Higher Education and Local Educational Attainment: Evidence from the Establishment of U.S. Colleges

Lauren Russell* Lei Yu† Michael J. Andrews‡

September 16, 2021

Abstract

We investigate how the presence of a college affects local educational attainment using historical natural experiments in which "runner-up" locations were strongly considered to become college sites but ultimately not chosen for as-good-as-random reasons. While runner-up counties have since had opportunity to establish their own colleges, winners are still more likely to have a college today. Using this variation, we find that winning counties today have college degree attainment rates 58% higher than runner-up counties and have larger shares of employment in high human capital sectors. These effects are not driven primarily by college employees, migration, or local development.

JEL Codes: I23; I24

*Fels Institute of Government, University of Pennsylvania. Email: lrus@sas.upenn.edu.
†University of Pennsylvania. Email: adamyu@sas.upenn.edu
‡Department of Economics, University of Maryland Baltimore County. Email: mandrews@umbc.edu

1 Introduction

Postsecondary educational attainment rates vary widely across areas of the U.S. As of 2018, 35% of adults 25 and older in urban areas had a bachelor's degree or higher compared to only 20% in rural areas (US Department of Agriculture, 2020). Scholars and policymakers have coined the term "the rural higher education crisis" to describe theses troubling inequities in higher education attainment across areas of the U.S. (Marcus and Krupnick, 2017). Differences in academic preparation cannot be responsible for these inequities since rural students actually score better on the National Assessment of Educational Progress than urban students and are more likely to graduate from high school (Marcus and Krupnick, 2017; Krupnick, 2018). Instead, many hypothesize that low attainment rates are directly caused by the lack of college options nearby, as rural areas cover 97% of U.S. land area but have only 14% of the nation's college campuses (Campbell, 2019).

Much previous work has shown that areas proximate to institutions of higher education have higher educational attainment rates (Card, 1995, 2001; Kane and Rouse, 1995; Kling, 2001; Do, 2004; Frenette, 2009; Jepsen and Montgomery, 2009; Doyle and Skinner, 2016).[1] However, this work implicitly assumes that higher education locations are randomly assigned. This assumption is important for understanding the causal effects of proximity. For instance, it may be the case that institutions of higher education are established in urban areas to respond to local demand for high skill jobs (Goldin and Katz, 2008; Autor, 2014), or in wealthy areas as a form of consumption (Bils and Klenow, 2000; MacLeod and Urquiola, 2019); both of these stories would lead to an overestimate of the causal effect of proximity to higher education on college attainment. Lending credence to these concerns, Andrews (2021a) shows that, in general, new colleges and universities are not randomly located, and chosen areas looked different than non-chosen areas along observable dimensions even before establishing the institution. In this paper, we deliver more credible estimates of the effects of local colleges on educational attainment by focusing on a group of higher education

[1] Others have used the presence of nearby higher education institutions to estimate, for instance, intergenerational transmission and spillovers of human capital (Currie and Moretti, 2003; Moretti, 2004) or productivity and innovation (Andersson et al., 2009; Cowan and Zinovyeva, 2013).

institutions for which the location decisions were selected essentially at random.

Our analysis builds on the approach of Andrews (2021a), who painstakingly reviewed establishment histories of a large number of U.S. institutions of higher education, including every land grant college, the first public university founded in each state, the flagship public university of each state, every state technical school and mining college, every federal military academy, every university belonging to a Power Five athletic conference, every national university ranked by U.S. News and World Reports in 2018, and the 25 top-ranked liberal arts colleges.[2] His review identifies 64 institutions, established between 1839 and 1954, in which several sites were considered for the site of a new institution and the winning location was ultimately selected for essentially random reasons. Prior to deciding the institution's location, the "winner" and "runner-up" counties are similar to one another, in both levels and pre-trends, for observable characteristics such as total population, the fraction of the population living in urban areas, and the fraction of the population attending school. We follow Andrews (2021a) in referring to these as "college site selection experiments."

Using contemporary education attainment data, we compare these counties today. We find that counties that won a historical site selection experiment have bachelor's and graduate degree attainment rates that are 14 percentage points (58%) higher than counties that narrowly lost. These effects are primarily driven by having fewer individuals who complete no college rather than shifting individuals from an associate degree to a bachelor's degree. Moreover, winning counties have a larger share of employment in human capital-intensive sectors like professional and business services and a smaller share of employment in relatively low human capital sectors like natural resources and mining than the runner-up counties.

We are somewhat limited in our ability to investigate what channels drive these differences with county-level data. Nonetheless, we conduct a number of tests to determine whether in-migration of college-educated individuals is likely driving the attainment effect. Our first test is a bounding exercise where we assess whether college employees could be inflating rates of college attainment in winning counties. We find that this could explain very little of the

[2] We also follow the Andrews (2021a) terminology and use the word "college" to refer to any institution of higher education in the sample.

effect we see. Our second test utilizes data from Opportunity Insights (Chetty et al., 2020, 2021). These data are useful because they report college attainment information for children who grew up in each county, regardless of whether they still resided in that county as adults, allowing us to abstract away from the effects of migration. We find positive, statistically significant educational attainment effects for individuals that grew up in winning counties, suggesting that the results are not entirely driven by net migration of highly educated individuals into winning counties. Instead, there is a place-specific effect of proximity to a college.

To shed light on the nature of this place-specific effect, we test whether runner-up counties that received a non-educational state institution such as a state capital, insane asylum, or prison as a "consolation prize" during the site selection experiment have similarly high rates of educational attainment today. This is a relevant comparison because Andrews (2021a) shows that establishing a consolation prize institution induces growth in local population and invention only slightly smaller than that caused by establishing a college. The difference in bachelor's degree attainment rates between the winning and consolation prize counties is even larger than our baseline estimates. This suggests that it is the college itself, rather than population growth or economic opportunities created by the presence of a large institution, that is responsible for differences in educational attainment.

We next make a methodological contribution by showing how these historical natural experiments can be used to estimate how the presence of a local college affects college attainment today. Winning a site selection experiment at an early date has persistent effects, with the winning counties having more institutions today, being less likely to have an education desert today, and having more total years of exposure to an institution of higher education over their entire history. We use success or failure in the historical site selection experiments to instrument for the presence of an institution of higher education today. We find that having at least one college in the county today, rather than no colleges, increases the share of the over 25 population with a bachelor's degree or higher by 53.9 percentage points. Moreover, the amount of time that a county has had exposure to colleges matters.

We find that increasing the total years the county has had any college by 100 years increases the share of the over 25 population with a bachelor's or graduate degree by 28.0 percentage points.

2 Data Description and Empirical Strategy

Data on currently operating colleges comes from the Integrated Postsecondary Data System (IPEDS) in 2018 (U.S. Department of Education, National Center for Education Statistics, 2020). We drop any institutions that offer only certificates or graduate degrees in our main sample, although as shown in the appendix ("Analysis Using All Institutions"), our results are very similar if we include these institutions. County-level data on educational attainment rates comes from the IPUMS National Historic Geographic Information System and American Community Surveys (Manson et al., 2019; US Census Bureau, 2020a), and county-level employment by industry information comes from the US Bureau of Labor Statistics Quarterly Census of Employment and Wages (US Bureau of Labor Statistics, 2018). All contemporary county-level outcomes correspond to 2018.

Our empirical strategy relies on historical data on the establishment of US colleges from 1839 to 1954 documented by Andrews (2021a). Specifically, we exploit the site selection natural experiments in which several "runner-up" sites were considered before settling on a final site for a new college. We restrict our sample to cases where the site selection is as-good-as random, leaving us with 64 experiments.[3] For some of these site selection natural experiments, the winning county was literally chosen at random, as in the case of the University of North Dakota and North Dakota State University, in which representatives of the finalist counties drew lots to determine which would receive a college. In many other cases (e.g., University of Arkansas, University of Florida, University of Illinois, Purdue University, University of Oregon), finalist counties submitted bids to become the site of a new college, and winning and runner-up bids were very similar. In still other cases, the decision of

[3] Similar "runner-up" methodologies are used by Greenstone et al. (2010) to study spillovers from large manufacturing plants and Kantor and Whalley (2019) to study spillovers from agricultural colleges.

where to locate the college was brought up to a vote, and often numerous rounds of balloting were required to find a winner (7 rounds of balloting for University of Mississippi, 8 rounds for Southern Arkansas University, 24 rounds for the Georgia Institute of Technology, and a whopping 111 for what would become University of Nebraska at Kearney). A list and map of the 64 experiments in our sample appears in Appendix Table A.1 and Appendix Figure A.1, respectively. Much more information on these historical location experiments and why they are as-good-as-random is provided in Andrews (2021a), and especially its Historical Appendix, which describes each of the site selection experiments in detail.

