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ABSTRACT

In-State College Enrollment and Later Life Location Decisions*

State and local policymakers are very interested in how attending college in one's home state affects the likelihood of living in that state after college. This paper uses cohort-level data from the American Community Survey, decennial censuses, and other sources to examine how birth-state college enrollment affects birth-state residence several years later. Ordinary least squares and instrumental variables estimates both suggest a statistically significant positive relationship. The preferred instrumental variable estimates suggest that a one percentage point increase in birth-state enrollment rates increases later life birth-state residence by roughly 0.41 percentage points. Implications for policy are discussed.

JEL Classification: H75, I25, J24, R23

Keywords: higher education policy, in-state college enrollment, migration, college attendance

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I. Introduction

College educated workers are very important for national, state, and local economies. They pay higher taxes and consume fewer public services (Trostel 2010). They also increase wages and employment outcomes for other workers in the area (Moretti 2004, 2013; Winters 2013, 2014), make the area a more desirable place to live (Shapiro 2006; Winters 2011a), and encourage future employment and population growth (Simon 1998; Simon and Nardinelli 2002; Glaeser and Saiz 2004). States often cite these benefits to justify higher education policies encouraging young people to attend college in-state, with the hope that in-state college enrollment will increase the likelihood of residing and working in that state after finishing college.[1] Many policymakers believe that their state loses too much homegrown talent to other states and want to slow this brain drain. This is especially prevalent in states that have a hard time attracting educated workers from other areas. For such states, keeping their homegrown talent might be a particularly desirable economic development strategy. However, higher education also increases the probability that an individual will move away from his or her birth state after college (Malamud and Wozniak 2012)[2], and out-migration may negate the benefits to the state of college educating more young people. Thus, there is much interest in how in-state enrollment affects the decisions of college-educated persons from the state to remain in the state after college. Despite this topic's importance, there is very little empirical research offering causal estimates. The current paper seeks to fill this important gap in the literature.

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[1] These higher education policies can include public subsidies to reduce in-state tuition rates, targeted financial aid, and resources devoted to academic quality, access in underserved geographic areas, campus amenities, marketing and recruiting. Some of these policies have the potential to affect multiple educational outcomes including educational attainment, educational quality, educational inequality, and others.

[2] Malamud and Wozniak (2012) identify exogenous increases in higher education in the U.S. using Vietnam Era draft induction risk. Böckerman and Haapanen (2013) find that converting vocational colleges to universities in Finland increased university attendance and migration rates. Machin, Salvanes and Pelkonen (2012) find that compulsory schooling laws in Norway increased secondary education and later-life migration rates. McHenry (2013) is a notable exception in this literature; he finds that increased secondary education from compulsory schooling laws in the U.S. actually reduce out-migration.

Of course, even if state human capital retention policies benefit an individual state, it does not mean that they benefit the nation as a whole. Policies that distort location decisions may reduce national well-being. Highly mobile college-educated workers generally move toward productive locations to earn high incomes and advance their careers (Chen and Rosenthal 2008). Also, agglomeration economies from concentrating skilled workers in a few areas may lead to human capital spillovers and increased innovation that increases national economic productivity (Moretti 2013). State policies that reduce mobility may reduce match quality between workers and firms and lead to fewer human capital externalities and less innovation at the national level, lowering national productivity and well-being.

State higher education policies can also have some other undesirable unintended consequences. For example, state merit aid programs shift students away from STEM majors and toward lower paying majors, perhaps trying to increase their grade point averages to maintain scholarship eligibility (Sjoquist and Winters 2015a). Similarly, some students induced by financial aid policies to attend college in-state may shift from a higher quality institution to a lower quality one (Sjoquist and Winters 2016). These unintended effects are likely harmful at the national level and reduce the net benefits to the states adopting them. The current study does not address the efficacy of any particular policy. Still, the relationship between birth-state college enrollment and later life residence is an important one to study and better understand, even if the policy implications that result are more general than specific.

Conceptually, each individual chooses the location in each time period that maximizes their net present value of expected future utility. Changing locations involves both monetary and emotional costs (Kennan and Walker 2011). Monetary costs include the expenses of finding a new residence and moving one’s possessions. Emotional costs involve the disutility from moving away from one's friends, family, and places of comfort and familiarity. However, relocating can confer considerable benefits through human capital accumulation, higher future wages, and potentially, a higher quality of life.

A young person finishing high school must choose whether to attend college and where to attend college if they do attend. Factors that affect college location decisions include tuition and financial aid policies, the quality of colleges and universities, the strength of local labor markets, cost of living, locational amenities, location decisions of friends and family, and proximity to prior locations (Rizzo and Ehrenberg 2004; Alm and Winters 2009; Winters 2012; Faggian and Franklin 2014). Once a person finishes college, they must make another location decision. Some will stay in the area where they attended college, some will move back to a previous location, and some will move on to a new location (Knapp, White, and Wolaver 2013). Factors affecting post-college location decisions include current and future employment prospects, cost of living, locational amenities, and various attachments to prior locations.[3] Attending college in a place likely strengthens one's ties to that area by increasing attachments to friends, employers, and location-specific amenities (Winters 2011b). Attending college in one's home state may have an especially important effect on post-college location decisions because of proximity to family and previous familiarity with the area. However, assessing the causal effect of in-state vs. out-of-state enrollment on later life location is challenging because persons who attend college out-of-state generally differ in both observable and unobservable dimensions from those who attend college in-state. In particular, out-of-state college attendees may have weaker attachment to their home state than in-state attendees, making the former more likely to live

[3] A large literature examines post-college location correlates in the U.S. (Ferguson et al. 2007; Chen and Rosenthal 2008; Whisler et al. 2008; Partridge et al. 2012; McHenry 2014) and other countries (Corcoran, Faggian, and McCann 2010; Brown and Scott 2012; Miguélez and Moreno 2014; Abreu, Faggian, and McCann 2015).

outside their birth state later in life. Thus, simply observing the relationship between in-state college enrollment and residence in one's home state later in life could lead to biased results.

Groen (2004) is the only other paper of which I am aware that directly examines this topic for the U.S.[4] He uses individual student data from the Mellon Foundation's College and Beyond (C&B) survey and the National Longitudinal Study of the High School Class of 1972.[5] His preferred specifications restrict the sample to college attendees who applied to at least one out-of-state college and control for the states to which the individuals applied. He finds that attending college in-state increases an individual's likelihood of living in the state 10-15 years later by roughly 10 percentage points. He interprets this as a modest effect. I use very different data and identification strategy, and I also address a somewhat different question than Groen (2004). In particular, I use cohort-level means, so my estimates include cohort-level network effects. My data are also more recent and focused on different marginal students. These differences may cause my study to produce very different results from Groen (2004).

Related research offers indirect evidence on the effects of in-state college enrollment on later life location decisions. Bound et al. (2004) estimate a modest relationship between the production and stock of college graduates in a state.[6] Several studies examine reduced form

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[4] There is a related international "brain drain" literature examining effects of attending college outside one's home country on the probability of residing outside one's home country later in life (e.g., Oosterbeek and Webbink 2011; Parey and Waldinger 2011; Di Pietro 2012). These studies find that foreign college enrollment has a significant positive effect on living outside one's home country later in life, but the magnitudes vary somewhat. Studying in a foreign country often involves greater cultural, linguistic, financial, and legal challenges than going to college out-of-state in the U.S., so it is not clear how comparable the effects should be.

[5] Groen and White (2004) report a similar analysis using the C&B survey, but their primary finding is that public universities set lower admission standards for in-state applicants than out-of-state applicants.

[6] Bound et al. (2004) use the Integrated Postsecondary Education Data System (IPEDS) to measure the production of college graduates in a state, but do not differentiate between in-state and out-of-state college enrollment. Winters (2018) uses the American Community Survey (ACS) to measure the production of college graduates among persons *from* a state regardless of where they completed the degree. He finds that increasing the production of college graduates from a state by one percentage increases the stock of college graduates residing in the state by 0.5 percentage points. Abel and Deitz (2012) use IPEDS data to examine the production-stock relationship for metropolitan areas and find a modest relationship. Kennan (2015) estimates a dynamic programming model for

effects of state merit-based financial aid programs (Hickman 2009, Hawley and Rork 2013; Sjoquist and Winters 2014; Fitzpatrick and Jones 2016; Bettinger et al. 2016; Harrington et al. 2016). They find positive effects of merit aid on later-life home-state residence, which may be partially due to positive effects of merit aid on in-state college enrollment (e.g. Cornwell et al. 2006; Toutkoushian and Hillman 2012; Winters 2012). However, merit aid may also affect post-college location decisions through other mechanisms.[7]

The current paper estimates the causal effect of attending college in one's birth state on the likelihood of living in one's birth state later in life. I use cohort-level data from the American Community Survey (ACS), decennial censuses, and other sources. My regression equations include birth-state fixed effects, so identification comes from variation in birth-state enrollment rates across cohorts within states. I also account for age and year effects and a number of cohort-level controls. Ordinary least squares (OLS) estimates are likely biased by omitted variables and measurement error. My preferred estimates are from two stage least squares (2SLS) regressions that instrument for birth-state enrollment rates using in-state tuition at public flagship universities in the birth state at age 17. I suggest that this instrument will affect college location decisions but not affect other factors related to post-college location decisions. The expectation is that lower in-state tuition increases birth-state enrollment, which then increases birth-state residence years later after college.

