How Does Access to College Affect Long-Term Life Outcomes? Evidence from U.S. Openings of Two-Year Public Colleges

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Abstract

More than eight hundred two-year public colleges opened in the United States between 1920 and 1980, creating major differences in access to college by location and date of birth for otherwise similar people. Using the variation arising from these college openings, I estimate the causal effect of greater access to college on economic, social, and health outcomes using linked Census and Social Security Administration data. The college openings led to about one-tenth of a year of additional college attainment on average for nearby college-age men and women. The openings resulted in 'democratization' and not 'diversion'—that is, to a higher probability of completing four years of college. Moreover, I find that the junior college openings (i.e., the openings between 1920 and 1940) had a positive causal effect on one's likelihood of working as a professional, of having a college-educated spouse, and of delaying family formation. The postwar community college openings led to a 1.0 percentage-point increase in one's likelihood of living past age 65.

The most recent version of this paper can be found ***here****.*

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1 Introduction

Americans who attain a four-year college degree earn an additional $25,000 annually relative to those who merely complete high school, are fifty percentage points more likely to have a spouse with at least a four-year college degree and live 4-6 years longer on average.[1] To what extent do these statistical associations reflect causality? I link newly-available datasets of Census and Social Security data and (as in Currie and Moretti (2003)) examine the effects of geographic differences in access to college, with a focus on U.S. two-year public colleges opening between 1920 and 1980. These college openings were a momentous development in the history of American education. I estimate the effects of these openings on economic, social and health outcomes.[2]

More than eight hundred two-year public colleges opened in the U.S. between 1920 and 1980, creating major differences in access to college for otherwise similar people. I evaluate this natural experiment in two parts. First, I link men from the 1920 to the 1940 Census to observe the effect of junior college openings in the 1920s and 1930s on mid-life outcomes: college attainment, occupation, and assortative marriage, as well as the question of 'democratization' or 'diversion' (whether access to a two-year college leads to a higher or lower likelihood of completing a four-year college degree). Second, using Social Security administrative data linked to the 2000 Census and the 2001-2015 American Community Survey, I estimate the effect of postwar community college openings for men and women on college attainment, democratization/diversion and longevity. With the available data one cannot estimate effects on longevity for the junior college cohorts or on mid-life outcomes

[1]The first figure is calculated from a published report of the U.S. Bureau of Labor Statistics (2020); the second figure is for men and women age 15-49 who married for the first time in the year 2010 (See Cohen, P. (2013)); The third figure (lifespan) is for men and women at age 25 and is based on *Health: United States, 2011*, Figure 32 and Tables 8 and 9 of Rostron et al. (2010). Moreover, relative to high school graduates who never attended college, persons with a bachelor's degree on average are less likely to be in poverty, have greater job safety, are less likely to be unemployed, have better self-reported health, are considerably more likely to practice good health behaviors, are less likely to be incarcerated, and are more likely to report being happy. See Trostel (2015).

[2]One related school of thought concerns the acquisition of human capital: Becker (1964), Goldin and Katz (2007). Another school concerns 'signaling': Spence (1973), Caplan (2019). To address the question of whether these college attainment correlations reflect causality, researchers have used research designs involving variation in college attainment among twins (Ashenfelter and Krueger (1994), Bound and Solon (1999)) and arising from variation across states in one's risk of being drafted for the Vietnam war (Buckles et al. (2016)). Some have theorized that what is learned in college leads to different thinking and decision-making patterns (Cutler and Lleras-Muney (2008), Cutler and Lleras-Muney (2010), Glied and Lleras-Muney (2003), de Walque (2010)); others that the pre-existing characteristics (such as one's discount factor) lead to both greater attainment and greater health (Fuchs (1982)).

for the community college cohorts.[3]

While I follow the basic research design of Currie and Moretti (2003) in my use of U.S. college openings as a source of variation in access to college, I depart from their research design in three important ways. First, I conduct my analysis at the level not of county but town (or township), enabling me to rule out county trends in the outcome variables as potential confounders and to observe how the effects of a college opening vary with distance from the college opening (0-5 miles, 5-10, etc.). Second, my analysis is based on one's childhood town, not one's location as an adult, allowing me to rule out the possibility of 'endogenous mobility bias.' Finally, whereas Currie and Moretti focus on the openings of four-year colleges and study their effects on outcomes for white mothers observed in birth records, I estimate the effects of two-year public college openings for men and women of all races and for the outcomes of college attainment, democratization/diversion, occupation, assortative marriage, and longevity.

In order to carry out this research design, I have linked several sets of detailed microdata, created a geocoded national college openings dataset, and developed algorithms to geocode hundreds of thousands of childhood towns/townships. In recent years the 1920 and the 1940 Census have been digitized and individuals have been linked from the 1920 to the 1940 Census, providing the basis for my analysis of the junior college openings.[4] The Social Security Numident dataset—which contains a record of every individual who has ever received a Social Security number and contains information on place of birth, date of birth and date of death—has recently been linked to the 2000 Census, the American Community Survey and the 1940 Census, enabling my analysis of the postwar community college openings. For my analysis I created a college openings dataset containing the date of opening and exact latitude and longitude of colleges that opened between 1920 and 1980, as well as the locations of colleges that were already in existence before the openings. I also developed algorithms to geocode about 70,000 towns/townships in each of the 1920 and the 1940 Censuses and over 100,000 locations of birth in Social Security administrative data.

As a complement to the nationwide analysis, I conduct a case study of the 1926 opening in Tyler, Texas of Tyler Junior College. Digitizing and linking high school and

[3]To be clear, the junior college cohorts were born 1895-1915 and affected by the junior college openings (1920-1940), and the community college cohorts were born 1921-1951 and affected by the postwar community college openings (1945-1980).

[4]The digitization was completed by Ancestry.com, IPUMS and FamilySearch, and linkage methods have been developed by the Census Linkage Project, IPUMS and others.

college enrollment information obtained from contemporaneous yearbooks, I show that the opening of Tyler Junior College created major differences in access to college across cohorts. Students graduating from Tyler High School in the class of 1926 or later were 20 percentage points more likely to attend any public college compared with students graduating in 1924 or earlier, with nearly all of the increase occurring between the 1924 and 1926 classes.

In my analysis I consider towns which, prior to the opening of a two-year public college, were at least 25 miles from the nearest college of any kind (excluding for-profit). Among those who lived in one of these towns as a child, the treatment group are those who were college-age or younger at the time of the opening, and the control group are those (sharing the same childhood town) who were older than college-age.

I estimate a treatment effect of the junior and community college openings of about one-tenth of a year of additional college attainment, with little or no detectable effect for towns beyond five miles from the college opening. The junior college openings (1920-1940) increased college attainment for those age 21 or younger at the time of the opening, while for the community college openings (1945-1980) the effect can be observed for those in their mid-20s and younger. In both cases the two-year public college openings led to 'democratization' and not 'diversion'—a one percentage point increase in the likelihood of completing four years of college.

There has been debate since at least 1960 about whether two-year public colleges increase college attainment ('democratization') or decrease attainment by diverting students from four-year colleges ('diversion').[5] A number of researchers in the 1960s through the 1980s found evidence of diversion, providing the empirical basis for the titular claim of the landmark 1989 book by Brint and Karabel, *The Diverted Dream*.[6] By contrast, I find evidence of democratization for both the junior college openings (1920-1940) and the community college openings (1945-1980).[7]

[5]See Clark, B. (1960) and Medsker (1960).

[6]Brint & Karabel (1989). *The Diverted Dream: Community Colleges and the Promise of Educational Opportunity in America, 1900-1985.* See p. 130-131 for a summary of the evidence.

[7]The results in this paper are for two-year public college openings taking place in higher education 'deserts' (locations at least 25 miles from the nearest college). The democratization/diversion effect of a two-year public college may be different when another college is nearby.

In the years since the publication of *The Diverted Dream*, researchers have addressed the question of democratization/diversion for community colleges in the modern period (1980-present) with increasingly sophisticated methodology and found mixed results. One set of papers finds evidence of democratization (Rouse (1995), Gill & Leigh (2003), Mountjoy (2021)), while another set of papers (Doyle (2009), Reynolds (2012)) finds evidence of diversion. The two-year public college evolved substantially over the course of the

Men in the junior college openings treatment group were about one percentage point more likely to have a professional occupation, with no detectable effect for towns beyond five miles from the opening. The treatment group was about one-percentage point more likely to have never married by the time of the 1940 Census (when the study population was age 25-45). I also find a treatment effect of the junior college openings on assortative marriage: conditional on being married, the college attainment of the spouses of men in the treatment group increased by about 4-5 hundredths of a year, about half the magnitude of the effect on their own college attainment. There is no detectable effect on assortative marriage for towns beyond five miles of the opening.

Finally, I find that the treatment group for the postwar community college openings lived 0.1 to 0.5 years longer on average, although the estimates are somewhat imprecise. The effect on longevity is confined, like the college attainment effect, to men and women whose childhood town was within five miles of a college opening and is larger for men than women. Taken at face value, the point estimates imply large effects of the community college openings on lifespan, considerably larger than the ordinary least squares relationship between years of college and years of lifespan. The estimates are imprecise, however, such that the 95% confidence interval (for the instrumental-variable effect of years of college on years of lifespan) contains values as small as 0.5 years of lifespan per year of college. These results support the causal effect hypothesis, that the strong correlation between college attainment and longevity reflects (at least in part) a substantial positive causal effect of college attainment on longevity.

The rest of this paper is organized as follows. Section II contains historical background information on the junior and community colleges. Section III is a case study of the opening of Tyler Junior College. In Section IV, I explain the research design, data sources and how I am geocoding and linking the Census and Social Security datasets in order to carry out the research design. Section V contains the results, and Section VI is the conclusion.

20th century (Cohen et al., 2014), such that conclusions about democratization or diversion in the modern era may not apply to earlier eras.

2 Historical Context

> *We can look upon the junior college movement which is now spreading throughout the United States as the most wholesome and significant occurrence in American education in the present century.*
>
> Ray Lyman Wilbur[8]
> President of Stanford University
> 1927

The 1920s and 1930s saw the openings of about 200 public colleges in the United States. Figure 1 is a map of the public college openings in the 1920s and 1930s along with the public colleges already in existence by 1920. Nearly all of the public colleges that opened were two-year ('junior') colleges, defined as:

> ...[A]n institution offering instruction strictly of collegiate grade. This curriculum may include those courses usually offered in the first two years of the four year college; in which case these courses must be identical, in scope and [thoroughness], with corresponding courses of the standard four year college.[9]

Between 1920 and 1940 enrollment at U.S. public junior colleges increased twenty-fold, from about 5,000 in 1920 to over 100,000 in 1940. Most of these colleges survive to this day, with many becoming community colleges and many others four-year public colleges.[10] I have collected this dataset—of pre-existing public colleges and 1920-1940 public college openings—from a number of contemporaneous national and state-specific sources and have hand-geocoded the exact locations of the colleges.[11]

A number of historical factors have been identified as leading to this wave of public two-year college openings in the 1920s and 1930s. One major factor was the enthusiastic support of existing four-year colleges in several states such as California, Illinois, Missouri, Minnesota and Texas. Such support was necessary for ensuring that courses taken in a junior college would count for credit at the four-year colleges. This support arose from rapidly growing enrollments and overcrowding at these four-year institutions, as well as a

[8] See Proctor, W. M. (1927). *The Junior College: Its Organization and Administration.* p. ix-x.

[9] *Report of the American Association of Junior Colleges in Annual Session* (1922), as quoted in Witt et al. (1994), p. 79.

[10] In this paper I distinguish between 'junior colleges' and 'community colleges' in the following way. The junior colleges were two-year public colleges operating between 1900 and 1940 that were for the most part upward extensions of public high schools with a curriculum dominated by the liberal arts. The community colleges in this paper are two-year public colleges operating during the postwar period (1945-onward) that were largely independent of public high schools and had a curriculum that was substantially vocational.

[11] See Section 4.2.

conviction on the part of university administrators that the freshman and sophomore years of college were more secondary in nature than collegiate. Another factor was growing demand on the part of parents and students for public junior colleges. This demand was partly a matter of major reductions in cost of attendance, partly of enabling students to attend the first two years of college while living at home under parental influence, and partly of broadening access to college to students who were not fully qualified for admission to the four-year colleges.[12]

The typical public junior college was a locally-controlled and funded upward extension of a high school. It required for its opening a vote of the local school board, a petition signed by a pre-specified share of local residents and a majority vote in a local election.[13] The president/principal of the typical junior college cited the following reasons for the college's founding: "popularizing higher education" and "continuing home influence [of parents on their children] during immaturity."[14] The typical junior college enrolled a student body of about 250 students that was split evenly by gender.[15] Most students had lived in the local school district as children and were 18-19 years of age as freshmen.[16] The curriculum of the typical junior college was dominated by liberal arts courses and taught by 17 faculty members, many of whom had graduate training in their field.[17] The opening of the typical junior college reduced the cost of attendance for local men and women by a factor of four, charging about $75 for annual tuition and offering no room or board to students.[18]

The landmark 1947 Report of the President's Commission on Higher Education ("Truman Commission") stated that:

> The time has come to make education through the fourteenth grade available in the same way high school education is now available...To achieve this, it will be necessary to develop much more extensively than at present such opportunities as are now provided in local communities by the 2-year junior college...such community colleges probably will have to carry a large part of the responsibility for expanding opportunities in higher education.[19]

[12]For more information on the historical factors leading to the wave of public junior college openings in the 1920s and 1930s, see McDowell (1919), ch. 1-3, and Brint & Karabel (1991), ch. 2.

[13]See Clement & Smith. (1932). *Public Junior College Legislation in the United States.* College of Education, University of Illinois, 1932. Ch. 3.

[14]See Appendix Figure 1. "Popularizing higher education" is defined as "lowering of the cost of [higher] education or bringing it nearer to the home of the student."

[15]See Appendix Table 3.

[16]See Appendix Figure 2 and Table LX in Koos (1924).

[17]See Koos (1924), Table VI and Appendix Table 3.

[18]See Appendix Figure 3 and Appendix Table 3.

[19]Zook, George F. (1947). *Higher Education for American Democracy: a Report of the President's Com-*

In the decades following the Second World War, there were both large expansions in the facilities of existing public colleges as well as a vast increase in the number of public colleges. Figure 3 is a map of the postwar college openings as well as colleges that were already in existence in 1945 (including public and private, two- and four-year colleges). Figure 4 is a line graph showing the number of colleges over time for each type of college. The majority of openings in the postwar period, over 700, were two-year public colleges, with the fastest period of growth being between 1960 and the early 1970s.[20] By 1958, one out of three freshmen in public colleges were enrolled in two-year public colleges,[21] and by the late 1960s new two-year public colleges were opening at a nationwide rate of five per month.[22] By 1968 a two-year public college had opened in every state except Nevada.[23]

Whereas the 1920-1940 wave of junior college openings was mostly a matter of local funding and initiative, state governments played a major role in funding and controlling the new two-year public colleges in the postwar period. States' plans were "simultaneously efforts to respond to demand, to expand access, and to coordinate public higher education along the lines of a hierarchically segmented system...".[24] While the 1920-1940 junior colleges were mostly upward extensions of public high schools with a curriculum dominated by the liberal arts, in the postwar period most community colleges were independent of high schools and 30-40% of the curriculum was vocational. Moreover, the family background of students attending the junior colleges was largely middle class, in contrast to the majority of students enrolled in the postwar community colleges, who were of working-class background.[25] Very few non-traditional students enrolled at two-year public colleges until the late 1960s and 1970s, which saw a major increase in the willingness of students to enroll at ages later than their early 20s, particularly among men.[26]

mission on Higher Education. Washington: U.S.G.P.O. Vol. 1, p. 37.

[20]For the purposes of this research project I exclude for-profit colleges. For more information on how I created this dataset see section 4.1.

[21]See Medsker (1960), p. 13.

[22]See U.S. Bureau of the Census. (1975). *Historical Statistics of the United States, Colonial Times to 1970*. p. 382.

[23]See Medsker & Tillery (1971), p. 24-25.

[24]Specifically, state plans in New York, Pennsylvania, Washington, and Georgia. See Brint & Karabel (1991), p. 72.

[25]See Brint & Karabel (1991), p. 74.

[26]For more information on how the two-year public college in the U.S. has evolved through the twentieth century, see Cohen et al. (2014). *The American Community College*. Ch. 1.

3 The Opening of Tyler Junior College: A Case Study

As a complement to the main (nationwide) analysis of the effects of the college openings I present a case study of the opening of Tyler Junior College. Using linked high school and college enrollment information, I obtain evidence on how the opening of Tyler Junior College affected college enrollment decisions for local men and women of different ages and locations at the time of the opening.

One hundred miles southeast of Dallas, the city of Tyler in 1920 was home to 12,085 residents. The 1920s were a decade of economic transition: long based on cotton, the local economy diversified to include truck farming and fruit orchards (by 1920), roses (by the mid-1920s) and then oil (by the mid-1930s).[27] By the early months of 1926 the Tyler Board of Education had found itself under increasing pressure from Tyler citizens to consider opening a junior college.[28] The cost of attending the University of Texas (at Austin), the main four-year public college in Texas, was about $600 per year, most of which covered room and board.[29] By contrast it would cost $150 annually to attend Tyler Junior College, with no out-of-pocket costs for room and board as students would live at home and commute. There was also concern about overcrowding and high student-teacher ratios at the University of Texas and the potentially adverse consequences on the quality of instruction. Furthermore, unlike the University of Texas, a new junior college would serve every student regardless of class rank, as long as they could benefit from attending.[30] Actuated by these concerns, citizens of Tyler supported the opening of Tyler Junior College not only politically but financially, through $15,000 worth of financial guarantees and $6,000 of funds raised for equipment and to establish the college library. This support proved sufficient to enable the opening of Tyler Junior College in September of 1926.[31]

[27] See Glover & Cross. (1976). *Tyler & Smith County, Texas: A Historical Survey.* Chapter VI.

[28] An anonymous letter to the editor of the *Tyler Courier-Times* on January 29th, 1926, suggested the establishment of a public junior college in Tyler ("'Citizen' Suggests Junior College for our City"). On February 15th, 1926, the Board of Education of Tyler Public Schools first discussed the possibility of opening a junior college (See Cross & Glover. (1985). *A History of Tyler Junior College*, p. 7). See also Ballard, R. (1971). Chapter 2: "Early History of Tyler Junior College."

[29] There were no other public colleges within commuting distance from the city of Tyler. Tyler Commercial College was a private, vocational college in Tyler that did not offer academic/university transfer courses.

[30] During the 1920s only students from the top 25% of their high school classes were assured of acceptance at the University of Texas. See "Mass Meeting About the Junior College Movement Tonight." (1926, May 25). *Tyler Courier-Times.*

[31] For more information on the founding of Tyler Junior College, see Ballard, R. (1971). *Tyler Junior College: Its Founding, Growth and Development.* [Unpublished doctoral dissertation]. East Texas State University.

An upward extension of Tyler High School (THS), Tyler Junior College remained closely connected to THS for the first two decades of its existence. The two institutions shared a building, a chief executive, faculty and tax revenue. Part of the THS building was designated as TJC and the superintendent of THS doubled as the president of TJC. Most TJC faculty also taught THS courses, and TJC was funded in part from the same tax revenues as THS. It was not until 1948, when TJC moved to its own building, that it realized a much greater degree of independence.

The Tyler Junior College curriculum included "standard college courses in English, history, economics, mathematics, chemistry, biology, public speaking, home economics, Spanish, French, music, education, and engineering drawing."[32] Appendix Figure 4 is a timeline of courses offered at Tyler Junior College between 1926 and 1940. Liberal arts courses dominated the curriculum, particularly before the addition of eight business courses in the late 1930s. This curriculum was taught by a junior college faculty whose members had in most cases attained master's degrees in their fields.

Students were admitted to TJC without conditions if they had completed fifteen high school credits in prescribed subjects, while admission by examination was an option for those with fewer than fifteen credits.[33] Initial (end-of-year) enrollment was 75 students in 1926-1927, a number that rose to 96 students by 1939 (see Appendix Figure 5). In terms of geography, about 81% of students in the early years came from the city of Tyler, with a total of 11% coming from elsewhere in Smith County, another 1% coming from other regions of Texas and another 1% coming from beyond Texas state lines (see Appendix Figure 6). Over time an increasing proportion of students matriculated from beyond the city of Tyler.

One very important question for my analysis is whether newly-opened colleges such as TJC enrolled students who would have otherwise forgone attending college. In other words, did the opening of TJC in 1926 create a major college access differential by age? There are good *a priori* reasons to think that the opening of TJC created such a differential. As previously noted, the cost of attendance at TJC was lower by a factor of four compared with the University of Texas, and admission to the University of Texas was assured only to students finishing in the top 25% of their high school classes. Moreover, the age distribution of junior college students in the 1920s was narrowly concentrated around ages 18 and 19.[34]

[32]Tyler Junior College Catalog, 1927-1928, "Curriculum."
[33]Tyler Junior College Catalog, 1927-1928, "Requirements for Admission."
[34]See Koos (1924), Table LX.

This readily available evidence, however, is not conclusive. In what follows, I link individuals from each 1920s class of THS graduates to enrollment records of Texas colleges, obtaining further evidence on whether in fact the opening of TJC created a major college access differential by age.

I start by digitizing the following information from the 1920-1935 yearbooks of Tyler High School (THS) and Tyler Junior College (TJC): first and last name, gender, and academic year.[35] I then link men from each cohort of THS seniors to men found in subsequent TJC yearbooks.[36] Finally, I plot the share of each cohort of THS male seniors who later attended TJC (Figure 5). On average, two percent of each pre-opening cohort later attended TJC, compared with 22% for post-opening cohorts. That is, whether one ever attended TJC is strongly influenced by whether one graduated from THS before or after the opening of TJC, suggesting that TJC did in fact create a major college access differential by age.

