costs and early homeownership

Similarly, we estimate a fixed effects model of the dependence of homeownership at age 28, 29, and 30 on tuition, or, alternatively, on the student debt accumulated by the state-cohort at age 24. Here we measure tuition from 2001 to 2009, student debt from 2003 to 2011, and, finally, the homeownership rate among younger consumers between 2007 and 2015. The model in this case is:

$$Y_{iclt}^{H} = X_{iclt}\beta^{H} + E_{cs}^{H}\gamma^{H} + \delta_{s}^{H} + \tau_{ct}^{H} + \varepsilon_{iclt}^{H},$$
(2)

where Y_{iclt}^{H} represents an indicator for whether individual *i* of cohort *c* residing in county *l* at time *t* (age *t-c*) owns a home that secures any standard home loan (including a first mortgage, home equity loan, or home equity line of credit). The vector of time-varying regressors X_{iclt} remains as it was in specification (1), now measured at ages 28 to 30. The specification includes fixed effects for each state and each age-cohort pair represented in the panel. The time-fixed education measure, E_{cs}^{H} , again represents state *s*, cohort *c*'s college tuition. In order to allow for correlation of residuals within state-cohorts, we report standard error estimates first clustering at the age-22 state-cohort level and second clustering at the age-22 state level.

3.3. The student debt channel

Our initial interest is in the comprehensive effect of tuition on later homeownership, which we estimate using expression (2), above. The validity of these estimates turns on the assumed exogeneity of state-cohort tuition variation, conditional on the set of observable characteristics and of state and cohort-year fixed effects described in expression (2). Challenges to this assumption include connections among state finances, housing markets, and tuition that are relevant to students and non-students alike, and that may generate a spurious estimated dependence of later homeownership on a state-cohort's public tuition. We address this endogeneity concern in Section 3.5, below.

The primary channel through which one might expect local tuition to affect subsequent local homeownership is student debt. However, one can imagine other channels through which tuition may affect postcollege outcomes. First, as discussed in the previous section, we will assess how tuition affects educational attainment. One might expect a decline in college enrollment, years of education and BA degree completion arising from tuition growth that would in turn reduce earnings and lead to a decline in homeownership. As we discuss below, perhaps somewhat surprisingly we find small and insignificant effects of tuition on all education outcomes, so this channel appears not to be active. However, tuition changes may also affect college quality and college major choices, which in turn could affect subsequent earnings and homeownership rates.

In addition to tuition-induced changes in educational attainment, tuition changes may affect homeownership several years hence through other channels. One possibility is that students may meet the increased tuition not through borrowing but through larger contributions from their parents.²⁹ If parents face budget constraints then higher spending on their children's tuition may make them less able to help fund their children's down payments for their first homes, thereby lowering later homeownership rates (Engelhardt and Mayer, 1998).

While these alternative channels are likely to play a role, we expect student debt to be the predominant channel through which tuition affects homeownership. To explore its importance further we present IV estimates that attribute all tuition-induced changes in homeownership to tuition-generated changes in student debt. As we expect homeownership to be negatively impacted by tuition through the omitted channels (reduced educational attainment and parental support), we expect our IV estimates of the impact of student debt on homeownership to be biased downward (more negative), and to represent an upper bound on the true magnitude of the impact of tuition-induced variation in student debt on homeownership.

Accordingly, we consider the same simple fixed effects model, represented by Eq. (2), relating local homeownership at ages 28 to 30 to E_{ics}^{H} , but with this variable now representing the individual's student debt at 24. Note that we again treat educational measure E_{ics}^{H} for cohort c in state s to be time-fixed in that cohort members typically attend college, and confront college costs, at a fixed point in the life-cycle. Contemporaneous variation in these factors may be either uninformative or clearly endogenous. We would not, for example, want to estimate the dependence of homeownership among members of cohort c in year t+1 on the tuition faced by cohort c+4, or, for that matter, on the change in student debt for a member of cohort c from t to t+1, as the latter would likely be driven by job market developments, and thus the relationship would tell us little about the causal effect of college costs on homeownership.

As discussed earlier, in estimating this version of Eq. (2) by assuming that tuition only influences homeownership through student debt, we can use the plausibly exogenous variation in the cohort-state tuition level as an instrumental variable in estimating the causal impact of student debt.

²⁸ Estimates based on age 20-22 tuition averages provide similar estimates.

²⁹ Note, however, that in some contexts borrowers may choose formal over family financing, even when real interest rates for family financing are small or negative. See, for example, Lee and Persson (2016), who document this phenomenon in the context of entrepreneurship, and rationalize it via the operation of informal family insurance markets. Both in Lee and Persson and in the case of college funding and homeownership, the possibility of repeated reliance on family financial networks discourages informal borrowing where formal markets are available.

Change in average student debt per person and tuition across states and cohorts



Fig. 5a. Cross-State & Cohort Relationship Between Tuition and Student Debt Changes.

Note: Plot of state averages in the change in mean public university tuition (measured in \$'000s) against the change in mean student debt at age 24 (measured in \$'000s) in three periods. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Student debt measured in the main Consumer Credit Panel sample; see text for details.

Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.

3.4. Estimation results

3.4.1. Descriptive evidence on tuition, debt, education, and homeownership relationships

Before presenting estimates based on our empirical models, we first review descriptive evidence on state-cohort trends over time. Fig. 5a relates state-level cross-cohort differences in age 24 student debt levels to differences in state-cohort tuition levels. As within-state tuition changes vary nonlinearly over time, rather than just comparing the 2001 and 2009 tuition cohorts, we compare cohorts two years apart. The figure reveals a clear positive association between tuition growth and student debt growth in each state. A simple pooled state-level regression of the changes yields a slope coefficient of 0.586 (t-value 2.74). Fig. 5b similarly relates state-level cross-cohort differences at age 24 in the years of post-secondary education to state-cohort differences in tuition levels. It shows little evidence of any meaningful association between the two, as reflected in an estimated slope coefficient of -0.002 (t-value 0.07).³⁰ Finally Fig. 5c plots state-level cross-cohort differences in age 28 homeownership rates against cross-cohort differences in tuition levels. There is a noticeable negative, though statistically insignificant, relationship between the two as reflected in the slope coefficient of -0.61 (t-value 1.0).

We next consider estimates of these relationships, as modelled in specifications (1) and (2), after extending the estimation sample to include all 2001–2009 cohorts, incorporating home ownership at ages 29 and 30, and controlling for state and cohort fixed effects, neighborhood composition, and time-varying local economic conditions facing different cohorts in the different states and counties.

3.4.2. The responsiveness of age 24 educational outcomes to tuition growth

We begin with estimates of expression (1) in which Y_{icl} represents age 24 student debt. The estimates of the effect of tuition on student debt, shown in columns 1 and 2 of Table 1 indicate that a \$1000 increase in the state-cohort's enrollment-weighted mean sticker price of public college (per school year) is associated with an approximately \$475 increase in mean student debt per capita at age 24.^{31,32} The estimates are surprisingly insensitive to controls for age 24 local economic conditions (given the inclusion of a full set of state and year fixed effects), including the employed share of the population, state youth unemployment, and mean weekly wages in state s in year t. These point estimates imply that the observed \$3578 increase in the mean annual sticker price of public college in the sample from 2001 to 2009 can explain \$1700 (or 30%) of the \$5707 rise in mean student debt per capita at age 24 in the estimation sample from 2003 to 2011. Hence the evidence suggests that an important margin of adjustment to the tuition hikes for these students is through student borrowing.

Turning to educational attainment, columns 1 and 2 of Table 2 show a very modest association between a state-cohort's tuition level and subsequent college enrollment rates by age 24. The point estimates indicate that a \$1000 increase in the enrollment-weighted mean public tuition

³⁰ We similarly find an absence of an association with proportion enrolled in college (slope coefficient -0.004 with t-value 0.7) and with the proportion with a BA (slope coefficient -0.003 and t-value 0.6).