The preferred 2SLS results suggest that increasing the percentage of a cohort attending college in their birth state by one percentage point increases the percentage of college attendees

college enrollment and pre- and post-college migration decisions. Kennan (2015) finds considerable moving costs and that state higher education policies may be able to have considerable long run effects on a state's workforce.

[7] These may include student effort, renewal requirements, peer quality, and other factors. Sjoquist and Winters (2014) compare state-specific effects of merit aid on in-state enrollment and adult birth-state residence. The correlation is only 0.187, suggesting that the effect of merit aid on adult location decisions depends on more than just in-state enrollment effects. I will later compare my preferred estimates to an approach where state merit aid programs are used as an instrument.

living in their birth state later in life by roughly 0.41 percentage points. This effect is less than proportional, but the magnitude is meaningfully different from zero. The positive effect is consistent with college students developing attachments to people and places during college that alter their post-college location decisions. The results, therefore, suggest that state higher education policies that motivate students to attend college in their home state can considerably affect their post-college location decisions and potentially benefit the state. However, higher education policies are often very expensive and at least some policies have limited effects on in-state attendance. In particular, in-state tuition at flagship universities has modest effects on birth-state enrollment, though it does have a strong enough effect to be a valid instrument. Other policies encouraging young people to attend college in-state may be more cost effective.

II. Data and Methods

The main data in this paper are from IPUMS (Ruggles et al. 2015). The main dependent variable is the percentage of all college attendees (including graduates and non-graduates) from a given birth state and birth year cohort who live in their birth state in the 2006-2014 ACS. I first use ordinary least squares (OLS) to estimate variants of:

$$Y_{scat} = \alpha + \beta PctInState_{sc} + \gamma StateControls_{scat} + \delta_s + \varphi_{sc} + \pi_a + \theta_t + \varepsilon_{scat}$$

, where the outcome (Y_{scat}) is measured for persons born in state s born in cohort year c observed at age a during ACS survey year t. I also examine some alternative dependent variables (with small adjustments to the covariates as discussed below) including the percentage of the cohort population from a given birth state and birth year that has attended at least some college AND resides in their birth state during the 2006-2014 ACS, which captures joint effects on education and adult location decisions and may be the primary outcome of interest to some stakeholders. The regression controls for a number of explanatory variables including fixed effects for state of birth (δ_s), region×year-of-birth (φ_{sc}), survey year (θ_t), and age (π_a) at the time of the ACS. Including birth state fixed effects means that identification comes from variation across cohorts within states. Region×year-of-birth fixed effects account for aggregate trends at the regional level. Survey year and age effects capture aggregate effects due to survey year and age. For all regressions, standard errors are clustered by birth state.

The main explanatory variable of interest is the percentage of college enrollees from birth state s and birth-year cohort c who enrolled in their birth state ($PctInState_{sc}$), computed using the 1980, 1990, and 2000 decennial censuses for persons ages 18-22 at the time of one of these censuses.[8] Census survey instructions explicitly inform household respondents that they are not to include college students who live somewhere else while attending college. College students are enumerated at the location where they reside while attending college.[9] The 18-22 age range was selected to reflect the peak college-going ages for traditional students.[10] This gives 750 (=3×5×50) state and year-of-birth cohorts.[11] Each cohort is observed once in each of the nine ACS years giving 6750 total observations. The expectation is that a higher percentage of college enrollees enrolled in their birth state will increase the percentage of college attendees (both graduates and non-graduates) who live in their birth state later in life.[12]

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[8] More specifically, for each birth state and birth year cohort, $PctInState_{sc}$ is computed as the number of college students enrolled in their birth state divided by the number of college students in the cohort enrolled anywhere in the U.S.

[9] Instructions can be found at https://usa.ipums.org/usa/voliii/tEnumForm.shtml.

[10] The percentage of all college students who are ages 18-22 varies over time due to demographic and educational trends. It was a little more than 50 percent in all three census years from 1980-2000.

[11] The sample includes three census years, five year-of-birth cohorts per census year, and 50 states.

[12] The dependent variable is measured based on educational attainment at adulthood. Some people first attend college after age 22; such people will affect the dependent variable but not the main explanatory variable of interest. This introduces some degree of measurement error in the latter to the extent that it is intended to measure the college location decisions of all college attendees in the cohort. The instrumental variables approach discussed below is intended to provide consistent local average treatment effect (LATE) estimates for traditional students.

Notice that the dependent variable is observed in the 2006-2014 ACS at different lengths of time post-college for the cohorts included in the study. The earliest cohorts have their college enrollment location observed at ages 18-22 in the 1980 census, while the most recent cohorts have their college enrollment location observed at ages 18-22 in the 2000 census. In a given ACS year, the oldest cohorts are about 20 years older than the youngest cohorts. The control variables including region×year-of-birth fixed effects and age dummies generally account for broad differences in birth-state location due to the amount of time since college attendance. Recall that birth-state fixed effects account for time-invariant differences across states, i.e., their inclusion subtracts out the time-invariant factors for each state, so that identifying variation comes from cohort differences relative to their birth-state's mean over time. Also including region×year-of-birth fixed effects means that identifying variation is further driven by comparing cohorts (net of birth-state fixed effects) relative to cohorts born in the same year and census region. Any aggregate differences at the region×year-of-birth level are netted out. Age dummies account for the fact that a given cohort is observed multiple times across the ACS years and will account for differences as cohorts age. I will later consider some additional model specifications to check the sensitivity of the main results.

The ACS and decennial census microdata are independently drawn samples, so persons in the census samples are generally not the same as those in the ACS samples. Thus, the analysis is based on cohort-level means from repeated cross-sections (Deaton 1985). This approach assumes that relative cohort size and composition are stable over time. Using the native population and defining cohorts by birth-state should minimize any effects of migration on cohort size and composition. The oldest cohorts in my sample reach a maximum age of 56 during the ACS years examined, so differential mortality is assumed to be a minimal concern.

Differences in individual endowments and preferences within cohorts are largely removed by cohort level averages. However, some differences in unobservables could still exist across cohorts within states. Therefore, in addition to birth state, birth year, survey year and age fixed effects, I also include several time-varying state control variables intended to account for differences in labor market conditions and home-state attachment across cohorts within states that might be correlated with both the dependent variable and the main explanatory variable.

From the 2006-2014 ACS, I compute the percentages of college attendees in the cohort that are female, Black, Asian, Hispanic, and other non-white and include these as regression control variables. The baseline specification also includes control variables from other sources. To account for state economic conditions around the time of initial college choices, I control for the log real personal income per capita and the log Housing Price Index the year a cohort is age 18; personal income data come from the Bureau of Economic Analysis and the Housing Price Index is from the Federal Housing Finance Agency.[13] I also include the log of the cohort size at age 18 obtained from Census Bureau annual population estimates. I control for possible effects of state merit-based financial aid programs by including a merit aid dummy variable based on Sjoquist and Winters (2014). This merit dummy variable equals one for cohorts born in states that implemented a merit scholarship program before or during the year the cohort was age 18. I also include three state-level variables measured at age 22 to control for labor market conditions around the time the cohort was finishing college; these include the state unemployment rate from the Bureau of Labor Statistics (BLS), the log of median household income computed from the Current Population Survey (CPS), and the return to a bachelor's degree computed from the CPS

[13] Lovenheim and Reynolds (2013) indicate that family housing wealth shifts some students, especially from lower income families, toward public flagship university enrollment and away from community college enrollment.

as the regression adjusted log wage differential between adults (ages 25-54) with a college degree and those with only a high school diploma.[14]

I also add some additional explanatory variables from the ACS and censuses to estimate denser specifications. The first is the percentage of a cohort's non-college attendees (persons who never attended any college) who live in their birth state during the 2006-2014 ACS to account for changing birth-state attachment across cohorts within states. I next include ACS controls for the percentage of the cohort with at least some college, the percentage of the cohort with at least a bachelor's degree, and the percentage of the cohort with a graduate degree. Finally, I also use the 1980-2000 censuses to compute the percentage of the entire cohort enrolled in college during ages 18-22. These additional birth-state explanatory variables could all be viewed as outcomes or mechanisms to some extent, so I estimate results with and without them, but my preferred results include them.[15]

Summary statistics for non-dummy variables are in Table 1. All statistics and regression results in this study use cohort weights, computed as the sum of ACS survey weights for individual observations in the cohort. This makes estimates nationally representative for sampled cohorts and increases precision by giving more weight to larger cohorts. The dependent variable mean is 0.59, indicating that roughly 59 percent of college attendees live in their birth state averaged across analytical sample cohorts. The mean for the main explanatory variable of interest is 0.68, meaning that about 68 percent of college enrollees in the sampled cohorts attended college in their birth-state.