Of our 64 experiments, the majority involve state flagships or land grants (25) and other public institutions, such as regional universities (2) and technical institutions (6). Two experiments involve military academies (US Air Force Academy and US Merchant Marine Academy), and three involve private colleges (Cornell University, Lincoln College of Illinois, and Southern Methodist University). The institutions vary in selectivity and quality. Some, such as the University of California-Berkeley, the Georgia Institute of Technology, and the University of Wisconsin-Madison, are ranked among the top 50 universities worldwide according to the Times Higher Education World University Rankings (Times Higher Education, 2021). Others such as Kentucky State University, the University of Maine, and the University of Wyoming are unranked.

Andrews (2021a) documents that counties with runner-up sites and counties with winning sites are comparable along observable dimensions prior the establishment of the college. In particular, in the census year prior to when the college was established, there are no statistically significant differences in the fraction of the population who attends school, total population, manufacturing or agricultural output, the fraction of interstate migrants, the fraction living in urban areas, mean age, or access to transportation. There are no differential pre-trends for any of these characteristics prior to establishing the colleges either. All of this evidence indicates that runner-up counties are an appropriate counterfactual for winner counties.

Treating runner-up counties as a counterfactual for winner counties, we then compare contemporary outcomes for runner-up and winner counties within each college location experiment by estimating a regression of the form

$$y_c = \alpha + \beta Winner_c + \gamma_e + \varepsilon_c \tag{1}$$

where y_c is an outcome for county c, $Winner_c$ is an indicator that equals 1 if this county won a college as part of a location experiment, and γ_e is a set of college site selection experiment fixed effects so that comparisons are between winning and runner-up counties for the same college. We report robust standard errors.

Other studies that use these college site selection experiments (Andrews, 2021a,b) use differences-in-differences methodologies that compare the winning to runner-up counties before and after establishing a college. In contrast to these studies, we are primarily interested in contemporary education outcomes. Moreover, rich educational attainment data is unavailable until relatively recent decades. While a differences-in-differences framework is therefore inappropriate in our setting, simply comparing the winning and runner-up counties today—that is, estimating a first difference—also has limitations since the runner-up counties may have established colleges of their own in the years since the historical experiments occurred. The runner-up counties are particularly likely to have received a college in the years following the historical experiments since they were seen, at one point in time, as equally suitable locations for a college as the winning counties. To overcome this issue, we use the college site selection experiment as an instrument for a county's exposure to colleges today. We estimate

$$y_c = \alpha + \beta College\widehat{Exposure}_c + \gamma_e + \varepsilon_c \tag{2}$$

where $College\widehat{Exposure}_c$ is a county-specific measure of exposure (such as an indicator for having at least one college, the total number of colleges, or the total years of exposure to colleges) predicted by whether or not county c was a winner or runner-up in the historical college site selection experiment.

3 Effects on Educational Access and Attainment

3.1 First Stage Estimates: Exposure to Colleges

We start by estimating a number of regressions to investigate how winning a college site between 1839 and 1954 impacted cumulative exposure to a local college and the number of colleges today. We find strong evidence that winning a college location experiment led to meaningful differences in cumulative exposure and persistent differences in local college access (Table 1). Winning counties are 26.2 percentage points more likely to have at least one college today. Similarly, they are less likely to be "education deserts", a term coined by Hillman (2016) to describe areas that have no four-year open-access institutions (public colleges with admissions rates of 75% or above).

To shed light on the intensive margin of access, we also assess effects on the total number of institutions available. The point estimate for column 3 indicates that winning counties have 1.9 more colleges today, on average, than runner-up counties, though this effect is estimated imprecisely. So that outliers have less of an effect on the estimate, in column 4 we estimate the effect on the natural log of the total number of colleges plus 1 to account for any counties with no colleges. We find that winning a college location experiment increases the number of colleges in the county today by 61% ($e^{0.477} - 1 \approx 0.61$).

Because winning a college in, say, 1880 may give the winning county many more years of exposure to a college than a runner-up county which may establish a college later, we also construct the following measure of years of exposure:

$$YearsExposureAllColleges_c = \sum_{i \in I_c} \text{Age of College}_i \tag{3}$$

where I_c is the set of all colleges currently operating in county c. We find that winning counties experienced 141 additional total years of college exposure (column 5). As a complement to this measure, we also assess effects on the number of years a county had any college, a measure we call years of exposure to any college. Winning counties have had 51 additional years of exposure to any college, on average (column 7).

3.2 Reduced Form Estimates: Contemporary Rates of Educational Attainment

Using data from the American Community Survey in 2018, we test whether there are contemporary differences in college attainment between runner-up and winning counties. We estimate equation (1) where the dependent variable is the share of the over age 25 population in the county with no high school diploma (high school dropout), no college (includes both high school dropouts and high school graduates without college credit), some college, an associate degree, and a bachelor's or graduate degree. We focus only on those over 25 since this is an age by which most people have completed their human capital investments. This set of regressions can be thought of as a set of reduced form regressions showing the effect of winning a historical college location experiment on a county's educational attainment rates today.

Table 2 Panel A reveals dramatic differences in college attainment rates between winner and runner-up counties. Winning a college is associated with a 14 percentage point increase in the share of the over 25 population with a bachelor's degree or higher. There are modest decreases in the share completing only some college or an associate degree, which is consistent with the fact that most colleges that were established were four-year institutions. Most of the increase in bachelor's attainment is driven by individuals completing college rather than completing no college at all. These effects are large in magnitude. The increase in bachelor's and graduate degree attainment corresponds to a 58% increase relative to the control group mean of 0.245. We also find that winning a college decreases the share of the population that is a high school dropout by 3.7 percentage points. This is broadly suggestive that these institutions may not just help individuals go to college but may have more widespread effects on changing views towards education.

3.2.1 Industry Mix Effects

Counties that won a college not only have different rates of contemporary educational attainment but also have local economies that are more human capital-intensive. Drawing on data from the 2018 Quarterly Census of Employment and Wages (US Bureau of Labor Statistics, 2018), Figure 1 shows that, on average, winning locations have more private sector jobs concentrated in service providing rather than goods producing industries.[4] Counties that won a college have a significantly higher share of private sector employment in professional and business services, information services, and leisure and hospitality, whereas runner-up counties have significantly higher shares of private sector employment in natural resources and mining and manufacturing. These differences were not present prior to college establishment between treatment and control counties, as shown in Appendix Figure A.2.

3.2.2 Channels

While a full analysis of the channels through which colleges increase local educational attainment is beyond the scope of this paper, we present some preliminary results here. One possible explanation for the differences in educational attainment across winning and runner-up counties is that colleges themselves are large employers of highly educated workers. Since college employees may be especially likely to move to their institution from other areas, if college employees were driving these large effects it could reflect migration rather than increased attainment rates for individuals born into the winning counties. To test this, we perform a bounding exercise in which we calculate educational attainment rates excluding college employees. This exercise uses data on the total number of employees at each higher education institution available in IPEDS in 2018 and assumes that all have at least a bachelor's degree and reside in the county where the college is located. This is a conservative approach since not all college employees have a four-year degree and not all reside in the same county as the college.

