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Distance to Degrees: How College Proximity Shapes Students' Enrollment Choices and Attainment Across Race-Ethnicity and Socioeconomic Status

Riley Acton
Miami University

Kalena E. Cortes
Texas A&M University

Lois Miller
University of South Carolina

Camila Morales
University of Texas at Dallas

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DISTANCE TO DEGREES: HOW COLLEGE PROXIMITY SHAPES STUDENTS' ENROLLMENT CHOICES AND ATTAINMENT ACROSS RACE-ETHNICITY AND SOCIOECONOMIC STATUS

Riley Acton*
Miami University

Kalena E. Cortes
Texas A&M University

Lois Miller
University of South Carolina

Camila Morales
University of Texas at Dallas

ABSTRACT: Leveraging rich data on the universe of Texas high school graduates, we estimate how the relationship between geographic access to public two- and four-year postsecondary institutions and postsecondary outcomes varies across race-ethnicity and socioeconomic status. We find that students are sensitive to the distance they must travel to access public colleges and universities, but there are heterogeneous effects across students – particularly with regard to distance to public two-year colleges (i.e., community colleges). White, Asian, and higher-income students who live in a community college desert (i.e., at least 30 minutes driving time from the nearest public two-year college) substitute towards four-year colleges and are more likely to complete bachelor's degrees. Meanwhile, Black, Hispanic, and lower-income students respond to living in a community college desert by forgoing college enrollment altogether, reducing the likelihood that they earn associate's *and* reducing the likelihood that they ultimately transfer to four-year colleges and earn bachelor's degrees. These relationships persist up to eight years following high school graduation, resulting in substantial long-term gaps in overall degree attainment by race-ethnicity and income in areas with limited postsecondary access.

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KEYWORDS: college accessibility; college proximity; college choices; college enrollment; college attainment; associate's degree, bachelor's degree, college enrollment patterns; two-year colleges; four-year colleges; public postsecondary institutions.

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* Acton: Department of Economics, Miami University, 800 E. High St., Oxford, OH 45056 (e-mail: actonr@miamioh.edu). Cortes: The Bush School of Government and Public Service, Texas A&M University, 4220 TAMU, 2088 Allen Building, College Station, TX 77843 (e-mail: kcortes@tamu.edu). Miller: Department of Economics, Darla Moore School of Business, 1014 Greene St, Columbia, SC 29208 (email: lois.miller@moore.sc.edu). Morales: Economics Program, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080 (email: camila.morales@utdallas.edu). We thank Rachel Baker, Zachary Bleemer, Sade Bonilla, Celeste Carruthers, Scott Imberman, Michael Lovenheim, Lori Taylor, and seminar and conference participants at Miami University, University of Pennsylvania's Graduate School of Education, the NBER's Financing Higher Education Spring 2024 conference, and the 2024 Access, Equity, and Education conference at the University of Texas at Dallas for their helpful comments and suggestions. Institutional support was provided by Miami University, University of South Carolina, University of Texas at Dallas, Texas A&M University, and Stanford University. This research uses data from the UT Dallas Education Research Center (ERC). The conclusions discussed in this paper do not reflect the opinions or official positions of the ERC, Texas Education Agency, the Texas Higher Education Coordinating Board, or the State of Texas.

I. INTRODUCTION

Over the past forty years, the earnings gap between Americans with and without a bachelor's degree has more than doubled (Autor, 2014; Ashworth and Ransom, 2019), indicating steep and historically high economic returns to postsecondary education. Prior research shows substantial value-added in earnings from enrollment and degree attainment, both on average across all students (e.g., Chetty et al., 2020), and specifically for low-income and minority students for whom attending college can boost earnings by 8 to 20 percent (e.g., Dale and Krueger, 2002, 2014; Smith, Goodman, and Hurwitz, 2020; Zimmerman, 2014).

Yet despite the rising premium to a college degree, disparities in postsecondary attainment between low- and high-income students, as well as between underrepresented minority (URM) and non-URM students, persist and have only grown larger over time (Bailey and Dynarski, 2011; Bleemer and Quincy, 2024). For example, in 1980, White young adults aged 25 to 29 were 13 percentage points more likely to hold a bachelor's degree compared to Black young adults (National Center for Education Statistics, 2017). Meanwhile, as of 2022, the Black-White gap in bachelor's degree attainment stands at 17 percentage points (Reber and Smith, 2023), roughly a 30 percent increase over the past five decades.[1] Changes in degree attainment by income are even starker: the high-low income gap in bachelor's degree attainment by age 24 has nearly doubled from a 24 percentage-point difference in 1980 to a 49 percentage-point gap in 2019 (Cahalan et al., 2021).[2]