[14] One could also consider controlling for these variables at age 18, but publicly available CPS data do not identify all individual states until 1977, so age 18 CPS variables are not available for the earliest cohorts in this study.
[15] I do not control for political variables because they are very numerous and are expected to be conditionally exogenous partial drivers of variation in the tuition instrument discussed below.

Of course, many college enrollees leave their birth state even before college. To provide additional background, I separately computed the percentage of young people ages 14-17 in the 1980-2000 decennial censuses residing in their birth state. Averaged over 1980-2000, 78.6 percent of people ages 14-17 reside in their birth state.[16] These are not the same cohorts as in the main analysis, but this gives a rough sense of the percentage of young people that attend high school in their birth state. Some people leave their birth state before college, some leave during college, and some leave after college. Of course, some people move back at various points, but the cumulative outflow appears to increase as a cohort ages. Appendix Table A also illustrates the main data via sample means by birth-state for birth-state college enrollment rates in 1980, 1990, and 2000 and mean birth-state residence rate for adult college attendees in 2006-2014.

Even after the large set of controls that are included, OLS estimates could still be biased and inconsistent. For one, there could still be unobserved differences in home-state attachment across cohorts within states even after including the detailed set of controls. Unobservable attachments could increase the share of the cohort staying in the birth-state for college and after college, inducing a positive bias in OLS estimates. Another important concern is that the main explanatory variable of interest is subject to measurement error due to sampling since it is computed based on a five percent sample of the U.S. population. Sample means for small cohorts will be especially prone to measurement error; see Appendix Table B for cohort size summary statistics. Classical measurement error will attenuate OLS coefficients toward zero, and the large set of control variables, including many fixed effects, is expected to exacerbate measurement error bias from small sub-samples (Devereux 2007a, b).[17] Measuring the

[16] Examining this separately by age and year reveals a slight decrease with age and a slight increase across census years. The percentages also differ by state, following a similar pattern as Appendix Table A.

[17] Devereux (2007a) indicates that sizable bias can exist for OLS estimates of synthetic cohort models even with 200 observations per group when cohort and year fixed effects are included in his analysis. The exact number of

explanatory variable of interest as a sample mean also biases OLS standard errors.[18] To account for these concerns, my preferred specifications utilize instrumental variables (IV) to estimate two stage least squares (2SLS) regressions.[19]

I instrument for the percentage of a cohort's college enrollees enrolled in their birth state using in-state tuition rates at public flagship universities in their birth state. I follow Rizzo and Ehrenberg (2004) and Winters (2012) and define flagship universities to include the 85 public institutions classified by the Carnegie Foundation in 1994 as Research Universities (I or II) and the top public institution in each state without a Carnegie designated Research University. The tuition data were obtained from the National Science Foundation's WebCASPAR database. Specifically, I compute the log of mean in-state undergraduate tuition and fees (in real $1000s) at flagship universities for each state. I match this to cohort birth states and use in-state tuition at age 17 as my preferred instrument. I call this the tuition instrument.

The expectation is that higher flagship in-state tuition will reduce in-state enrollment, consistent with the law of demand. My instrument focuses on flagship institutions because students making marginal decisions to enroll in-state or out-of-state are likely choosing among higher quality options and tuition rates at less prestigious options are likely less important. However, results are qualitatively robust to using log mean in-state tuition at all bachelor's degree granting colleges and universities in one's birth state for the instrument. Age 17 is chosen for the tuition instrument because it is likely the most salient and exogenous information

observations per group needed to eliminate meaningful bias depends on the application, but Devereux (2007a) indicates that thousands of observations per group may be necessary in his setting. My analysis includes an even larger set of fixed effects including state-of-birth and region×year-of-birth.

[18] Murphy and Topel (1985) suggest a correction approach for standard errors in two-step econometric models. Standard errors in the current study are clustered by state of birth via a robust sandwich estimator, which Hardin (2000) indicates is a reasonable alternative to the Murphy-Topel estimator.

[19] If measurement error were the only source of bias, an errors-in-variables regression model might be a reasonable alternative (Deaton 1985; Devereux 2007b). However, errors-in-variables estimation does not account for bias from unobservable differences in birth-state attachment across cohorts. The traditional error-in-variables estimator is also biased in settings with large numbers of cohort and year fixed effects (Devereux 2007b).

for college attendees choosing to attend in-state or not. Tuition at ages 18 or older is often not known when making initial college decisions, especially for institutions that don't finalize tuition rates until just before the start of the fall semester. Tuition at older ages could also be influenced by a cohort's demand for in-state education, inducing possible endogeneity in the instrument. Results below are qualitatively robust to using in-state tuition at age 18 or age 16 as the instrument.

Tuition rate changes within states over time are likely driven by as good as random variation in public policies, the political process, and other idiosyncratic factors that are otherwise uncorrelated with future location decisions. More specifically, in-state tuition at flagship universities depends on numerous factors including state and university resources, instructional costs, student demand, the tuition policy environment, political preferences, past tuition levels, and interactions among these factors (McLendon, Hearn, and Mokher 2009; McLendon, Mokher, and Doyle 2009; Calhoun and Kamerschen 2010; Bell et al. 2011; Deming and Walters 2017; Li 2017). Some of these factors are largely fixed over time; state fixed effects will account for persistent differences across states and require identifying variation to come across cohorts within states. Some factors increase tuition over time for all institutions at a roughly similar rate and will be accounted for by region×year-of-birth dummies. Still, some factors related to tuition vary across cohorts within a state in differential ways across states in a region. Changes in resources for higher education largely depend on state business cycles and long run income growth; economic downturns are one of the most important causes of tuition increases (Deming and Walters 2017; Li 2017). Changes in instructional costs over time within states largely reflect increased compensation and living costs for workers. The demand for flagship attendance depends on macroeconomic conditions, institutional quality, and local amenities. The tuition policy environment varies across states, from very centralized to very decentralized, but these differences are largely fixed over time.[20] Political preferences for higher education evolve over time in complicated ways including party affiliation, gubernatorial power, unified government, lobbying influence, and where an elected official attended school (McLendon, Hearn, and Mokher 2009; McLendon, Mokher, and Doyle 2009; Li 2017). Tuition levels depend on past tuition rates both because nominal decreases are rare and because states occasionally limit nominal tuition increases (Deming and Walters 2017). The flagship tuition instrument is powered by time-varying political factors, their interactions with state economic conditions, and semi-arbitrary decisions that result.[21]

One possible concern is that the tuition instrument could directly affect education attainment levels, and thus alter the sample of those with any college or alter migration propensities through effects of education levels. I account for this by controlling for education levels in the full specification. However, I also present reduced form results below suggesting that in-state flagship tuition does not affect adult educational attainment levels.[22] The reduced form effects on education levels also serve somewhat as a falsification test. If in-state flagship tuition was correlated with the supply or demand for education across cohorts in a state, we

[20] Final decision-making authority for tuition decisions at flagship universities varies by states. Some states allow universities considerable autonomy, while in others the state legislature or a statewide governing board has final say (Lenth 1993; Calhoun and Kamerschen 2010; Bell et al. 2011)

[21] One could alternatively include a large number of political variables as excluded instruments, but they are likely to be individually weak instruments, and using a large number of weak instruments is undesirable (Angrist and Pischke 2009). My preferred approach is to use a single strong instrument, log in-state tuition at public flagship universities. Another idea is to use state higher education appropriations to instrument for birth-state enrollment. However, appropriations often depend on enrollment levels and are potentially endogenous to enrollment demand.