It is possible that the opening of TJC merely changed the institution that THS graduates attended, without substantially increasing the rate of attending college.[37] I gather evidence about this possibility by obtaining the annual 'registers of students' for the 1920s and 1930s published by the University of Texas (at Austin), Texas A&M, and Texas Tech—the three major Texas four-year public colleges in the 1920s and 1930s.[38] I then link male students from each cohort of THS seniors to the students from Tyler who subsequently attended these three four-year colleges. Finally, I plot (Figure 5) the share of each THS cohort who attended any of the three public four-year colleges as a freshman or sophomore. On average, the share of each cohort who attended a four-year public college as a freshman or a sophomore is roughly the same before and after the opening of TJC. Moreover, the share attending any of these four colleges–TJC, University of Texas, Texas A&M, or Texas Tech—as a freshman or a sophomore rises by about 20 percentage points after the opening of TJC. That is to say, the opening of Tyler Junior College created a major college access differential by age among students graduating from Tyler High School.

[35] I plot the number of students enrolled at THS and THC by year in Appendix Figure 5.

[36] See Appendix Figure 7 for an illustration of the linkage procedure. I am able to link about 70% of men from each year of TJC enrollment back to a Tyler High School senior—see Appendix Figure 8.

[37] Under this scenario the opening of TJC could still have increased access to college in a different way—by making the first two years of college far less expensive and enabling students to allocate the savings to their third and fourth years of college.

[38] The registers of students contain the following information for each enrolled student: name, hometown, and year (freshman, sophomore, etc). For all of these registers, I have digitized the information for all students whose hometown is listed as 'Tyler, Texas.' I plot the number of such students by academic year and college in Appendix Figure 9.

4 Data and Empirical Strategy

4.1 Data Sources

My analysis requires data of three kinds: Census and Social Security Administration datasets, college openings data and geographic information. Of the first kind are three decennial U.S. Censuses (1920, 1940, and 2000), the Social Security Numident dataset ('Numident'), and the 2001-2015 American Community Survey (ACS). For the junior college openings I use the 1920 Census to observe one's childhood town/township of residence, from which I calculate the distance in miles to the nearest college. The 1940 Census enables me to observe one's educational attainment, labor market, and family formation outcomes in one's 30s. I use the 2000 Census and the 2001-2015 ACS to observe educational attainment for those affected by the postwar openings. Numident—which contains a record of every person who has ever received a Social Security number—provides information on date of birth and city/town of birth, with which I calculate the distance from one's town of birth to the nearest college. The variable 'date of death' in Numident enables me to calculate the lifespan of those affected by the college openings. See appendix A1 for more information on the Census datasets, the ACS and Numident.

The second kind of data concerns college openings. For my analysis I have compiled a dataset containing the locations of colleges in the United States for each year between 1920 and 1996. Figure 1 illustrates the U.S. public colleges that opened between 1920 and 1940 as well as those that were already in existence by 1920. Figure 3 illustrates the same for the period 1945-1985. I collated information on the junior college openings from a number of contemporaneous national and state-specific sources. My main source for the postwar openings is the 1996 Integrated Postsecondary Education Data System (IPEDS) dataset, supplemented by the 2009 IPEDS dataset (for the latitude and longitude of many of the colleges) and the 1984 Higher Education General Information Survey (HEGIS) dataset (for information on the year coursework was first offered). As far as possible, I have geocoded the exact location of the college; When not possible, I have geocoded the college's town of location. See Appendix A2 for more information on the creation and nature of the college openings datasets.

The third kind of data is geographic. In order to calculate the main treatment variable for my analysis (the distance to the nearest college from one's childhood town at the

time one was college-age), I have geocoded as many towns and townships as possible in the 1920 and 1940 Censuses and in Numident. To this end, by far the most important geographic data source is the Geographic Names Information System (GNIS), a national dataset of geographic entities compiled from existing U.S. government maps and supplemented by state and local maps and a variety of historical documents. In addition to the GNIS, I also make use of the Public Land Survey System (PLSS), as well as Census Bureau state- and county-level maps of minor civil divisions relevant for the 1920 and 1940 Census. See Appendix A3 for more information on the sources of geographic information.

4.2 Geocoding and Record Linkage Procedures

For the purposes of my analysis, I have developed algorithms to geocode as many towns and townships as possible in the 1920 and 1940 Censuses using the Geographic Names Information System (GNIS), the Public Land Survey System (PLSS), and Census Bureau state- and county-level maps of minor civil divisions relevant for the 1920 Census. Figure 6 contains a map of all geocoded 1920 towns and townships, and Appendix Figure 10 contains the share of geocodes obtained through each data source, both for the 1920 Census overall and for the subset of counties near a college opening. I obtain 82.6% of geocodes through matching towns and townships by name to the GNIS. I obtain an additional one percent by matching to the PLSS, and another 6.5% by hand-geocoding towns/townships located near a college opening, a process that involves georeferencing 98 historical Census Bureau maps of minor civil divisions. In all, I am able to geocode 90.2% of all 70,756 towns and townships in the 1920 Census, and 99.1% of all towns and townships that are located near a college opening. The additional hand-geocoding of 5,926 towns and townships, by means of georeferencing 98 Census maps, ensures that the results are nationally representative.[39] In a similar manner I have geocoded as many towns and townships as possible in the 1940 Census.

When it comes to geocoding 'place of birth' in Numident, I adapt an algorithm by Bailey et al. (2016) that geocodes individuals from Numident to their county of birth. My adapted algorithm assigns individuals to the latitude and longitude of their 'place of birth.' Approximately 140,000 places of birth can be geocoded using this adapted algorithm. For

[39]In particular, Figure 6 shows that most of the hand-geocoded towns/townships are located in Texas and Mississippi, two states with a large number of junior college openings.

more information on the procedure by which I geocode the 1920/1940 Census and Numident, see Appendix B.

I create the datasets for my analysis by linking individuals across Census and Social Security administration data. If the 1920 and 1940 Census both contained the same unique identifier (such as Social Security number), then this identifier could be used to link individuals unambiguously from the 1920 to the 1940 Census. As neither Census includes any such unique identifier, one must instead rely on combinations of non-unique variables—in this case, 'first name,' 'last name,' 'state of birth,' 'year of birth,' and 'gender.' A number of methods have recently been developed and used to link the 1920 to the 1940 Census (Abramitzky et al. (2019), Helgertz (2020)). I use five available methods—four from the Census Linkage Project and one from IPUMS—and find that the results of this paper are substantially the same regardless of the linkage method used. The linkage method underlying the results in this paper is the Abramitzky-Boustan-Eriksson "ABE" linkage method.

I also link Numident to the 1940 Census to observe location of residence in 1940 (for those born before 1940). This linkage was carried out by Masey et al. (2018) and the resulting crosswalk from Numident to the 1940 Census has been made available to researchers at the Census Bureau. Finally, I link Numident to the 2000 Census and the 2001-2015 American Community Survey, in both cases using crosswalks provided to researchers by the Census Bureau.

4.3 Imputation of Missing Dates of Death

Numident contains date of death information for only about half of the postwar community college openings study population (born between 1921 and 1951). Many of those for whom date of death is missing are still alive in 2021; the rest are deceased and the dates of death were never recorded by the Social Security Administration. Numident date of death information is highly comprehensive for deaths occurring in 1973 or later.[40] Accordingly, one can impute missing dates of death using the following procedure. If date of death is missing and the person is alive in the year 2000, it can reasonably be inferred that the person is still alive in 2021. On the other hand, if a person's date of death is missing and he is no longer alive in the year 2000, then it can be reasonably inferred that the person died before the year 2000 and therefore likely before 1973. I use the full count 2000 Census—which has been

[40] See Finlay & Genadek (2021), Figure 1.

linked to Numident at very high linkage rates for the relevant age groups[41]—to implement this date of death imputation procedure, which is summarized in Appendix Figure 11.

4.4 Research Design

The basic empirical specification is a two-way fixed effects model, given by the following regression equation:

$$Y_{iyc} = \beta_1 AgeDist_{yc} + \Sigma_y \beta_{2,y} BirthCohort_y + \Sigma_c \beta_{3,c} Town_c + \epsilon_{iyc} \quad (1)$$

The treatment variable is an indicator for both the distance from one's childhood town to the nearby college opening and one's age group at the time of the opening (e.g., 0-2.5 miles from the college opening and age 10-21 at the time of the opening).[42] One set of fixed effects are for childhood town, which ensure that the estimated treatment effect will be orthogonal to any fixed characteristics of one's hometown (e.g., a town's long history of supporting public education). The second set of fixed effects are for each childhood-county-by-birth-year, which ensure that the estimated treatment effect will be orthogonal to any trends over time in the outcome at the county, region, state or national level (such as a county-wide increase in funding for elementary school).

Using this two-way fixed effects model, the results in this paper have a causal interpretation under the assumption of conditional mean independence:

$$E(\epsilon|DistAge, BirthCohort, Town) = E(\epsilon|BirthCohort, Town) \quad (2)$$

That is, conditional on one's birth cohort (or childhood-county-by-birth-year) and childhood town, one's age at the time of the local college opening was as good as randomly assigned. This assumption is also known as 'exchangeability', and captures the idea that in a natural experiment the treatment and control groups should be otherwise similar (or 'exchangeable'). While this assumption of exchangeability cannot be directly tested, one can obtain evidence on its plausibility. This assumption would be implausible given evidence that the treatment

[41] See Appendix Table 5

[42] Over the course of the twentieth century 'college-age' has come to include older ages. For that reason, I use age 21 as the college-age cutoff for the junior college openings and age 25 for the postwar community college openings.

and control groups were substantially different in some way relevant to the outcome: for example, if treated men and women had substantially greater aptitude for college or had parents who were substantially wealthier or better-educated on average.[43]

Others have used research designs that involve one's proximity to the nearest college as a natural experiment (Card (1995), Kling (2001), Currie & Moretti (2003)). See Appendix C for more information on the relationship between previous such research designs and the research design for this paper.

[43] I use covariate balance regressions, event study analyses and the case study of Tyler Junior College for evidence on whether the exchangeability assumption is reasonable.

5 Results

5.1 Summary Statistics

The first three columns of Table 1 contain summary statistics for the junior colleges study population. Every person in the study population is male. The typical person was born in 1908, is white, and completed four-tenths of a year of college (by 1940). In 1940, five percent of the study population has a professional occupation, 29 percent has never married (as of 1940), and among those married in 1940, the mean years of their spouse's college attainment is 0.3. The overall sample size for the junior colleges study population is 6.6 million, and the size of the event study sample—those whose childhood town was brought within 2.5 miles of a public college by a junior college opening—is about 100,000. Appendix Table 1 contains more detailed summary statistics for the junior colleges study population.

The second three columns contain summary statistics for the community colleges study population. This study population is split evenly by gender. The typical person was born in 1937, enrolled in Social Security at age 17 (see Appendix Table 2), and attained about 1.2 years of college. Three-quarters of the study population survived to at least age 65. Eleven percent have dates of death that are left-censored at 1972, and 38 percent have dates of death that are right-censored at the year 2020. The overall sample size is about 81 million people, but the subset most affected by the openings—those whose childhood hometown was brought within 5 miles of the nearest college by a two-year public college opening—contains about one million people, 23 percent of whom have an educational attainment observable in the 2000 Census or the 2001-2015 American Community Survey. Appendix Table 2 contains more detailed summary statistics for the community colleges study population.

5.2 Covariate Balance Regressions

Appendix Tables 6 and 7 are the covariate balance tables for the junior college openings. There is no evidence of an 'effect' of the treatment variable on a range of family background outcome variables, including measures of father's occupation and indicators of whether one's parents and grandparents were born in the United States (Appendix Table 6). After controlling for these family background variables, the main estimates change by about 5% or less (Appendix Table 7). These results provide support for the assumption of

exchangeability: that the treatment and control groups are similar (in all ways relevant to the outcomes of interest) except for their treatment status.

Appendix Table 8 is the covariate balance table for the postwar community college openings. The sample is restricted to men and women whose educational attainment is observed in the 2000 Census or the 2001-2015 American Community Survey and for whom both father's and mother's educational attainment is observed in the 1940 Census. In columns 1 and 2, I find that the treatment variable does not predict either mother or father's years of college. In columns 3 and 4, I estimate the treatment effect of the community college openings on years of college and years of lifespan, respectively. In columns 5 and 6, I control for father's and mother's college attainment, and I find that the estimated treatment effect of the college openings changes by about 5% or less. In this way, Appendix Table 8 provides support for the assumption of exchangeability for the community college openings.

5.3 Event Study Analysis

Figure 7 contains four event study graphs for the junior college openings. Each graph displays an outcome variable as a function of one's age at the time of the public junior college opening for men whose childhood town was brought within 2.5 miles of the nearest public college by a junior college opening. The event study graph plots linear regression coefficients in a two-way fixed effects model, with childhood town/township fixed effects and childhood-county-by-birth-year fixed effects. The coefficients are estimated relative to a reference group, those age 31-33 at the time of the college opening. In Figure 7.1, the outcome variable is 'years of college' (as observed in the 1940 Census). Relative to men age 31-33, there is no statistical difference for men age 25-30 or age 34-39 in the mean number of years of college attained. Beginning with those age 19-21 at the time of the opening, there is an increase in completed years of college of about one-tenth of a year for each age category, statistically significant at the five-percent level.[44]

In Figure 7.2, the event study regression is identical except for the outcome variable, which is now an indicator for whether a person completed at least four years of college. This regression is a way of obtaining evidence on whether the junior college openings led to 'democratization' or 'diversion.' Those age 21 or younger at the time of the opening were

[44]In these event study graphs, and indeed throughout all of the results in this paper, the standard errors are clustered at the level of childhood town/township.

1-2 percentage points more likely to complete four years of college—evidence that the college openings led to 'democratization.' In Figure 7.3, there is likewise evidence that the junior college openings led to an increased likelihood (1 percentage point) of having a professional occupation, and in Figure 7.4, a more educated spouse (five hundredths of a year of college on average).

Figure 8 is the postwar (community college) analog of Figure 7. The reference group is those age 32-34 at the time of the opening, and the sample is limited to men and women whose childhood towns were brought within 5 miles of the nearest college by a community college opening. In Figure 8.1, relative to those age 32-34, those 26-28 or younger saw an increase of between five hundredths and one-tenth of a year of additional college attainment. In Figure 8.2, the outcome is now an indicator for completing at least a bachelor's degree, and those 26-28 or younger were 1-2 percentage points more likely to attain a bachelor's degree relative to those age 32-34. The outcome in Figure 8.3 is 'lifespan in years,' with right-censored lifespans projected on the basis of age and gender using the 2019 Social Security life tables. The point estimates in Figure 8.3 show an increase of about three-tenths of a year on average for those in their mid-20s or younger at the time of the opening, although for most age groups the effect is not statistically different from the age 31-33 reference group. In Figure 8.4, the outcome variable is the same ('years of lifespan') but the sample is no longer restricted to those for whom we observe educational attainment and is consequently about four times larger than the sample in Figure 8.3. In Figure 8.4, there is an increase in lifespan of about 0.5 years on average for men and women in their mid-20s or younger at the time of the opening, relative to men and women in the same towns who were age 31-32 when the local community college opened.

5.4 Regression Estimates

In the following regression tables, I keep the same two-way fixed effects model that I use in the event study analysis while consolidating the age-specific indicator variables. In Table 2, the first explanatory variable combines the youngest four age categories from the Figure 7 event study graphs (i.e., ages 10-21), and the omitted/reference category combines the oldest six age categories (ages 22-39). The second and third explanatory variables in Table 3 are identical to the first explanatory variable except that they refer to those whose childhood towns were brought within 2.5 to 5 miles and 5 to 20 miles, respectively, of the

nearest public college by a junior college opening.

The outcome variables in Table 2 are 'years of college' and indicators for completing at least two and at least four years of college. All specifications in Table 2 include childhood town and childhood-county-by-birth-year fixed effects. In column 1, the first coefficient can be interpreted as follows: Among those whose childhood town/township was brought within 2.5 miles of the nearest public college by a junior college opening, being age 10-21 at the time of the opening is associated with about one-tenth of a year of additional college attainment on average relative to those (with the same childhood town) who were age 22-39 at the time of the opening—a 21% increase in college attainment.[45] For those whose childhood town was brought within 2.5 to 5 miles, the magnitude of the effect is about 3.6 hundredths of a year. For towns beyond five miles the effect of the local college opening is not statistically distinguishable from zero.

In column 2 of Table 2, the outcome variable is now an indicator for attaining at least two years of college. Those whose childhood towns were brought within 2.5 miles of a college by an opening were 2.8 percentage points more likely to attain at least two years of college, while for those brought within 2.5 to 5 miles the estimate is 1.0 percentage points. In column 3, the outcome is an indicator for attaining at least four years of college. Those whose childhood towns were brought within 2.5 miles of a public college by a junior opening were 1.3 percentage points more likely to attain at least four years of college, while for those brought within 2.5 to 5 miles the estimate is 0.6 percentage points.

There is a long-running debate, going back to at least 1960, about whether the overall effects of two-year public colleges on college attainment are positive ('democratization') or negative ('diversion').[46] A number of researchers in the 1960s through the 1980s found evidence of diversion, as Brint and Karabel note in *The Diverted Dream* (1991). In the years since *The Diverted Dream*, researchers have addressed the question with increasingly sophisticated methodology and found mixed results. One set of papers, which uses distance

[45] The mean of the dependent variable is 0.44, yielding a percent change of $\frac{0.0927}{0.44} = 21\%$.

[46] See Clark, B. (1960) and Medsker (1960). In this paper I address a narrower version of the question of 'democratization' v. 'diversion' than is sometimes addressed by other researchers with different data sources. I address the question of how access to two-year college affects overall college attainment and four-year degree attainment. Other researchers (with data on enrollment) have also addressed the question of the number of people who are 'diverted' from starting college at a four-year institution by increased access to a two-year institution, as well as the number of people for whom the two-year college democratizes higher education (i.e., who are induced to attend college by increased access to a two-year college but would otherwise not attend college).

from one's high school to the nearest two- and four-year colleges for identification, finds evidence of democratization (Rouse (1995), Gill and Leigh (2003), Mountjoy (2021)). Another set of papers uses propensity score matching and sensitivity analyses (Doyle (2009), Reynolds (2012)) and finds evidence of diversion. Both sets of papers study two-year public colleges in the modern period (1980 onward), and in each case, the key identification assumption is selection (only) on observable variables.

By contrast, the junior college and community college openings in the present paper are part of two earlier eras of the two-year public college in the U.S.: the eras of the junior college (1900-1940) and the comprehensive community college (1940-1980). The two-year public college evolved considerably since its first appearance in Illinois around 1900, and the two-year college in one era may well have had a different effect on overall college attainment than in the other eras.[47]

In Table 2, I control for trends across county birth cohorts in college attainment by using childhood-county-by-birth-year fixed effects. In this way one can rule out any trend (at the county-level or higher) as an explanation for the observed increase in college attainment. Using childhood town/township fixed effects one can also rule out as an explanation any fixed characteristic of individual towns/townships.[48] One cannot, however, rule out in this way an upward trend in college attainment within towns/townships. Elsewhere—in the event study analysis, the covariate balance regressions and the Tyler Junior College case study—I find evidence against this possible explanation.[49]

Columns 4-6 of Table 2 are the postwar community college analog of columns 1-3. In column 4, the effect of the postwar community college openings (for those whose childhood town was brought within 5 miles of a college by a community college opening)

[47]One important difference, for example, is the share of students enrolled in vocational programs, which was very low in the junior college era (1900-1940) and roughly 30-40% in the era of the comprehensive community college (1940-1980), but over 50% in the modern era (1980-present). Another difference is that in the modern era but not the earlier eras, one could enroll in a vocational/occupational program and then transfer with credit to a degree program at a four-year college. See Cohen et al. (2014).

[48]The inclusion of childhood town/township fixed effects in all specifications means that the observed effect is estimated relative to persons with the same childhood town/township; in this way, one can rule out the possibility that the observed increase in college attainment can be explained by any fixed characteristics of the towns/townships near the college openings (or to be more precise, any characteristic of the townships that is fixed with respect to all of a given town's birth cohorts in the study population, the 1895-1915 birth cohorts).

[49]In particular, I find no pre-trend in college attainment across the birth cohorts (those age 22-39 at the time of the local junior college opening), and I also find that there are no differences in family background across the treatment and control groups in covariate balance regressions (See Section 5.2).

is 7.4 hundredths of a year. This estimate is about 80% of the magnitude of the junior colleges estimate in column 1.[50] In column 5 of Table 2, the outcome variable is an indicator for completing at least an associate's degree. The effect of the postwar openings (for those brought within 5 miles of a college by a college opening) is a 1.7 percentage-point increase in the likelihood of completing at least an associate's degree. In column 6, the effect of the postwar openings is a 1.4 percentage-point increase in the likelihood of completing at least a bachelor's degree. Across all six columns in table 2, there is no detectable effect of the college openings for towns beyond five miles from a junior or community college opening.[51]

In Tables 3 and 4, I estimate the reduced-form effect of the junior college openings on mid-life outcomes on the 1940 Census, when the study population is age 25-45. Across all columns of these tables, I keep the right-hand side of specification 1 from Table 2 (that is, the regression with childhood town/township and childhood county-by-birth-year fixed effects), changing only the outcome variable from one specification to the next. I continue to cluster standard errors at the town/township level. The point estimates for the treatment group (for towns within 2.5 miles of a local opening) are plotted in Figures 9 and 10.

In Table 3 the outcome variables are indicators for occupation categories from the 1940 Census. Among those whose childhood town/township was brought within 2.5 miles of the nearest college by a junior college opening, being age 10-21 at the time of the opening is associated with being 1.0 percentage points more likely to have a professional occupation in 1940, 1.3 percentage points more likely to have a farm-related occupation, and 1.0 percentage points less likely to be a 'craftsman, foreman or kindred occupation.' There are three times as many farmers as professionals in the study population, and accordingly the largest effect in percent terms is an increase in professionals of 18% (as opposed to 8% for farmers).[52] At

[50] Comparisons between the estimates must be made with caution, however, as the locations of individuals in the junior colleges study population are observed at age 12 on average but at age 3 on average for the community colleges study population. Accordingly, the attenuation of the coefficients from inter-town childhood migration—between the time one's childhood location is observed and the time one is college-age—will *ceteris paribus* be greater for the postwar openings.