³¹ Based on an IPUMS-based average of 1.5 years spent in college per cohort member by the age of 24, the \$1,000 annual tuition increase implies a \$1,500 mean increase in overall college cost. Our estimates indicate that \$475 of this cost increase is absorbed through student borrowing. The balance may be funded through changes in grant aid, funding from parents, or work while in college.

³² These estimates are significant at the one percent level.



Change in years of education per person and tuition across states and cohorts

Fig. 5b. Cross-State & Cohort Relationship Between Tuition and Years-of-Education Changes.

Note: Plot of state averages in the change in mean public university tuition (measured in \$'000s) against the change in number of years of postsecondary education obtained by 24-year-olds in three periods. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Years of postsecondary education approximates the number of years of completed postsecondary schooling by detailed education response among 2003–2011 age-24 respondents to the American Community Survey.

Source: American Community Survey (Ruggles et al. 2020) and federal administrative data.

Table 1

First-stage relationship between student debt and state university tuition.

	Student Debt	
State Public	0.479***	0.471***
Tuition, Age 22	(0.024)	(0.024)
	(0.146)	(0.141)
County Emp-to-Pop		0.033***
Ratio		(0.001)
State Youth		-0.009
Unemployment		(0.008)
County Average		1.719***
Wages		(0.092)
Year-Cohort FEs	Х	Х
Ethnicity FEs		Х
Observations	3,872,274	3,872,274

Note: OLS regression of age 24 total student debt on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Covariates measure the age-24 county-level annual employment-topopulation ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18–30) unemployment from the CPS, average county-level wages from the QCEW, and race and ethnicity indicators; see data section for details. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at ge 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data*.

and fees for a state-cohort is associated with a 0.077 to 0.178 percentage point decrease in the probability of ever enrolling in college. The decreases are small, insignificant, and relatively insensitive to the inclusion of controls for local economic conditions. Estimates in columns 3 and 4 and columns 5 and 6 reveal similar findings for total years of postsecondary education and BA degree attainment. The estimates indicate that a \$1000 increase tuition is associated with a small and precisely estimated 0.013 to 0.016 increase in the total years in post-secondary education and a 0.329 to 0.371 percentage point change in the probability of obtaining a BA degree.³³ Thus the evidence so far suggests substantial adjustment to rising tuition via student borrowing, and yet no meaningful adjustment on the schooling margin. It is consistent with students' having accommodated the large climb in college costs by amassing (further) debt, without resorting to leaving school. Such a pattern may indicate that the U.S. student loan system has provided students with needed credit access in the face of large shocks to the price of education.

Additional results demonstrate a steep time trend in student debt and educational attainment, independent of the rise in college tuition. The year estimates reflect a monotonic upward path in student debt over time, all else equal. In addition, college attendance, years of education and BA degree attainment are estimated to dip slightly in 2005–2006 but increase overall from 2003 to 2011: the different measures in 2011 are estimated to be roughly 3 percentage points above 2003 levels, all else equal. These student debt and educational attainment trends could potentially reflect declines in parents' ability or willingness to pay, in

³³ Only the estimated 0.371 percentage point increase in the probability of obtaining a bachelor's degree was significantly different from zero, and was so only at the ten percent level.



Change in homeownership and tuition across states and cohorts

Fig. 5c. Cross-State & Cohort Relationship Between Tuition and Homeownership Rate Changes.

Note: Plot of state averages in the change in mean public university tuition (measured in \$'000s) against the change in age 28–30 homeownership (0–100) in three periods. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Homeownership measured in the main Consumer Credit Panel sample; see text for details.

Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.

Table 2

Relationship between college enrollment and state university tuition.

	Any College		Years of Education		Earned BA	
State Public	-0.178	-0.077	0.013	0.016	0.371*	0.329*
Tuition, Age 22	(0.241)	(0.222)	(0.012)	(0.011)	(0.201)	(0.199)
	(0.281)	(0.265)	(0.017)	(0.015)	(0.284)	(0.244)
County Emp-to-Pop		-0.071		-0.004		0.193*
Ratio		(0.129)		(0.007)		(0.103)
State Youth		0.141		0.002		-0.046
Unemployment		(0.096)		(0.005)		(0.076)
County Average		6.698		0.644		-1.292
Wages		(7.417)		(0.446)		(7.886)
Year FEs	х	Х	х	х	х	X
Ethnicity FEs		Х		Х		х
Observations	261,181	261,181	261,181	261,181	261,181	261,181

Note: OLS regression of college enrollment, years of schooling, and college attainment on average public university tuition in the respondent's state. Any college indicates having enrolled at a postsecondary institution; years of education approximates the number of years of completed schooling by detailed education response; and Earned BA indicates having earned a four-year college degree. The sample includes 2003–2011 age-24 respondents to the American Community Survey. Average state tuition weighted by fulltime first-time student enrollment, both from IPEDS, and merged to the respondent's contemporaneous state of residence. Covariates measure the age-24 county-level annual employment-to-population ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18-30) unemployment from the CPS, and average county-level wages from the QCEW as well as ACS ethnicity fixed effects; see data section for details. All estimates include both state and year fixed effects. Standard errors in parentheses are clustered by state-cohort or (in the second set of parentheses) clustered by state. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: American Community Survey (Ruggles et al 2020) and federal administrative data.*

grant aid or self-financing, and changes in preferences for, and the perceived returns to, college attendance and BA completion.

While using individual-level data on educational outcomes, Censusblock-level data on the racial composition of the neighborhood, and county-variation in local economic conditions, we rely on state-cohortlevel tuition variation to estimate the relationship between tuition levels and educational outcomes. As discussed above, to account for remaining state-level correlation in errors, even after accounting for state and cohort fixed effects, one may want to adjust the standard errors for clustering. Our baseline estimates are estimated with clustered standard errors at the age-22 state-cohort level (at which a cohort's tuition is measured), but the estimated impacts of tuition on student

Table 3

Relationship among tuition, student debt, and homeownership.

	Homeownership					
State Public	-0.324***	-0.341***				
Tuition, Age 22	(0.058)	(0.058)				
	(0.137)	(0.106)				
Age 24 Student Debt			-0.669***	-0.742***		
			(0.125)	(0.132)		
			(0.233)	(0.255)		
State Youth		0.001		0.001		
Unemployment		(0.002)		(0.002)		
County Emp-to-Pop		-0.040***		-0.021***		
Ratio		(0.003)		(0.005)		
County Average		-3.571***		-0.455		
Wages		(0.156)		(0.630)		
Year-Cohort FEs	Х	Х	Х	Х		
Ethnicity FEs		Х		Х		
Model	OLS	OLS	2SLS	2SLS		
Observations	3,872,274	3,872,274	3,872,274	3,872,274		

Note: OLS regression of age 28-30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. Covariates measure the age-28-to-30 county-level annual employment-to-population ratio (using employment from QCEW and population from the US Census), fourthquarter state youth (18-30) unemployment from the CPS, average county-level wages from the QCEW, and neighborhood ethnic and racial composition indicators; see data section for details. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.

debt remain highly statistically significant when clustered at the state level, while those for the impact on educational outcomes remain small enough to rule out economically meaningful effects.

3.4.3. State-cohort tuition effects on later homeownership

With estimates in hand regarding students' response to rising tuition in the nature of their educational investments and college finance, we finally turn to estimates of the dependence of eventual homeownership on the college costs faced by individuals across states and cohorts.

Table 3 reports estimates of the dependence of homeownership, as measured at age 28, 29, and 30, on tuition for that cohort and state and on contemporary local economic conditions, along with estimates of age and cohort fixed effects, with state fixed effects included but estimates suppressed.