Policymakers across the U.S. have stated goals of closing racial-ethnic and income gaps in educational attainment and improving economic mobility (Harnisch and Laderman, 2023), making it critical to understand why low-income and URM students are substantially less likely to enroll in college and complete degrees. This study investigates a relatively underexplored factor that may contribute to disparities in educational attainment by race-ethnicity and income: the spatial distribution of colleges and universities.[3] Conceptually, the geographic location of U.S. colleges and universities may generate disparities in educational attainment across demographic groups for

[1] The Hispanic-White gap in bachelor degree attainment has also increased over time from 17 percentage points in 1980 to 20 percentage points as of 2022 (National Center for Education Statistics, 2017; Reber and Smith, 2023).

[2] High- and low-income categories correspond to the top and bottom family income quartiles, respectively (Cahalan et al., 2021).

[3] Throughout the paper, we use race-ethnicity to denote race *and* ethnicity. The Hispanic student population is identified as an ethnicity in our sample, while all other groups correspond to non-Hispanic students stratified by race corresponding to self-reported information.

two reasons. First, if the *supply* of colleges differs across communities, and students face attendance costs that vary with distance (e.g., transportation and opportunity costs of travel time), then students living in areas with fewer college options may be less likely to enroll in college and attain degrees. That is, spatial differences in access to local colleges may generate disparities in postsecondary attainment. Second, even if the supply of colleges were equal across communities, students' *demand* for attending a local institution may differ across demographic groups due to differences in preferences or distance-related attendance costs (e.g., differences in access to transportation or caregiving responsibilities). That is, even if access to local postsecondary institutions is even across groups, differences in students' elasticity to distance may also generate disparities in postsecondary attainment.

Policy-wise, examining how distance to college influences gaps in educational attainment is an increasingly relevant issue in the U.S. It is well-documented that postsecondary institutions are unevenly distributed across the country (Hillman, 2016; Hillman and Weichman, 2016), with millions of Americans, particularly in rural areas, lacking access to nearby colleges and universities.[4] Since people in the U.S. are geographically segregated by race-ethnicity and income, this dispersion of college locations can generate racial-ethnic and income gaps in local college access. Moreover, states may – and indeed, do – use changes in the supply of public colleges as a lever to address challenges stemming from changing demographic and college enrollment trends. Whether states are considering consolidating (Gardner, 2021; Gretzinger, 2024) or expanding access to public colleges (Waxmann, 2024), our results provide meaningful insights into how supply-side policy changes may influence educational attainment across demographic groups.

In this paper, we descriptively examine how distance to nearby two- and four-year public postsecondary institutions is associated with students' college enrollment, credit accumulation, and degree attainment, with a focus on how these relationships differ by students' race-ethnicity and socioeconomic status (SES). We conduct these analyses leveraging rich, administrative data from Texas, which offers a compelling context to study this topic due to several features. First, Texas has a large and diverse population, both overall and in rural areas, where access to college tends to be more limited (U.S. Census Bureau, 2021; Johnson and Lichter, 2022). Second, it boasts

[4] For instance, using 2019 Integrated Postsecondary Education Data System (IPEDS) college location data and U.S. Census Bureau population estimates, we estimate that 16.5 million (5 percent) Americans across 41 states live in a commuting zone without a public two-year college, and 35.3 million (11 percent) across 45 states live in a commuting zone without a public four-year college.

a robust public higher education sector that features six distinct public university systems with 37 universities between them – two of which are Historically Black Colleges and Universities (HBCUs) and 25 of which are Hispanic Serving Institutions (HSIs) – along with 50 independent community college districts, many of which contain multiple stand-alone campuses, and a public, two-year technical college system.[5] Combined, these institutions enroll upwards of 1.4 million students annually, or nearly 10 percent of all enrolled college students nationwide (National Center for Education Statistics, 2023).

Our analytic sample consists of the universe of Texas public high school graduates spanning five cohorts (2013-2017). We observe college enrollment behavior across all two-year and four-year public institutions in Texas, along with transcript and graduation information, which we use to construct measures of credit accumulation and degree attainment. We link these data with information on the driving distance from all public high schools in Texas to the nearest public two-year and four-year college campuses, constructed from records on the latitudes and longitudes of each high school and college campus in the state. We especially focus on how enrollment, credit accumulation, and degree completion patterns differ for students who live in a community college desert, which we define as high schools without any public two-year college within 30 minutes driving time.