[51] Appendix Table 4 is an expanded version of Table 2 in which I also estimate effects using childhood-SEA-by-birth-year fixed effects instead of childhood-county-by-birth year fixed effects (SEAs are State Economic Areas, groups of counties within states). The results are not substantially different for the junior college openings, and in the case of the community college openings the point estimates for both 0-5 and 5-20 miles fall by about three-hundredths of a year, suggesting that in the case of the community college openings there are county trends in college attainment that are controlled for with childhood-county-by-birth-year fixed effects.

[52] How one should interpret the observed effect on having a farming occupation is not entirely clear. In supplementary analyses, I estimate effects of the junior college openings on joint educational attainment-occupation group outcomes. I find that the observed treatment effect on being a professional is mostly a

the time of the 1940 Census (April, 1940), the U.S. unemployment rate was about 15%. It may be that in better economic times (e.g., at the time of the 1950 Census), the observed effect of the junior college openings would be different.

In Table 4 I estimate the effect of the junior college openings on assortative marriage outcomes. In column 1 of Table 4, I find that the treatment effect of the college openings on the likelihood of being never married is positive, about one percentage point. As the study population was born between 1895-1915—and therefore age 25-45 when I observe them in 1940—this effect could merely be a matter of delaying marriage, not forgoing it. In column 2, the outcome is an indicator for having a spouse that completed at least one year of college, and the sample is restricted to those who were married in 1940. The estimated effect is a 1.6 percentage point increase in the likelihood of having a spouse with at least one year of college attainment. In columns 3-6 the outcomes are indicators for spouse's attainment being zero years of college, 1-2, 3-4, and at least one year of graduate attainment. The estimated treatment effects are -1.6 percentage points for having a spouse with zero years of college, and 0.8 percentage points for having a spouse with 1-2 and for having a spouse with 3-4 years of college. It is possible, given the research design, that the junior college opening is in many cases not changing the person that one marries, but merely changing her college attainment as well as one's own.

In Table 5, I estimate the effect of the postwar community college openings on longevity outcomes. In column 1, the outcome is years of lifespan, in which right-censored lifespans are projected on the basis of gender and age using the 2019 Social Security Administration period life tables.[53] The treatment group—those living in towns brought within 5 miles of the nearest college by a community college opening and age 10-25 at the time of the opening—lived an additional 0.48 years on average. An effect on longevity is not detectable for towns brought within 5-20 miles of the college opening (consistent with the geographic pattern for college attainment in Table 2, column 4). In column 2, the outcome variable is now an indicator for surviving to at least age 55, and the estimated treatment effect of the

treatment effect on the joint outcome of being a professional and having completed at least four years of college. On the other hand, most of the observed effect on being a farmer is an effect on the joint outcome of being a farmer and having completed less than two years of high school. As a rule, one could not enroll in a junior college unless one had completed high school. It follows that the observed effect on being a farmer is not an effect for men who attended junior college. One possible explanation is that the observed effect on having a farming occupation is spurious.

[53]Social Security Administration Period Life Table (2019). <https://www.ssa.gov/oact/STATS/table4c6.html>

community college opening is 0.5 percentage points. For ages 60, 65 and 68, the estimates are 0.77, 1.0, and 1.3 percentage points, respectively. In each case, there is again no detectable effect beyond five miles from the college opening.[54]

In Figure 11, I plot the estimated treatment effects (for towns within 5 miles of a community college opening) on college attainment and longevity by race and gender. The estimate on college attainment in the first row, for white women, is about one-tenth of a year and statistically significant at the five percent level. The point estimates for the three other demographics—white men, black men and black women—are all positive and between 0 and one-tenth of a year, but not statistically different from zero or from the effect for white women. In rows 5-8, the outcome is lifespan in years, and the sample is restricted to those for whom we can observe educational attainment. The point estimates for white men and white women are positive, with that of white men equal to about three tenths of a year and statistically different from zero. The point estimates for black women and men are negative but not statistically distinguishable from zero or from the point estimates for white men and women. In the last four rows, the outcome is again 'lifespan in years,' but this time I estimate effects on the full sample (i.e., without restriction to those for whom educational attainment is observed). The point estimates for black men, white men and white women are positive, with those of black and white men equal to slightly more than 0.5 years and statistically different from zero. Moreover, the effect for white men is statistically larger than the effect for white women. The point estimate for black women is negative but not statistically different from zero or from the estimate for white women.

In Table 6, I estimate the effect of the community college openings on college attainment and on longevity using the education subsample, and I also estimate the ordinary least squares correlation between college attainment and lifespan. The first column of Table 6 is identical to column 4 from Table 2. In the third column, I estimate a treatment effect of 0.3 additional years of lifespan on this education subsample which is 40% smaller than the estimate (0.5) on the full sample (column 1 of Table 5). In column 2, I use an alternative age grouping for the treatment and control groups—ten instead of fifteen years—so that the treatment group are those whose childhood town was within 5 miles of a two-year public

[54]The ages in columns 2-5 (55, 60, 65, and 68) are chosen because they can be estimated without any additional projections of lifespans. One cannot estimate age 50, for example, without making some assumption about left-censored deaths, because men and women born in 1921 with left-censored deaths are age 52 in 1973. Likewise, one cannot estimate an effect for age 70, because men and women born in 1951 were 69 years of age in 2020.

college opening and age 15-24 (inclusive) at the time of the opening, while the control group is analogous, but age 25-35. The estimated treatment effect on education (column 2) is 5.9 hundredths of a year on average, while the estimated treatment effect on lifespan is 0.11 years. The implied instrumental variables (IV) effect of the community colleges on lifespan is therefore 1.9 years (with ten-year treatment and control groups) and 4.1 years (with fifteen-year treatment and control groups). In column five, I estimate the ordinary least squares relationship between college attainment and lifespan, and the estimated association is equal to 0.5 years of lifespan for each additional year of college attainment.

There are at least three possible explanations for this result, that the estimated instrumental variables effect of years of college on years of lifespan arising from the community college openings is considerably larger than the estimated nationwide ordinary least squares association. First, the estimate from the community college openings is for 'compliers': those whose childhood towns previously had no college within 25 miles but which were brought within five miles of the nearest college by a two-year public college opening, and who were induced to attain additional years of college by the college opening. It follows that many of the compliers are men and women who could not afford to go to college but for the opening of the local two-year public college. The compliers stand in contrast to the average college-going individual in the national sample, who has a family background that is considerably better off in terms of parents' socioeconomic status and typically would have lived in a place closer to the nearest college. One important difference between the typical complier and the typical college-going individual is the counterfactual occupation outcome if the person did not attend college. For the compliers, particularly male compliers, it is conceivable that the counterfactual occupation could be much more likely to lead to a relatively short lifespan than for the typical college-educated American male. For example, a complier in the control group may be much more likely to serve in the military, or to have a working-class occupation with an elevated risk of a relatively early death. I am not able to observe occupation or cause of death directly in the available data for the community college openings study population, so I cannot directly test these possibilities.

Second, it could be that the college openings created positive spillovers in terms of lifespan. The ordinary least squares estimate of college attainment on lifespan does not capture positive spillovers because it is estimated at the individual level. By contrast, the community college treatment varies at the level of clusters—those age 25 or younger at

the time of the opening whose childhood towns were within five miles of a two-year public college opening—which means that the IV estimate of college attainment on longevity from the community college openings will capture positive spillovers within these treated clusters. If one's spouse, siblings and/or peers attain additional college, it is conceivable that they could exert an influence on one's own health behaviors that could lead to greater longevity. Lleras-Muney et al. (2020) find evidence that the association between educational attainment and longevity for men is particularly strong in U.S. states (and within birth cohorts in U.S. states) that have greater levels of educational attainment.[55]

Third, some considerable part of the difference between the OLS estimate and the IV estimate could be a result of sampling variability. The lifespan estimates are somewhat imprecise, particularly on the education subsample (the point estimate in Table 6, Column 4 is 0.3, with a 95% confidence interval of [0.0664, 0.5638]), and one cannot rule out IV estimates of considerably less than one year of lifespan for each additional year of college. The imprecise estimates are a result of the fact that the lifespan outcome variable is inherently noisy with respect to educational attainment. Precise estimates of the effect of college attainment on lifespan would require a much larger first-stage effect on educational attainment than is generally observed in related papers—that is, papers evaluating natural experiments to estimate the causal effects of educational attainment using college openings (e.g, Currie & Moretti (2003)) or compulsory schooling laws (Lleras Muney et al. (2005) and others).

Alternatively, the large estimated effect of college attainment on longevity arising from the community college openings may be the result of some other unobserved factor that is varying between the treatment and control groups—that is, some violation of the research design assumption of (conditional mean) exchangeability. In this case, as in the case of any natural experiment, there is some irreducible uncertainty about this assumption. As the locations and dates of the college openings were the result not of random assignment but of political processes at the state and local level, there is no *a priori* guarantee of exchangeability between the treatment and control groups arising from these openings. The research design enables me to rule out exchangeability violations arising from trends at the county level or higher, as well as from any fixed characteristics of one's childhood town. I have also obtained evidence that the exchangeability assumption seems reasonable using covariate balance tables, event study regressions and a case study of the opening of Tyler Junior

[55]See Lleras-Muney, Price, & Yue. (2020). Figures A-9 and A-10.

College. However, if there is some other trend orthogonal to observed family background variables that is varying at the level of towns along with the openings of the postwar two-year public colleges, it could perhaps explain at least part of the estimated effect of the openings on longevity.

A number of recent papers have used natural experiments to estimate causal effects of educational attainment on longevity. One set of papers concerns the effect of additional high school attainment, using changes in compulsory schooling laws as a source of quasi-experimental variation.[56] The magnitudes of the effects estimated in these papers range from 0 to a 6.9 percentage-point reduction in mortality over a ten-year period. There is one published paper that estimates the causal effect of increased college attainment on mortality, using state-level variation in one's risk of being drafted for the Vietnam War (Buckles et al., 2016). The estimated effect of an additional year of college attainment in this case is a 2.6 percentage point reduction in mortality over a 26-year period (starting in one's 30s). Put in comparable terms, my estimate of the effect of one year of additional college attainment is a 6.6 percentage point reduction in mortality between ages 55 and 65. This estimated effect is larger than the estimate from Vietnam draft risk and at the higher end of the range of estimates for compulsory schooling laws.[57]

[56] See Lleras-Muney et al. (2018) for a review of these papers.

[57] These three types of natural experiments—compulsory schooling law changes, variation in the risk of being drafted for the Vietnam War, and community college openings—involve both different types of education (high school, general college, and community college) and different types of compliers. The complier for compulsory-schooling-law natural experiments is the high school student who would drop out at the earliest point permitted by law and only attains additional schooling because it is legally compulsory. In the case of Vietnam draft risk, the complier is a person who is attaining additional years of college solely because he wants to reduce his risk of being drafted for the Vietnam War. By contrast, in the case of local college openings, the complier is a person who is attaining additional years of college because it has been made more affordable. As a result of these differences—the different types of education and the different compliers—it is reasonable to think that the magnitudes of the estimands (the effect of increased educational attainment on mortality that the researcher is seeking to estimate) and hence of the estimates will differ.

6 Conclusion

In this paper I examine the effects of the great expansion of two-year public college in the US between 1920 and 1980. This expansion had two waves: the junior college openings (1920-1940) and the community college openings (1945-1980). Both waves led to about one-tenth of a year of additional college attainment for local men who were college-age or younger at the time of the opening and to 'democratization' and not 'diversion.' The junior college openings led to a higher likelihood of having a professional occupation and a college-educated spouse, and the community college openings led to between 0.1 and 0.5 years of additional lifespan.

The results of this paper rest on the assumption of exchangeability (i.e., the assumption that the treatment and control groups are substantially the same in every respect relevant to the outcomes). As with any natural experiment, there is some irreducible uncertainty about this assumption. I am able to rule out exchangeability violations arising from trends at the county level or higher, as well as from any fixed characteristics of one's childhood town. I have also obtained evidence that the exchangeability assumption seems reasonable, using covariate balance tables, event study regressions and a case study of the opening of Tyler Junior College.

The college openings may have affected a number of important life outcomes that are beyond the scope of this paper. Some relate to education, such as the institution attended and one's area of study. There are also longer-term outcomes, including income, political participation (e.g., propensity to vote), outcomes relating to culture (e.g., religiosity), criminal justice, geographic mobility, as well as inter-generational college attainment and longevity. All of these outcomes are important topics for future research.

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Table 1

Summary Statistics

Junior Colleges (1920-1940) Study Population				*Community Colleges (1945-1980) Study Population*			
Variable	Mean	Std. Dev.	Share Nonmissing	Variable	Mean	Std. Dev.	Share Nonmissing
	(1)	(2)	(3)		(4)	(5)	(6)
Male	1		1	Male	0.51	0.50	1
Birth Year	1908.0	7.1	1	Birth Year	1937.0	9.4	1
African-American	0.06	0.25	1	African-American	0.12	0.33	0.98
Education Outcomes:				*Education Outcomes:*			
Years of College	0.4	1.2	0.98	Years of College	1.2	1.9	0.23
Indicators: Completed...				*Indicators: Completed...*			
At Least Two Years of College	0.12	0.32	0.98	At Least an Associate's Degree	0.23	0.42	0.23
At Least Four Years of College	0.07	0.25	0.98	At Least a Bachelor's Degree	0.19	0.39	0.23
Labor Market Outcomes: Indicator...				*Longevity Outcomes:*			
Professional Occupation	0.05	0.22	0.93	Lived to at Least Age 55	0.84	0.37	1
Private Sector Wage Worker	0.66	0.47	0.94	Lived to at Least Age 65	0.75	0.43	1
				Lifespan (Projected)	74.0	18.8	1
Assortative Marriage Outcomes:				Lifespan Left-Censored	0.11	0.31	1
Indicator: Never Married (as of 1940)	0.29	0.45	1	Lifespan Right-Censored	0.38	0.48	1
Spouse's Years of College	0.30	0.93	0.65				
N (Event Study Sample: Education Subset)		97,795		N (Event Study Sample: Education Subset)		231,000	
N (Overall Event Study Sample)		100,068		N (Overall Event Study Sample)		1,003,000	
N		6,626,090		N		80,950,000	

Notes: The junior colleges study population consists of men born 1895-1915 who can be linked (using the ABE method) to the 1940 Census and whose town/township of residence in 1920 can be geocoded. The community colleges study population consists of the subset of the Social Security 'Numident' Dataset born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence). The junior colleges 'event study sample' is the subset of the study population whose childhood town was brought within 2.5 of the nearest public college by a junior college opening. The community colleges 'event study sample' is the subset of the study population whose childhood town was brought within 5 miles of the nearest college by a community college opening. The 'Event Study Sample: Education Subset' is the subset of the Event Study Sample for which educational attainment is observed.

Table 2

Effect of Two-Year Public College Openings on College Attainment

	Junior College Openings (1920-1940)			*Community College Openings (1945-1980)*		
		Indicator: Attained at Least…			*Indicator: Attained at Least a(n)…*	
	Years of College	Two Years of College	Four Years of College	Years of College	Associate's Degree	Bachelor's Degree
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-21 at Time of Opening	0.0927***	0.0280***	0.0133***			
	(0.0148)	(0.0042)	(0.0030)			
Indicator: ...2.5 to 5 Miles…	0.0360*	0.0099*	0.0064			
	(0.0161)	(0.0045)	(0.0034)			
Indicator: ...5 to 20 Miles…	-0.0055	-0.0014	-0.0002			
	(0.0072)	(0.0020)	(0.0015)			
Indicator: ... Within 5 Miles…Age 10-25…				0.0739***	0.0173***	0.0141***
				(0.0206)	(0.0046)	(0.0042)
Indicator: ... 5-20 Miles…Age 10-25…				-0.0091	-0.0008	-0.002
				(0.0114)	(0.0026)	(0.0023)
Childhood Town FEs	Yes	Yes	Yes	Yes	Yes	Yes
Childhood County By Birth Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Dep. Var. Mean	0.44	0.118	0.0723	1.16	0.232	0.19
Observations	5,276,588	5,276,588	5,276,588	18,300,000	18,300,000	18,300,000

Notes: Standard errors are clustered at the level of childhood town. The junior colleges study population onsists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method developed by the Census Linkage Project. The community colleges study population consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which can be linked to either the 2000 Census long form or the 2001-2015 American Community Survey. The omitted explanatory variable for each junior college distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 40 at the time of the college opening, and for the community colleges the omitted age category is age 26-40. The college openings in this analysis are two-year public college openings that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Table 3

Effect of Junior College Openings on Occupation

	Indicator: Occupation is a…							
	Professional	Semi-Professional	Proprietor, Manager or Official	Craftsman, Foreman, or Kindred Occupation	Operative or Kindred Occupation	Farmer	Laborer	Service Occupation
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a College Opening and Age 10-21 at Time of Opening	0.0102***	0.0002	-0.0025	-0.0103*	-0.0077	0.0137***	-0.0047	0.0011
	(0.0027)	(0.0014)	(0.0045)	(0.0041)	(0.0047)	(0.0038)	(0.0035)	(0.0024)
Indicator: ...2.5 to 5 Miles…	0.0044	0.0009	-0.0034	-0.0117*	-0.0094	0.0113*	-0.0003	0.0081*
	(0.0032)	(0.0018)	(0.0062)	(0.0059)	(0.0064)	(0.0057)	(0.0051)	(0.0033)
Indicator: ...5 to 20 Miles…	0.0007	-0.0016*	0.0039	0.0015	-0.0028	-0.0031	-0.0008	0.0021
	(0.0014)	(0.0007)	(0.0026)	(0.0023)	(0.0026)	(0.0026)	(0.0021)	(0.0014)
Dep. Var. Mean	0.0566	0.0172	0.244	0.155	0.198	0.171	0.109	0.0498
Observations	5,103,458	5,103,458	5,103,458	5,103,458	5,103,458	5,103,458	5,103,458	5,103,458

Notes: All specifications include childhood town fixed effects and childhood county by birth year fixed effects. The underlying dataset consists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 39 at the time of the college opening.

Table 4

Effect of Junior College Openings on Assortative Marriage

			Indicator: Wife Completed…				
	Indicator: Never Married	Wife's Years of College	...At Least One Year of College	...Zero Years of College	...1-2 Years of College	...3-4 Years of College	…At Least One Year of Graduate School
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a College Opening and Age 10-21 at Time of Opening	0.0104*	0.0444***	0.0157***	-0.0165***	0.0078*	0.0080**	0.0006
	(0.0047)	(0.0130)	(0.0046)	(0.0046)	(0.0036)	(0.0029)	(0.0010)
Indicator: ...2.5 to 5 Miles…	0.0112	-0.0158	-0.0004	0.0011	0.0054	-0.0069	0.0003
	(0.0061)	(0.0162)	(0.0058)	(0.0058)	(0.0048)	(0.0037)	(0.0012)
Indicator: ...5 to 20 Miles…	0.0018	-0.0103	-0.002	0.0023	-0.0006	-0.0013	-0.0003
	(0.0025)	(0.0068)	(0.0024)	(0.0025)	(0.0019)	(0.0016)	(0.0005)
Dep. Var. Mean	0.202	0.318	0.121	0.876	0.0688	0.0498	0.00506
Observations	5,409,615	3,941,646	3,927,645	3,941,646	3,941,646	3,941,646	3,941,646

Notes: All specifications include childhood town fixed effects and childhood-county-by-birth-year fixed effects. The underlying dataset consists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 39 at the time of the college opening.