The coefficients on tuition in columns 1 and 2 of Table 3 indicate that a \$1000 increase in enrollment-weighted state-cohort mean college tuition and fees is associated with a 0.324 to 0.341 percentage point decline in the share of homeowners at ages 28 to 30. The estimated impact on homeownership again displays little sensitivity to the inclusion of local economic condition regressors. Its magnitude suggests that the observed \$3578 increase in mean annual tuition from 2001 to 2009 for the sample can explain about 1.2 percentage points (or 15%) of the observed 7.74 percentage point decline in age 28 to 30 homeownership rates for this sample from 2007 to 2015. Each of these point estimates differs significantly from zero at the one percent level whether we cluster at the state-cohort or the state level.

In interpreting the magnitude of share of the homeownership decline explained by the rise in tuition, it is important to note that on average cohort members spend 1.5 years in college by the age of 24. Another way to characterize and quantify the impact of tuition on homeownership is by taking into account that on average 45% of each cohort does not attend college (and thus never pays tuition), while 28% attends at least 4 years in college and obtains a BA. With non-college goers not affected by tuition, this implies a tuition impact for college goers that is roughly 1.8 times as large as for the overall population, while it is at least 3.6 times as large for BA recipients. This suggests that the observed tuition increase would likely explain a considerably larger share of the homeownership declines for those groups. We investigate this further in section 3.5 below.

By and large, for the cohorts overall, the observed tuition increase is able to explain roughly 15% of the 2007 to 2015 decline in age 28 to 30 homeownership. As college costs increase, we observe no meaningful change in human capital investment, and yet a slowing of the affected cohorts' progress toward homeownership. The costs to the local economy of a shift of the cost of human capital investment onto the current young cohort are estimated to appear not in a decline in workforce skills, but instead in a more muted participation of the young cohort in the local housing market in years to come.

3.4.4. Instrumental variables estimates of the effect of student debt on later homeownership

Let us now turn to the role of student debt in young consumers' path to homeownership. As discussed in subsection 3.3, above, we can obtain further insight into this relationship by attributing all of the tuition impact on homeownership to its effect on student debt. We expect the resulting IV estimate to represent an upper bound on the true causal impact of student debt.

Such an estimate provides valuable new information regarding the magnitude of the effect of the student debt amassed in response to rising education costs on later homeownership. The estimated coefficients presented in Table 1 show the first-stage regression for this instrumental variables approach, with the precisely-estimated relationship between tuition and student debt ruling out any concern of tuition as a weak instrument.

The instrumental variables estimates are reported in columns 3 and 4 of Table 3. First stage estimates of the effect of tuition on student debt are identical to those reported in Table 1, and have t-statistics of 20.0 and 3.3 (with age-22-state clustered standard errors), both exceeding the 3.2 standard threshold for the avoidance of weak instrument concerns. Unfortunately, with only one excluded regressor, we lack the opportunity to perform a Sargan-Hansen or related test of the validity of the exclusion. The instrumental variable estimates of the effect of student debt on homeownership indicate that a \$1,000 increase in student debt, arising from increased tuition, leads to a 0.67-0.74 percentage point decline in later homeownership among the state-cohort. The estimate is statistically significant at the 1% level when clustering standard errors at the age-22-state level. Like the other results discussed to this point, after controlling for a full set of state, cohort, and age effects, the addition of regressors describing local economic conditions to the model has little effect on the instrumental variables coefficient estimate. Given the \$5707 mean per capita student debt growth across state-cohorts from 2003 to 2011, the column 4 student debt coefficient estimate is able to explain up to 3.84 percentage points (or 50%) of the observed 7.74 percentage point homeownership rate decline across these nine cohorts from 2007 to 2015. In sum, the estimated effect of student debt that arises from instrumenting student debt using across-state-cohort variation in enrollment-weighted mean college tuition is large, and able to explain half of the steep decline in age 28 to 30 homeownership observed for this sample from 2007 to 2015.

Of course, as noted earlier, this estimate may be biased downward (more negative) as it rules out other channels than student debt through which tuition may negatively affect homeownership. While the estimated insensitivity of educational attainment to tuition suggests that a decline in the quantity of college education did not represent a significant channel, there may have been a decline in the quality of acquired college education that could have negatively impacted homeownership. Similarly, if rising tuition taxes the budgets of parents who, as a result, are less able to make contribution to students' down payments on future homes, this should also lead our student debt effect estimate to be downward biased (more negative). This would suggest that the true effect of tuition-driven student debt increases across state-cohorts on age 28 to 30 homeownership is somewhat less negative than the large point estimates we find in Table 3.

Putting all of the tuition and student debt estimates together, our estimates suggest that the steeply rising costs of education and the associated increase in student debt experienced by the 2001 to 2009 college cohorts that we study are able to explain between one and four of the eight percentage point drop in homeownership at age 28 to 30 that we observe for these same nine cohorts between 2007 and 2015.

3.5. Sensitivity analysis

As homeownership is very persistent, one may argue that, in addition to current local economic conditions, one should also condition on economic conditions at earlier ages. As shown in column 2 of Table 3, including local economic conditions at age 24 in the state at which we measure the consumer's state-cohort tuition leads to a small decline in the magnitude of the estimated tuition effect.

Another concern that may remain regarding the tuition estimates, and tuition-instrumented student debt estimates, is that the tuition levels confronted by a state-cohort may have been shaped by local economic conditions and the state's associated tax receipts when the cohort was in college. If these conditions affect aspects of the cohort's collegeera decision-making, or if they have a lasting impact on the cohort's expectations, then they may operate in specifications (1) and (2) as omitted factors, and generate correlation between state-cohort tuition and the error term. In one example, a state-cohort whose state experienced a housing market downturn as the cohort entered college may have both drawn low tax revenues that led to tight state budgets and higher university tuition, and, also owing to the housing downturn, instilled in its current college cohort an impression that housing investment does not pay.

In order to address this possibility, and any resulting endogeneity biases, we re-estimate specifications (1) and (2) with the addition (to X_{icst}) of measures of the QCEW state employment to population ratio, QCEW state mean weekly wage, and CPS-based state youth unemployment all measured in the year in which the relevant cohort was 18 years old, at the location at which we measure that cohort's public tuition. In this modified specification, we retain current measures of local economic conditions as employed in the baseline specifications: age 24 for student debt and educational attainment measures, and ages 28–30 for homeownership.

A glance at Table 4, in which estimates based on this extended specification are reported, reveals that the coefficient estimates of interest are qualitatively similar, and, indeed, approximately unchanged by the addition of college-era economic conditions. Throughout the paper, we have found that the addition of measures of local economic conditions, whatever their timing, has little effect on the estimates once one includes a complete set of fixed effects representing the contributions of year, state, and age to the outcome at hand.

In an additional specification, we also include local house price appreciation values as part of the age 18 local economic conditions, calculated at the county level, using data from the CoreLogic home price index (HPI). The tuition effect estimates are largely unchanged, while HPI at age 18 has a positive significant independent effect (coefficient 0.006) on homeownership. Finally, Table 4 reports the results of a specification in which we estimate the dependence of homeownership at ages 28 to 30 on student debt and contemporaneous economic conditions including house prices. While this specification is the only one in the table that produces an appreciable decline in the magnitude of the student debt coefficient, the coefficient remains at -0.509, implying a half of a percentage point drop in homeownership for every \$1000 increase in student debt. This coefficient remains significant at the one percent level, and may be compared to our baseline coefficient on student debt of -0.673.

While encouraging, a potential criticism to any analysis that controls for local home prices concerns their likely endogeneity. Beyond home prices there may be other omitted variables correlated with both tuition and homeownership, such as state finances. Besides representing a threat to the assumed exogeneity of tuition, an effect of tuition on homeownership through home prices and state finances would also invalidate the IV exclusion restriction, resulting in biases in the estimated effects of student debt, with the direction of the bias being unclear.