Overall, we find that students are less likely to complete an associate's degrees if they live far away from community colleges. Specifically, students who live in a community college desert are 2.7 percentage points (31 percent of the mean) less likely to obtain an associate's degree within six years of high school graduation, even after accounting for a rich set of students' demographics and academic characteristics as well as the driving distance to their nearest public four-year university. We show that this effect operates through *both* the enrollment and persistence channels. Specifically, about 50 percent of the distance effect on degree attainment can be explained by a lower likelihood of enrolling in two-year colleges altogether, with the remaining proportion being explained by lower levels of credit accumulation and higher likelihood of stop- or drop-out before degree completion. Meanwhile, when students live farther from a four-year public college, they

[5] Throughout the text, we use the phrases "community colleges" or "two-year community colleges" or "two-year colleges" to refer to Texas' public community and technical colleges, and use the phrases "four-year colleges" or "four-year universities" or "universities" to refer to the state's public universities, as defined by the THECB: http://www.txhighereddata.org/Interactive/Institutions.cfm. All public four-year institutions in Texas have "university" in their names, but they differ substantially in their research and graduate degree production (see Acton, 2022 for more information on the distinction between four-year colleges and universities.)

are *more* likely to complete an associate's degree, because they substitute enrollment away from four-year colleges into two-year colleges, and accumulate more credits at community colleges.

While all students who live in a community college desert are less likely to complete an associate's degree, their alternative enrollment and degree completion outcomes vary sharply by race-ethnicity and SES. For high-income and non-URM students, living farther from a two-year public college does not predict overall degree attainment, but predicts the *type* of degree a student completes: they are less likely to obtain an associate's degree but more likely to complete a bachelor's degree and accumulate credits in four-year colleges, because when these students live farther from community colleges they substitute enrollment into four-year universities. In contrast, economically disadvantaged and URM students living in a community college desert do not substitute towards the four-year sector and, in fact, are *less* likely to complete bachelor's degrees, implying that community colleges and the transfer opportunities they provide are an important pathway to bachelor's degree completion for underrepresented populations. As a result of reduced associate's and bachelor's degree completion, living in a community college desert is associated with 3.3 percentage point (16.9 percent of mean) and 2.6 percentage point (15.7 percent of mean) reductions in overall degree completion for URM and economically disadvantaged students, respectively. These effects persist over time, with similar gaps in credit accumulation and degree completion outcomes by race-ethnicity and SES occurring 4 to 8 years following high school graduation. We also explore the relationship between degree completion and distance to *four-year* universities, but do not find heterogeneity by race-ethnicity and SES. This implies that changing the spatial distribution of community colleges could be an important policy lever for closing racial-ethnic and income gaps in educational attainment – in a way that changing the spatial distribution of public four-year universities may not.

This current study is motivated by our prior research that examines the relationship between geographic proximity to college and initial postsecondary enrollment choices (Acton, Cortes, and Morales, 2024). In that paper, we show that students are sensitive to the distance they must travel to access public colleges; however, this relationship is heterogeneous across students' race-ethnicity and socioeconomic status. Specifically, White and non-economically disadvantaged students respond to living far from public two-year colleges primarily by enrolling in four-year colleges, whereas Black, Hispanic, and economically disadvantaged students respond primarily by forgoing college enrollment altogether.

We build on these previous findings in four key ways. First, this paper considers the relationship between geographic proximity to college and behavior following matriculation, such as credit accumulation and degree attainment. We also examine the extent to which these longer-term outcomes operate through enrollment or whether they persist conditional on initial entry to college. Second, we explore longer time horizons, enabling us to assess both the evolution of the *distance-enrollment* and *distance-degree* gradients up to seven years following high school graduation. Third, we estimate heterogeneous effects by students' academic preparation, thus allowing us to investigate the extent to which prior achievement moderates the predictive role of college proximity on postsecondary outcomes. Finally, while our prior study measured proximity to the nearest college in "as the crow flies" (i.e., the straight-line distance) miles, this paper uses driving distance as our main variable of interest to more accurately account for the time students must travel to reach a college campus.