Table 5

Effect of Community College Openings on Longevity

		Indicator: Lived to at Least Age…			
	Lifespan in Years	...55	…60	…65	…68
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-25 at Time of Opening	0.4802***	0.0052***	0.0077***	0.0100***	0.0132***
	(0.0822)	(0.0016)	(0.0018)	(0.0020)	(0.0022)
Indicator: ... 5-20 Miles…	-0.0389	-0.0009	-0.0011	-0.0014	-0.0016
	(0.0556)	(0.0010)	(0.0012)	(0.0015)	(0.0016)
Childhood Town FEs	Yes	Yes	Yes	Yes	Yes
Childhood County By Birth Year FEs	Yes	Yes	Yes	Yes	Yes
Dep. Var. Mean	78.800	0.93600	0.89600	0.83800	0.79400
Observations	72,160,000	72,160,000	72,160,000	72,160,000	72,160,000
Number of Clusters	135,000	135,000	135,000	135,000	135,000

Notes: The underlying dataset consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which has a date of death in Numident or the date of death is right censored in 2020. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 5 miles, and 5 to 20 miles) consists of those who were age 26 to 40 at the time of the college opening. SEAs are the state economic areas, which are groups of counties within states. The college openings in this analysis are those that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Table 6

Effect of Community College Openings on College Attainment and Longevity

First Stage, Reduced Form, OLS

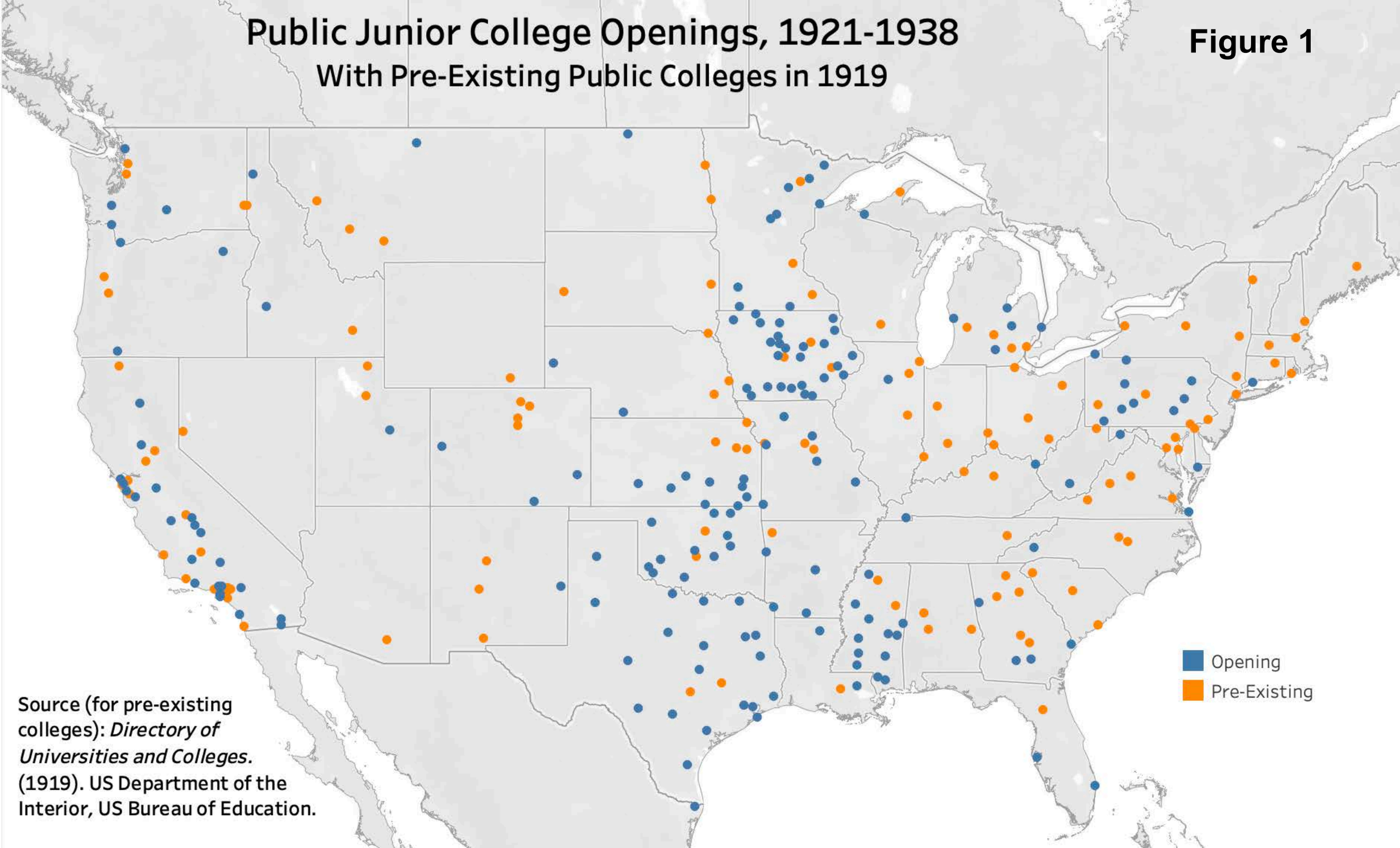
	Years of College		Lifespan in Years		
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-25 at Time of Opening	0.0739***		0.3016*		
	(0.0206)		(0.1200)		
Indicator: ... 5-20 Miles…	-0.0091		0.0542		
	(0.0114)		(0.0818)		
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 15-24 at Time of Opening		0.0586**		0.114	
		(0.0199)		(0.1171)	
Indicator: ... 5-20 Miles…		-0.0069		0.0574	
		(0.0113)		(0.0838)	
Years of College					0.4951***
					(0.0046)
Childhood Town FEs	Yes	Yes	Yes	Yes	Yes
Childhood County By Birth Year FEs	Yes	Yes	Yes	Yes	Yes
Dep. Var. Mean	1.16	1.16	83.0	83.0	83.0
Observations	18,300,000	18,300,000	18,300,000	18,300,000	18,300,000
Number of Clusters	114,000	114,000	114,000	114,000	114,000

Notes: The underlying dataset consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which can be linked to either the 2000 Census long form or the 2001-2015 American Community Survey. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for the 10-25 age category is the 26-40 age category; the omitted explanatory variable for the 15-24 age category is the 25-35 age category. The college openings in this analysis are those that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Public Junior College Openings, 1921-1938

With Pre-Existing Public Colleges in 1919

Figure 1

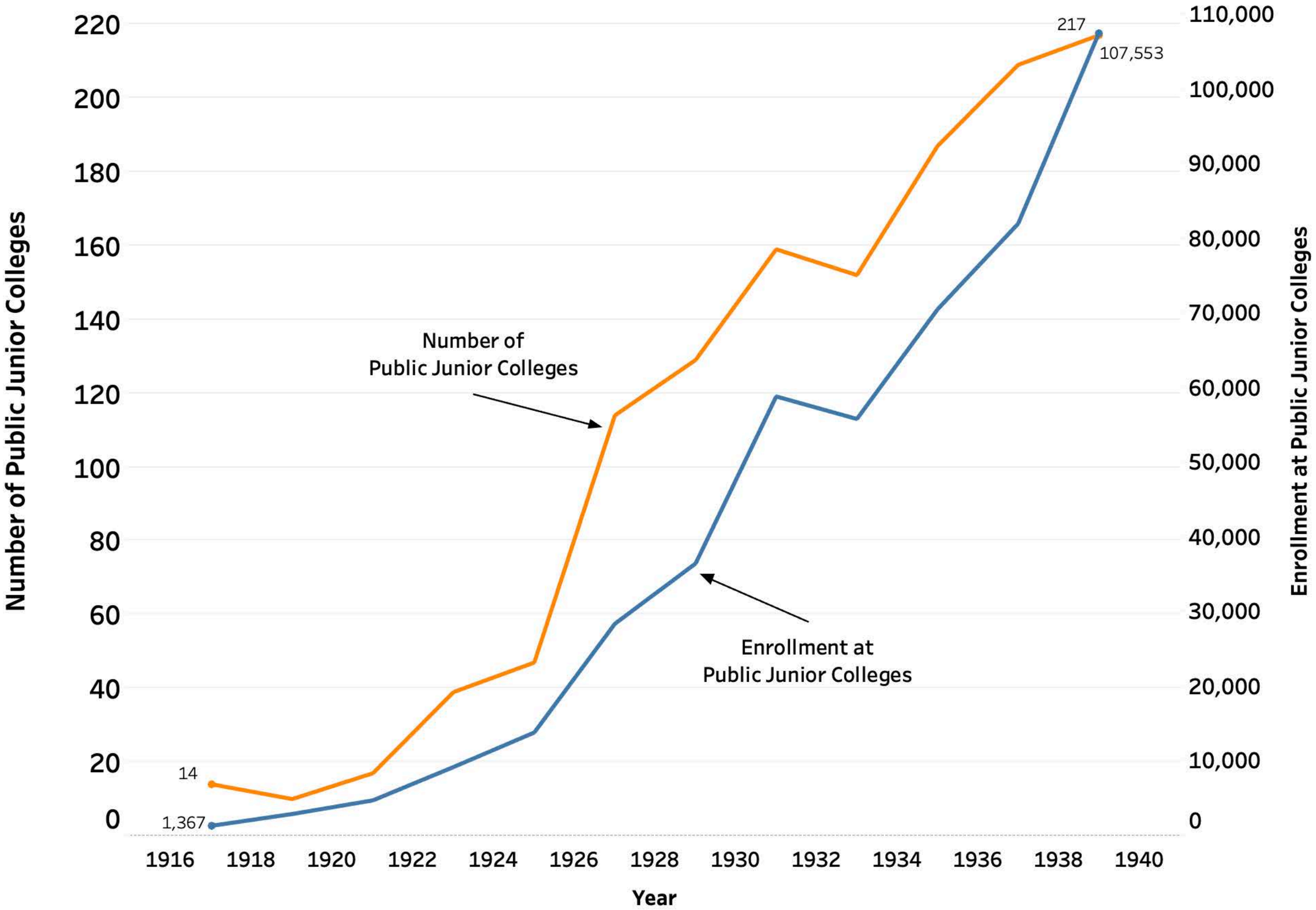


Source (for pre-existing colleges): *Directory of Universities and Colleges.* (1919). US Department of the Interior, US Bureau of Education.

Figure 2

U.S. Junior College Openings, 1917-1940

Number of Colleges and Total Enrollment

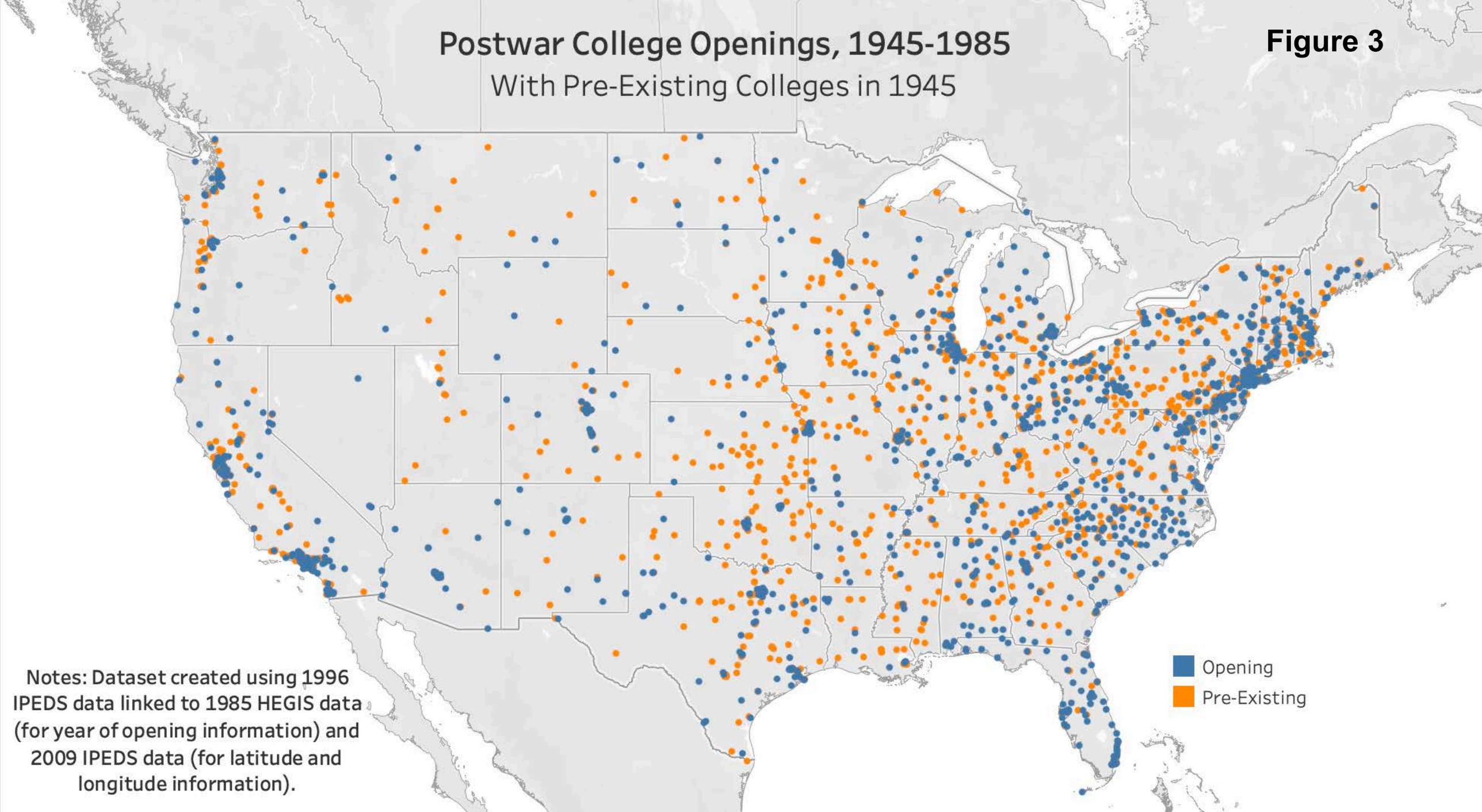


Source: United States Office of Education. Biennial Survey of Education in the United States, 1938-1940: Statistics of Higher Education. Table III, p. 6.

Figure 3

Postwar College Openings, 1945-1985

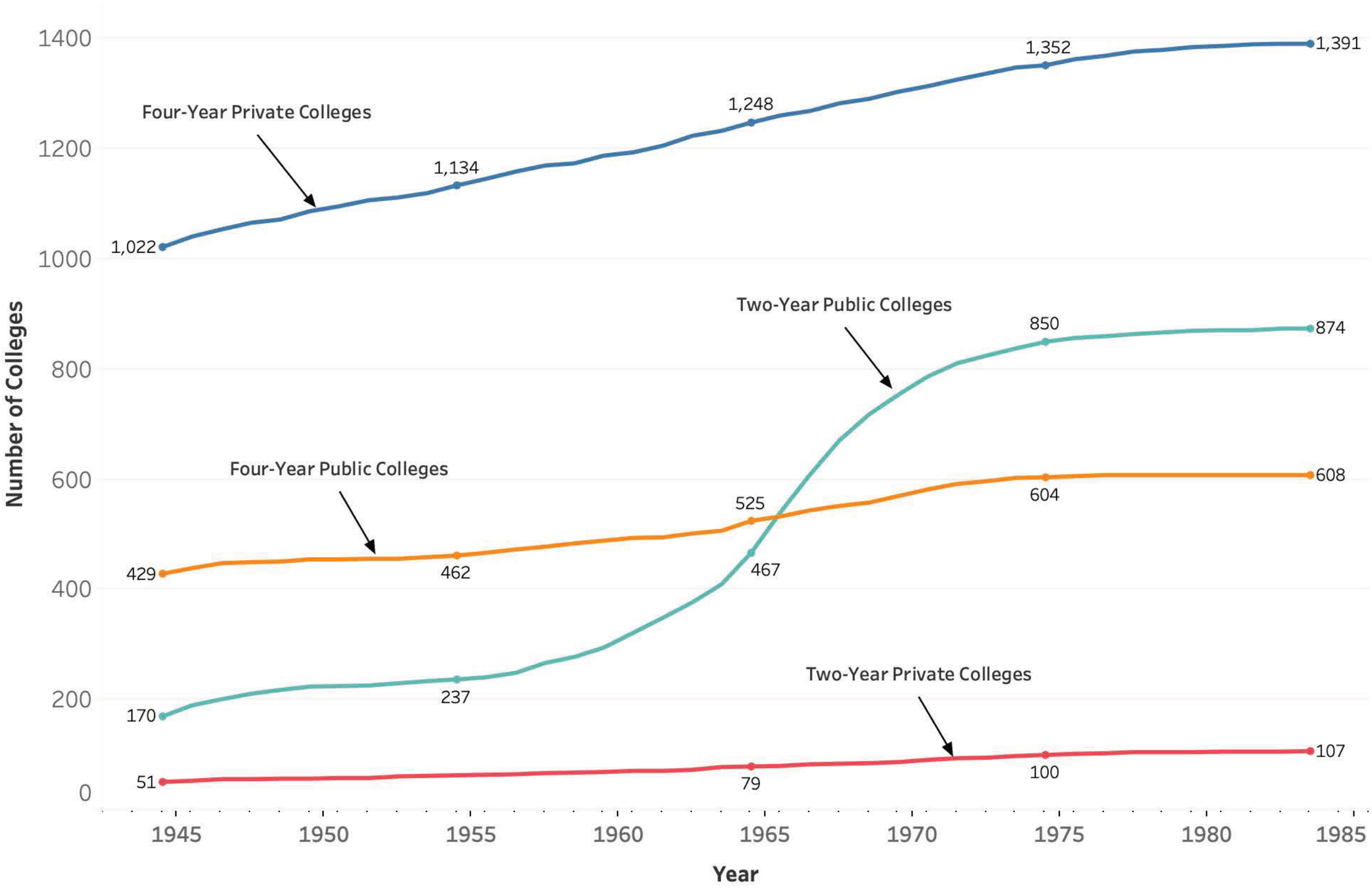
With Pre-Existing Colleges in 1945



Notes: Dataset created using 1996 IPEDS data linked to 1985 HEGIS data (for year of opening information) and 2009 IPEDS data (for latitude and longitude information).

Figure 4

Postwar College Openings By College Type
1945-1985



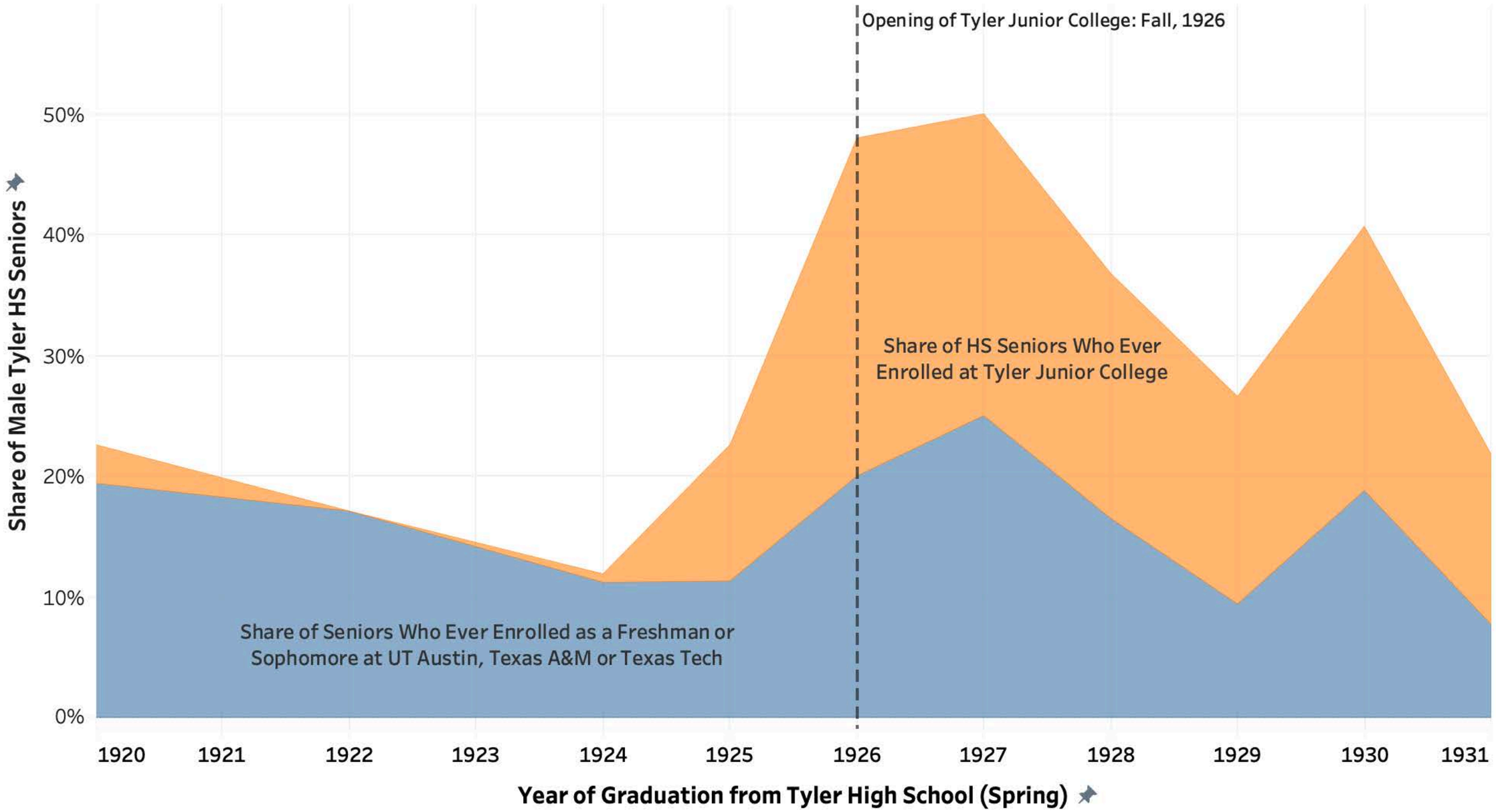
Notes: Dataset created using 1996 IPEDS data linked to 1985 HEGIS data (for year of opening information) and 2009 IPEDS data (for latitude and longitude information).

Did the Opening of TJC Lead to a College Access Differential by Age?