[22] Another possibility is that flagship tuition changes might relate to academic quality. Time-varying academic quality is hard to measure, especially for early years with limited data. With that limitation in mind, I examined the relationship between 2001-2015 changes in flagship university student test scores and in-state tuition and found no significant relationship. Thus, student quality changes appear unrelated to the flagship tuition instrument.

would expect to see it correlated with educational attainment levels, but we do not, which supports in-state flagship tuition as an exogenous instrument for birth-state college enrollment.[23]

IV coefficient estimates are interpreted as local average treatment effects (LATE), which may differ from the average treatment effect (ATE) with heterogeneous effects. The IV approach estimates a local effect for those potentially affected by the instrument, i.e., students qualified for flagship attendance, considering it as an option, and at the margin of attending college in-state or out-of-state. This is an important group to study (Hoekstra 2009).

III. Empirical Results

A. OLS Estimates

OLS regression results for the main explanatory variable of interest are reported in Table 2. The first column reports results that include birth state, region×year-of-birth, survey year and age fixed effects, along with ACS demographic variables and other baseline explanatory variables. The second column adds the ACS percentage of non-college attendees who reside in their birth state, and the third column adds the rest of the additional birth state explanatory variables (Census college enrollment rates and ACS educational attainment rates).

The OLS results in all three columns suggest that the percentage of a cohort's college enrollees enrolled in their birth state significantly increases the proportion of college attendees living in their birth state later in life. Adding the additional controls alters the coefficient only slightly. Results with the full set of control variables in column 3 suggest that a one percentage

[23] I also considered using alternative instruments such as supply-side factors linked to college attainment by Bound and Turner (2007) and Bound, Lovenheim, and Turner (2012). However, factors that primarily affect college attainment are not ideal instruments for my primary question of interest, even with controls for adult educational attainment levels, because those induced to increase attainment may have differing geographic attachments and mobility propensities from those already likely to attend college. The in-state flagship tuition instrument that I use is particularly well-suited to my setting because it is expected to primarily affect in-state enrollment.

point increase in birth state college enrollment increases later life birth-state residence by 0.168 percentage points.

B. Main 2SLS Estimates

The main 2SLS results are in Table 3. The three columns again add progressively more controls as in Table 2. As expected, the instrument has a statistically significant negative effect in the first stage for each column. I estimate cluster robust first-stage F-statistics for the excluded instrument. A first-stage F-statistic greater than 10 indicates that weak instrument issues are minimal (Stock, Yogo and Wright 2002; Angrist and Pischke 2009; Andrews, Stock and Sun 2018). The first-stage F-statistics in Table 3 all exceed 10.

Second-stage results in Table 3 indicate that the percentage of a cohort's college enrollees enrolled in their birth state has a statistically significant positive effect on the percentage of college attendees living in their birth state later in life. Like the OLS estimates, adding the additional control variables in columns 2 and 3 minimally affects the 2SLS coefficient estimates. The 2SLS coefficient estimates are meaningfully larger than their OLS counterparts, possibly due to measurement error bias in the latter exacerbated by the large set of control variables including fixed effects. The 2SLS coefficient estimates in Table 3 and corresponding OLS estimates were compared using a Hausman type endogeneity test (estat endogenous in Stata); p-values were from 0.10 to 0.12, indicating weakly suggestive evidence of endogeneity and OLS bias.

The results with the full set of controls in column 3 suggest that a one percentage point increase in the birth-state enrollment rate among college attendees increases later-life home state residence for college attendees by 0.41 percentage points.[24] This suggests that if changes in higher education policies induced 100 additional students to enroll in-state who would have previously enrolled out-of-state, roughly 41 of these additional students would still be in the state later in life. This is a relatively large effect that is four times as large as the effect estimated by Groen (2004) using different data and methods. However, it should also be noted that the first-stage results suggest modest effects of flagship in-state tuition on birth-state enrollment. Lowering in-state tuition at public flagship universities by 10 percent would only increase birth-state enrollment by about four-tenths of one percentage point. Thus, keeping young people in-state for college does affect their post-college location decisions, but specific policies to do so may not be cost-effective.

C. Alternative Instruments

The 2SLS coefficient estimates in Table 3 are a good bit larger than OLS estimates in Table 2. I suggest that this is likely because of attenuation bias due to measurement error from sampling in the OLS estimates, but some readers may be surprised that attenuation bias is so large. To address this, I next estimate 2SLS regressions using alternative instruments and the full set of control variables with results in Table 4.[25]

The 1980-2000 decennial census data used above come from the 5% state samples, but for these years the U.S. Census Bureau also released separate 1% metro samples. The census 5% and 1% samples have the same underlying sampling structure, but they provide slightly different information useful for different purposes; see Ruggles et al. (2015) for more details. One major difference is identifying small geographic areas. The 5% samples always identify state of

[24] Appendix Table C provides results for the birth-state-year cohort control variables from the full specifications in column 3 of Tables 2 and 3.
[25] Results with partial sets of control variables as in Tables 2 and 3 are similar and available by request.

residence but often do not identify metropolitan area for small areas in order to preserve confidentiality. The 1% metro samples in 1980 and 1990 suppress state of residence for some observations in order to identify some small metropolitan areas and still preserve confidentiality. The 5% samples are clearly preferable for my main analysis because they include state of residence and have much larger samples.

I use the 1980-2000 1% decennial census samples to compute for each birth-state and birth-year cohort the percentage of college enrollees who are enrolled in their birth state and use this as an alternative instrument. I.e., I use birth-state college enrollment rates in the 1% samples as an instrument for birth-state college enrollment rates in the 5% samples. In constructing this instrument, I exclude observations with suppressed state of residence; this eliminates less than three percent of observations in 1980, less than two percent in 1990, and no observations in 2000. 2SLS results using this instrument with the full set of control variables included are in the first column of Table 4. The first-stage coefficient of 0.176 is significantly positive, but it is well less than one, consistent with measurement error bias toward zero in the first stage; if there were no measurement error in this instrument, we would expect a first-stage coefficient of one for the first column of Table 4 because the two variables are measuring the same thing. Because the 5% and 1% samples are independently drawn random samples of the population, sampling error should be independent across the two, and the second-stage estimates for this IV strategy correct for measurement error bias. However, this IV does not account for potential omitted variables that affect the changing desirability of or attachment to a birth state. The second-stage gives a coefficient estimate of 0.444 that is statistically significant at the one percent level. This is larger than the OLS estimates in Table 2 but only modestly larger than the preferred 2SLS estimate in Table 3. The endogeneity test indicates that this estimate is significantly different from the OLS estimate at the one percent level, but it is not significantly different from the preferred 2SLS estimate.

My second alternative IV approach is to use the one-cohort-year lag of the birth-state college enrollment rate (from the 5% sample). Results are in column 2 of Table 4. If the sampling error is independent across cohorts, using the one-cohort-year lag as an instrument will account for bias due to measurement error. However, it may not account for omitted variable bias from factors correlated with both birth-state college enrollment and later life birth-state residence. Additionally, the birth-state enrollment rate is only measured for cohorts ages 18-22 in the 1980-2000 decennial censuses, so the lag is not measured for cohorts age 22 during the census year, meaning that the lagged IV approach loses one fifth of the total observations and reduces the number from 6750 to 5400.

The first-stage results in column 2 of Table 4 show that the one-cohort-year lag is indeed a strong predictor of the birth-state college enrollment rate for the following cohort. The second-stage coefficient is 0.450 and statistically significant at the one percent level.[26] The second-stage estimates in columns 1 and 2 of Table 4 are very similar. Both are potentially subject to omitted variable bias, so they are not the preferred estimates. However, their value is that they support the contention that OLS estimates in Table 2 are likely attenuated due to measurement error bias.[27] Thus, finding 2SLS estimates with the preferred tuition IV in Table 3 that exceed OLS estimates is plausible and not unexpected.

I also explored using the merit aid variable as an instrument with results in column 3 of Table 4. Previous literature has found that exposure to a state merit aid program increases the

[26] This estimate is also significantly different from the OLS estimate at the one percent level but not significantly different from the preferred 2SLS estimate.
[27] Column 2 of Table 4 also includes fewer cohorts than the OLS estimates. Estimating OLS for the same cohorts as in Table 4 gives a coefficient of 0.215, so the difference is not primarily due to the differing cohorts included.

probability of later life residence in one's birth state and suggested that this may be partially driven by merit aid effects on birth-state college enrollment (Hickman 2009, Hawley and Rork 2013; Sjoquist and Winters 2014; Fitzpatrick and Jones 2016). However, merit aid may have other effects, some of which influence future geographic mobility (Sjoquist and Winters 2015a; Winters 2017). Additionally, merit program characteristics differ across states, and merit program effects on in-state enrollment and later life residence may differ across states also (Sjoquist and Winters 2014). The analytical sample for the current study includes fewer merit states and fewer merit-exposed cohorts than previous studies, so results are not directly comparable but still of interest. The second-stage coefficient estimate of 0.674 in column 3 is significant at the one percent level.[28] Thus, using a merit aid instrument yields directionally similar estimates as the preferred results, but the point estimate is somewhat larger.