Our work further brings together two main literatures. First, we contribute to the large literature on the determinants of race-ethnicity and income gaps in college enrollment and degree completion by considering how distance to college operates differently for URM and low-SES students relative to their more advantaged peers. Prior studies demonstrate that differences between groups in academic preparedness, financial and credit constraints, and informational barriers are predictive of these gaps (Bailey and Dynarski, 2011; Barr and Castleman, 2021; Belley and Lochner, 2007; Black, Cortes, and Lincove, 2015, 2020; Bleemer and Zafar, 2018; Cortes, and Lincove, 2016, 2019; Dynarski et al., 2022; Dynarski, Page, and Scott-Clayton, 2022; Flores et al., 2017; Hoxby and Turner, 2013; Lochner and Monge-Naranjo, 2012; Reber and Smith, 2023). However, disparities persist even after accounting for these factors, indicating a meaningful role of institutional and contextual determinants. Other work has highlighted how uncertainty and the complexity of navigating higher education in the United States can exacerbate educational inequities (see Dynarski, Nurshatayeva, Page, and Scott-Clayton, 2022 for a comprehensive review of non-financial barriers to college success). In addition, several studies have found promising results from comprehensive support interventions that aim to address many barriers at once (Weiss et al., 2019; Andrews, Imberman, and Lovenheim, 2020; Evans et al. 2020). To our knowledge, few interventions have targeted students whose primary barrier to college access and completion is geographic accessibility of college campuses, but our results imply that addressing these geographic barriers could be impactful.

Second, we contribute to an evolving literature on the importance of geographic proximity to colleges in students' decision-making and outcomes. Previous work has shown that distance matters for students' college decisions (Long, 2004; Griffith and Rothstein, 2009; Turley, 2009; Fu et al., 2022), particularly on the community college enrollment margin (Rouse, 1995; Mountjoy, 2022), and has shown that geographic *access* varies by race-ethnicity and SES (Hillman, 2016).[6] We add the novel insight that students' *sensitivity* to distance also varies by race-ethnicity and SES. This finding has implications for a large body of work that uses distance to college as an instrument for estimating the returns to education, a strategy proposed by Card (1995) and used in many subsequent studies (e.g., Cameron and Taber, 2004; Carneiro et al., 2011; Doyle and Skinner, 2016).[7] Our work gives insight into who the "compliers" for this instrument are and how their counterfactual outcomes differ by race-ethnicity and SES.

Specifically, our results suggest that if non-URM and high-SES students were to live closer to public two-year colleges, they would substitute four-year college enrollment for two-year college enrollment, becoming more likely to earn associate's degrees and less likely to earn bachelor's degrees (i.e., decreasing their educational attainment). In contrast, if URM and low-SES students were to live closer to public two-year colleges, they would be *more* likely to enroll in college, and more likely to earn both associate's and bachelor's, increasing their educational attainment. [8] That is, in the framework of Rouse (1995), living near a community college tends to "democratize" educational opportunity for URM and low-SES students, but at the same time, "divert" non-URM and high-SES students from completing four-year degrees. Given the stark differences in these counterfactual outcomes, using distance to a student's nearest public two-year college as an instrument for educational attainment is unlikely to satisfy the standard monotonicity assumption needed to interpret instrumental variables estimates as local average treatment effects (Imbens and Angrist, 1994). As such, we encourage researchers employing this approach to

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[6] Students may be especially sensitive to distance on the community college enrollment margin because community colleges in 38 states offer lower tuition rates for students residing within their local taxing areas or "districts" (Baker et al., 2023). Research by Denning (2017) and Acton (2021) demonstrates that residing within a taxing district increases community college enrollment, even when controlling for the distance to a community college campus.
[7] A related line of literature considers the effects of new college openings on enrollment and educational attainment. See, for example, Lapid (2017), which finds URM students respond more strongly to the opening of a new public four-year university, and Russel and Andrews (2022), which find that new universities increase intergenerational income mobility, but also may increase income inequality.
[8] See Mountjoy (2022) for a method of disentangling these two different complier margins.

separately analyze their population by race-ethnicity and/or SES, or to consider whether the monotonicity assumption can be relaxed in their setting (de Chaisemartin, 2017).

II. DATA SOURCES

A. Administrative Records from Texas K-12 and Higher Education Sectors

Our analysis draws upon individual-level records from the Texas Education Agency (TEA) containing detailed demographic and academic information covering the universe of K-12 students enrolled in public schools in the state. We define our analytic sample to be students who graduated from a public high school in Texas between 2013 and 2017. We observe a large set of demographic and academic background characteristics for these students, including their race-ethnicity, economic disadvantage status,[9] and 8th grade English Language Arts and math test scores, which are standardized within subject and cohort to have a mean of zero and standard deviation of one.[10] We use students' reported race-ethnicity and SES measured in their last year in high school to stratify our sample along these dimensions, and to construct an indicator for URM status by grouping Black, Hispanic, and students of "other" race-ethnicity.[11]