Figure 5

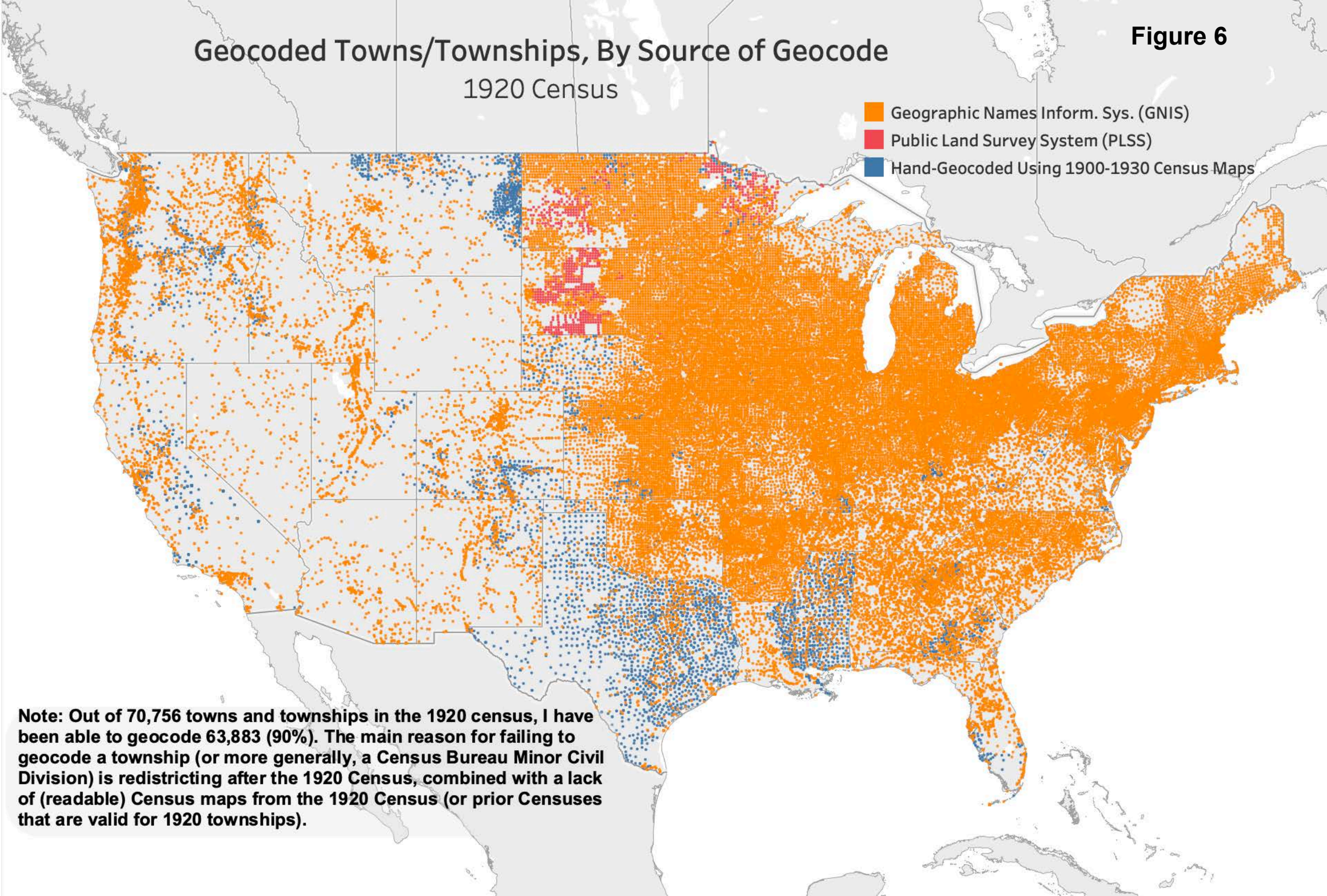
College Enrollment of Tyler High School Seniors

Men, 1920 to 1930



This figure shows the share of male seniors in each Tyler High School yearbook who can be identified as a student enrolled at Tyler Junior College or one of the three major four-year public colleges in Texas in the 1920s: University of Texas at Austin, Texas Tech, and Texas A&M. I obtained the data underlying these results by first computerizing and then linking the names of the individuals in the 1920-1940 yearbooks of Tyler High School and Tyler Junior College and in the annual registers of students at the three four-year colleges. I have not been able to find a Tyler High School yearbook for the academic years 1920-21 or 1922-23. No Tyler High School or Tyler Junior College yearbook was published in 1932-33 (on account of financial hardship arising from the Great Depression) and no register of students was published for Texas A&M for the year 1925-1926.

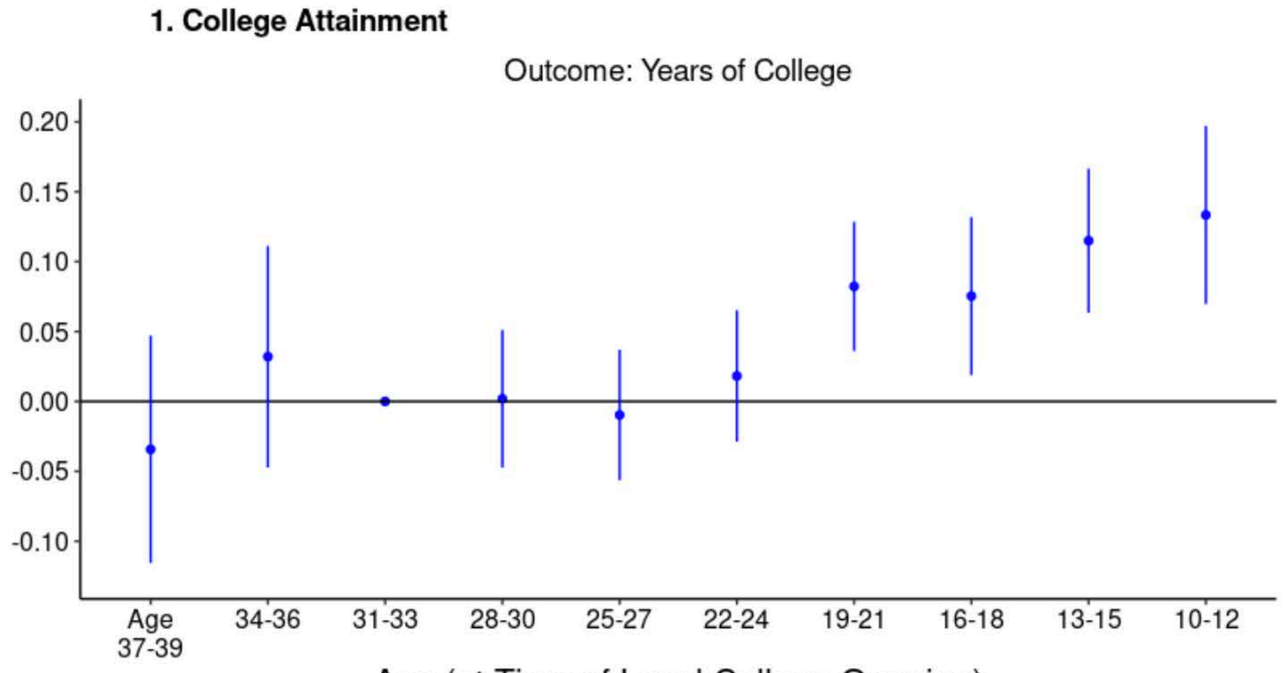
Figure 6

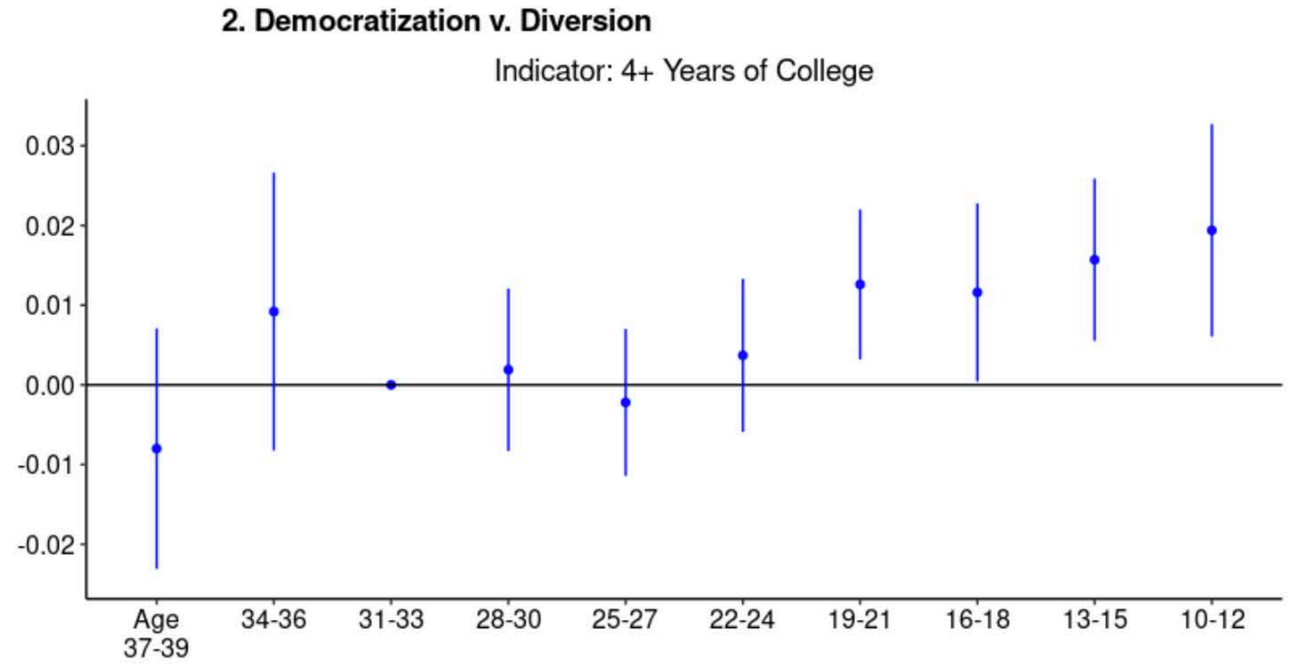

Geocoded Towns/Townships, By Source of Geocode
1920 Census
Geographic Names Inform. Sys. (GNIS)
Public Land Survey System (PLSS)
Hand-Geocoded Using 1900-1930 Census Maps
Note: Out of 70,756 towns and townships in the 1920 census, I have been able to geocode 63,883 (90%). The main reason for failing to geocode a township (or more generally, a Census Bureau Minor Civil Division) is redistricting after the 1920 Census, combined with a lack of (readable) Census maps from the 1920 Census (or prior Censuses that are valid for 1920 townships).

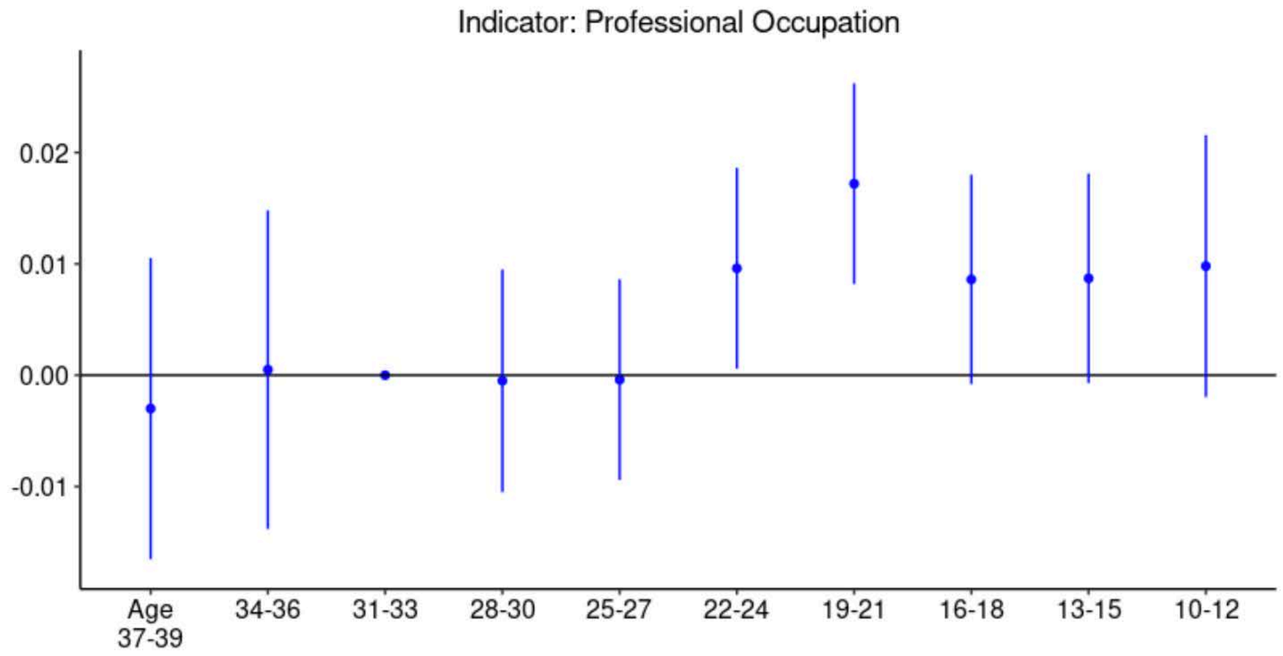
Effect of Junior College Openings (1920-1940) on Mid-Life Outcomes

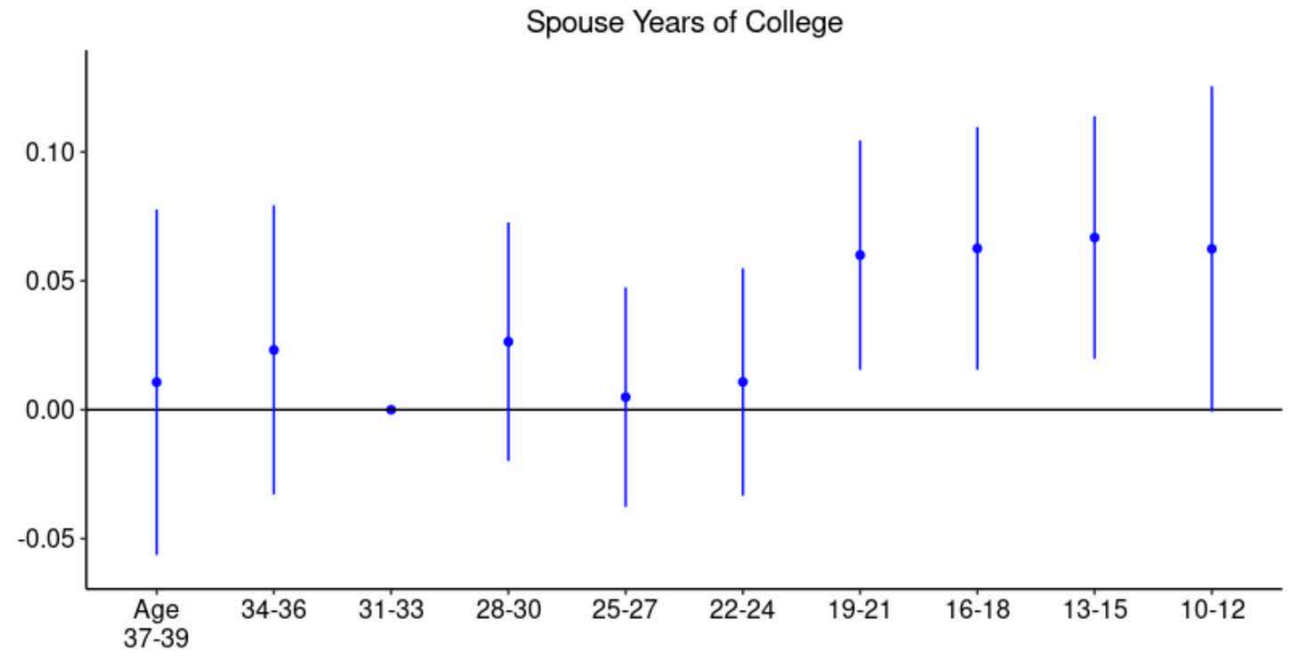
Figure 7

For Men Whose Childhood Towns Were Brought Within 2.5 Miles of the Nearest College by a Two-Year Public College Opening









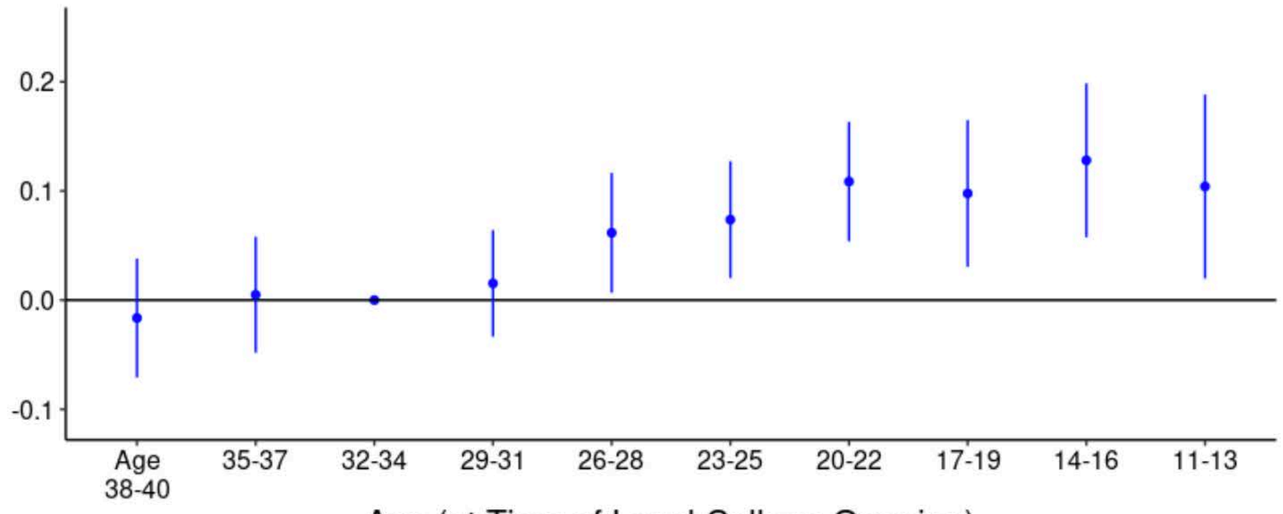
Notes: All specifications include childhood (i.e., 1920) town of residence and county-by-birth-year fixed effects, with standard errors clustered at the level of town of residence. Coefficients are relative to the coefficient for age 31-33. Error bars are 95% confidence intervals. Outcomes are observed in 1940 Census.

Effect of Community College Openings (1945-1980) on College Attainment and Longevity

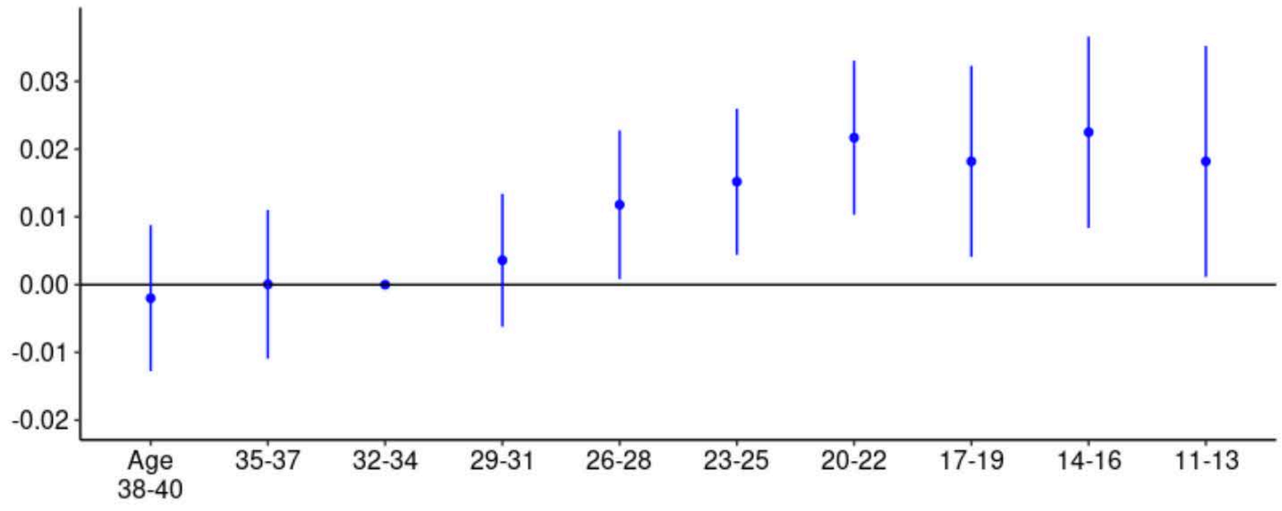
For Men and Women Whose Childhood Towns Were Brought Within 5 Miles of the Nearest College by a Two-Year Public College Opening

Figure 8

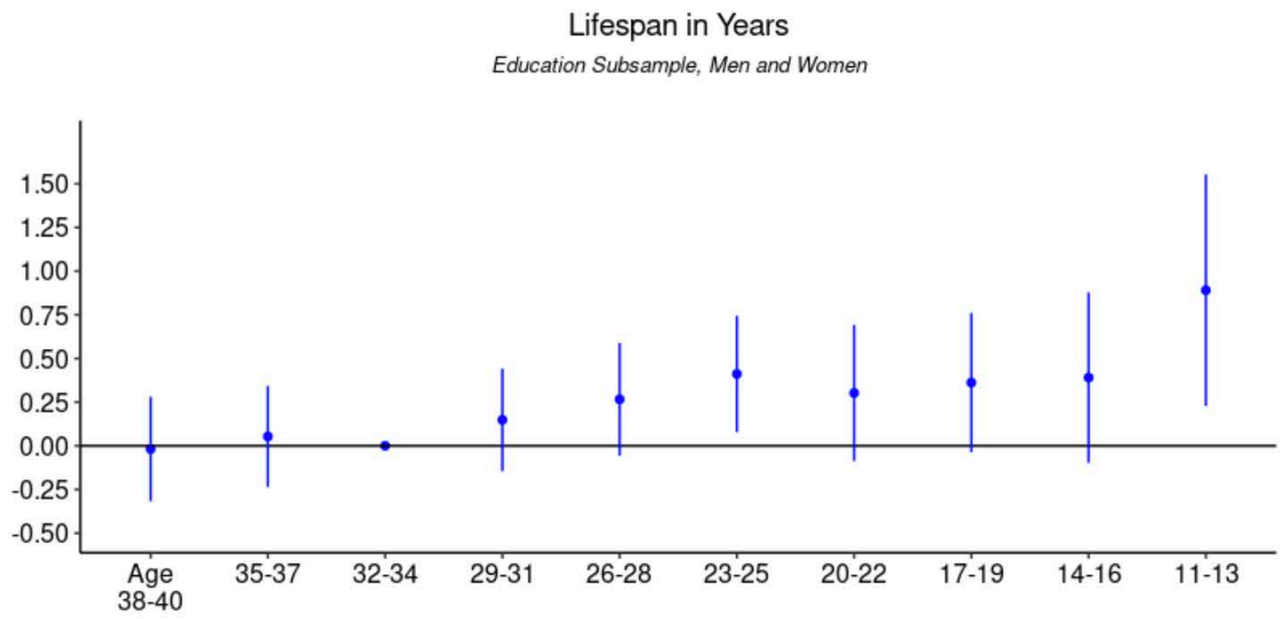
1. Years of College



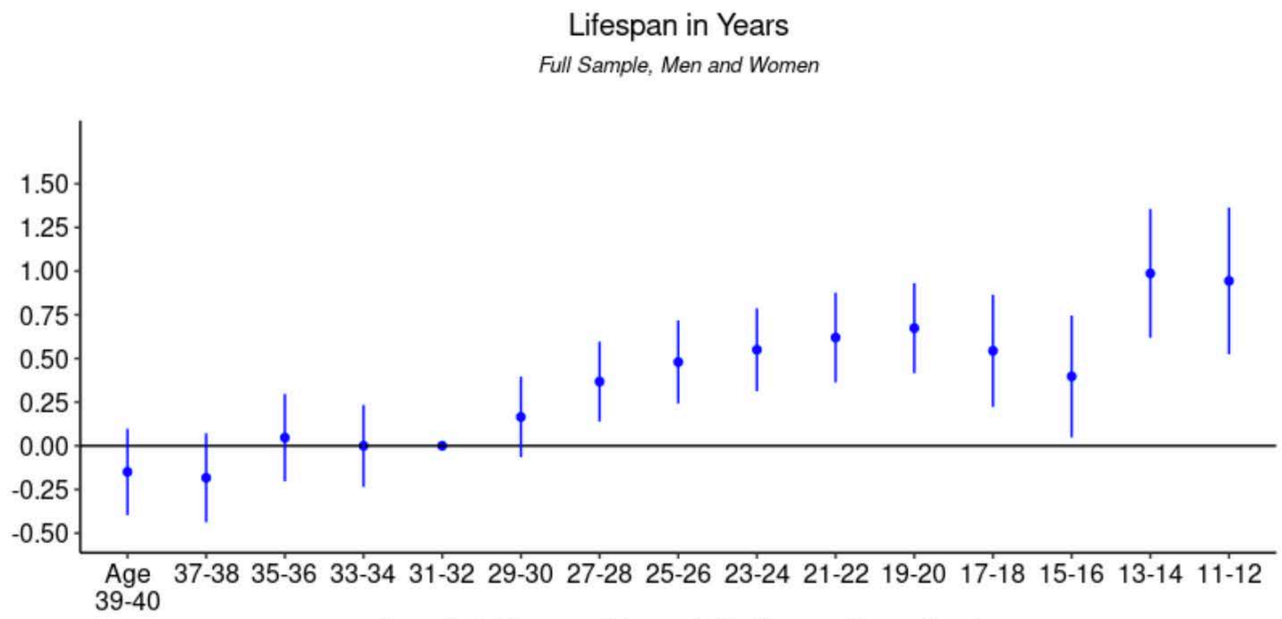
2. Democratization v. Diversion



3. Lifespan



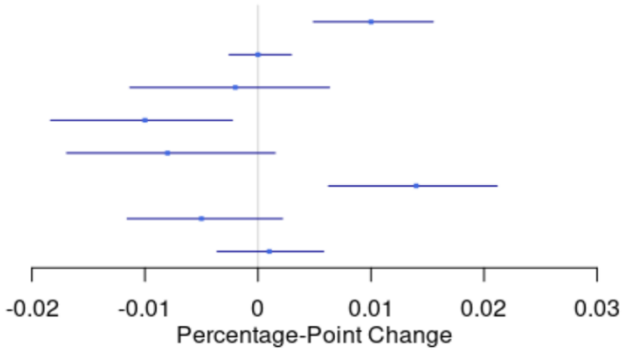
4. Lifespan (Full Sample)



Notes: All specifications include childhood (i.e., 1940 or Numident) town fixed effects and childhood-county-by-birth-year fixed effects, with standard errors clustered at the level of childhood town. Coefficients are relative to the coefficient for age 32-34 (31-32 for full sample). Error bars are 95% confidence intervals.