D. Other Related Outcomes

I next consider some additional outcomes related to the main dependent variable. Table 5 presents results for birth-state enrollment effects on later life birth-state residence separately for college graduates and non-graduating college attendees. The results thus far use a dependent variable that pools all college attendees, but graduates and non-graduating attendees might respond differently. Table 5 dependent variables in panels A and B are the share of college graduates (A) and non-graduating attendees (B) who live in their birth state in the 2006-2014 ACS. Results are reported for OLS and for 2SLS using the tuition instrument in columns 1 and 2, respectively. Both OLS and 2SLS results weakly suggest that the response to birth-state enrollment is stronger for non-graduating attendees. The 2SLS coefficient for graduates (0.286)

[28] This estimate is significantly different from the OLS estimate at the five percent level but not significantly different from the preferred 2SLS estimate.

is not statistically significant at the five percent level, but it is significant at the ten percent level and the magnitude is larger than the OLS estimate for graduates (0.134), which is statistically significant at the one percent level. The imprecision in 2SLS estimates in Table 5 prevents strong conclusions, but it appears that the effect of birth-state enrollment is likely still meaningfully large for both graduates and non-graduates, with the effect perhaps smaller for college graduates. However, a major limitation to Table 5 is that the birth-state enrollment rate is measured for the full cohort of college enrollees and we cannot necessarily assume that those who eventually graduate and those who do not graduate have the same pattern of birth-state enrollment. Thus, Table 5 results are suggestive but not conclusive.

I next return to an issue mentioned at the end of Section II that the tuition instrument might affect education levels and somehow distort the main results. Table 6 reports results from reduced form OLS regressions that use three cohort level education outcomes as the dependent variable and examines effects of the in-state flagship tuition variable on these. The educational outcome dependent variables are the shares of the cohort with some college or higher, a bachelor's degree or higher, and a master's degree or higher. The controls are the same as in column 1 of Tables 2-3, except that the demographic shares are measured for persons of all education levels and not conditional on college attendance; using the same demographic controls as Tables 2-3 does not alter results. Coefficient estimates in Table 6 are small and not statistically significant at conventional levels. Furthermore, the associated confidence intervals are relatively narrow, so the estimates can be interpreted as somewhat precisely estimated zeroes. In other words, I can reject nulls of relatively modest magnitude effects. This does not mean that education levels are unrelated to tuition levels at less selective public institutions, but they do appear unrelated to in-state tuition levels at flagship universities. Finding no effect of flagship tuition on education levels reduces one possible concern for the instrument. This also serves somewhat as a falsification test. In-state flagship tuition significantly affects what we expect it to (birth-state enrollment) and does not affect something else (educational attainment levels) that it might if driven by endogenous factors.

Table 7 reports results in which the dependent variable is the share of the year-state-age cohort that currently resides in their birth state AND has attended at least some college. Thus, instead of measuring birth-state residence conditional on college attendance, the dependent variable in Table 7 measures the joint outcome of birth-state residence and having attended at least some college.[29] The explanatory variable of interest for Table 7 is again the share of college enrollees enrolled in their birth state, measured from the 1980-2000 decennial censuses. We have already seen in Table 6 that the in-state flagship tuition instrument has no meaningful effect on educational attainment. However, the joint outcome dependent variable in Table 7 may be the primary outcome of interest for some stakeholders and is important to consider.

Column 1 of Table 7 presents OLS results similar to column 1 of Table 2. Columns 2 and 3 of Table 7 present 2SLS results using the flagship tuition instrument similar to columns 1 and 2 of Table 3. I do not include the ACS or Census education control variables because these are jointly determined with the educational portion of the dependent variable in Table 7. First-stage results for Table 7 are very similar to Table 3 and are omitted to conserve space. Notably, the dependent variable in Table 7 has a mean of 0.37, roughly equal to the product of means for the primary dependent variable in this study (0.59) and the cohort share with some college or higher (0.64), subject to some rounding error. Consequently, I expect the coefficients in Table 7 to be somewhat smaller than corresponding coefficients in Table 2 and 3. The coefficient

[29] Mathematically, these dependent variables have the same numerator but different denominators. See the Data Appendix for more details.

estimates are positive and statistically significant at the one percent level in all three columns of Table 7. The OLS coefficient in Table 7 is 0.101, which is about 60 percent as large as the corresponding estimate in Table 2. The Table 7 columns 2 and 3 coefficients are 0.308 and 0.309, respectively, which are about 80 percent as large as corresponding estimates in Table 3. To make results for these two dependent variables more comparable, I compute elasticities by combining coefficients with the variable means. This yields elasticities of 0.186, 0.567, and 0.568 for columns 1-3 of Table 7, respectively. Elasticities for corresponding Tables 2 and 3 specifications are 0.201, 0.452, and 0.453, respectively. Thus, these two dependent variables yield similar effect elasticities, though the elasticities for Table 7 2SLS appear somewhat larger.

I also looked at additional outcomes related to marriage. Staying in one's birth-state for college is expected to increase the likelihood of marrying someone from the same birth state, since many relationships leading to marriage start in college and staying in-state for college will expose one to more potential spouses from the same birth-state. Staying in one's birth-state after college might also increase the likelihood of marrying someone from the same birth state. Of course, causality could also go in the other direction. Meeting a future marriage partner before or during college could affect college and post-college location decisions. Table 8 takes a brief look at the effects of in-state college enrollment on marriage outcomes via 2SLS regressions with the flagship tuition instrument and the full set of controls. The three dependent variables in Table 8 are constructed using the 2006-2014 ACS as cohort percentages for college attendees by birth state, birth year, and ACS year similar to the main dependent variable. The specifications in Table 8 are identical to Table 3 column 3 except for the dependent variables; first-stage results are the same as in Table 3 column 3.

Column 1 examines the percentage of the cohort who are married during the ACS survey as the dependent variable. Column 2 has a dependent variable defined as the percentage of the cohort that is married and to someone from the same birth state. The column 3 dependent variable is the cohort percentage that is married and to a college attendee from the same birth state. Thus, the second and third column dependent variables are joint outcomes (and not conditional on being married at all). The second and third outcomes differ in that marrying a non-college attendee is counted in column 2 but not column 3.

The coefficient estimate in column 1 is positive but not statistically significant at conventional levels. The coefficient estimates of 0.449 and 0.462 in columns 2 and 3, respectively, are both positive and significant at the one percent level. Thus, there is no clear effect of birth-state enrollment on the overall probability of marriage, but there is a strong effect of birth-state enrollment on marrying someone from the same birth-state, especially a college attendee from the same birth state. This is an interesting finding in itself in helping understand how marriages form. It also is consistent with the network formation story as a possible mechanism for why birth-state college enrollment affects later-life birth-state residence. Specifically, birth-state college enrollment likely affects one's social network and strengthens ties to other people from the same state including potential marriage partners. This likely increases the desirability of remaining in the birth-state after college. Of course, this does not rule out other possible mechanisms. We also cannot be very precise about the timing of events. Some people might choose to stay in their birth-state after college before beginning a relationship with their future spouse. Thus, the results in Table 8 are consistent with the network formation mechanism, but we cannot definitively assess the mechanism's importance.

Table 9 brings in additional data from the 1990 and 2000 census 5% samples to take a different look at the main question. The dependent variable in Table 9 is the share of cohort college attendees who live in their birth state 10 years after their college location decisions are observed. These adult location decisions are measured via the 1990 Census for the cohorts enrolled in college in 1980, the 2000 Census for the cohorts enrolled in 1990 and the pooled 2009-2011 ACS for cohorts enrolled in 2000; I combine the pooled 2009-2011 ACS to treat it as a single 2010 "census" observation period.[30] This approach includes the same 750 (=3×5×50) state and year-of-birth cohorts, but post-college location decisions are now only observed once per cohort, yielding 750 total observations. The explanatory variable of interest is measured the same as in the preferred specification. OLS and 2SLS estimates in Table 9 correspond to the third columns of Tables 2 and 3, respectively. The OLS coefficient (0.182) is slightly larger than the corresponding estimate in Table 2 (0.168). The 2SLS coefficient estimate (0.739) in Table 9 is notably larger than the preferred estimate in Table 3 (0.408).