As a final effort to address the possibility that a spurious relationship between tuition and later homeownership may arise as a result of historical dynamics that affect state finances, house prices, and public college tuition together, we perform a placebo exercise using the members of our sample with no history of student borrowing.³⁴ These non-borrowers nevertheless are subject to the same housing markets and state finances as those who borrow for college. The goal is to isolate sample members for whom college tuition is less relevant, including the large segment of the sample who never enroll in college, and to ask whether state finances and other non-college factors generate a significant association between state-cohort tuition and later homeownership for them as well. These estimates are reported in Table 5. The estimated effect of tuition on homeownership for consumers without a history of student borrowing is statistically insignificant (using either standard error) and an order of magnitude smaller than our baseline estimates in the full sample. This suggests that any association between tuition growth and later homeownership that operates among those who never borrow for college is comparatively trivial. We infer that outside factors affecting both tuition and homeownership that would also operate among non-student borrowers, including the many non-college goers in our sample, are unlikely to pose an important challenge to our identifying assumption that state-cohort variation in public college tuition is exogenous to homeownership, conditional on characteristics X_{iclt} and the full complement of state and cohort-year effects. To the extent that our placebo estimates suggest no effect of tuition on homeownership that does not operate through student loans, these results also provide support for the exclusion restriction in our instrumental variables estimation.

Overall, despite the plausibility of competing explanations for the negative estimated association between tuition, or tuition-mediated student debt, and homeownership based on the local economic circumstances under which a state-cohort's tuition was determined, the addition of economic controls from that era generates very little change in the estimated relationships between public tuition, student debt, and homeownership. Moreover, despite the plausibility of alternative explanations relating tuition to later homeownership via state finances and house prices that should affect all residents, a set of placebo estimates using only sample youth who never borrow for college generates an estimated relationship between state-cohort tuition and later homeownership that is insignificant and of trivial economic magnitude. By and large, our New York Fed Consumer Credit Panel estimates, using a large and detailed panel drawn from administrative Equifax credit reports and rich geographic variation, demonstrate a substantial negative association between college costs, whether measured in terms of tuition or (tuition-mediated) student debt, and subsequent homeownership. In combination with the estimates on parental co-residence that appear in Bleemer et al. (2017), our results suggest that those states in which tuition is raised from cohort to cohort can expect to see meaningful housing market changes several years later, as young consumers shy away from homeownership and increasingly move home to parents.

³⁴ We thank one referee for noting these potential channels through which tuition may be associated with homeownership and for suggesting this placebo exercise.

Table 4

Robustness of relationship among tuition, student debt, and homeownership.

	Homeownership						
State Public	-0.308***	-0.311***					
Tuition, Age 22	(0.059)	(0.060)					
	(0.141)	(0.108)					
Student Debt			-0.682***	-0.684***	-0.509***	-0.608***	-0.987***
			(0.137)	(0.138)	(0.146)	(0.134)	(0.294)
			(0.246)	(0.247)	(0.238)	(0.266)	(0.422)
State Youth	0.001	0.021	0.001	0.001	0.005***		0.003*
Unemployment	(0.002)	(0.022)	(0.002)	(0.003)	(0.002)		(0.002)
County Emp-to-Pop	-0.059***	0.064***	-0.047***	-0.047***	-0.025***		-0.011
Ratio	(0.003)	(0.005)	(0.004)	(0.015)	(0.005)		(0.009)
County Average	-2.031***	-3.552***	1.830**	1.848	-1.251*		0.945
Wages	(0.194)	(0.424)	(0.806)	(1.900)	(0.698)		(1.386)
State Youth	0.018	0.021	0.006	0.007			
Unemp., Age 24	(0.022)	(0.022)	(0.023)	(0.041)			
County Emp-to-Pop	0.046***	0.064***	0.066***	0.068***			
Katio, Age 24	(0.003)	(0.005)	(0.005)	(0.020)			
	-4.1/4	-3.332***	-0.051	-5.370**			
State Vouth	(0.258)	(0.424)	(0.467)	(2.088)		0.000	
Junomp Ago 19		0.000		-0.002		(0.005)	
County Emp-to-Pop		0.003)		0.004)		0.003)	
Ratio Age 18		(0.005)		(0.030)		(0.017)	
County Average		-0.462		-0.745		-4 000**	
Wages Age 18		(0.381)		(0.630)		(1 827)	
State House Price		(0.501)		(0.050)	0.030***	(1.027)	
Index					(0.004)		
State House Price					()	0.006**	
Index, Age 18						(0.002)	
Year-Cohort FEs	Х	Х	Х	Х	Х	X	Х
State Time Trends							Х
Estimator	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Observations	3,872,274	3,872,274	3,872,274	3,872,274	3,872,274	3,872,274	3,872,274

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. Covariates measure the age-28-to-30, age 24, or age 18 county-level annual employment-topopulation ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18–30) unemployment from the CPS, average county-level wages from the QCEW, and average statelevel house prices from CoreLogic, matched by contemporaneous location of residence; see data section for details. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.*

3.6. Heterogeneity in the effect of tuition on homeownership

Having identified a meaningful and arguably causal influence of tuition, or of student debt arising from tuition, on homeownership early in the life cycle, academic and policy interests may next fall on the extent to which subgroups of younger American consumers may be particularly affected. We begin by comparing the relationship between college costs and homeownership for residents of urban and rural communities. In panel 1 of Table 6, we report estimates of expression (2) in the subset of our CCP sample who reside in urban areas, using the Census definition. We also report estimates for those who reside in rural areas, again following the Census definition. This categorization of our data is a partition; all of our CCP estimation sample members are classified as either urban or rural. In addition, it may help to note that suburban neighborhoods largely meet the Census urban area criteria, so that our urban sample may be interpreted as a pooled group of urban and suburban residents. As a result, 785,016 of our 3,770,583 observations are classified as rural.

The estimates in panel 1 of Table 6 paint very different pictures of the relationship between college costs and later homeownership among urban and rural communities.³⁵ Our estimates indicate a precisely estimated zero effect of tuition, or of student debt, on age

28 to 30 homeownership among residents of rural communities. Point estimates imply an increase in the rate of homeownership of 0.006 percentage points with a \$1000 increase in annual public college tuition, or of 0.011 with a \$1000 increase in student debt. In the urban (and suburban) sample, however, a tuition increase of \$1000 reduces homeownership by 0.409 percentage points. Or, again assuming the excludability of tuition, a \$1000 increase in student debt decreases age 28 to 30 homeownership by 0.864 percentage points. The difference in the relationship between tuition and homeownership in rural and suburban/urban regions is highly statistically significant.

A similar finding, qualitatively, emerges when we divide our sample based on population density. The second panel of Table 6 reports estimates for three samples of counties, representing population-weighted terciles of U.S. counties by county population density. In the reduced form and in the second stage, the estimated homeownership effects of tuition and of student debt are small and insignificant in low-density counties. Estimates for the middle and top tercile population density counties are significant and substantial. In counties with middling (high) population density, a \$1000 tuition increase lowers homeownership by 0.463 (0.375) percentage points, and a \$1000 student debt increase lowers homeownership by 0.907 (0.685) percentage points.

 $^{^{35}}$ Sample sizes, standard errors and first-stage estimates of the effect of tuition on student debt for each of the heterogeneity analyses considered in Table 6, are reported in

Tables A3–A9 of the Appendix. First-stage estimates are all statistically significant and consistent across subgroups.

Table 5

Relationship between tuition and homeownership among youth *without student debt* as a placebo exercise.