Figure 9

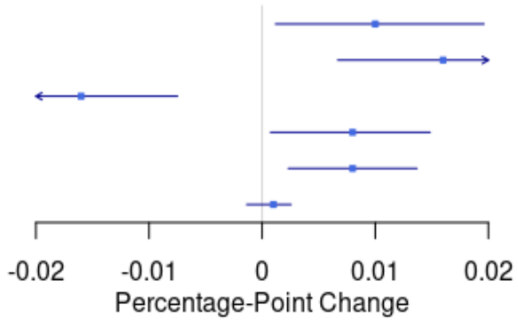
Effect of Junior College Openings (1920-1940) on Occupation



Dependent Variable: Occupation	Point Estimate	Dependent Variable Mean	Percent Change
Professional	0.010	0.06	+18%
Semi-Professional	0.000	0.02	+1%
Proprietor/Manager/Official	-0.002	0.24	-1%
Craftsman/Foreman/Kindred Occupation	-0.010	0.16	-7%
Operative/Kindred Occupation	-0.008	0.20	-4%
Farmer	0.014	0.17	+8%
Laborer	-0.005	0.11	-4%
Service Worker	0.001	0.05	+2%

Figure 10

Effect of Junior College Openings (1920-1940) on Assortative Marriage

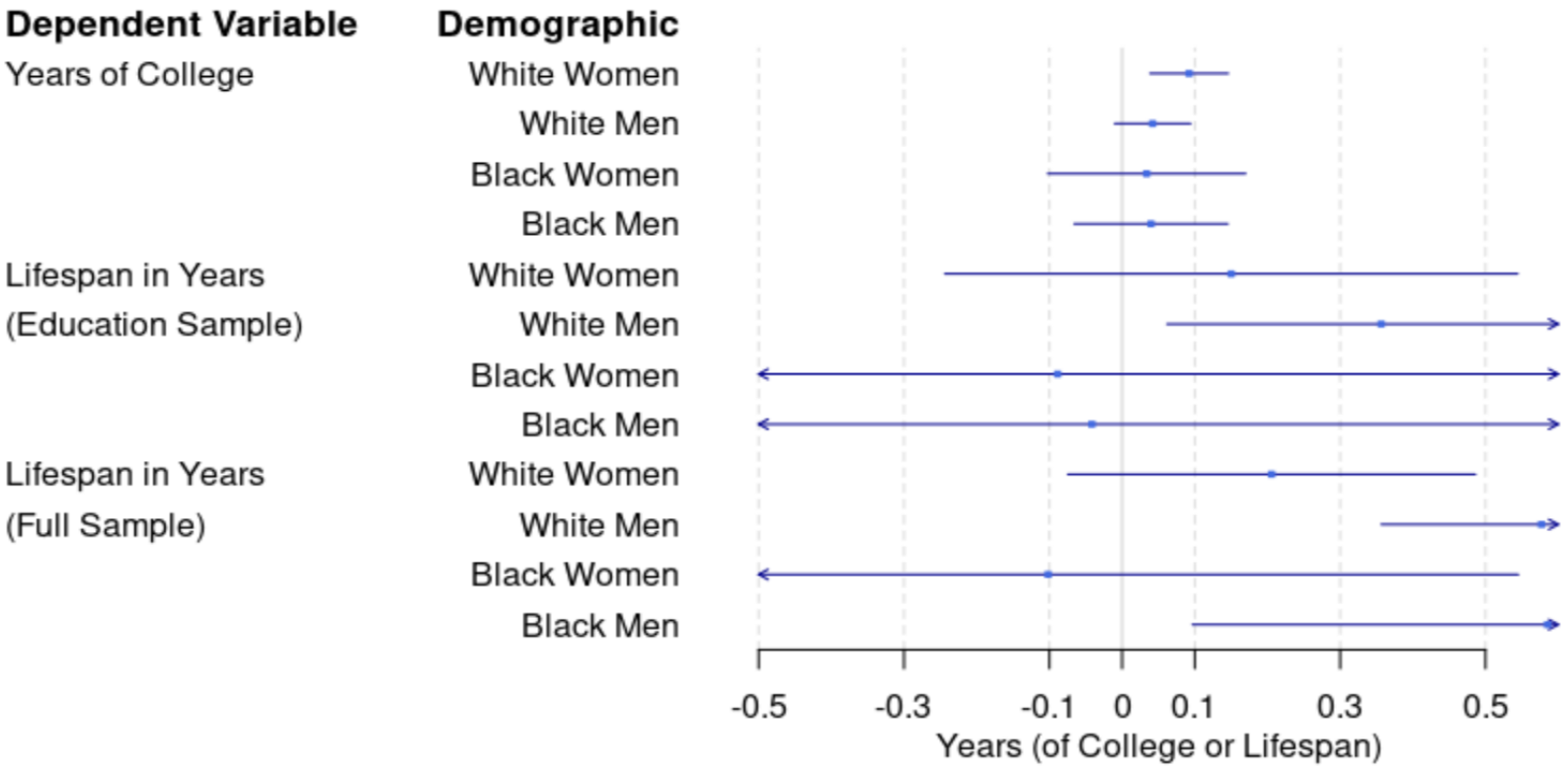


Dependent Variable	Point Estimate	Dependent Variable Mean	Percent Change
Never Married (as of 1940)	0.010	0.20	+5%
Spouse Completed...At Least One Year of College	0.016	0.12	+13%
...Zero Years of College	-0.016	0.88	-2%
...One or Two Years	0.008	0.07	+11%
...Three or Four Years	0.008	0.05	+16%
...At Least One Year of Graduate Attainment	0.001	0.01	+12%

Figure 11

Effect of Community College Openings (1945-1980) on College Attainment and Longevity

By Gender and Race



Appendix Table 1

Summary Statistics for Junior College Openings

Men Linked from the 1920 to the 1940 Census

Variable	Mean (1)	Std. Dev. (2)	Share Nonmissing (3)
1920 Census Characteristics			
Male	1		1
Birth Year	1908.0	7.1	1
African-American	0.06	0.25	1
Indicators: U.S.-Born Parentage			
Both Parents	0.74	0.44	1
All Four Grandparents	0.47	0.50	0.82
Distance to the Nearest Public College at Age 19:			
in Miles	43.0	37.4	1
Indicators: Region of the United States			
Lives in Northest	0.26	0.44	1
Lives in Midwest	0.38	0.49	1
Lives in South	0.27	0.44	1
Lives in West	0.09	0.28	1
N (Event Study Sample: Education Subset)		97,795	
N (Overall Event Study Sample)		100,068	
N		6,626,090	

Variable	Mean (4)	Std. Dev. (5)	Share Nonmissing (6)
1940 Census Outcomes			
Education Outcomes:			
Years of College	0.4	1.2	0.98
Indicators: Completed...			
At Least Two Years of College	0.12	0.32	0.98
At Least Four Years of College	0.07	0.25	0.98
Labor Market Outcomes:			
Wage Income (1940 USD)	$934	$991	0.94
Median Income of Occupation in 1950 (1950 USD)	$2,486	$1,045	0.95
Indicator: Non-Wage Income > $50	0.27	0.44	1.0
Indicator: Professional Occupation	0.05	0.22	0.9
Indicators: Worker Type			
Private Sector Wage Worker	0.66	0.47	0.94
Government Wage Worker	0.12	0.33	0.94
Employer	0.02	0.15	0.94
'Works on Own Account'	0.17	0.38	0.94
Unpaid Family Worker	0.02	0.14	0.94

Notes: The overall sample consists of men born 1895-1915 who can be linked (using the ABE method) to the 1940 Census and whose town/township of residence in 1920 can be geocoded. The overall event study sample consists of the subset whose childhood town/township was brought within 2.5 miles of the nearest college by a college opening. The 'Event Study Sample: Education Subset' is the subset of the overall event study sample for whom educational attainment is observed.

Appendix Table 2

Summary Statistics: Community College Openings Dataset

Variable	Full Sample			Event Study Sample		
	Mean	Std. Dev.	Share Nonmissing	Mean	Std. Dev.	Share Nonmissing
Year of Birth	1937	9.4	1	1939	9.2	1
Age at Social Security Enrollment	16.67	53.6	0.98	17.5	21.9	0.98
Race and Gender						
Male	0.51	0.5	1	0.50	0.5	1
White	0.84	0.37	0.98	0.81	0.39	0.99
Black	0.12	0.33	0.98	0.13	0.34	0.99
Other	0.03	0.16	0.98	0.05	0.21	0.99
Unknown	0.01	0.11	0.98	0.01	0.11	0.99
Location Information						
Location Observable at Birth but not in 1940	0.68	0.47	1	0.79	0.41	1
Location Observable at Birth and in 1940	0.30	0.46	1	0.20	0.40	1
Location Observable in 1940 but not at Birth	0.02	0.15	1	0.02	0.12	1
Age At Which Location is Observed	3.22	5.65	1	2.12	4.81	1
Educational Attainment						
Mother's Years of College	0.18	0.73	0.33	0.18	0.71	0.24
Father's Years of College	0.27	0.96	0.31	0.23	0.88	0.22
Years of College	1.16	1.89	0.23	1.16	1.84	0.24
Attained At Least An Associate's Degree	0.23	0.42	0.23	0.24	0.43	0.24
Attained At Least A Bachelor's Degree	0.19	0.39	0.23	0.19	0.39	0.24
Longevity						
Lived To At Least Age 55	0.84	0.37	1	0.83	0.37	1
Lived To At Least Age 65	0.75	0.43	1	0.74	0.44	1
Lifespan (Projected)	74.0	18.8	1	73.6	19.1	1
Lifespan Left-Censored	0.11	0.31	1	0.11	0.31	1
Lifespan Right-Censored	0.38	0.48	1	0.41	0.49	1
N	80,950,000			1,003,000		

Appendix Table 3

Summary Statistics: Junior Colleges in 1934

128 U.S. Junior Colleges that Opened Between 1921 and 1934

	United States		By Region							
			Midwest		Northeast		South		West	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of Junior Colleges	128		51		4		43		30	
Share Controlled...										
...Publicly	0.97		1		0		1		0.93	
...Publicly and Locally	0.83		0.88		0		0.82		0.78	
Year Established	1926.4	(3.1)	1925.5	(2.6)	1928.8	(2.9)	1926.8	(3.0)	1927.1	(3.9)
Number of Faculty Members (1933-34)	16.8	(16.3)	11.5	(5.7)	14.0	(3.6)	15.0	(6.4)	29.2	(29.6)
Enrollment	246	(345.0)	144	(119.7)	134	(25.2)	220	(136.5)	476	(631.3)
Male Share of Enrollment	0.54	(0.1)	0.53	(0.1)	0.62	(0.1)	0.53	(0.1)	0.54	(0.1)
Number of Graduates (June 1934)	46.3	(60.5)	35.7	(29.8)	9.3	(18.5)	42.1	(26.2)	75.0	(109.8)
Local Resident Tuition (1934 USD)	$76.6	($66.6)	$73.5	($38.1)	$315.0	($30.0)	$83.4	($50.4)	$35.6	($49.9)
Share of Junior Colleges...										
...With Dormitories	0.11	(0.3)	0.02	(0.1)	0.00	(0.0)	0.29	(0.5)	0.03	(0.2)
...Offering a Degree	0.23	(0.4)	0.22	(0.4)	0.25	(0.5)	0.10	(0.3)	0.45	(0.5)

This table is based on Greenleaf (1936), and includes 128 junior colleges that opened between 1920 and 1934. This table excludes public colleges that opened between 1920 and 1934 that were not considered junior colleges, such as Texas Tech and Murray State University. This table includes a few private junior colleges, such as (what is now) the University of Pittsburgh at Johnstown.

Greenleaf, Walter J. (1936). "Junior Colleges." U.S. Department of the Interior, Office of Education. Bulletin No. 3.

Appendix Table 4

Effect of Two-Year Public College Openings on College Attainment

	Junior College Openings (1920-1940)						*Community College Openings (1940-1980)*					
			Indicator: Attained at Least a(n)…						*Indicator: Attained at Least a(n)…*			
	Years of College		Associate's Degree		Bachelor's Degree		Years of College		Associate's Degree		Bachelor's Degree	
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-21 at Time of Opening	0.0927***	0.1018***	0.0280***	0.0294***	0.0133***	0.0139***						
	(0.0148)	(0.0139)	(0.0042)	(0.0038)	(0.0030)	(0.0027)						
Indicator: ...2.5 to 5 Miles…	0.0360*	0.0494**	0.0099*	0.0130*	0.0064	0.0076*						
	(0.0161)	(0.0180)	(0.0045)	(0.0054)	(0.0034)	(0.0036)						
Indicator: ...5 to 20 Miles…	-0.0055	0.0036	-0.0014	0.001	-0.0002	0.0004						
	(0.0072)	(0.0058)	(0.0020)	(0.0016)	(0.0015)	(0.0012)						
Indicator: ... Within 5 Miles…Age 10-25…							0.0739***	0.0366**	0.0173***	0.0088**	0.0141***	0.0056*
							(0.0206)	(0.0136)	(0.0046)	(0.0031)	(0.0042)	(0.0027)
Indicator: ... 5-20 Miles…Age 10-25…							-0.0091	-0.0339***	-0.0008	-0.0065**	-0.002	-0.0080***
							(0.0114)	(0.0101)	(0.0026)	(0.0022)	(0.0023)	(0.0020)
Childhood Town FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Childhood County By Birth Year FEs	Yes		Yes		Yes		Yes		Yes		Yes	
Childhood SEA By Birth Year FEs		Yes		Yes		Yes		Yes		Yes		Yes
Dep. Var. Mean	0.44	0.44	0.118	0.118	0.0723	0.0723	1.16	1.16	0.232	0.232	0.19	0.19
Observations	5,276,588	5,276,588	5,276,588	5,276,588	5,276,588	5,276,588	18,300,000	18,300,000	18,300,000	18,300,000	18,300,000	18,300,000

Notes: The junior colleges study population onsists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method. The community colleges study population consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which can be linked to either the 2000 Census long form or the 2001-2015 American Community Survey. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each junior college distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 40 at the time of the college opening, and for the community colleges the omitted age category is age 26-40. SEAs are the state economic areas, which are groups of counties within states. The college openings in this analysis are two-year public college openings that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Appendix Table 5

Linkage (PIK) Rates from Numident to the 2000 and 2010 Census

	2000 Census	2010 Census
Overall PIK (Linkage) Rate	87.8%	88.4%
PIK Rates by Age (at time of Census enumeration)		
Age 45-64	*[Not Yet Available]*	93.0%
Age 65-74		94.4%
Age 75+		93.5%

Factors Affecting PIK Rate

More Likely to be PIKed:	Less Likely to be PIKed:
Taxpayers	Mobile/Transient Populations
Workers	US Residents without SSN
Persons on Medicare	Children not claimed on tax forms
Persons Receiving housing/medical/food assistance	
Men ever registered for Selective Service	

Notes: For PIK rates in upper panel, see Rastogi and O'Hara (2012), Table 12 and Masey et al. (2018), Table 4. The lower panel largely reflects a given person's presence in federal administrative data (see Appendix A of Masey et al. (2018)).

Appendix Table 6

Covariate Balance Table A, Junior College Openings (1920-1940)

'Effect' of Junior College Openings on Family Background Variables (1920 Census)

	Indicator: Father is (a)…					*Indicator: … Are U.S.-Born*		*Father Occupation…*	
	…Professional	…Wage/Salary Worker	…Worker 'on own Account'	…an Employer	…Literate	Both Parents	All Four Grandparents	...Education Score	...Income Score
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a College Opening and Age 10-21 at Time of Opening	0.002	-0.0061	0.0029	0.0032	-0.0017	-0.0033	-0.0037	0.1096	11.27
	(0.0020)	(0.0059)	(0.0054)	(0.0038)	(0.0027)	(0.0055)	(0.0057)	(0.1820)	(17.08)
Indicator: ...2.5 to 5 Miles…	0.0051*	-0.0039	0.0002	0.0037	-0.0053	0.0019	0.00008	0.2037	-4.183
	(0.0023)	(0.0077)	(0.0074)	(0.0053)	(0.0043)	(0.0061)	(0.0087)	(0.2195)	(22.08)
Indicator: ...5 to 20 Miles…	0.0011	0.0004	-0.001	0.0006	0.0014	-0.0027	-0.0006	-0.002	-4.14
	(0.0009)	(0.0029)	(0.0030)	(0.0023)	(0.0017)	(0.0031)	(0.0032)	(0.0863)	(8.008)
Dep. Var. Mean	0.0226	0.483	0.373	0.145	0.946	0.726	0.367	8.58	1,830
Observations	4,193,600	3,419,421	3,419,421	3,419,421	4,193,530	5,409,615	5,409,615	3,418,165	4,193,600

Notes: All specifications include childhood-town fixed effects and childhood-county-by-birth-year fixed effects. The underlying dataset consists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 39 at the time of the college opening.

Appendix Table 7

Covariate Balance Table B, Junior College Openings (1920-1940)

Main Effects of Junior College Openings Controlling for Family Background Variables (1920 Census)

	Years of College		Indicator: At Least Four Years of College		Indicator: Professional Occupation		Spouse's Years of College	
Indicator: Childhood Town Brought Within 2.5 Miles of Nearest College by a College Opening and Age 10-21 at Time of Opening	0.0508**	0.0497**	0.0074	0.0072	0.0065	0.0064	0.0323	0.0302
	(0.0192)	(0.0182)	(0.0040)	(0.0038)	(0.0037)	(0.0036)	(0.0181)	(0.0175)
Indicator: ...2.5 to 5 Miles…	0.0011	-0.006	0.0017	0.0003	-0.0012	-0.0022	-0.0048	-0.0056
	(0.0208)	(0.0203)	(0.0044)	(0.0042)	(0.0045)	(0.0044)	(0.0224)	(0.0220)
Indicator: ...5 to 20 Miles…	0.0055	0.0056	0.0021	0.0021	0.0011	0.0009	-0.0051	-0.006
	(0.0087)	(0.0085)	(0.0018)	(0.0018)	(0.0018)	(0.0017)	(0.0087)	(0.0086)
Family Background Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Dep. Var. Mean	0.437	0.437	0.0719	0.0719	0.0558	0.0558	0.321	0.321
Observations	3,335,668	3,335,668	3,335,668	3,335,668	3,234,396	3,234,396	2,445,653	2,445,653

Notes: All specifications include childhood-town fixed effects and childhood-county-by-birth-year fixed effects. The underlying dataset consists of the subset of the 1920 Census born 1895-1915 with a geocodable 1920 town/township of residence and which can be linked to the 1940 Census using the ABE linkage method. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 2.5 miles, 2.5 to 5 miles, and 5 to 20 miles) consists of those who were age 22 to 39 at the time of the college opening. The family background variables used as controls are indicators for father's occupation (professional, having a wage/salary occupation, working on own account, being literate), indicators for U.S.-born parentage (both parents U.S.-born, all four grandparents U.S.-born), father's occupation education score and father's occupation income score.