To understand how we calculate adjusted college attainment rates excluding college employees, consider the following illustrative example. Suppose a county has a population of 30,000 aged 25+; the county has 9,000 adults with a bachelor's degree or higher, 2,700 with an associate degree, 6,000 with some college, and 12,300 with no college, and the county has colleges employing a total of 5,000 people. We would assume that 5,000 of the 9,000

[4] Detailed employment by sector information at the county-level is unavailable for public sector employment in the Quarterly Census of Employment and Wages.

people with a bachelor's degree or higher were college employees. We would then recalculate attainment rates using a non-college 25+ population of 25,000, assuming that only 4,000 have a bachelor's degree or higher, and keeping counts for the other education categories the same. This deflates the bachelor's or higher attainment rate in the counties with colleges and represents a lower bound on the true bachelor's or higher attainment rate among non-college employees. We then re-estimate the effects of winning a college using these adjusted attainment rates. Panel B of Table 2 shows winning counties still have significantly higher shares of the 25+ population with a bachelor's degree or higher, even after adjusting for the part of the county population that may be directly employed by the college.

To more directly test for whether migration is driving the observed effects, in Panel C we conduct additional analyses using Opportunity Insights (OI) data (Chetty et al., 2020, 2021). These data report college attainment information for children who grew up in each county, regardless of whether they still resided in that county as adults. While the ACS data used in the other panels contain data for the entire population aged 25+, the OI data only contains individuals born between 1978 and 1983. Their educational attainment is defined as the highest level of education they report completing in the 2005-2015 American Community Surveys or 2020 Census long form, whichever is more recent and available for each respondent.[5] Microdata are aggregated and reported at the county level; an exposure weighting approach is used to account for individuals who move across counties during their childhood.[6]

Using the OI data, we find that individuals who grew up in winning counties have higher educational attainment than those who grew up in the runner-up counties, regardless of where they currently reside. This suggests that migration is not the sole mechanism by which having a local college increases aggregate levels of educational attainment. The Opportunity Insights data does reveal a slightly smaller magnitude for the effect on the fraction with a bachelor's degree or higher. Some of this difference could be attributable to the different ages

[5] See "Opportunity Insights Data" in the Appendix for more details on how the Opportunity Insights data differs from our baseline sample and how this affects the interpretation of results.)

[6] See page 15 of Chetty et al. (2020) for more details.

of sampled individuals: because the individuals in the OI data were born between 1978 and 1983, the OI sample does not contain each county's full 25+ population, in contrast to the ACS. Since older individuals are more likely to have completed their schooling, this difference between samples could deflate the share completing a bachelor's degree or graduate degree in the OI results relative to the ACS. Of course, it is also possible that there has been some net migration of college-educated individuals into the winning counties.

Another possible channel is that high educational attainment rates are a consequence of local economic development (as suggested, for instance, by Bils and Klenow (2000)), and winning a college drives local development. To investigate this possibility, in Panel D of Table 2, we restrict attention to 11 college site selection experiments in which a runner-up county receives what Andrews (2021a) refers to as a "consolation prize."[7] In these 11 experiments, state governments were deciding where to allocate multiple state institutions at the same time. One county received a flagship state university or land grant college, while the runner-up counties received the state capital, an insane asylum, or a state penitentiary or other penal institution. Andrews (2021a) shows that establishing a consolation prize cause an increase in local population and invention similarly to establishing a college. If high levels of educational attainment are indeed just a consequence of local economic development, then the consolation prize counties should have similar levels of educational attainment to the winning counties today. Instead, we find using the baseline ACS data that the effect of winning a college on college attainment is even larger when comparing winning locations to consolation prize locations. This suggests that it is the college itself, rather than population growth or economic opportunities created by the presence of a large institution, that is responsible for differences in educational attainment.

3.2.3 Heterogeneity

Since the sample of colleges contains many different types of institutions, we also investigated whether certain types of college are more successful in promoting college attainment. These

[7] Appendix Table A.2 lists these 11 experiments and the type of consolation prize.

heterogeneity results are shown in Appendix Table A.3. We find similar effects for different types of public institutions including state flagships, technical schools, military academies, and other public institutions, but smaller and not statistically significant effects for private colleges. Effects are also similar for colleges established pre-1900 and post-1900 and perhaps somewhat larger for highly ranked colleges as opposed to unranked colleges according to the Timer Higher Education Worldwide University Rankings, although our small sample size makes drawing definitive conclusions difficult.

3.2.4 Trajectories of College Attainment Over Time

Since counties that lost in the site selection process have had decades to establish their own colleges, it is possible that the gap in college attainment between winning and losing counties has shrunk over time. To investigate this possibility, we use data from the decennial population censuses for 1940-2010 and from the American Community Survey for 2010-2018 (Manson et al., 2019; US Census Bureau, 2020a).[8] We drop the one experiment from our sample where the college was established after 1940. We then estimate a series of regressions, one for each year where college attainment information is available. We omit results based on the 1960 Census because publicly-available college attainment information is only available for about half of the experimental counties in our sample for this year. The dependent variable for each of these regressions is the share of the over 25 population that has a bachelor's degree or higher. We then plot these year-specific treatment effects in Figure 2.

The gap in college attainment between winning and losing counties actually widens over time, particularly between 1940 and 1980, a period in which the U.S. experienced an almost four-fold increase in the share of the population with a college degree (US Census Bureau, 2020b). Then from 1980 to the present, the gap has remained roughly constant with winning counties having rates of college attainment between 11 and 15 percentage points higher than losing counties. The evidence indicates that local investments by state governments in

[8]The coding of educational attainment changed with the 1990 Census. Prior to 1990, educational attainment was coded based on years of education. For these years, we code the share with a bachelor's degree or higher as the share of the over 25 population reporting four or more years of college. From 1990 onward, individuals reported whether or not they had a bachelor's degree or higher.

higher education institutions have not only had long lasting effects but that these historical investments have become more, rather than less, important over time.

3.3 Two Stage Least Squares Estimates: Causal Effects of Local College Access

Next, we apply the historical site selection experiments methodology to estimate causal effects of local college access and cumulative exposure. For this analysis, we report results only for our first stage measures of college exposure that have F-statistics that exceed 10 (Stock and Yogo, 2005). Along with the main estimates, we also present results from conservative college attainment measures that exclude college employees using the same approach described previously.

Our main estimates in Panel A indicate that regardless of what measure of college exposure is used, counties with greater exposure have higher college attainment rates. The estimate from row 1, column 5 indicates that the extensive margin (having at least one college in the county) is a significant determinant of college attainment rates in a county. Only one out of five counties in our experimental sample has no colleges, and the average college attainment rate in these counties is only 19%. Having at least one college increases the BA college attainment rate by 53.9 percentage points. This effect is extremely large, but not implausibly so. The interactive map of Campbell (2019) shows that numerous states have neighboring counties with college attainment rates that differ by 30 percentage points or more.

The intensive margin of college access also matters. Our model indicates that increasing the number of colleges by 10% increases the share of the over 25 population with a college degree by 3 percentage points. Finally, cumulative exposure over time, which likely impacts attitudes towards higher education and the culture of an area, affects high school completion and college attainment rates. Increasing the total years of exposure summed over all colleges by 100 increases the college attainment rate by 10 percentage points and decreases the high school dropout rate by 2.6 percentage points while increasing the years of exposure to any college by 100 increases the college attainment rate by 28 percentage points and decreases the high school dropout rate by 7.3 percentage points.[9]

4 Conclusion

In this paper, we provide new evidence to inform whether the presence of a local college has a causal impact on educational attainment using college site selection experiments. We show that counties that were lucky enough to "win" a college between 1839 and 1954 have had dramatically different trajectories than counties that narrowly lost. Over time, winning counties have increased their educational attainment rates much more than their runner-up counterparts. Today, four-year college degree attainment rates in winning counties are 58% higher, and their local economies are more heavily concentrated in service providing rather than goods producing industries. We also find that higher education institutions are a particularly important type of public investment. Runner-up counties that received other types of state institutions, such as capitals, prisons, and asylums, experience comparable rates of population growth and urbanization Andrews (2021a) but actually experience worse educational attainment outcomes than losing counties that did not receive these types of public investments. The fact that higher education institutions reduce high school dropout rates as well as increase college attainment suggests that these institutions shape the culture or dynamics of a place in such a way that human capital investments become desirable.