The larger 2SLS estimate in Table 9 is consistent with the possibility of a diminishing effect with age. In Table 9 the dependent variable is observed at cohort ages 28-32 with a mean age of 30. The Table 3 dependent variable from the 2006-2014 ACS includes ages 24-56, and the mean age is 40. A diminishing effect with age would result if attending college in-state has a larger magnitude effect on birth-state residence 10 years later than say 20 years later. I also examined cohorts 20 years after their college enrollment locations were observed via a similar approach, but this necessitated excluding the cohorts in college in 2000, and the smaller sample yielded weaker first-stage power and noisier estimates.[31] While we cannot draw strong conclusions about diminishing effects with age, Table 9 does indicate a significant and important

[30] This is somewhat similar to the estimation strategy in Hunt (2017).
[31] For 2SLS, the first-stage F-statistic was 2.69; the second-stage coefficient (standard error) was 0.481 (0.510).

positive effect. If there are diminishing effects with age, then the preferred estimate in Table 3 corresponds to an average over ages 24 to 56. This age range is a rough (though not perfect) approximation of primary working ages, and the Table 3 estimate provides a useful summary measure over an important age range.

E. Additional Sensitivity Analysis

I also conducted additional analysis to examine the sensitivity of my main results to alternative specifications. Results are available from the author's personal website. I first returned to the preferred specification in Table 3 but re-estimated the equation excluding the earliest cohorts, i.e, those ages 18-22 in 1980. The 2SLS coefficient estimate is 0.442 and significant at the 10 percent level but not the five percent level. Losing observations makes the coefficient estimate noisier, but it is not very different from the preferred estimate in Table 3.

I next considered the possible effect of the main variables from the censuses and ACS being especially noisily estimated for small population states due to sampling error. I conducted a simple robustness check by excluding the 12 states with year 1980 population less than one million people. 2SLS estimation yields a statistically significant coefficient of 0.416, which is very similar to the corresponding coefficient estimate of 0.408 in column 3 of Table 3.

I next tested a log-log specification. In the main specification, both the dependent variable and explanatory variable of interest are measured as cohort-level population shares and a linear relationship is assumed. A reasonable alternative is to measure both the dependent variable and explanatory variable of interest as logs of cohort-level population shares and model that relationship linearly with 2SLS using the flagship tuition instrument and the same control variables as column 3 of Table 3.[32] Doing this yields a coefficient of 0.505 that is significant at the one percent level. I prefer the primary specification a priori, but the main qualitative result is similar using a log-log specification.

F. Reconciling Results with Previous Literature

Groen (2004) is the most similar study. We both find significant positive effects, but my preferred estimates are larger. One important difference is that Groen (2004) uses individual-level data on in-state enrollment while I use cohort-level means. There may be cohort-level network effects. For example, if a higher percentage of one's high school friends stay in-state for college, it may strengthen friendships and prospects for finding a significant other from the same home state, increasing attachment to the home state. My results are correctly interpreted as cohort level effects, which may differ from the individual-level estimates of Groen (2004).

A second difference with Groen (2004) is that my measure captures enrollment in an individual's birth state, while his measure captures enrollment in the individual's state of residence during high school. These are the same for most young people but not all. Young people living in the same state since birth may be especially attached to that state and likely to stay after college. Students who leave their birth state before high school may be less attached to any state. A third difference is that his sample is restricted to persons applying to college in multiple states, while my main results exploit variation in birth-state enrollment from in-state flagship tuition rates. These different margins may yield different LATE estimates. A final important difference is that my data are more recent; larger effects may partially result from declining internal migration in the U.S. (Partridge et al. 2012). As people become less mobile, where they attend college may play a more important role in where they locate later in life.

[32] I use the same control variables as Table 3 column 3. Some are already in logs; others have numerous zeros.

IV. Conclusion

This paper uses cohort-level data from the 1980-2000 decennial censuses and 2006-2014 ACS to examine effects of birth-state college enrollment on birth-state residence later in life. I include state and year fixed effects and time-varying controls. My preferred results use flagship in-state tuition to instrument for birth-state college enrollment. 2SLS results indicate a significant positive effect, consistent with expectations that in-state college enrollment increases attachment to friends, family, and things in one's home state, which makes moving more costly later in life. The preferred 2SLS estimates suggest that a one percentage point increase in the share of a cohort's college enrollees enrolled in their birth-state increases later life residence in that state by 0.408 percentage points. Inducing 100 additional students to attend college in their home state rather than out-of-state would cause 41 additional college attendees from the state to reside there later in life. This effect is economically meaningful, though less than proportional.

Policymakers can help build the stock of college-educated labor in their state by increasing in-state college enrollment, but some policies are not cost effective. Tuition and financial aid policies affect in-state enrollment and post-college residence, but they are expensive policy levers (Groen 2011). Lowering in-state tuition at flagship universities by 10 percent only increases birth-state enrollment by four-tenths of one percentage point. Flagship tuition does not affect educational attainment. Merit aid programs keep some students in-state, but the effect is small relative to the costs and state merit programs do not increase overall college attainment (Sjoquist and Winters 2015b). Higher education policies may also have unintended effects that reduce net benefits to a state (Sjoquist and Winters 2015a, 2016). Furthermore, policies that reduce mobility may reduce national well-being, even if they benefit an individual state.

State leaders may want to consider other policies such as growing networks among students and alumni, internship programs with in-state employers, service-forgivable student loans, enhanced academic quality, increased marketing and recruiting, more robust campus amenities, need-based aid, better access in geographically remote areas, expanded distance learning programs, and improved K-12 education to help students succeed in college. There is still much unknown about how various policies affect college outcomes and location decisions. The current study does not answer every question or assess the efficacy of any particular higher education policy, but it does provide strong evidence that increasing the share of young people who attend college in their home state increases the share living in their home state later in life.

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Table 1: Summary Statistics

	Mean	Std. Dev.
Dependent Variable (from 2006-2014 ACS)		
% with Any College Living in Birth State	0.590	0.086
Main Explanatory Variable (from 1980-2000 Census)		
% of College Enrollees Enrolled in Birth State	0.681	0.083
Instrumental Variables		
Log Mean In-State Tuition ($1000s) of Flagship Universities at Age 17	1.287	0.411
% of College Enrollees Enrolled in Birth State for 1% PUMS	0.686	0.092
One Cohort Year Lag of Main Explanatory Variable	0.678	0.083
2006-2014 ACS Demographic Variables		
% Female for All College Attendees	0.538	0.032
% Black for All College Attendees	0.112	0.084
% Asian for All College Attendees	0.015	0.034
% Hispanic for All College Attendees	0.066	0.083
% Other Non-white for All College Attendees	0.022	0.025
Other Baseline Explanatory Variables		
Log of Personal Income Per Capita at Age 18	10.434	0.180
Log of Housing Price Index at Age 18	4.938	0.453
Log of Cohort Size at Age 18	11.683	0.870
Merit Dummy at Age 18	0.094	0.293
Unemployment Rate at Age 22	6.772	2.124
Return to Bachelor's Degree at Age 22	0.259	0.106
Log Median Household Income at Age 22	10.844	0.156
Additional Birth State Explanatory Variables		
% in 2006-2014 ACS with No College Living in Birth State	0.705	0.082
% in 1980-2000 Census Enrolled in College	0.364	0.103
% in 2006-2014 ACS with Some College or Higher	0.638	0.066
% in 2006-2014 ACS with a Bachelor's Degree or Higher	0.309	0.061
% in 2006-2014 ACS with a Graduate Degree	0.102	0.033

Notes: the full analytical sample includes 6,750 year-state-age cohort observations. All variables from the American Community Survey and decennial censuses are constructed using survey weights. All summary statistics are weighted using cohort weights computed as the sum of ACS survey weights for all college attendee individual observations in the cohort.

Table 2: OLS Estimates of Birth-State College Enrollment and Later Life Residence in Birth-State

	(1)	(2)	(3)
% of College Enrollees Enrolled in Birth State	0.174	0.165	0.168
	(0.032)***	(0.031)***	(0.033)***
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	No	Yes	Yes
ACS and Census Education Control Variables	No	No	Yes
Number of Observations (Year-State-Age Cohorts)	6750	6750	6750

Notes: Standard errors in parentheses are clustered by birth state. The dependent variable is the year-state-age cohort percent with any college who live in their birth state during the 2006-2014 ACS. All regressions are weighted using cohort weights computed as the sum of ACS survey weights for all college attendee individual observations in the cohort.