	Homeownership	
State Public	-0.041	-0.056
Tuition, Age 22	(0.163)	(0.163)
	(0.196)	(0.189)
Youth Unemployment		-0.007*
		(0.004)
Employment Ratio		-0.023***
		(0.005)
Wages		-2.332***
		(0.399)
Year-Cohort FEs	Х	Х
Observations	498,314	498,314

Note: OLS regression of age 28-30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, who did not hold any student debt at age 24, with observations for each age between 28 and 30; see the text for selection into the CCP. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. Covariates measure the age-28-to-30 countylevel annual employment-to-population ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18-30) unemployment from the CPS, and average county-level wages from the QCEW; see data section for details. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.

Hence we find that the overall sample estimates that we have observed, and which imply a substantial effect of college costs on homeownership, appear to be driven by urban and suburban residents. Further, the magnitude of the estimated effect of tuition on homeownership increases substantially when we drop the roughly one quarter of our estimation sample who live in rural areas, and simply focus on urban and suburban communities in which the emerging affordability crisis is most relevant.

Next we are interested in the extent to which housing markets with more and fewer young participants may be exposed to tuition effects. For example, is it the case that tuition does not move the rate of early homeownership in The Villages of central Florida, where youths make up a small share of the residential population, but has a substantial effect on early homeownership in Austin, Texas? To address the magnitude of the tuition-homeownership relationship in older and younger housing markets, we re-estimate expression (2) in samples representing adult population-weighted terciles of counties by the share of adult residents under 40 years of age. Given the above findings, and the decisive urban-rural age gradient, we determine terciles and estimate using only urban and suburban counties. Results are reported in the third panel of Table 6. ³⁶ Estimates of the effect of college costs on homeownership are negative and significant (or marginally significant) in all cases, but we estimate greater homeownership effects of college costs in the regions with middling or high youth shares of the population. While a \$1000 tuition increase is estimated to bring a 0.216 percentage point decline in early homeownership in the lowest youth population tercile, in the middle (highest) youth population tercile a \$1000 increase in tuition leads to a 0.592 (0.652) percentage point decline in homeownership, and a \$1000 increase in student debt lowers early homeownership by 1.305 (1.150) percentage points. Here we note that the greatest magnitude effects of college costs on later homeownership appear

Table 6

Heterogeneity in relationship between tuition, student debt, and homeownership.

	Homeownership	
	State Public Tuition	Student Debt
1. Urbanicity of Census Block		
Rural	0.006	0.011
Urban	-0.409***	-0.864***
2. County Population Density		
Bottom Tercile	-0.076	-0.178
Middle Tercile	-0.463***	-0.907***
Top Tercile	-0.375***	-0.685***
3. County Population Youth Sh	nare (urban areas only)	
Bottom Tercile	-0.216*	-0.515*
Middle Tercile	-0.592***	-1.305***
Top Tercile	-0.652***	-1.150***
4. Census Block Race/Ethnicity	1	
Majority White	-0.249**	-0.439**
Majority Black	-0.076	-0.213
No majority	-0.262*	-1.274*
5. Conforming Loan Limit in C	County	
Normal	-0.193	-0.445
High	-0.488***	-0.731***
6. Census Region		
Northeast	-0.565***	-1.752***
South	-0.096	-0.319
Midwest	0.04	0.193
West	-0.472**	-1.561*
7. Age 22 Cohort		
Age 22 in 2001–2004	-0.336*	-1.098*
Age 22 in 2005–2009	-0.256**	-1.095**
Estimator	OLS	2SLS

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Student debt is observed at age 24. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax, FHFA, US Census, the American Community Survey, and federal administrative data.*

both in youthful housing markets and in housing markets in which substantial shares of younger and older homebuyers meet, though the difference is only statistically significant at the 10 percent level.³⁷

We are also able to examine differences in the estimated tuition effect on homeownership by race or ethnicity. We begin by dividing the sample based on the majority race or ethnicity of the sample member's Census block. This step generates substantial subsamples of members whose Census blocks are majority white (2.23 million) and majority black (203,065), as well as those whose Census block groups are comparatively diverse, with no single majority race or ethnicity.³⁸ In panel 4 of Table 6, we report the results of estimating expression (2) in these three subsamples. While the estimates reflect a small and insignificant effect of college costs on later homeownership in majority black neighborhoods, we find a substantial and significant negative effect of college costs on homeownership among residents of diverse neighborhoods and

³⁶ Note that weighting by adult population in generating these terciles leads to differences in sample sizes across our three youth share terciles for this youth-only sample. Our first through third tercile samples include 740,879, 1,023,472, and 1,217,182 members, respectively.

 $^{^{37}}$ In addition, we see some evidence that older communities are relatively protected from the estimated tuition drag on homeownership. We estimate expression (2) again in terciles based on county share of over-60 residents. In the tercile of counties with the most over-60 residents, we find precise, near-zero estimates of the effect of tuition on later homeownership.

³⁸ Other race and ethnicity groups are in the majority for a considerably smaller number of our sample observations.

majority white neighborhoods. The point estimates are greatest for residents of diverse neighborhoods, with a \$1000 increase in tuition decreasing homeownership by 0.262 (0.249) percentage points, and an increase in student debt decreasing homeownership by 1.274 (0.439) percentage points, in diverse neighborhoods (majority white neighborhoods).

In section 3.5, we examined the sensitivity of the estimates to the inclusion of contemporaneous, as well as past, house price indices as controls. Another revealing step may be estimating expression (2) separately in standard and expensive housing markets. Here we are able to consider the extent to which the estimated tuition-homeownership relationship persists within narrower bands of the house price distribution. At the same time, separating high- and moderate-price housing markets can tell us more about where the estimated tuition drag on homeownership manifests, and this in no small manner allows us to infer the extent and nature of the economic or policy concern it represents.

Most U.S. counties are subject to the standard conforming loan limit (CLL) on mortgages set annually by the FHFA in order to qualify for purchase or guarantee by Fannie Mae or Freddie Mac. A minority of counties are subject to larger CLLs as a result of higher prevailing prices. We separate our sample counties into standard and high CLL categories and re-estimate expression (2). Among our youth sample, 74% live in standard CLL counties and 26% live in high CLL counties. As reported in panel 5 of Table 6, the estimated effect of college costs on homeownership are moderate and imprecise for the standard CLL counties. The estimates for the high CLL counties, however, are both precise and relatively large. A \$1000 increase in tuition decreases homeownership by 0.488 percentage points, and a \$1000 increase in student debt decreases homeownership by 0.731 percentage points, in the high CLL sample. The division of the sample into narrower house price groupings shows us that, while the qualitative relationships among college cost, educational attainment, and later homeownership are reasonably similar for each group, the largest point estimates of the homeownership effect belong to the high house price (and presumably high required down payment) communities.

Given substantial differences in college enrollment rates, tuition, and housing affordability across the U.S., one might next ask whether the estimated tuition drag on homeownership manifests in all regions of the country. In panel 6 of Table 6, we estimate expression (2) separately among sample members living in the Northeast, South, Midwest, and West of the U.S., following Census definitions of the four regions. The results are decisive. In the Northwest and West, a \$1000 tuition increase decreases later homeownership by 0.565 and 0.472 percentage points, respectively; a \$1000 increase in student debt decreases later homeownership by 1.752 and 1.561 percentage points, respectively. These effects are large and, for the most part, highly significant. The estimates for the South and Midwest, however, are mostly small and all insignificant, and significantly lower than in the Northeast and West. Hence the tuition-homeownership connections we have described throughout the paper appear to be driven largely by housing and education markets in the Northeast and the West.