We believe our results have a number of implications for both policy and the existing literature on college attainment. First, with regards to higher education policy, Hillman and Weichman (2016) argue that policy interventions have focused far too often on addressing information problems in the college application process while neglecting the importance of place and geography. While addressing information problems is important, our results confirm what Hillman and Weichman hypothesized: the presence of a local college has dramatic, causal effects on aggregate rates of educational attainment, especially in the long run.

[9] In results available upon request, we test whether years of exposure to colleges matters above and beyond total number of colleges. We estimated 2SLS regressions using a dummy for winning the college location experiment as an instrument for ln(Colleges+1) and an interaction between the dummy for winning the experiment and years since the experiment as an instrument for ln(Yrs Exposure All Colleges+1). Unfortunately, the estimates are too noisy to be informative.

Second, our results provide more credible evidence that the correlation between distance to college and the years of education documented throughout the labor and education literature is not an entirely spurious correlation driven by the non-random locations of colleges. There is a strong causal relationship between the presence of a college and attainment, although we believe that research that uses college proximity or the presence of a local college as an instrumental variable should at least ensure that results are robust to limiting to the sample to the set of colleges whose locations were randomly assigned. Finally, existing research has used measures of college exposure based on whether students have a college nearby contemporaneously. We find that historical exposure (how many years a place has had access to a college) matters as well. Dynamic effects also reveal that having a local college has become more, rather than less, important over time in driving differences in college attainment.

References

Andersson, R., Quigley, J. M., and Wilhelmsson, M. (2009). Urbanization, productivity, and innovation: evidence from investment in higher education. *Journal of Urban Economics*, 66(1):2–15.

Andrews, M. J. (2021a). How do institutions of higher education affect local invention? evidence from the establishment of U.S. colleges. Working Paper.

Andrews, M. J. (2021b). Local effects of land grant colleges on agricultural innovation and output. In Moser, P., editor, *Economics of Research and Innovation in Agriculture*. University of Chicago Press, Chicago. Forthcoming.

Autor, D. H. (2014). Skills, education, and the rise of ernings inequality among the “other 99 percent”. *Science*, 344(6186):843–851.

Bils, M. and Klenow, P. J. (2000). Does schooling cause growth? *American Economic Review*, 90(5):1160–1183.

Campbell, C. (2019). Those left behind: Gaps in college attainment by race and geography. Center for American Progress Report.

Card, D. (1995). Using geographic variation in college proximity to estimate the return to schooling. In Christofides, L., Grant, E. K., and Swidinsky, R., editors, *Aspects of labour market behaviour: Essays in honour of John Vanderkamp*. University of Toronto Press, Toronto.

Card, D. (2001). Estimating the return to schooling: progress on some persistent econometric problems. *Econometrica*, 69(5):1127–1160.

Chetty, R., Friedman, J. N., Hendren, N., Jones, M. R., and Porter, S. R. (2020). The opportunity atlas: Mapping the childhood roots of social mobility. Working Paper. `https://opportunityinsights.org/wp-content/uploads/2018/10/atlas_paper.pdf`.

Chetty, R., Friedman, J. N., Hendren, N., Jones, M. R., and Porter, S. R. (2021). The opportunity atlas: Mapping the childhood roots of social mobility. Data Library: All Outcomes by County, Race, Gender and Parental INcome Percentile. `https://opportunityinsights.org/data/`.

Cowan, R. and Zinovyeva, N. (2013). University effects on regional innovation. *Research Policy*, 42(3):788–800.

Currie, J. and Moretti, E. (2003). Mother's education and the intergenerational transmission of human capital: evidence from college openings. *Quarterly Journal of Economics*, 118(4):1495–1532.

Do, C. (2004). The effects of local colleges on the quality of college attended. *Economics of Education Review*, 23(3):249–257.

Doyle, W. and Skinner, B. (2016). Estimating the education-earnings equation using geographic variation. *Economics of Education Review*, 53:254–267.

Frenette, M. (2009). Do universities benefit local youth? Evidence from the creation of new universities. *Economics of Education Review*, 28:318–328.

Goldin, C. and Katz, L. F. (2008). *The race between education and technology*. The Belknap Press of the Harvard University Press, Cambridge, MA.

Greenstone, M., Hornbeck, R., and Moretti, E. (2010). Identifying agglomeration spillovers: evidence from winners and losers of large plant openings. *Journal of Political Economy*, 118(3):536–598.

Hillman, N. and Weichman, T. (2016). Education deserts: The continued significance of ‘place’ in the twenty-first century. American Council on Education.

Hillman, N. W. (2016). Geography of college opportunity: The case of education deserts. *American Educational Research Journal*, 53(4):987–1021.

Jepsen, C. and Montgomery, M. (2009). Miles to go before I learn: The effect of travel distance on the mature person's choice of a community college. *Journal of Urban Economics*, 65(1):64–73.

Kane, T. J. and Rouse, C. E. (1995). Labor market returns to two- and four-year colleges: Is a credit a credit and do degrees matter? *American Economic Review*, 85(3):600–614.

Kantor, S. and Whalley, A. (2019). Research proximity and productivity: long-term evidence from agriculture. *Journal of Political Economy*, 127(2):819–854.

Kling, J. R. (2001). Interpreting instrumental variables estimates of the returns to schooling. *Journal of Business & Economic Statistics*, 19(3):358–364.

Krupnick, M. (2018). Divided we learn. The Hechinger Report.

MacLeod, W. B. and Urquiola, M. (2019). Is education consumption or investment? Iimplications for school competition. *Annual Review of Economics*, 11:563–589.

Manson, S., Schroeder, J., Van Riper, D., and Ruggles, S. (2019). IPUMS National Historic Geographic Information System: Version 14.0. [Database]. Minneapolis, MN: IPUMS. `http://doi.org/10.18128/D050.V14.0`.

Marcus, J. and Krupnick, M. (2017). The rural higher-education crisis. The Atlantic.

Moretti, E. (2004). Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data. *Journal of Econometrics*, 121(1-2):175–212.

Stock, J. H. and Yogo, M. (2005). Testing for weak instruments in linear IV regression. In Stock, J. H. and Andrews, D., editors, *Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg*, chapter 5. Cambridge University Press.

Times Higher Education (2021). World university rankings 2021. Best Overall Universities Worldwide.

US Bureau of Labor Statistics (2018). Quarterly Census of Employment and Wages. [County High-Level Excel File].

US Census Bureau (2020a). 2010-2018 American Community Survey 5-year public use microdata samples. [CSV Data File].

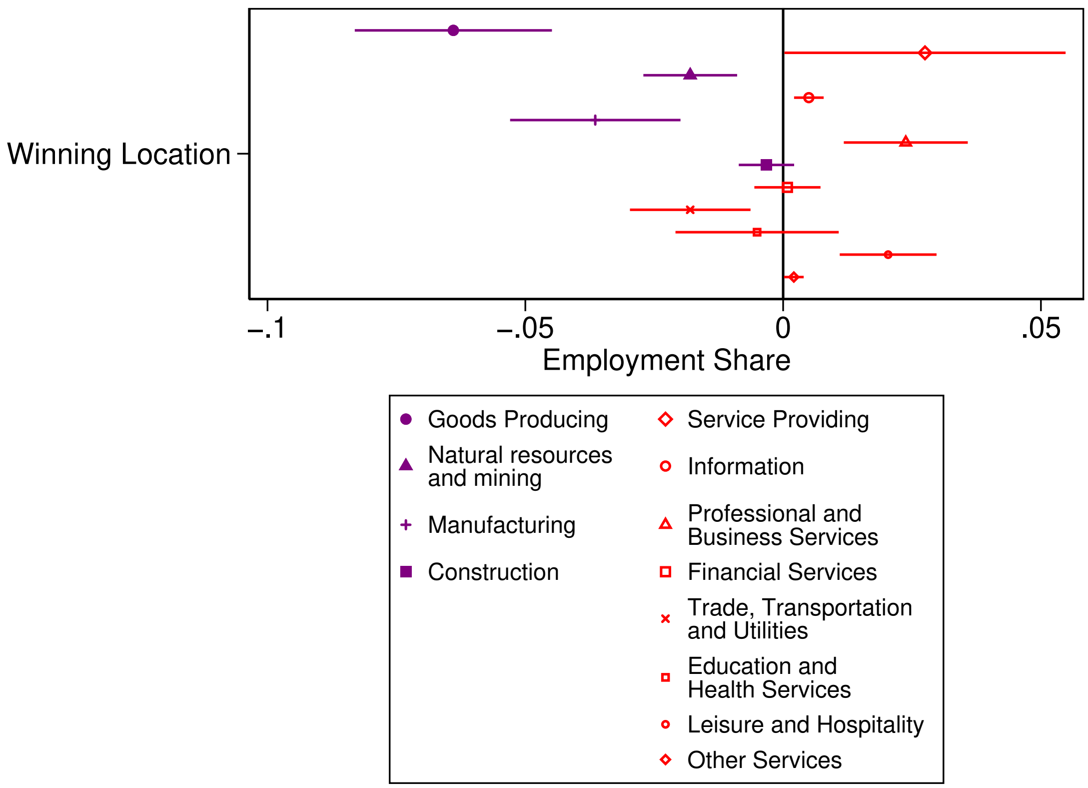
US Census Bureau (2020b). CPS Historical Time Series Tables. Table A-2 Percent of People 25 Years and Over Who Have Completed High School or College, by Race, Hispanic Origin and Sex: Selected Years 1940-2019.