***Statistically significantly different from zero at the 1% level of significance.

Table 3: 2SLS Estimates for Birth-State Enrollment and Later Residence Using In-State Tuition IV

	(1)	(2)	(3)
A. First-Stage			
Log In-State Tuition Flagship Universities at Age 17	-0.042	-0.042	-0.038
	(0.010)***	(0.010)***	(0.009)***
F-Statistic	18.13	19.49	18.27
B. Second Stage			
% of College Enrollees Enrolled in Birth State	0.392	0.393	0.408
	(0.111)***	(0.105)***	(0.124)***
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	No	Yes	Yes
ACS and Census Education Control Variables	No	No	Yes
Number of Observations (Year-State-Age Cohorts)	6750	6750	6750

Notes: Standard errors in parentheses are clustered by birth state. The dependent variable is the year-state-age cohort percent with any college who live in their birth state during the 2006-2014 ACS. All regressions are weighted using cohort weights computed as the sum of ACS survey weights for all college attendee individual observations in the cohort.

***Statistically significantly different from zero at the 1% level of significance.

Table 4: 2SLS Estimates for Birth-State Enrollment and Later Residence Using Alternative Instruments

	(1)	(2)	(3)
A. First-Stage			
% of College Enrollees Enrolled in Birth State for 1% PUMS	0.176		
	(0.027)***		
% of College Enrollees Enrolled in Birth State for cohort c-1		0.382	
		(0.055)***	
Merit Aid Dummy			0.021
			(0.007)***
F-Statistic	41.35	48.57	9.43
B. Second Stage			
% of College Enrollees Enrolled in Birth State	0.444	0.450	0.674
	(0.068)***	(0.079)***	(0.215)***
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	Yes	Yes	Yes
ACS and Census Education Control Variables	Yes	Yes	Yes
Number of Observations (Year-State-Age Cohorts)	6750	5400	6750

Notes: Standard errors are clustered by birth state. The dependent variable is the year-state-age cohort percent with any college who live in their birth state during the 2006-2014 ACS. All regressions are weighted using cohort weights computed as the sum of ACS survey weights for all college attendee individual observations in the cohort.

***Statistically significantly different from zero at the 1% level of significance.

Table 5: OLS and 2SLS Estimates for Birth-State Enrollment Effects for Alternative Education Groups

	(1) OLS	(2) 2SLS Tuition IV
A. College Graduates (Bachelor's or Higher)		
% of College Enrollees Enrolled in Birth State	0.134	0.286
	(0.037)***	(0.164)*
First-stage F-Statistic	N/A	16.85
B. Non-Graduating College Attendees	0.196	0.541
% of College Enrollees Enrolled in Birth State	(0.041)***	(0.157)***
First-stage F-Statistic	N/A	19.47
Birth-State Dummies	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes
Age Dummies	Yes	Yes
Survey Year Dummies	Yes	Yes
ACS Demographic Variables	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes
ACS % with No College Living in Birth State	Yes	Yes
ACS and Census Education Control Variables	Yes	Yes
Number of Observations (Year-State-Age Cohorts)	6750	6750

Notes: Standard errors in parentheses are clustered by birth state. The dependent variables are year-state-age cohort percents who live in their birth state during the 2006-2014 ACS for college graduates (bachelor's or higher) in Panel A and non-graduating college attendees in Panel B. Other first-stage statistics for the 2SLS tuition IV model are very similar to Tables 3 and are suppressed for brevity. All regressions are weighted using cohort weights computed as the sum of ACS survey weights for individual observations in the cohort and corresponding education group.
*Statistically significantly different from zero at the 10% level of significance; ***Significant at the 1% level.

Table 6: Reduced Form OLS Estimates of In-State Flagship Tuition Effects on Educational Attainment

	(1)	(2)	(3)
	% with Some College or Higher	% with Bachelor's or Higher	% with Master's or Higher
Log In-State Tuition of Flagship Universities at Age 17	-0.006	0.003	-0.0003
	(0.005)	(0.004)	(0.002)
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	No	No	No
ACS and Census Education Control Variables	No	No	No
Number of Observations (Year-State-Age Cohorts)	6750	6750	6750

Notes: Standard errors in parentheses are clustered by birth state. The dependent variable is the year-state-age cohort percent in the 2006-2014 ACS with specified education level. All regressions are weighted using total cohort weights computed as the sum of ACS survey weights for all individual observations in the cohort.

Table 7: OLS and 2SLS Joint Effect of Attending At Least Some College and Residing in Birth State

	(1) OLS	(2) 2SLS	(3) 2SLS
% of College Enrollees Enrolled in Birth State	0.101	0.308	0.309
	(0.020)***	(0.113)***	(0.112)***
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	No	No	Yes
ACS and Census Education Control Variables	No	No	No
Number of Observations (Year-State-Age Cohorts)	6750	6750	6750

Notes: Standard errors are clustered by birth state. The dependent variable is the year-state-age cohort percentage of the population that has attended at least some college AND currently resides in their birth state during the 2006-2014 ACS; this variables has a mean of 0.37. The instrument for columns 2 and 3 is the log in-state tuition of flagship universities at age 17, the same as used in Table 3. First-stage statistics for columns 2 and 3 are very similar to Table 3 and are omitted to conserve space. All regressions are weighted using total cohort weights computed as the sum of ACS survey weights for all individual observations in the cohort.

***Statistically significantly different from zero at the 1% level of significance.

Table 8: 2SLS Results for Marriage Outcomes of College Attendees Using In-State Tuition IV

	(1)	(2)	(3)
Second-Stage Dependent Variable:	% Married	% Married and Spouse Same Birth State	% Married and College-Educated Spouse Same Birth State
% of College Enrollees Enrolled in Birth State	0.219	0.449	0.462
	(0.228)	(0.123)***	(0.118)***
Birth-State Dummies	Yes	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes
Survey Year Dummies	Yes	Yes	Yes
ACS Demographic Variables	Yes	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes	Yes
ACS % with No College Living in Birth State	Yes	Yes	Yes
ACS and Census Education Control Variables	Yes	Yes	Yes
Number of Observations (Year-State-Age Cohorts)	6750	6750	6750

Notes: Standard errors are clustered by birth state. The specifications are identical to Table 3 column 3 except for the dependent variables. All regressions are weighted using cohort weights computed as the sum of ACS survey weights for all college attendee individual observations in the cohort.

***Statistically significantly different from zero at the 1% level of significance.

Table 9: Estimates of Birth-State Enrollment Effects on Birth-State Residence 10 Years After

	(1) OLS	(2) 2SLS Tuition IV
% of College Enrollees Enrolled in Birth State	0.182	0.739
	(0.056)***	(0.135)***
First-stage F-Statistic	N/A	13.74
Birth-State Dummies	Yes	Yes
Region*Year-of-Birth Dummies	Yes	Yes
Age Dummies	Yes	Yes
Survey Year Dummies	Yes	Yes
ACS Demographic Variables	Yes	Yes
Other Baseline Explanatory Variables	Yes	Yes
ACS % with No College Living in Birth State	Yes	Yes
ACS and Census Education Control Variables	Yes	Yes
Number of Year-State-Age Cohorts	750	750

Notes: Standard errors are clustered by birth state. The dependent variable is the year-state-age cohort percent with any college who live in their birth state 10 years after their college location decisions are observed; these adult location decisions are observed via the 1990 Census for the cohorts enrolled in college in 1980, the 2000 Census for the cohorts enrolled in 1990 and the pooled 2009-2011 ACS for cohorts enrolled in 2000.

***Statistically significantly different from zero at the 1% level of significance.

Data Appendix

The main data in this paper are constructed using the 2006-2014 ACS and the 1980-2000 decennial census microdata accessed from IPUMS (Ruggles et al. 2015). Each year of the ACS includes a one percent random sample of the U.S. population and each decennial census file includes a five percent sample of the population. These are independently drawn samples, so roughly five percent of the ACS sample is also included in the census sample, but we cannot link persons across surveys to identify which observations appear in both the ACS and census microdata. The ACS and census microdata both report the state in which an individual currently resides and the state in which they were born, and these variables are used to construct the main variables in this study. These samples include persons residing in traditional households and group quarters such as college dorms, military barracks, and correctional institutions. Survey weights are provided that can be used to account for sampling design and individual non-response to make the samples representative of the U.S. population. I use survey weights for all variables constructed from the decennial censuses and ACS.

The main explanatory variable of interest is subject to measurement error due to sampling since it is computed based on a five percent sample of the U.S. population. Appendix Table B reports summary statistics for college enrollee observation counts per year-of-birth cohort for each birth-state for the relevant cohorts in the 1980-2000 censuses. Some low population states like Alaska, Wyoming, Vermont, Nevada, and Delaware have on average fewer than 200 college enrollees per birth-year cohort.

The in-state tuition data from the National Science Foundation's WebCASPAR database are based on data collected by the National Center for Education Statistics (NCES) Higher Education General Information Survey (HEGIS) and Integrated Postsecondary Education Data

System (IPEDS). For states with multiple public flagship universities, I compute the arithmetic mean of in-state tuition among all public flagships in the state for each year.