As noted above, one merit of our study relative to Mezza et al., and to the broader literature, is our ability to estimate homeownership choices for a very large administrative sample in recent years. This means that we are able to investigate the magnitude of the housing effect of college tuition during and after the Great Recession in the U.S., and the extent to which the barrier that college costs pose to post-college homeownership has been intensifying in recent years. To understand the progress of the effect of college costs on homeownership over time, we divide our sample into cohorts who were of college age (age 22) from 2001 to 2004, and from 2005 to 2009. These groups were ages 28 to 30, and making housing decisions, from 2007 to 2012 and from 2011 to 2017, respectively. Hence we estimate the influence of tuition (and of student debt) on post-college homeownership for a group of young consumers who are choosing whether to buy a home during a period that includes the Great Recession and for a group of young consumers who are choosing whether to buy a home after the Great Recession, and even well into the subsequent recovery.

The effects of tuition and of student debt on post-college homeownership are surprisingly stable over time. Results for our pre-recession and recession-era college students (or recession-era homebuyers and post-recession/recovery-era homebuyers) appear in panel 7 of Table 6. Estimates indicate that a tuition increase of \$1000 decreases the probability of homeownership at 28 to 30 by 0.336 percentage points during the period that includes the Great Recession and still 0.256 percentage points in the recovery. Even more strikingly, \$1000 increase in student debt is estimated, using the instrumental variables specification, to decrease age 28 to 30 homeownership by 1.098 percentage points during the recession, and by 1.095 percentage points during the recovery. Despite the attention drawn to the post-schooling economic effects of higher college costs in recent years, perhaps owing to some large post-Great Recession tuition increases, the dampening effect of college tuition on housing market activity is similarly evident for cohorts approaching the age of first home purchase between 2007 and 2012 and between 2011 and 2017. While college tuition's effect on housing appears unexpectedly stable, the unabated rise in tuition and student debt implies a growing drag on young homeownership.

As we discussed earlier, with some 45% of each cohort not enrolling in college, we expect the tuition increase to have a greater impact, and to explain a larger share of the homeownership decline, among those with college education. With college enrollment and educational attainment rates varying across states, one would expect a similarly sized increase in tuition to have a greater impact in states where more youth attend college. To investigate this, we added interactions between our cohort-state tuition variable with indicators for whether the cross-cohort average educational attainment rate for the state in question is above or below the median of educational attainment across states.³⁹ Estimates in Table 7 indicate first that, as expected, a tuition increase leads to considerably larger increases in student debt in states where a greater share of youth enroll in college or receive a bachelor's degree, or where youth attend more years of post-secondary education. All interaction coefficient estimates are positive, substantial, and statistically significant, based on standard or state-clustered standard errors. Similarly, we find substantially more negative effects of tuition on homeownership in states where greater cohort shares attend college, with the tuition effects in the higher educational attainment locales amounting to nearly double the tuition effects in the lower attainment locales (Table A2, A4-A8).

The variation in college attendance rates across states could also be used to sharpen our estimates by computing an "effective tuition" measure, calculated as the product of our state-cohort average tuition variable with the proportion in the state who attended college, or alternatively with the average number of years of college education. We perform this experiment in Appendix Table A10. Replacing our earlier tuition measure with this new "effective tuition" measure leads to the Appendix Table A10 estimates. All indicate a considerably stronger, and more precisely estimated, impact of effective tuition on student debt and homeownership. For example, the estimate in column 3 indicates that a \$1000 increase in "effective" annual tuition (per college-goer) leads to a 0.618 percentage point decline in the probability of owning a home at ages 28-30, while the estimate in column 4 indicates that a \$1000 increase in the effective annual tuition per year of college enrollment leads to a 0.202 percentage point decline in the likelihood of owning a home, implying an approximate 0.81 percentage point decline for 4 years of college.⁴⁰

Our investigation into the nature of the homeownership response to rising tuition across various populations of U.S. students, and potential students, has taught us several new things. College tuition serves as

 $^{^{39}}$ As before, these specifications include the full complement of state and cohort-age fixed effects.

⁴⁰ Note that the estimate of -0.618 is about 1.91 times the estimate of -0.324 in Table 3, which is close to the calibrated tuition impact per college-goer computed in section 3.4.3.

Table 7

Relationship among tuition, student debt, and homeownership by state educational take-up.

	Student Debt			Homeownership		
State Public	0.396***	0.447***	0.430***	-0.230***	-0.209***	-0.194***
Tuition, Age 22	(0.024)	(0.025)	(0.025)	(0.063)	(0.065)	(0.065)
	(0.167)	(0.178)	(0.173)	(0.139)	(0.110)	(0.109)
Tuition x Top	0.134***			-0.156***		
Half Some College	(0.008)			(0.041)		
Tuition x Top		0.064***			-0.171***	
Half Years Ed		(0.009)			(0.041)	
Tuition x Top			0.040***			-0.145***
Half BA Attain.			(0.009)			(0.041)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х
Observations	3,872,274	3,872,274	3,872,274	3,872,274	3,872,274	3,872,274

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Student debt is observed at age 24. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Tuition is interacted with indicators for being in the top half of states (by cohort) using ACS averages of the following: age-24 prior enrollment at a postsecondary institution; age-24 years of education as approximated by the number of years of completed schooling by detailed education response; and age-24 four-year degree attainment. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax, the American Community Survey (Ruggles et al 2020), and federal administrative data.*

more of a barrier to homeownership in urban and suburban than in rural housing markets. Its effect is more pronounced in the Northeast and the West, in diverse and majority white neighborhoods, in higher-priced housing markets, in relatively young counties, and in areas in which a greater share of the younger cohort attends college. At the same time, the dampening effect that college tuition has on the local housing market appears to be a surprisingly stable feature of the problem over time and across the business cycle. What may, at first, have appeared to be a novel phenomenon ushered in by the Great Recession is estimated in our data to have persisted since the mid-2000s boom, if not before. And, moreover, the drag on homeownership arising from higher tuition is estimated to have endured well into the recovery.

4. Discussion

Motivated by the upheaval we've observed over the past thirteenplus years in young Americans' college borrowing, homeownership, and co-residence with parents, this paper investigates the influence of a steep rise in the cost of college on recent cohorts' student borrowing, educational attainment, and post-recession homeownership. We construct aggregates in state-cohort cells on young consumers' college tuition, and we relate these tuition aggregates to their subsequent educational attainment, student borrowing, and debt-funded homeownership using the New York Fed Consumer Credit Panel, the American Community Survey, and the Department of Education's Integrated Postsecondary Education Data System. Information on local conditions from additional data sources and a complete set of fixed effects representing state, year, and age round out the model. Given the complex relationship between local college costs and young consumers' later homeownership, we represent college costs in the estimation first through state-cohort enrollment-weighted tuition averages, and relate these to state-cohort student debt aggregates, graduation rates, and homeownership rates. We then explore the importance of student debt for homeownership by conducting an analysis that attributes the entire tuition impact on homeownership to its effect through student debt.

We find that the steep growth in tuition from 2001 to 2009 is associated with a substantial increase in mean per capita student debt at 24 for these same cohorts (as measured between 2003 and 2011). The observed \$3578 increase in the mean of enrollment-weighted average public college tuition across the states, given the model estimates, can explain roughly \$1628 of the observed \$5707 increase in mean per capita student debt at age 24 over the 2003 to 2011 period in our sample. However, the estimates show no meaningful change in college enrollment, years of schooling, or BA receipt in response to the climb in college costs. Our evidence is consistent with American students having accommodated such large positive shocks to the cost of college not by forgoing schooling, but instead by amassing substantially more student debt.