US Department of Agriculture (2020). Rural education. `https://www.ers.usda.gov/topics/rural-economy-population/employment-education/rural-education`.

U.S. Department of Education, National Center for Education Statistics (2020). Integrated Postsecondary Education Data System (IPEDS). Complete Survey Files.

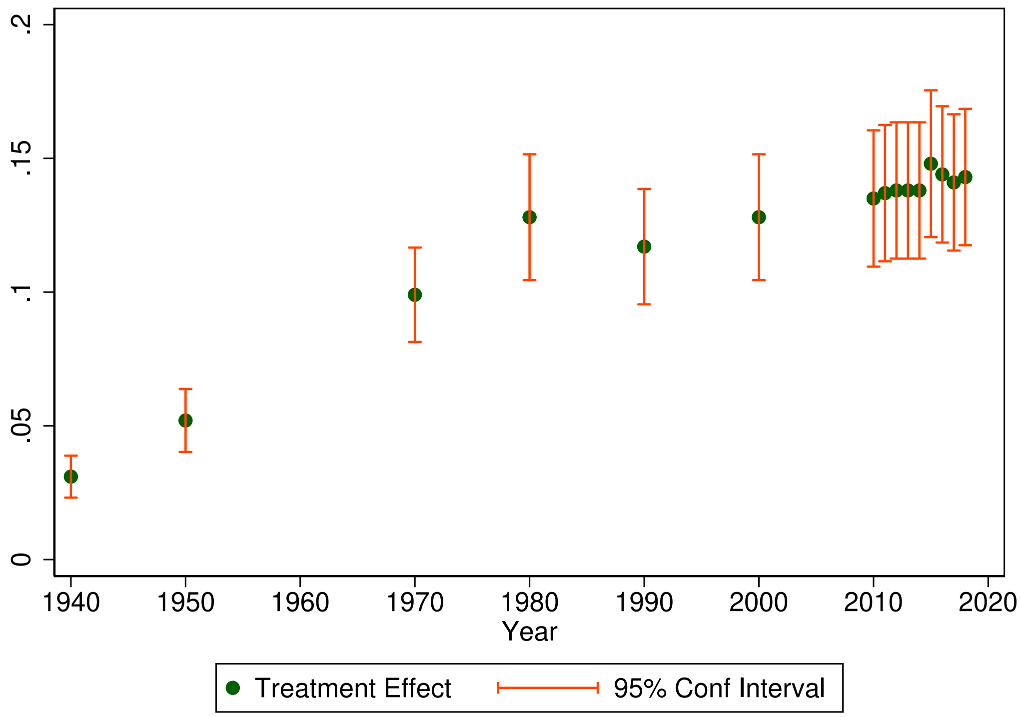
Figures

Figure 1: Estimated Effects of Winning a College Location on Private Employment Shares by Industry



Notes: Each point estimate is from a separate county-level regression where the dependent variable is private employment in the indicated industry category as a share of total employment according to the US Bureau of Labor Statistics Quarterly Census of Employment and Wages in 2018. We show results both for the more general categories of good producing and service providing and the more detailed subcategories of natural resources and mining, construction, manufacturing, trade, transportation and utilities, information, financial services, professional and business services, education and health services, leisure and hospitality, and other services. All regressions include experiment fixed effects. The bars display the 95% confidence interval using robust standard errors for the effect of winning (rather than losing) the college location experiment.

Figure 2: Estimated Effects of Winning a College Location Experiment Over Time



Notes: Each point estimate is from a separate county-level regression where the dependent variable is the share of the over 25 population with a bachelor's or graduate degree in the indicated Census or American Community Survey year and the independent variable is an indicator for whether the county won the site selection experiment. All regressions include experiment fixed effects. The orange bars display the 95% confidence interval for the effect of winning (rather than losing) the college location experiment using robust standard errors. We drop the one experiment from our sample where the college was established after 1940. We do not present results based on the 1960 Census because publicly-available college attainment information is available for only about half of the counties in our experimental sample. (For the 1960 Census, publicly-available data are reported at the county tract level, which means that the estimated educational attainment data was available for some, but not all, counties.)

Tables

Table 1: Effects of Winning a College Location Experiment on Exposure to Colleges

	Has a College	Education Desert	Colleges	Ln(Colleges + 1)	Yrs Exposure All Colleges	Ln(Yrs Exposure All Colleges + 1)	Yrs Exposure Any Colleges
Winning Location	0.262***	-0.348***	1.948*	0.477***	140.946***	1.589***	50.381***
	(0.047)	(0.075)	(0.828)	(0.103)	(39.746)	(0.333)	(9.723)
F-Statistic	30.6	21.8	5.5	21.6	12.6	22.8	26.8
Control Mean	.703	.703	2.586	.895	172.461	3.295	78.961
R^2	0.424	0.437	0.538	0.554	0.553	0.530	0.535
Counties	192	192	192	192	192	192	192
Experiments	64	64	64	64	64	64	64

Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate county-level regression where the dependent variable is the column variable and the independent variable is an indicator for whether the county won the site selection experiment. All regressions include experiment fixed effects.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Effects of Winning a College on Contemporary Educational Attainment

	(1) HS Dropout	(2) No College	(3) Some College	(4) AA Degree	(5) BA or Grad Degree
Panel A: Main Estimates					
Winning Location	-0.037***	-0.119***	-0.016***	-0.007**	0.141***
	(0.005)	(0.011)	(0.003)	(0.002)	(0.013)
Control Mean	.124	.445	.22	.09	.245
R^2	0.697	0.690	0.669	0.688	0.667
Counties	192	192	192	192	192
Experiments	64	64	64	64	64
Panel B: Excluding College Employees Bounding Exercise					
Winning Location	-0.031***	-0.097***	-0.000	0.000	0.097***
	(0.005)	(0.011)	(0.004)	(0.002)	(0.013)
Control Mean	.126	.452	.224	.091	.234
R^2	0.699	0.678	0.600	0.675	0.610
Counties	192	192	192	192	192
Experiments	64	64	64	64	64
Panel C: Opportunity Insights Data					
Winning Location	-0.018***	-0.060***	-0.015***	-0.013***	0.088***
	(0.003)	(0.007)	(0.004)	(0.003)	(0.010)
Control Mean	.138	.311	.238	.106	.345
R^2	0.763	0.617	0.649	0.631	0.634
Counties	192	192	192	192	192
Experiments	64	64	64	64	64
Panel D: Effects Relative to Consolation Prizes					
Winning Location	-0.053***	-0.175***	-0.030**	-0.013	0.218***
	(0.007)	(0.022)	(0.009)	(0.007)	(0.030)
Control Mean	.11	.435	.222	.1	.242
R^2	0.846	0.814	0.826	0.753	0.779
Counties	27	27	27	27	27
Experiments	11	11	11	11	11

Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate county-level regression where the dependent variable is the column variable and the independent variable is an indicator for whether the county won the site selection experiment. All regressions include experiment fixed effects. For panels A, B, and D, college attainment shares correspond to the over 25 population in the county. For panel C, based on the Opportunity Insights data, college attainment shares correspond to individuals born between 1978 and 1983.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Two Stage Least Squares Results

	(1) HS Dropout	(2) No College	(3) Some College	(4) AA Degree	(5) BA or Grad Degree
Panel A: Main Estimates					
Has a College	-0.140***	-0.454***	-0.060***	-0.025***	0.539***
	(0.024)	(0.067)	(0.014)	(0.007)	(0.079)
Education Desert	0.105***	0.341***	0.045***	0.019**	-0.405***
	(0.019)	(0.057)	(0.011)	(0.006)	(0.068)
Ln(Colleges+1)	-0.077***	-0.249***	-0.033***	-0.014**	0.296***
	(0.015)	(0.042)	(0.008)	(0.004)	(0.050)
Yrs Exposure All Colleges (100s)	-0.026***	-0.084***	-0.011***	-0.005**	0.100***
	(0.006)	(0.019)	(0.003)	(0.002)	(0.023)
Ln(Yrs Exposure All Colleges +1)	-0.023***	-0.075***	-0.010***	-0.004**	0.089***
	(0.004)	(0.012)	(0.002)	(0.001)	(0.015)
Yrs Exposure Any College (100s)	-0.073***	-0.236***	-0.031***	-0.013**	0.280***
	(0.013)	(0.035)	(0.007)	(0.004)	(0.042)
Counties	192	192	192	192	192
Experiments	64	64	64	64	64
Panel B: Excluding College Employees Bounding Exercise					
Has a College	-0.118***	-0.368***	0.000	0.001	0.367***
	(0.023)	(0.060)	(0.014)	(0.008)	(0.068)
Education Desert	0.089***	0.277***	-0.000	-0.001	-0.276***
	(0.017)	(0.048)	(0.010)	(0.006)	(0.053)
Ln(Colleges+1)	-0.065***	-0.202***	0.000	0.000	0.202***
	(0.013)	(0.034)	(0.008)	(0.004)	(0.035)
Yrs Exposure All Colleges (100s)	-0.022***	-0.068***	0.000	0.000	0.068***
	(0.005)	(0.016)	(0.003)	(0.001)	(0.015)
Ln(Yrs Exposure All Colleges +1)	-0.019***	-0.061***	0.000	0.000	0.061***
	(0.004)	(0.011)	(0.002)	(0.001)	(0.012)
Yrs Exposure Any College (100s)	-0.061***	-0.191***	0.000	0.000	0.191***
	(0.012)	(0.032)	(0.007)	(0.004)	(0.035)
Counties	192	192	192	192	192
Experiments	64	64	64	64	64

Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate 2SLS regression where the dependent variable is the column variable, the endogenous variable is the row variable, and the instrument is whether the county won or lost the college site selection experiment. All regressions include experiment fixed effects. College attainment shares correspond to the over 25 population in the county.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix Materials