The main dependent variable is computed using ACS microdata as:

$$Y_{scat} = \frac{CollegeStayerPopulation}{CollegeCohortPopulation}$$

$CollegeStayerPopulation$ is the total number of college attendees from birth state s and cohort c observed in ACS survey year t at age a who reside in their birth state.

$CollegeCohortPopulation$ is the total number of college attendees from birth state s and cohort c observed in ACS survey year t at age a who reside anywhere in the U.S.

Table 7 presents results using an alternative dependent variable computed using ACS microdata as:

$$\widetilde{Y_{scat}} = \frac{CollegeStayerPopulation}{TotalCohortPopulation}$$

$CollegeStayerPopulation$ is defined the same as above. $TotalCohortPopulation$ is the total number of all individuals from birth state s and cohort c observed in ACS survey year t at age a who reside anywhere in the U.S. and have any education level. The main dependent variable and this alternative dependent variable have the same numerator but different denominators. The denominator for the main dependent variable is restricted to college attendees, while the denominator for the alternative dependent variable is not restricted based on education.

Appendix Table A: Analytical Sample Mean Birth-State Enrollment and Adult Residence Rates by State

	% of College Enrollees Enrolled in Birth State, 1980	% of College Enrollees Enrolled in Birth State, 1990	% of College Enrollees Enrolled in Birth State, 2000	% with Any College Living in Birth State, 2006-2014
Alabama	0.711	0.745	0.733	0.618
Alaska	0.176	0.287	0.242	0.258
Arizona	0.598	0.629	0.647	0.584
Arkansas	0.630	0.682	0.730	0.566
California	0.792	0.766	0.779	0.665
Colorado	0.550	0.545	0.563	0.528
Connecticut	0.542	0.541	0.513	0.513
Delaware	0.471	0.486	0.518	0.433
Florida	0.613	0.630	0.696	0.584
Georgia	0.667	0.673	0.695	0.656
Hawaii	0.536	0.487	0.482	0.473
Idaho	0.428	0.500	0.540	0.463
Illinois	0.650	0.641	0.657	0.573
Indiana	0.678	0.696	0.718	0.577
Iowa	0.631	0.642	0.664	0.511
Kansas	0.588	0.619	0.660	0.496
Kentucky	0.696	0.713	0.683	0.615
Louisiana	0.749	0.733	0.733	0.561
Maine	0.576	0.598	0.555	0.540
Maryland	0.590	0.551	0.584	0.536
Massachusetts	0.677	0.664	0.623	0.563
Michigan	0.771	0.760	0.781	0.628
Minnesota	0.712	0.681	0.653	0.663
Mississippi	0.701	0.725	0.746	0.547
Missouri	0.625	0.638	0.662	0.581
Montana	0.552	0.521	0.522	0.436
Nebraska	0.622	0.621	0.618	0.512
Nevada	0.327	0.438	0.462	0.440
New Hampshire	0.533	0.477	0.428	0.467
New Jersey	0.538	0.547	0.554	0.506
New Mexico	0.487	0.536	0.574	0.469
New York	0.660	0.654	0.662	0.524
North Carolina	0.754	0.770	0.777	0.686
North Dakota	0.586	0.542	0.592	0.417
Ohio	0.689	0.700	0.723	0.602
Oklahoma	0.646	0.689	0.688	0.562
Oregon	0.658	0.630	0.600	0.557
Pennsylvania	0.687	0.717	0.721	0.587
Rhode Island	0.612	0.546	0.557	0.478
South Carolina	0.722	0.739	0.715	0.608
South Dakota	0.525	0.523	0.514	0.430
Tennessee	0.698	0.695	0.681	0.622
Texas	0.772	0.790	0.771	0.739
Utah	0.721	0.734	0.729	0.627
Vermont	0.470	0.508	0.490	0.448
Virginia	0.603	0.610	0.637	0.540
Washington	0.639	0.651	0.665	0.620
West Virginia	0.608	0.632	0.630	0.455
Wisconsin	0.748	0.730	0.727	0.634
Wyoming	0.346	0.480	0.379	0.337

Notes: means are weighted averages over cohorts within states.

Appendix Table B: College Enrollee Sample Observations Counts per Cohort by Birth-State

	Mean	Std. Dev.	Min	Max
Alabama	1,118	442	672	2,279
Alaska	119	52	56	248
Arizona	615	258	302	1,216
Arkansas	530	224	297	1,139
California	6,838	2,017	4,094	10,879
Colorado	800	314	429	1,506
Connecticut	1,011	290	658	1,539
Delaware	182	58	114	329
Florida	1,841	754	908	3,624
Georgia	1,482	655	770	3,198
Hawaii	332	84	209	517
Idaho	251	86	150	477
Illinois	3,830	1,152	2,375	6,426
Indiana	1,584	624	760	3,162
Iowa	956	343	486	1,624
Kansas	738	250	414	1,284
Kentucky	906	343	523	1,767
Louisiana	1,260	446	669	2,400
Maine	292	124	156	636
Maryland	1,090	330	666	1,938
Massachusetts	2,001	631	1,103	3,157
Michigan	2,970	993	1,645	5,355
Minnesota	1,406	494	758	2,558
Mississippi	832	364	420	1,760
Missouri	1,414	508	744	2,529
Montana	235	83	141	457
Nebraska	538	198	297	985
Nevada	163	64	81	313
New Hampshire	222	92	89	442
New Jersey	2,334	708	1,394	3,810
New Mexico	384	155	219	801
New York	6,404	1,958	3,841	10,264
North Carolina	1,610	642	950	3,301
North Dakota	247	88	118	439
Ohio	3,354	1,250	1,704	6,503
Oklahoma	749	278	365	1,421
Oregon	601	215	338	1,031
Pennsylvania	3,561	1,171	2,085	6,229
Rhode Island	310	88	191	520
South Carolina	867	339	466	1,707
South Dakota	226	90	107	435
Tennessee	1,157	455	678	2,369
Texas	4,140	1,760	1,970	8,357
Utah	491	206	272	938
Vermont	130	46	67	237
Virginia	1,428	487	871	2,611
Washington	1,080	352	653	1,892
West Virginia	472	179	283	947
Wisconsin	1,422	483	818	2,522
Wyoming	120	49	56	222

Notes: Cohorts are defined by state-of-birth and year-of-birth and observed at ages 18-22 in the 1980-2000 decennial census 5% PUMS. The observation counts are based on individuals enrolled in college at the time of the census survey, roughly on April 1 of the census year.

Appendix Table C: Results for Control Variables in Full Specification of Tables 2 & 3

	(1) OLS	(2) IV w/ Tuition
% Female for All College Attendees	0.036	0.036
	(0.012)***	(0.011)***
% Black for All College Attendees	0.031	0.032
	(0.035)	(0.033)
% Asian for All College Attendees	0.162	0.171
	(0.094)*	(0.083)**
% Hispanic for All College Attendees	0.109	0.122
	(0.040)***	(0.037)***
% Other Non-white for All College Attendees	-0.018	-0.015
	(0.046)	(0.045)
Log Personal Income Per Capita at Age 18	-0.082	-0.077
	(0.048)*	(0.045)*
Log Housing Price Index at Age 18	-0.016	-0.004
	(0.019)	(0.019)
Log of Cohort Size at Age 18	-0.057	-0.075
	(0.026)**	(0.026)***
Merit Dummy at Age 18	0.011	0.006
	(0.005)**	(0.005)
Unemployment Rate at Age 22	-0.002	-0.001
	(0.002)	(0.002)
Return to Bachelor's Degree at Age 22	-0.001	-0.003
	(0.007)	(0.007)
Log Median Household Income at Age 22	0.006	0.012
	(0.018)	(0.019)
% in 2006-2014 ACS w/ No College Living in Birth State	0.047	0.036
	(0.013)***	(0.014)**
% in 1980-2000 Census Enrolled in College	-0.049	-0.126
	(0.031)	(0.050)**
% in 2006-2014 ACS with Some College or More	0.098	0.092
	(0.020)***	(0.019)***
% in 2006-2014 ACS with a Bachelor's Degree or More	-0.158	-0.147
	(0.024)***	(0.024)***
% in 2006-2014 ACS with a Graduate Degree	-0.088	-0.082
	(0.040)**	(0.039)**
Full Specification in Column 3 of Tables 2 & 3	Yes	Yes
Number of Observations (Year-State-Age Cohorts)	6750	6750

Notes: Standard errors are clustered by birth state. The dependent variable is the year-state-age cohort percent with any college who live in their birth state during the 2006-2014 ACS. *Statistically significantly different from zero at the 10% level of significance; **Significant at the 5% level; ***Significant at the 1% level.