To the extent that the ongoing de-funding of public higher education has not been met, according to these estimates, by significant declines in educational attainment, some policymakers might be tempted to infer that de-funding public higher education is costless. Despite a substantial decline in the cost of public higher education per taxpayer, the skill of the local workforce remains approximately stable. However, our estimates indicate that the cost of shifting the burden of funding higher education onto the student may arrive with a lag: Early homeownership, in our empirical models, appears responsive to the costs of higher education. The decline in age 28 to 30 homeownership that we estimate in response to increasing college costs appears across a variety of specifications. Summing up findings from a broad range of specifications, we find that the increase in the cost of college and student debt that our sample cohorts experienced from 2001 to 2009 is able to explain around 11-35% of the measured 7.7 percentage point drop in the rate of age 28 to 30 homeownership in the U.S. from 2007 to 2015. These declines are driven by youths in urban areas, particularly in the Northeast and West of the US, and living in higher-priced housing markets and locations in which younger adults make up a bigger share of the local housing market.

It is worth noting that our estimates may represent some combination of the influence of student borrowing on later homeownership through the burden of loan payments and debt balance qualifications and the influence of student borrowing on later homeownership through repayment struggles, lost creditworthiness, and borrower confusion. Based on our findings, along with the U-shaped yet always-high rate of student loan repayment difficulty as a function of student debt balance, we suspect that exposure to the student loan system, in addition to the dollars borrowed, deserves attention as a possible mechanism by which student borrowing may impact post-college consumption. To the extent that negative effects of exposure to the student loan system are driven by repayment difficulties, these and related findings may point to a need for greater focus by policymakers on "fixing" repayment, as has been argued by Dynarski (2014).

At the same time, the estimates generally indicate that college costs and the aggregate student loan balance of a state-cohort is a significant factor in its transition to homeownership.⁴¹ Moreover, a

⁴¹ Note that our findings are also likely to have implications regarding the evolution of the education-homeownership and income-homeownership relationships analyzed by Gyourko and Linneman (1996).

Journal of Urban Economics 122 (2021) 103298

number of post-recession surveys, described in section 1.2, provide compelling evidence that young consumers feel their progress toward ownership is slowed by their student debt. One mechanism by which student loan dollars may matter is through total debt-to-income (DTI) ratios used in mortgage underwriting. Such underwriting practices have been a particularly active area of policy reform over the past few years. Our estimates, and the survey results discussed in section 1.2, suggest that student loan dollars outstanding have been a relevant factor in the transition to homeownership. The repeated modifications we have observed since the financial crisis of the treatment of student debt balances in DTI calculations by the FHA, Fannie Mae, and others suggest that relevant policymakers and lending agencies suspect the DTI treatment of student debt of having meaningful effects on first time homebuying. In combination with our estimates of the effect of student debt on later homeownership, such evidence suggests that the DTI treatment of student debt in mortgage underwriting may be an effective additional policy lever for re-energizing young homebuyers.

Finally, the growth in tuitions and student debt and the proliferation of repayment difficulties has occurred in a context of rapid defunding of public higher education among states. Our estimates here and in Bleemer et al. (2017) indicate a negative association between cohort-to-cohort tuition growth within a state and cohort-to-cohort growth in early homeownership, and, similarly, a substantial positive association between cohort-to-cohort tuition growth and the rate at which the affected youth move home to parents during their midtwenties. Hence our estimates suggest that states that hike tuition might hope to avoid meaningful declines in workforce skills, as student borrowing allows young college-goers to accommodate the tuition shock. However, these states, on average, can expect both weaker starter housing markets and more "boomeranging" adult children to follow. The evidence points to a final policy opportunity to stimulate youth homeownership over the long run: funding state higher education.

Appendix

Table A1

Summary statistics for estimation sample.

	Mean	Median	SD	Min	Max
State Public Tuition (1000s USD)	6.24	5.79	2.25	2.79	20.46
Student Debt, Age 24 (1000s USD)	6.71	0	15.4	0	295.22
Youth Unemployment, CPS	1.02	10.79	3.39	2.87	21.2
Employment Ratio, QCEW	54.58	52.81	16.88	0	396.3
Wages, QCEW (1000s USD)	0.92	0.88	0.24	0	4.41
Youth Unemployment, CPS, Age 18	7.45	7.37	1.9	1.78	15.34
Employment Ratio, QCEW, Age 18	58.23	56.67	18.36	0	316.1
Wages, QCEW, Age 18 (1000s USD)	0.87	0.83	0.23	0	5.38
Youth Unemployment, CPS, Age 24	9.95	9.15	3.29	2.55	20.72
Employment Ratio, QCEW, Age 24	55.77	54.72	17	0	273.26
Wages, QCEW, Age 24 (1000s USD)	0.89	0.87	0.22	0	4.41
Years of Postsecondary Ed., Age 24	1.51	1	1.74	0	7
Proportion with Any College, Age 24	55.32	100	49.72	0	100
Proportion with BA, Age 24	28.35	0	45.07	0	100

Note: Summary statistics for the main estimation sample. The sample (until the last three rows) includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Covariates measure the age-28-to-30 county-level annual employment-to-population ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18–30) unemployment from the CPS, and average county-level wages from the QCEW; see data section for details. The sample for the last three rows is 2003–2011 age-24 American Community Survey respondents. Any college indicates having enrolled at a postsecondary institution; years of postsecondary education approximates the number of years of posthigh-school completed schooling by detailed education response; and Earned BA indicates having earned a four-year college degree. *Source: New York Fed Consumer Credit Panel / Equifax, the American Community Survey (Ruggles et al 2020), and federal administrative data.*

	Any college	Years of Ed	Prop. With BA
State Public	-0.067	0.017	0.294
Tuition, Age 22	(0.255)	(0.013)	(0.216)
	(0.259)	(0.015)	(0.243)
State Youth	0.140	0.152	-0.034
Unemp., Age 24	(0.096)	(0.095)	(0.082)
County Emp-to-Pop	-0.072	-0.071	0.200
Ratio, Age 24	(0.139)	(0.138)	(0.122)
County Average	7.539	7.032	-1.911
Wages, Age 24	(10.067)	(9.451)	(8.845)
State Youth	-0.001	0.000	0.013
Unemp., Age 18	(0.011)	(0.001)	(0.009)
County Emp-to-Pop	-0.042	-0.009	-0.030
Ratio, Age 18	(0.175)	(0.009)	(0.142)
County Average	-1.420	0.425	7.003
Wages, Age 18	(8.937)	(0.454)	(7.789)
Year FEs	Х	Х	Х
Ethnicity FEs	Х	Х	Х
Estimator	OLS	OLS	OLS
Observations	261,181	261,181	261,181

Table A2

Robustness of relationship between college enrollment and state university tuition.

Note: OLS regression of college enrollment, years of schooling, and college attainment on average public university tuition in the respondent's state. Any college indicates having enrolled at a postsecondary institution; years of education approximates the number of years of completed schooling by detailed education response; and Earned BA indicates having earned a four-year college degree. The sample includes 2003–2011 age-24 respondents to the American Community Survey. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS, and merged to the respondent's contemporaneous state of residence. Covariates measure the age 18 or 24 county-level annual employment-to-population ratio (using employment from QCEW and population from the US Census), fourth-quarter state youth (18–30) unemployment from the CPS, and average county-level wages from the QCEW as well as ACS ethnicity fixed effects; see data section for details. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by state-cohort or (in the second set of parentheses) clustered by state. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: American Community Survey (Ruggles et al 2020) and federal administrative data.*

Table A3 Relationship among tuition, student debt, and homeownership in urban and rural regions.

	Student Debt	Homeownership		Student Debt	Homeownership	
State Public	0.522***	0.006		0.471***	-0.409***	
Tuition, Age 22	(0.048)	(0.138)		(0.028)	(0.065)	
		(0.164)			(0.157)	
Student Debt			0.011			-0.864***
			(0.262)			(0.148)
			(0.307)			(0.295)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х
Sample	Rural Census Blocks			Urban Census Blocks		
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	785,016	785,016	785,016	2,985,567	2,985,567	2,985,567

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by urban/rural status at age 28–30, as defined by the US Census at the Census block level; an area is termed urban if it is part of an 'urban area' with population greater than 50,000. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.*

Table A4 Relationship among tuition, student debt, and homeownership by population density.