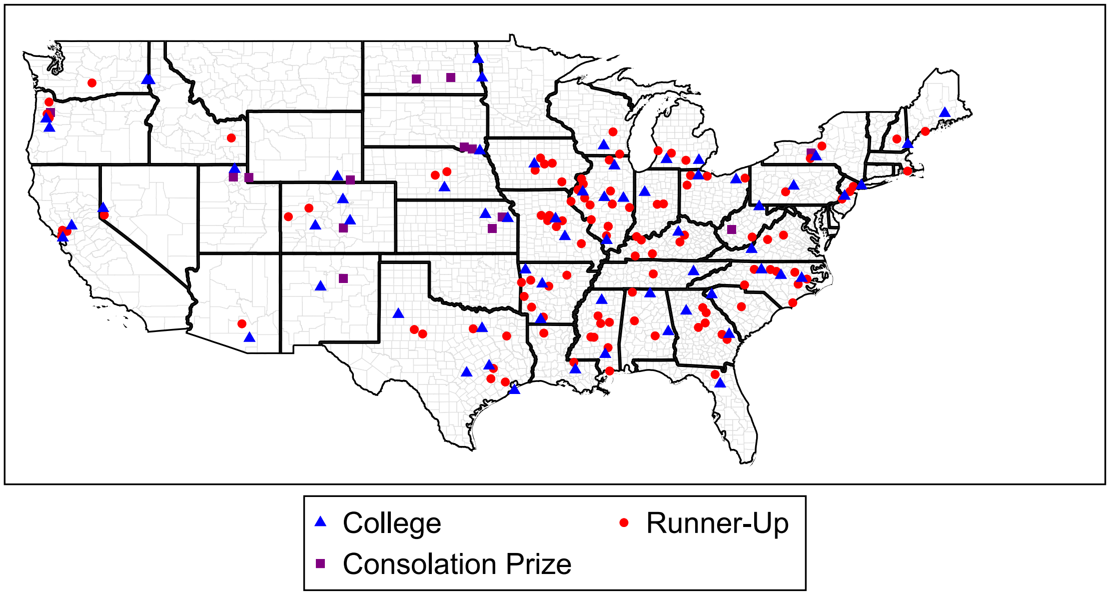
Details on the Colleges Sample

Table A.1: List of College Site Selection Experiments

	College	County	State	Runner-Up Counties	Experiment Year	College Type	Consolation Prize
1	University of Missouri	Boone	Missouri	Callaway; Howard; Cole; Saline; Cooper	1839	Other Public	
2	University of Mississippi	Lafayette	Mississippi	Montgomery; Rankin; Monroe; Winston; Attala; Harrison	1841	Other Public	
3	Eastern Michigan University	Washtenaw	Michigan	Jackson	1849	Normal School	
4	Pennsylvania State University	Centre	Pennsylvania	Blair	1855	Land Grant	
5	The College of New Jersey	Mercer	New Jersey	Essex; Burlington; Middlesex	1855	Normal School	
6	University of California Berkeley	Alameda	California	Napa; Contra Costa	1857	Land Grant	
7	Iowa State University	Story	Iowa	Tama; Hardin; Jefferson; Marshall; Polk	1859	Land Grant	
8	University of South Dakota	Clay	South Dakota	Bon Homme; Yankton	1862	Other Public	YES
9	Kansas State University	Riley	Kansas	Shawnee	1863	Land Grant	YES
10	University of Kansas	Douglas	Kansas	Lyon	1863	Other Public	YES
11	Lincoln College (IL)	Logan	Illinois	Warrick; Edgar; Macon	1864	Other Private	
12	Cornell University	Tompkins	New York	Seneca; Schuyler; Onondaga	1865	Land Grant	YES
13	University of Maine	Penobscot	Maine	Sagadahoc	1866	Land Grant	
14	University of Wisconsin	Dane	Wisconsin	Fond du Lac	1866	Land Grant	
15	University of Illinois	Champaign	Illinois	Morgan; McLean	1867	Land Grant	
16	West Virginia University	Monongalia	West Virginia	Greenbrier; Kanawha	1867	Land Grant	YES
17	Oregon State University	Benton	Oregon	Marion	1868	Land Grant	YES
18	Purdue University	Tippecanoe	Indiana	Hancock; Marion	1869	Land Grant	
19	Southern Illinois University	Jackson	Illinois	Jefferson; Clinton; Washington; Perry; Marion	1869	Normal School	
20	University of Tennessee	Knox	Tennessee	Rutherford	1869	Land Grant	
21	Louisiana State University	Eastbatonr	Louisiana	Bienville; East Feliciana	1870	Land Grant	
22	Missouri University of Science and Technology	Phelps	Missouri	Iron	1870	Technical School	
23	Texas A and M University	Brazos	Texas	Austin; Grimes	1871	Land Grant	
24	University of Arkansas	Washington	Arkansas	Independence	1871	Land Grant	
25	Auburn University	Lee	Alabama	Tuscaloosa; Lauderdale	1872	Land Grant	
26	University of Oregon	Lane	Oregon	Linn; Polk; Washington	1872	Other Public	
27	Virginia Polytechnic Institute	Montgomery	Virginia	Rockbridge; Albemarle	1872	Land Grant	
28	University of Colorado	Boulder	Colorado	Fremont	1874	Other Public	YES
29	University of Texas Austin	Travis	Texas	Smith	1881	Other Public	
30	University of Texas Medical Branch	Galveston	Texas	Harris	1881	Technical School	
31	North Dakota State University	Cass	North Dakota	Stutsman	1883	HBCU	YES
32	University of North Dakota	Grandforks	North Dakota	Burleigh	1883	HBCU	YES
33	University of Arizona	Pima	Arizona	Pinal	1885	Other Public	YES
34	University of Nevada	Washoe	Nevada	Carson City	1885	Land Grant	
35	Georgia Institute of Technology	Fulton	Georgia	Greene; Baldwin; Bibb; Clarke	1886	Technical School	
36	Kentucky State University	Franklin	Kentucky	Boyle; Christian; Fayette; Warren; Daviess	1886	HBCU	
37	North Carolina State University	Wake	North Carolina	Mecklenburg; Lenoir	1886	Land Grant	
38	University of Wyoming	Albany	Wyoming	Uinta; Laramie	1886	Land Grant	YES
39	Utah State University	Cache	Utah	Weber	1888	Land Grant	YES
40	Clemson University	Pickens	South Carolina	Richland	1889	Land Grant	
41	University of Idaho	Latah	Idaho	Bonneville	1889	Land Grant	
42	University of New Mexico	Bernalillo	New Mexico	San Miguel	1889	Other Public	YES
43	Alabama Agricultural and Mechanical University	Madison	Alabama	Montgomery	1891	HBCU	
44	University of New Hampshire	Strafford	New Hampshire	Belknap	1891	Land Grant	
45	Washington State University	Whitman	Washington	Yakima	1891	Land Grant	
46	North Carolina A and T University	Guilford	North Carolina	Alamance; Forsyth; Durham; New Hanover	1892	HBCU	
47	Northern Illinois University	Dekalb	Illinois	Winnebago	1895	Normal School	
48	Western Illinois University	Mcdonough	Illinois	Mercer; Schuyler; Adams; Hancock; Warren	1899	Normal School	
49	University of Nebraska at Kearney	Buffalo	Nebraska	Custer; Valley	1903	Normal School	
50	Western Michigan University	Kalamazoo	Michigan	Allegan; Barry	1903	Normal School	
51	University of Florida	Alachua	Florida	Columbia	1905	Land Grant	
52	Georgia Southern College	Bulloch	Georgia	Emanuel; Tattnall	1906	Other Public	
53	University of California Davis	Yolo	California	Solano	1906	Land Grant	
54	East Carolina University	Pitt	North Carolina	Edgecombe; Beaufort	1907	Technical School	
55	Western State Colorado University	Gunnison	Colorado	Garfield; Mesa	1909	Normal School	
56	Arkansas Tech University	Pope	Arkansas	Conway; Franklin; Sebastian	1910	Technical School	
57	Bowling Green State University	Wood	Ohio	Henry; Sandusky; Van Wert	1910	Normal School	
58	Kent State University	Portage	Ohio	Trumbull	1910	Normal School	
59	Southern Arkansas University	Columbia	Arkansas	Hempstead; Ouachita; Polk	1910	Other Public	
60	Southern Mississippi University	Forrest	Mississippi	Hinds; Jones	1910	Normal School	
61	Southern Methodist University	Dallas	Texas	Tarrant	1911	Other Private	
62	Texas Tech	Lubbock	Texas	Scurry; Nolan	1923	Technical School	
63	US Merchant Marine Academy	Nassau	New York	Bristol	1941	Military Academy	
64	US Air Force Academy	Elpaso	Colorado	Walworth; Madison	1954	Military Academy	

Notes: List of college site selection experiments used in the sample in chronological order by the experiment date.

Figure A.1: Map of College and Runner-Up Counties in the Sample



Notes: College locations are shown by diamonds. Runners-up locations that do not receive a consolation prize are shown by circles. Runner-up locations that do receive a consolation prize are shown by squares.

Table A.2: List of Consolation Prizes

	College	State	College County	Consolation Prize County	Consolation Prize Type
1	University of Colorado	Colorado	Boulder	Fremont	Penitentiary
2	Kansas State University	Kansas	Riley	Shawnee	Capital
3	University of New Mexico	New Mexico	Bernalillo	San Miguel	Asylum
4	Cornell University	New York	Tompkins	Seneca	Asylum
5	North Dakota State University	North Dakota	Cass	Stutsman	Asylum
6	University of North Dakota	North Dakota	Grand Forks	Burleigh	Penitentiary
7	Oregon State University	Oregon	Benton	Marion	Capital
8	University of South Dakota	South Dakota	Clay	Yankton	Capital
9	University of South Dakota	South Dakota	Clay	Bon Homme	Penitentiary
10	Utah State University	Utah	Cache	Weber	Penitentiary
11	West Virginia University	West Virginia	Monongalia	Kanawha	Capital
12	University of Wyoming	Wyoming	Albany	Uinta	Asylum
13	University of Wyoming	Wyoming	Albany	Laramie	Capital

Notes: List of the colleges in which a runner-up county received a consolation prize, along with details about the consolation prize.

Heterogeneity

Table A.3: Heterogeneity

	(1) HS Dropout	(2) No College	(3) Some College	(4) AA Degree	(5) BA or Grad Degree
Panel A: Type of College					
State Flagship	-0.036***	-0.131***	-0.021***	-0.011***	0.163***
	(0.006)	(0.018)	(0.005)	(0.003)	(0.021)
Tech School	-0.055***	-0.131***	-0.001	0.001	0.131***
	(0.012)	(0.029)	(0.008)	(0.007)	(0.032)
Military Academy	-0.041**	-0.133***	-0.008	0.005	0.136***
	(0.013)	(0.006)	(0.013)	(0.010)	(0.021)
Other Public	-0.037***	-0.113***	-0.015**	-0.004	0.132***
	(0.008)	(0.018)	(0.005)	(0.004)	(0.020)
Private	0.003	-0.048	-0.023	-0.017***	0.088
	(0.028)	(0.064)	(0.021)	(0.005)	(0.081)
R^2	0.708	0.697	0.677	0.701	0.673
Panel B: Year of First Class					
Pre-1900	-0.039***	-0.122***	-0.017***	-0.007**	0.146***
	(0.006)	(0.014)	(0.004)	(0.003)	(0.017)
Post-1900	-0.031***	-0.111***	-0.013	-0.005	0.129***
	(0.008)	(0.017)	(0.007)	(0.004)	(0.015)
R^2	0.698	0.691	0.670	0.689	0.668
Panel C: Times Higher Education Ranking					
Ranked Top 100	-0.031**	-0.123***	-0.038***	-0.016**	0.177***
	(0.011)	(0.028)	(0.010)	(0.005)	(0.031)
Ranked 101-500	-0.061***	-0.165***	-0.028***	-0.003	0.196***
	(0.012)	(0.026)	(0.007)	(0.003)	(0.032)
Ranked 501-1000	-0.036***	-0.131***	-0.004	-0.008	0.143***
	(0.009)	(0.022)	(0.004)	(0.006)	(0.022)
Ranked 1000+	-0.039	-0.177***	0.006	0.008	0.162***
	(0.022)	(0.026)	(0.009)	(0.007)	(0.016)
Unranked	-0.025***	-0.083***	-0.010	-0.006	0.099***
	(0.007)	(0.017)	(0.005)	(0.004)	(0.019)
R^2	0.715	0.713	0.702	0.699	0.693
Control Mean	.124	.445	.22	.09	.245
Counties	192	192	192	192	192
Experiments	64	64	64	64	64

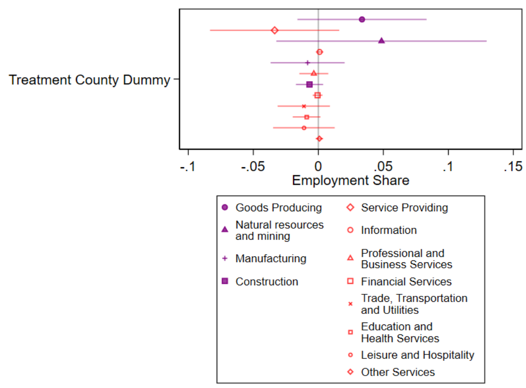
Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate county-level regression where the dependent variable is the column variable and the independent variable is an indicator for whether the county won the site selection experiment interacted with the characteristic of the type of college indicated by the row label. All regressions include experiment fixed effects. College attainment shares correspond to the over 25 population in the county.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Industry Mix in 1900