Appendix Table 8

Community College Openings: Covariate Balance Table

	Parents' College Attainment				*Controlling for Parents' College Attainment*	
	Mother's Years of College	Father's Years of College	Years of College	Years of Lifespan	Years of College	Years of Lifespan
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-25 at Time of Opening	-0.0034	0.0134	0.0702	0.044	0.0671	0.0422
	(0.0187)	(0.0197)	(0.0372)	(0.2156)	(0.0359)	(0.2147)
Indicator: ...5 to 20 Miles…	-0.0009	0.0245	0.0244	0.0136	0.0173	0.0092
	(0.0127)	(0.0151)	(0.0267)	(0.1605)	(0.0259)	(0.1605)
Mother's Years of College					0.2782***	0.1951***
					(0.0026)	(0.0068)
Father's Years of College					0.3011***	0.1845***
					(0.0025)	(0.0052)
Childhood Town of Residence FEs	Yes	Yes	Yes	Yes	Yes	Yes
Childhood County by Birth Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	67,000	67,000	67,000	67,000	67,000	67,000
Dep. Var. Mean	0.201	0.29	0.977	85.6	0.977	85.6
Observations	5,287,000	5,287,000	5,287,000	5,287,000	5,287,000	5,287,000

Notes: The underlying dataset consists of the subset of Numident born 1921-1940 that can be linked to the 1940 Census, for which father's and mother's educational attainment is observed in the 1940 census, for which own educational attainment can be observed in the 2000 census or the 2001-2015 American Community Survey, and whose childhood town is geocodable from the 1940 Census or Numident. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 5 miles, and 5 to 20 miles) consists of those who were age 26 to 40 at the time of the college opening. The college openings in this analysis are those that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Appendix Table 9

Correlation Between Treatment Variable and Linkage to 2000 Census and American Community Survey

	Indicator: Linkable to…		
	2000 Census	2000 Census Long Form	2000 Census Long Form or 2001-2015 ACS
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-25 at Time of Opening	0.0080***	-0.0004	-0.0012
	(0.0022)	(0.0015)	(0.0019)
Indicator: ... 5-20 Miles…	-0.0002	-0.0010	-0.0015
	(0.0015)	(0.0012)	(0.0015)
Childhood Town FEs	Yes	Yes	Yes
Childhood County By Birth Year FEs	Yes	Yes	Yes
Dep. Var. Mean	0.78000	0.13400	0.24700
Observations	72,160,000	72,160,000	72,160,000
Number of Clusters	135,000	135,000	135,000

Notes: The underlying dataset consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which has a date of death in Numident or the date of death is right censored in 2020. Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 5 miles, and 5 to 20 miles) consists of those who were age 26 to 40 at the time of the college opening. SEAs are the state economic areas, which are groups of counties within states. The college openings in this analysis are those that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Appendix Table 10

Effect of Community College Openings on College Attainment and Longevity, By Gender and Race

	Education Subset:			*Full Sample:*
	Years of College	Indicator: Competed At Least a Bachelor's Degree	Lifespan in Years	Lifespan in Years
Indicator: Childhood Town Brought Within 5 Miles of Nearest College by a Two-Year Public College Opening and Age 10-25 at Time of Opening	0.042	0.0102	0.3565*	0.5770***
	(0.0266)	(0.0057)	(0.1503)	(0.1124)
Indicator: Female X Indicator: Childhood Town…	0.0502	0.0051	-0.2063	-0.3713**
	(0.0274)	(0.0060)	(0.2010)	(0.1430)
Indicator: Black X Indicator: Childhood Town…	-0.0022	0.01	-0.398	0.0084
	(0.0539)	(0.0119)	(0.5046)	(0.2493)
Indicator: Black X Indicator: Female X Indicator: Childhood Town…	-0.0562	-0.0204	0.1591	-0.3159
	(0.0694)	(0.0149)	(0.6716)	(0.3300)
Childhood Town by Race by Gender FEs	Yes	Yes	Yes	Yes
Childhood County By Birth Year By Race by Gender FEs	Yes	Yes	Yes	Yes
Dep. Var. Mean	1.16	0.19	83.0	78.800
Observations	18,300,000	18,300,000	18,300,000	72,160,000
Number of Clusters	114,000	114,000	114,000	135,000

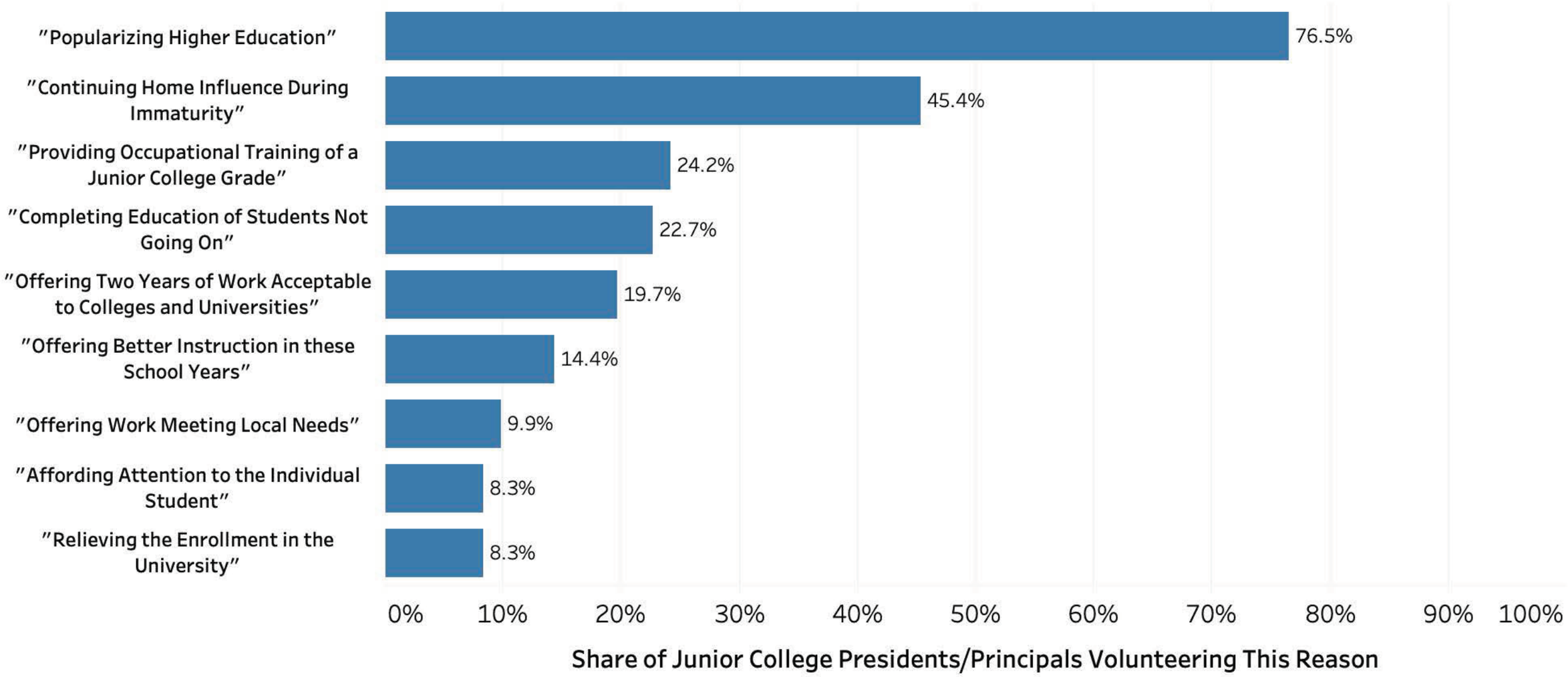
Notes: The underlying dataset for columns 1-3 consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence) and which can be linked to either the 2000 Census long form or the 2001-2015 American Community Survey. The underlying dataset for column 4 consists of the subset of Numident born 1921-1951 with a geocodable town of birth (or geocodable 1940 town of residence). Standard errors are clustered at the level of childhood town. The omitted explanatory variable for each distance category (0 to 5 miles) consists of those who were age 26 to 40 at the time of the college opening. The college openings in this analysis are those that opened in places where the distance to the nearest college (of any kind) prior to the opening was at least 25 miles.

Appendix Figure 1

Reasons for Opening Public Junior Colleges

According to Junior College Presidents/Principals

In 1927-1928, 132 public junior college presidents/principals were asked:
"Please give the reasons for the organization of your junior college and its special purpose"



Source: Whitney (1928), Table XXV. The question was free response, and the responses were grouped into categories by Whitney, who followed Koos's method of grouping statements.
The category "Popularizing higher education" is defined as "statements bearing on the lowering of the cost of education on this level or bringing it nearer the home of the student" (see p. 22 of Koos (1925)).

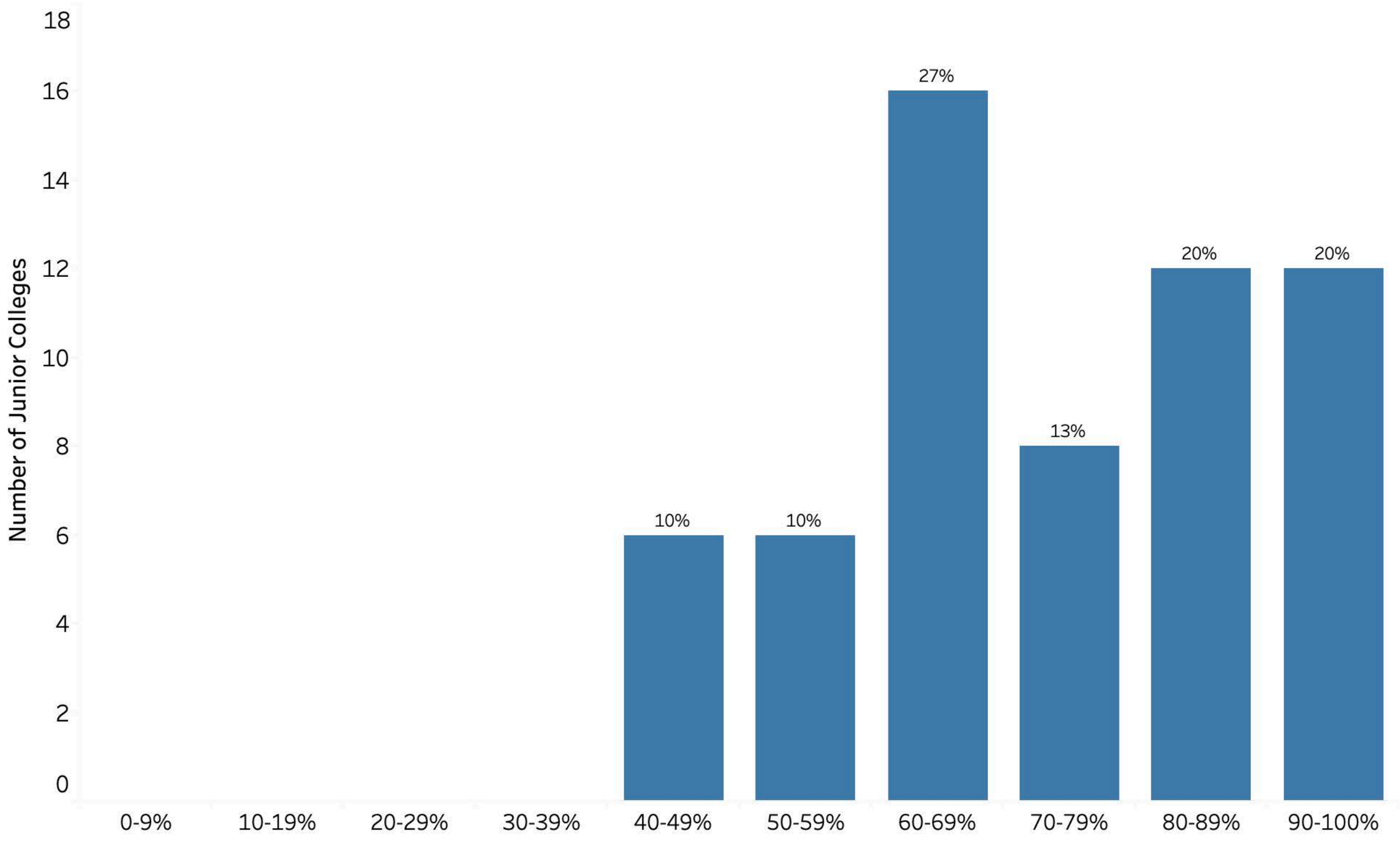
Koos, L.V. (1925). *The Junior College Movement.* Ginn and Company.
Whitney, F. L. (1928). *The Junior College in America*. Colorado State Teachers College Education Series, No. 5. Greeley, Colorado.

Appendix Figure 2

Share of Total Enrollment Belonging to Local School District

60 Public Junior Colleges, 1928

Question: "What percent of your junior-college students are enrolled from your own school district?"

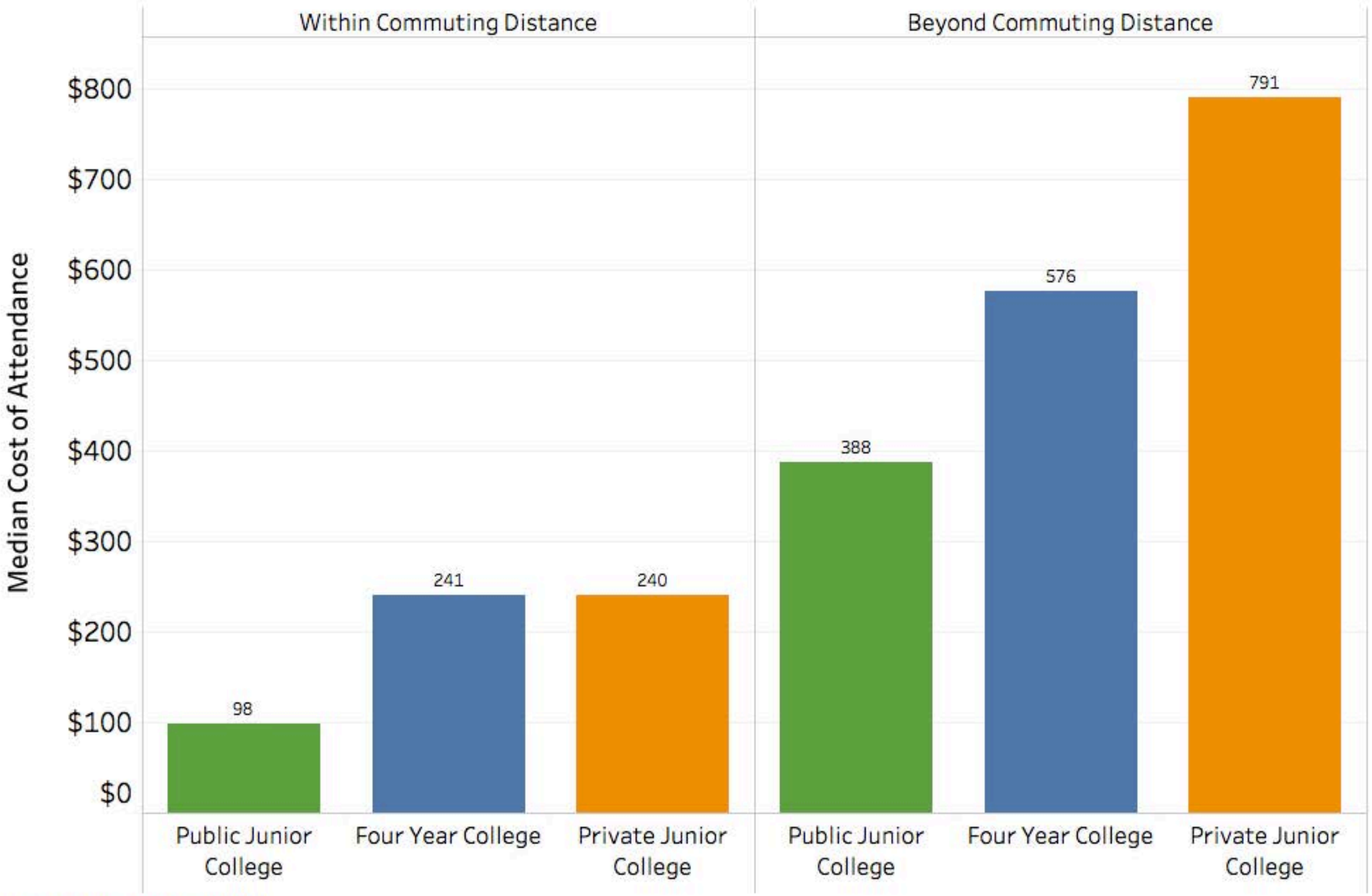


The question was asked of 80 public junior colleges, with 72 replies, of which 60 were "sufficiently complete" to be used. The mean response is 71.6%.

Source: Green, Rhue. (1929). "Is the Public Junior College Popularizing Higher Education? An Investigation of What the Junior Colleges are Actually Doing." *School Executives Magazine*, October, 1929.

Appendix Figure 3

Junior Colleges and Cost of Attendance, 1921

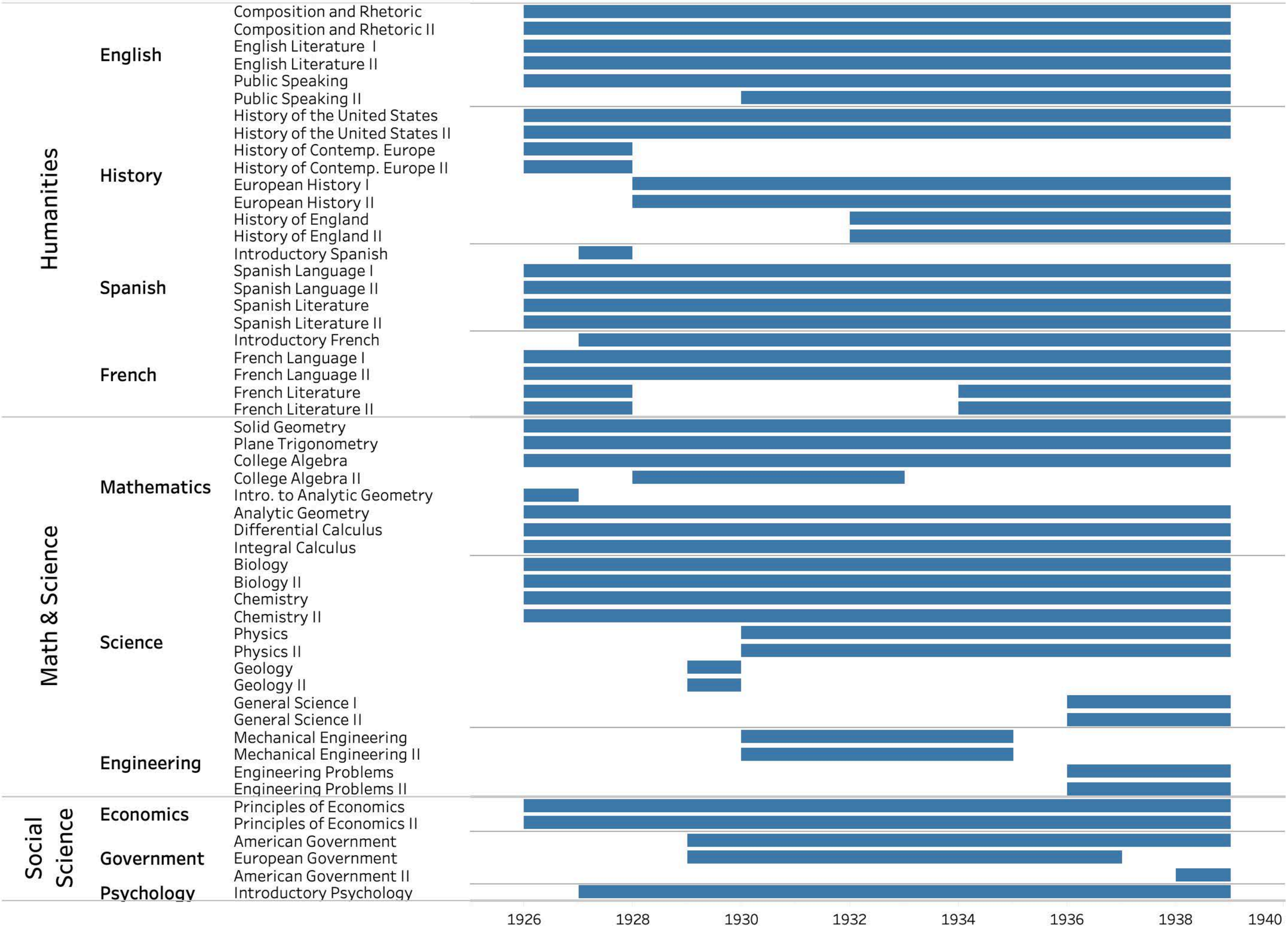


Source: Koos (1924), Table L, Page 129.