	Student Debt	Homeownersh	ip	Student Debt	Homeownersh	ip	Student Debt	Homeownersh	ip
State Public	0.433***	-0.076		0.509***	-0.463***		0.543***	-0.375***	
Tuition, Age 22	(0.064)	(0.123)		(0.076)	(0.133)		(0.101)	(0.129)	
	(0.116)	(0.164)		(0.142)	(0.174)		(0.162)	(0.156)	
Student Debt			-0.178			-0.907***			-0.685***
			(0.286)			(0.264)			(0.243)
			(0.374)			(0.358)			(0.275)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х	Х	Х	Х
Sample	First Tercile			Second Tercile			Third Tercile		
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	1,244,408	1,244,408	1,244,408	1,274,921	1,274,921	1,274,921	1,289,512	1,289,512	1,289,512

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by county-level population density terciles. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and American Community Survey.*

 Table A5

 Relationship among tuition, student debt, and homeownership by youth share of the population, urban & suburban only.

	Student Debt	Homeowners	ship	Student Debt	Homeownersh	ip	Student Debt	Homeownersh	ip
State Public	0.419***	-0.216*		0.450***	-0.592***		0.570***	-0.652***	
Tuition, Age 22	(0.097)	(0.123)		(0.090)	(0.159)		(0.113)	(0.209)	
	(0.184)	(0.135)		(0.151)	(0.248)		(0.229)	(0.376)	
Student Debt			-0.515*			-1.305***			-1.150***
			(0.277)			(0.419)			(0.319)
			(0.241)			(0.625)			(0.490)
Year-Cohort FEs	Х	Х	X	Х	Х	Х	Х	Х	Х
Sample	First Tercile			Second Tercile			Third Tercile		
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	740,879	740,879	740,879	1,023,472	1,023,472	1,023,472	1,217,182	1,217,182	1,217,182

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is restricted to regions Census-designated as 'urban areas' (with population greater than 50,000) and split by the county-level youth share of adult residents weighted by adult population. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and US Census*.

Table A6

Relationship among tuition, student debt, and homeownership by census block race/ethnicity.

	Student Debt	Homeownersh	ip	Student Debt	Homeowner	ship	Student Debt	Homeownersh	nip
State Public	0.563***	-0.249**		0.365***	-0.076		0.203**	-0.262*	
Tuition, Age 22	(0.081)	(0.116)		(0.070)	(0.146)		(0.090)	(0.145)	
	(0.153)	(0.127)		(0.082)	(0.116)		(0.191)	(0.251)	
Student Debt			-0.439**			-0.213			-1.274*
			(0.208)			(0.407)			(0.662)
			(0.237)			(0.320)			(0.843)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х	Х	Х	Х
Sample	Majority White Neigh.		Majority Black Neigh.		No Majority Neigh.				
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	2,230,606	2,230,606	2,230,606	203,065	203,065	203,065	1075,858	1,075,858	1,075,858

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by the racial make-up of each individual's age22 Census block: blocks are characterized as white or Black if at least 75 percent of residents are members of that ethnicity, and 'no majority' if no ethnicity makes up more than 75 percent of residents. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and US Census*.

Table A7		
Relationship among tuition, stude	ent debt, and homeownership l	by conforming loan limit (CLL).

	Student Debt	Homeownership		Student Debt	Homeownership	
State Public	0.439***	-0.193		0.562***	-0.488***	
Tuition, Age 22	(0.062)	(0.136)		(0.201)	(0.138)	
	(0.114)	(0.181)		(0.416)	(0.197)	
Student Debt			-0.445			-0.731***
			(0.297)			(0.246)
			(0.367)			(0.290)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х
Sample	Normal CLL			High CLL		
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	2,849,271	2,849,271	2,849,271	1,023,003	1,023,003	1,023,003

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by whether the residential county is subject to above-typical conforming loan limits for mortgages, indicating high prevailing house prices. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and FHFA*.

 Table A8

 Relationship among tuition, student debt, and homeownership in the four U.S. census regions.

	Homeownership							
State Public	-0.565***		-0.096		0.040		-0.472**	
Tuition, Age 22	(0.140)		(0.128)		(0.176)		(0.200)	
	(0.151)		(0.118)		(0.182)		(0.218)	
Student Debt		-1.752***		-0.319		0.193		-1.561*
		(0.502)		(0.421)		(0.821)		(0.851)
		(0.483)		(0.355)		(0.811)		(1.348)
Year-Cohort FEs	Х	X	Х	Х	Х	Х	Х	X
Sample	Northeast Region		South Region		Midwest Region	ı	West Region	
Estimator	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Observations	639,647	639,647	1,458,824	1,458,824	866,242	866,242	907,555	907,555

Note: OLS regression of age 28-30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by residential region (as defined by the U.S. Census). Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax.*

Table A9 Relationship among tuition, student debt, and homeownership during and after the great recession.

	Student Debt	Homeownership		Student Debt	Homeownership	
State Public	0.304***	-0.336*		0.229***	-0.256**	
Tuition, Age 22	(0.059)	(0.179)		(0.052)	(0.105)	
		(0.404)			(0.195)	
Student Debt			-1.098*			-1.095**
			(0.635)			(0.516)
			(1.298)			(0.874)
Year-Cohort FEs	Х	Х	Х	Х	Х	Х
Sample	Age 22 in 2001–2004			Age 22 in 2005–2009		
Estimator	OLS	OLS	2SLS	OLS	OLS	2SLS
Observations	1,880,906	1,880,906	1,880,906	1,991,368	1,991,368	1,991,368

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. The sample is split by whether the individual turned 22 before or after 2005; the latter group turns 28 after the Great Recession. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. 2SLS estimates instrument age 24 student debt by age 22 average state public tuition. All estimates include state and cohort-year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax and federal administrative data.*

Table A10

Relationship between student debt and homeownership by state educational take-up, continuous.

	Student Debt		Homeownership	
Tuition x Coll.	1.286***		-0.618***	
Attendance Rate	(0.039)		(0.096)	
	(0.318)		(0.245)	
Tuition x Years		0.416***		-0.202***
of Education		(0.012)		(0.032)
		(0.103)		(0.079)
Year-Cohort FEs	Х	X	Х	Х
Observations	3,872,268	3,872,268	3,872,268	3,872,268

Note: OLS regression of age 28–30 homeownership on average public university tuition in the state where the individual resided at age 22. The sample includes all members of the Consumer Credit Panel observed at ages 22, 24 (between 2001 and 2009), and between 28 and 30, with observations for each age between 28 and 30; see the text for selection into the CCP. Student debt is observed at age 24. Average state tuition weighted by full-time first-time student enrollment, both from IPEDS. Tuition is interacted with state-cohort ACS averages of the following: age-24 prior enrollment at a postsecondary institution and age-24 years of education as approximated by the number of years of completed schooling by detailed education response. All estimates include state and cohort year fixed effects. Standard errors in parentheses are clustered by individual or (in the second set of parentheses) state at age 22. * indicates significance at the ten percent, ** the five percent, and *** the one percent level. *Source: New York Fed Consumer Credit Panel / Equifax, the American Community Survey (Ruggles et al 2020), and federal administrative data.*

CRediT authorship contribution statement

Zachary Bleemer: Conceptualization, Methodology, Software, Formal analysis, Validation, Writing - review & editing. Meta Brown: Conceptualization, Methodology, Software, Formal analysis, Validation, Writing - original draft, Writing - review & editing. Donghoon Lee: Conceptualization, Methodology, Validation, Formal analysis, Data curation. Katherine Strair: Software, Formal analysis, Validation. Wilbert van der Klaauw: Conceptualization, Methodology, Formal analysis, Validation, Writing - review & editing.

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