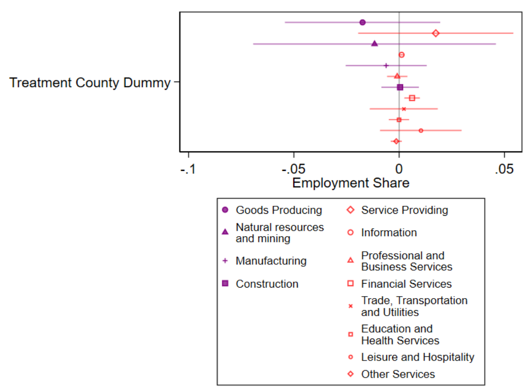
In Section 3.2.1, we show that counties that won a college in a historical experiment have larger employment shares in human capital-intensive sectors today. To show that this result is not reflecting a differential industry mix in the years before the college experiments, we replicate the Section 3.2.1 results using the earliest available data on employment by industry. This data comes from the 1900 decennial population census (Manson et al., 2019). Because many of our historical experiments occurred before 1900, we split up our data into those experiments that occurred before and after 1900. For both samples, there are no statistically significant differences in industry mix between the winning and runner-up counties. For the experiments that occurred after 1900, if anything the winning counties had a larger share of employment in goods producing sectors and a smaller share in service providing sectors. For the experiments that occurred before 1900, results are qualitatively similar to those observed today, although we again stress that all estimates are noisy.

Figure A.2: Estimated Effects of Winning a College Location on Private Employment Shares by Industry in 1900

(a) Colleges not established in 1900



(b) Colleges established by 1900



Notes: Each point estimate is from a separate county-level regression where the dependent variable is private employment in the indicated industry category as a share of total employment according to the 100% U.S decennial population census in 1900. 1900 is the first census for which we have harmonized industry codes ("ind1950"). We map ind1950 codes to employment categories given in the US Bureau of Labor Statistics Quarterly Census of Employment and Wages in 2018. We show results both for the more general categories of good producing and service providing and the more detailed subcategories of natural resources and mining, construction, manufacturing, trade, transportation and utilities, information, financial services, professional and business services, education and health services, leisure and hospitality, and other services. All regressions include experiment fixed effects. The bars display the 95% confidence interval using robust standard errors for the effect of winning (rather than losing) the college location experiment. We split results into the sample of colleges that were not yet established in 1900 (a) and those that were established before 1900 (b).

Analysis Using All Institutions

The two tables below show the estimated first stage and 2SLS results if we use the sample of all institutions, including those that offer only certificate or graduate degrees or do not report which degree type(s) they offer in the IPEDS data. We omit results for the years of exposure measures since we do not have data on establishment year for all institutions in this sample.

Table A.4: Effects of Winning a College Location Experiment on Exposure to Colleges (All Institutions Included)

	(1) Has a College	(2) Education Desert	(3) Colleges	(4) Ln(Colleges+1)
Winning Location	0.232***	-0.348***	3.150*	0.571***
	(0.046)	(0.075)	(1.341)	(0.121)
F-Statistic	26	21.8	5.5	22.1
Control Mean	.734	.703	4.148	1.117
R^2	0.412	0.437	0.559	0.549
Counties	192	192	192	192
Experiments	64	64	64	64

Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate county-level regression where the dependent variable is the column variable and the independent variable is an indicator for whether the county won the site selection experiment. All regressions include experiment fixed effects.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.5: Two Stage Least Squares Results (All Institutions Included)

	(1) HS Dropout	(2) No College	(3) Some College	(4) AA Degree	(5) BA or Grad Degree
Panel A: Main Estimates					
Has a College	-0.157***	-0.512***	-0.068***	-0.028**	0.608***
	(0.029)	(0.082)	(0.016)	(0.009)	(0.098)
Education Desert	0.105***	0.341***	0.045***	0.019**	-0.405***
	(0.019)	(0.057)	(0.011)	(0.006)	(0.068)
Ln(Colleges+1)	-0.064***	-0.208***	-0.028***	-0.011**	0.247***
	(0.012)	(0.034)	(0.007)	(0.004)	(0.041)
Counties	192	192	192	192	192
Experiments	64	64	64	64	64
Panel B: Excluding College Employees Bounding Exercise					
Has a College	-0.132***	-0.413***	0.001	0.001	0.411***
	(0.027)	(0.074)	(0.016)	(0.009)	(0.082)
Education Desert	0.088***	0.276***	-0.001	-0.001	-0.274***
	(0.017)	(0.048)	(0.010)	(0.006)	(0.053)
Ln(Colleges+1)	-0.054***	-0.168***	0.000	0.000	0.167***
	(0.010)	(0.027)	(0.006)	(0.004)	(0.028)
Counties	192	192	192	192	192
Experiments	64	64	64	64	64

Notes: Robust standard errors are in parentheses. Each row and column displays the results from a separate 2SLS regression where the dependent variable is the column variable, the endogenous variable is the row variable, and the instrument is whether the county won or lost the college site selection experiment. All regressions include experiment fixed effects. College attainment shares correspond to the over 25 population in the county.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Opportunity Insights Data

As a complement to our main results using the ACS county-level data, we estimated reduced form effects of winning a college location experiment on county-level outcomes provided by Opportunity Insights, specifically "All Outcomes by County, Race, Gender, and Parental Income Percentile" from "The Opportunity Atlas: Mapping the Childhood Roots of Social Mobility" (Chetty et al., 2020, 2021). Because these data contain information for individuals linked to the counties in which they resided while they were growing up, this analysis sheds some light on whether the educational attainment effects we find are attributable solely to net inflows of college-educated individuals.

Recall that for the ACS sample, the county-level educational attainment shares correspond to the over 25 population currently residing in the county. The Opportunity Insights sample contains people born between 1978 and 1983 who lived in a county when they were growing up, regardless of whether they still resided in the county when they were older.[10] The college attainment outcomes in the Opportunity Insights data are from either the 2005-2015 American Community Survey or the 2000 Census long form data, whichever is more recent for each respondent.

We choose the outcomes available in the Opportunity Insights data which most closely approximate the college attainment outcomes in our main analysis. In the Opportunity Insights data, all education variables are defined as having at least that level of education or higher.

- The fraction who have completed high school or more is reported in the hs_pooled_pooled_mean variable. To get the "HS Dropout" fraction, we use one minus the fraction of children who completed high school or obtained a GED, among children who received the ACS or 2000 long form at age 19+.
- For the analogous outcome to "No College" in the main estimates, we add the fraction with just a high school diploma (which we obtain by subtracting the fraction with some college or more from the high school or more fraction) to the high school dropout fraction.
- The "Some College" fraction is obtained by taking the fraction with some college or higher and subtracting the fraction with a community college degree or higher.
- To approximate the fraction with just an associates degree, we take the fraction of children who have at least a community college degree, among children who received the ACS or 2000 Census long form at age 25+, and subtract the fraction with a four-year degree.
- To get the fraction with a BA or graduate degree, we use the four-year college fraction reported in the Opportunity Insights data since this is the fraction of children who have at least a four-year college degree among children who received the ACS or 2000 Census long form at age 25+.

Note that to protect privacy, a small amount of noise is added to each estimate in the Opportunity Insights data.[11] It is possible that the infusion of noise contributes slightly to the attenuation of estimates in the Opportunity Insights results relative to the ACS results, although we expect the effect of this bias to be small.

[10] An exposure weighting approach is used to account for individuals who move across counties during their childhood. See page 15 of Chetty et al. (2020) for more details.

[11] For more details, see "Codebook for Table 5: All Outcomes by County, Race, Gender, and Parental Income Percentile" (Chetty et al., 2021), which reports that the infused noise is "usually less than one tenth of a standard deviation."