Courses Offered at Tyler Junior College, 1926-1940

Part I: Liberal Arts

Appendix Figure 4



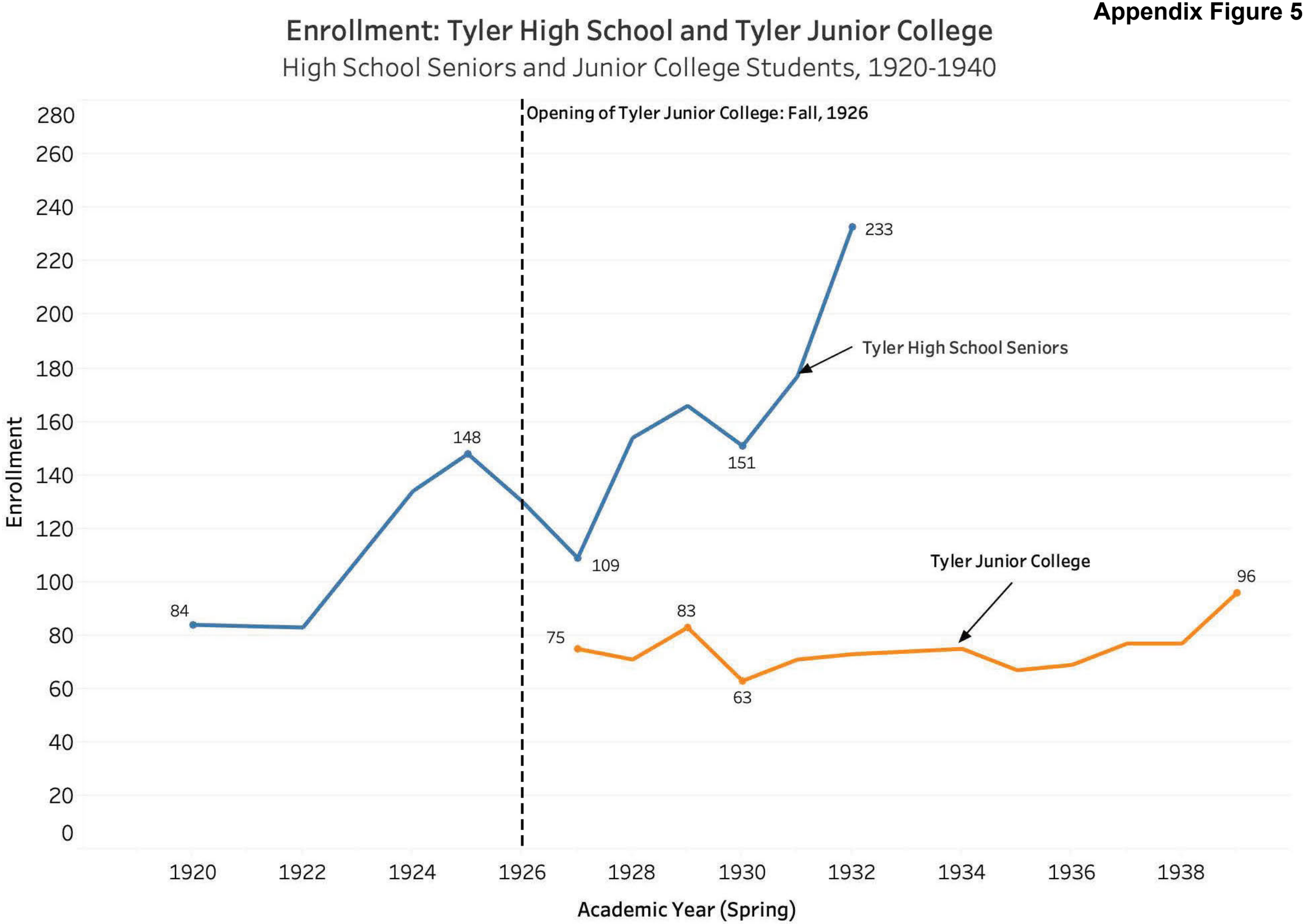
Courses Offered at Tyler Junior College, 1926-1940

Part II: Teacher Training/Vocational Courses

Appendix Figure 4

I obtained the availability of courses for each year from Tyler Junior College Catalogs. I have not been able to find a catalog for the academic years 1933-34, 1935-36, and 1937-38; accordingly, the availability of courses for these academic years is imputed from the neighboring years.

Appendix Figure 5

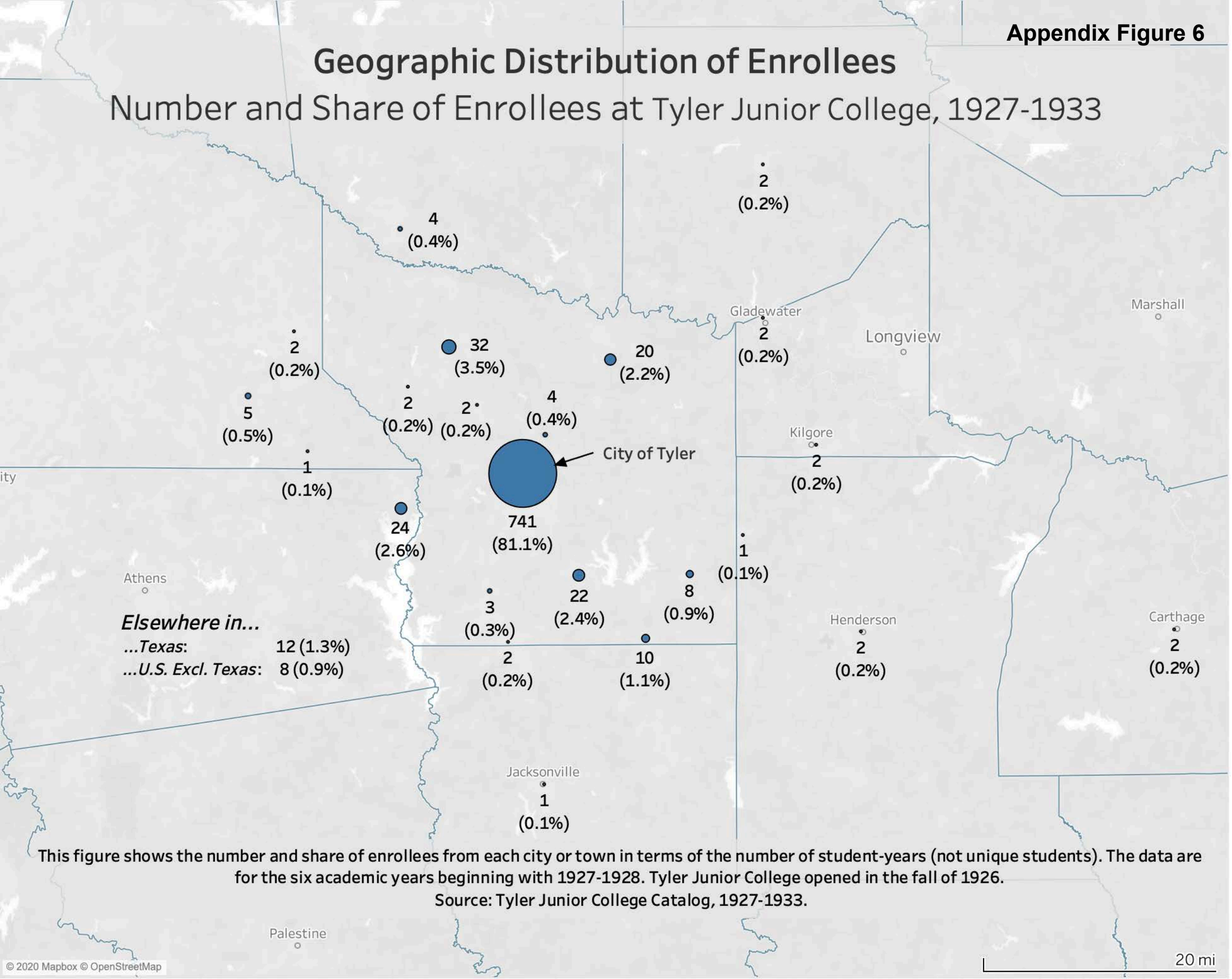


This figure shows total annual enrollment at Tyler Junior College and among seniors Tyler High School, as given in the respective yearbooks. I obtained the data underlying these results by computerizing names of individuals in the 1920-1940 yearbooks of Tyler High School and Tyler Junior College. I have not been able to find a Tyler High School Yearbook for the academic years 1920-1921 or 1922-1923. No Tyler High School or Tyler Junior College yearbook was published in 1932-33, on account of financial hardship arising from the Great Depression.

Appendix Figure 6

Geographic Distribution of Enrollees

Number and Share of Enrollees at Tyler Junior College, 1927-1933



Elsewhere in...	
...Texas:	12 (1.3%)
...U.S. Excl. Texas:	8 (0.9%)

This figure shows the number and share of enrollees from each city or town in terms of the number of student-years (not unique students). The data are for the six academic years beginning with 1927-1928. Tyler Junior College opened in the fall of 1926.

Source: Tyler Junior College Catalog, 1927-1933.

Appendix Figure 7

Example: Linking Students Across Yearbooks

Tyler High School and Tyler Junior College

Tyler High School Yearbooks (1920-1927)				
Last Name	*First*	*Middle*	*Academic Year*	*Grade Level*
Acker	Ruby		1923-1924	Senior
...	...	...	...	...
Barton	Exa		1926-1927	Senior
Barton	**Glaucius**		**1925-1926**	**Senior**
Benford	James		1923-1924	Senior
...	...	...	...	...
Wolf	Clifton		1923-1924	Senior

Academic Years: 1919-1920 through 1926-1927

N = 362

Linkage Variables:

Last Name, First Name, Middle Name/Initial, Gender = Male

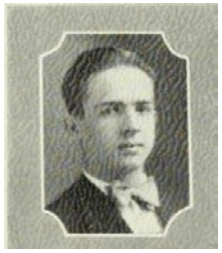
Tyler Junior College Yearbooks (1927-1928)				
Last Name	*First*	*Middle*	*Academic Year*	*Grade Level*
Barton	**Glaucius**		**1927-1928**	**Enrolled**
Bell	Eddie		1927-1928	Enrolled
Brinkerhoff	Jake		1927-1928	Enrolled
...	...	...	...	...
Scurlock	Bill		1927-1928	Enrolled
Smith	Henry		1927-1928	Enrolled
Ward	William		1927-1928	Enrolled

Academic Years: 1927-1928

N = 25

GLAUCIUS BARTON—
Curtain Club '25; Director of J. C. C. '26; Alcalde Staff '26; Vice-President Senior Class '25-'26; S. S. S., '25-'26; B Plus Club.

1925-1926 Yearbook



GLAUCIUS BARTON

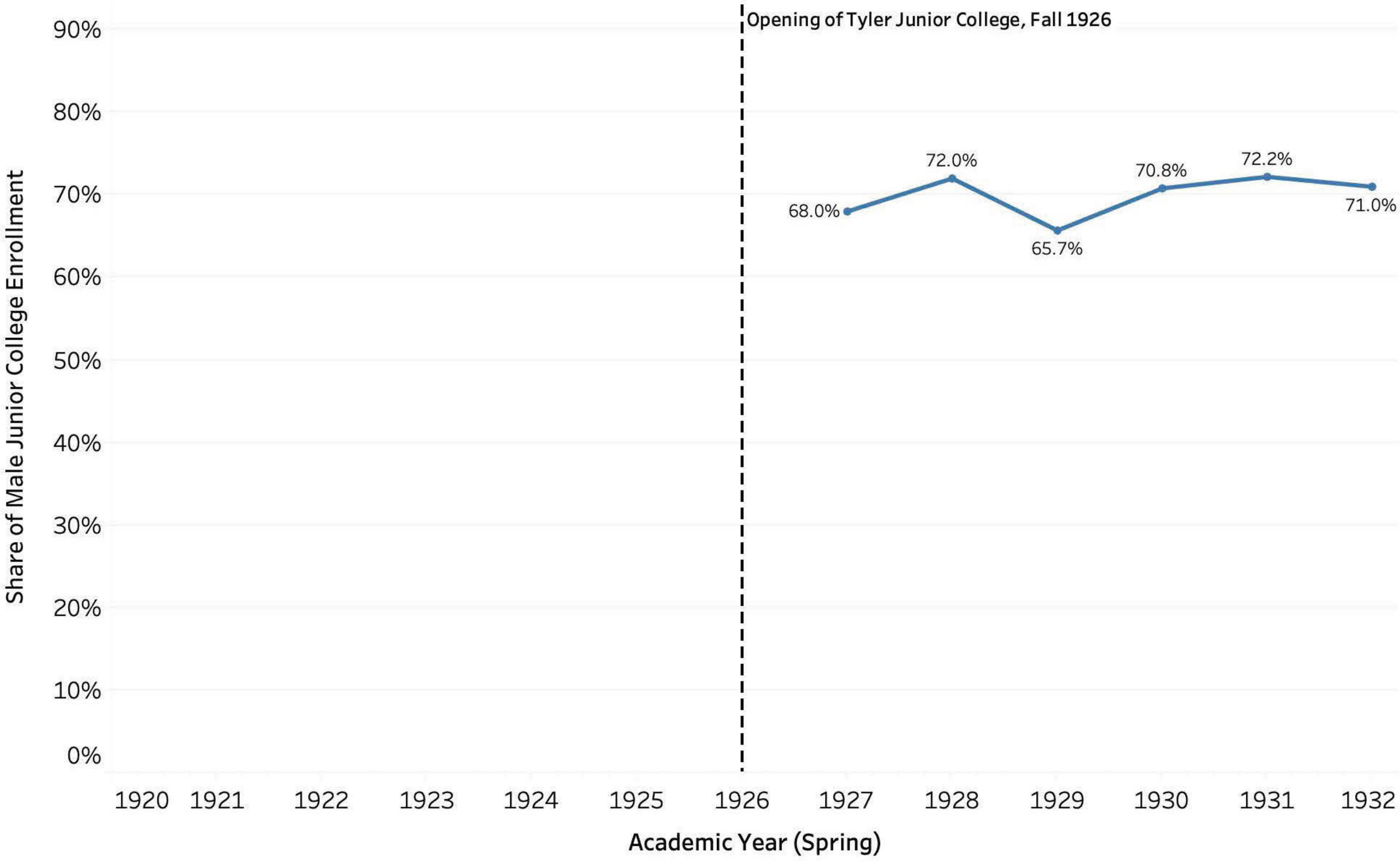
"And I made a rural pen,
And I stained the water clear,
And I wrote my happy songs
Every child may joy to hear."

1927-1928 Yearbook

Share of Junior College Enrollment Attending Tyler High School

Appendix Figure 8

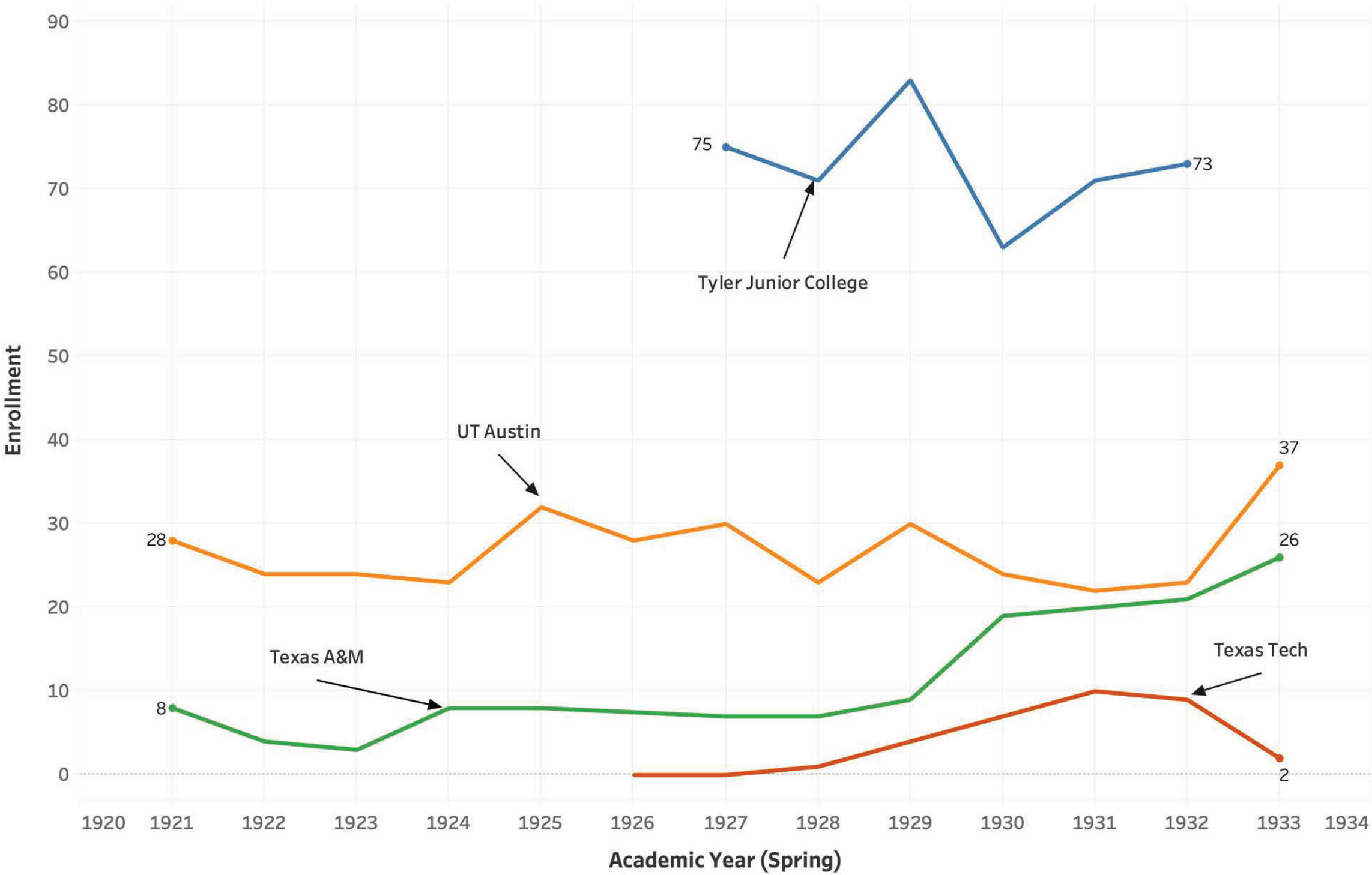
Men, 1920-1932



This figure shows the share of male students in each Tyler Junior College yearbook who can be identified as a senior in a Tyler High School yearbook. I obtained the data underlying these results by first computerizing and then linking the names of individuals in the 1920-1940 yearbooks of Tyler High School and Tyler Junior College. I have not been able to find a Tyler High School Yearbook for the academic years 1920-1921 or 1922-1923. No Tyler High School or Tyler Junior College yearbook was published in 1932-33, on account of financial hardship arising from the Great Depression.

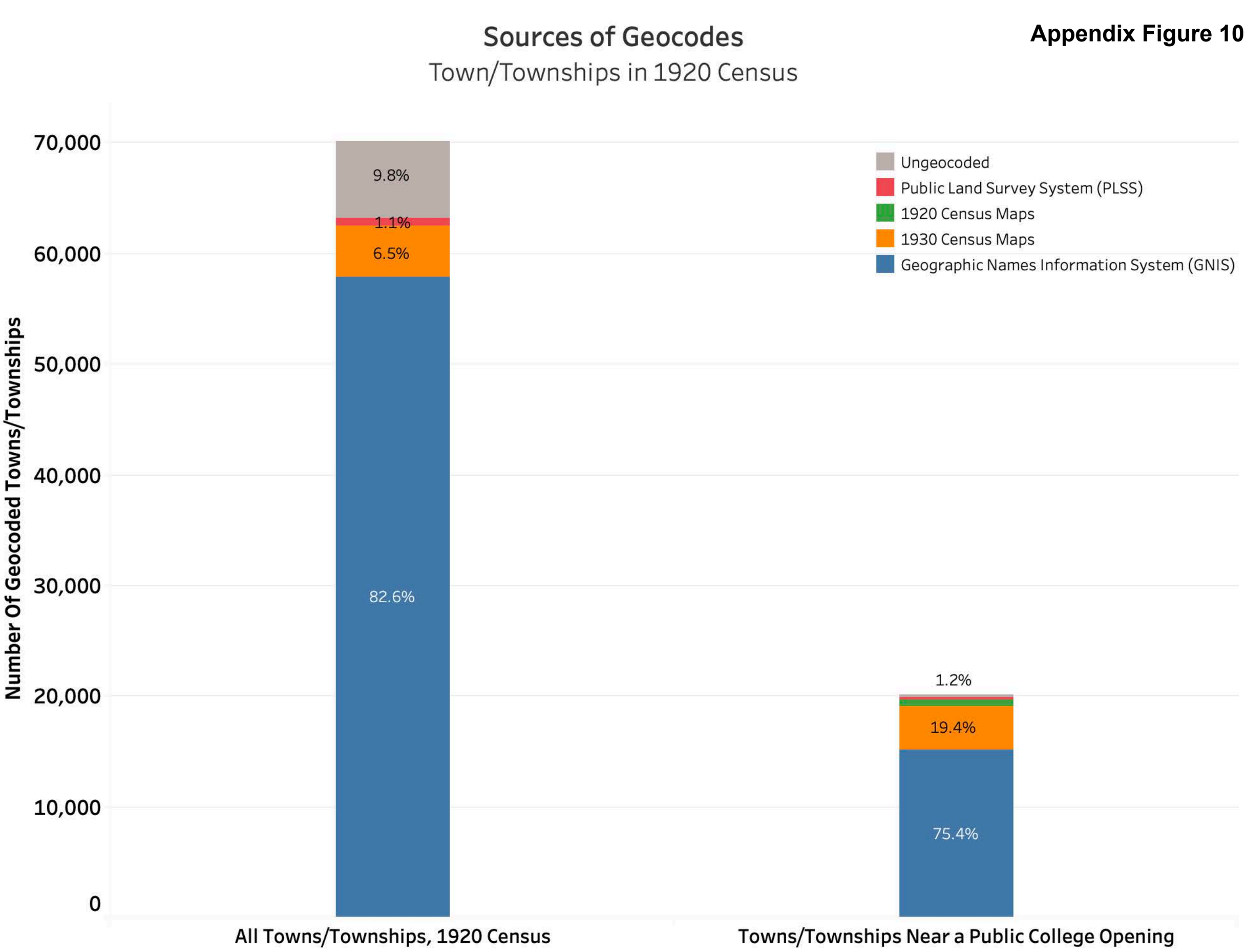
Appendix Figure 9

College Enrollment of Students from Tyler, Texas
1920-1932



This figure gives the total enrollment at Tyler Junior College and total enrollment at three Texas colleges of students whose hometown is "Tyler, Texas": University of Texas at Austin, Texas A&M and Texas Tech. I obtained these figures from annual yearbooks (Tyler Junior College) and annual registers of students.

Appendix Figure 10



The category "1920 Census Maps" includes maps from the 1910 and 1900 Censuses (that are valid for 1920 Census townships). The 1930 Census maps used are all state-level ones, while the 1920 and earlier ones are county-level maps.

Appendix Figure 11

Imputation of Missing Death Dates