We link these records to administrative information from the Texas Higher Education Coordinating Board (THECB) capturing enrollment in all of Texas' public two-year and four-year postsecondary institutions, associated transcript information, and graduation records. Using these files, we construct our three key outcome measures: enrollment in a public two-year or four-year college, number of credits attempted, and degree completion by type (associate's vs. bachelor's degrees). We observe college enrollment and credits attempted from 2013 to 2020, and graduation records through 2021. Consequently, for the earliest high school graduation cohorts in our sample (2013-2014) who matriculated into any public college, we track their enrollment and credit accumulation outcomes up to seven years and their degree completion outcomes up to eight years. For cohorts that graduated between 2015 and 2017, the available data allows for progressively shorter follow-up periods. These differences in data coverage across cohorts do not pose a

[9] Economic disadvantage status is largely determined based on eligibility for free or reduced-price meals, though students may also qualify via eligibility for Temporary Assistance to Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), or other public assistance programs, or by having an annual family income below the official federal poverty line.
[10] We do not observe 8th grade test scores for approximately 11 percent of students. For these students, we impute their test scores to be the mean of their high school and graduation cohort and include a binary variable indicating whether we have imputed their math and/or English Language Arts test scores in our regression specifications.
[11] The "other" category includes students of multiple races, as well as native American and native Alaskan students.

significant issue when evaluating college enrollment, as most students enroll within 1-2 years of high school graduation, though they mechanically introduce a decline in the number of credits and the likelihood of degree attainment that can be observed for more recent cohorts.[12] We mitigate the implications of this data constraint by controlling for cohort fixed effects and therefore absorbing any cohort-specific differences in the number of years we can observe particular outcomes.

A second limitation of our data is the fact that we only track college outcomes among those who matriculate in public postsecondary institutions in the state, resulting in measurement error for those who attend private institutions and those who enroll in an out-of-state college. That said, these are arguably minor concerns in our context for several reasons. First, Texas has among the lowest outmigration rates in the U.S. both overall (Aisch and Gebeloff, 2014), and specifically among college-bound students (National Center for Education Statistics, 2019). For example, only about 5 percent of Texas high school graduates enroll in out-of-state postsecondary institutions (Texas Higher Education Coordinating Board, 2017), and just 4 percent of Texas high school graduates enroll in private colleges in the state. Further, the students who are most likely to have their college enrollment choices affected by the proximity of local colleges are unlikely to travel out of state or attend costly private colleges. Thus, we expect that any bias in our estimates due to these data restrictions is limited.

B. Texas High Schools and Colleges: Locations, Characteristics, and Distance Calculations

We supplement our individual-level data with information on the locations and characteristics of Texas high schools from the National Center for Education Statistics (NCES) Common Core of Data (CCD). The CCD records enable us to capture annual school-level information on urbanicity, total enrollment, school-wide resources (e.g., student-teacher ratio and Title I eligibility), and charter or magnet designation. We leverage this information, in conjunction with the student-level characteristics we observe in the TEA data, to construct school-by-cohort control variables.

Importantly, we use the CCD to identify a high school's exact location (latitude and longitude coordinates), which we use as a proxy for students' home addresses in our distance

[12] For example, among the earlier cohorts, students complete roughly 10 additional credits between years 4 and 7 following high school graduation, and are 3 to 4 percentage points more likely to complete a degree.

calculations.[13] We then use several data sources to collect information on the geographical locations of all public and private, not-for-profit two-year and four-year colleges in Texas, as of 2023. First, we obtain records on the latitudes and longitudes of all college campuses in the Integrated Postsecondary Education Data System (IPEDS), which includes all postsecondary institutions involved in federal student financial aid programs. However, because postsecondary institutions may report data from multiple campuses under one IPEDS observation, we supplement IPEDS records with individual campus locations reported in other sources, namely: the THECB, the American Association of Community Colleges (AACC), and the Texas Association of Community Colleges (TACC).[14] Together, these supplemental data sources enrich our set of college campuses significantly, more than doubling the number of two-year college campuses in the state from 65 reported in IPEDS to 169.[15] In total, we observe the locations of 244 college campuses: 169 public two-years, 37 public four-years, and 38 private four-years.

Figure 1 presents the locations of these 244 college campuses, overlaying county-level quartiles of the share of the youth population (aged 5-24) that is White, Black, and Hispanic, as well the child poverty rate and the percentage of households with broadband access, all of which we obtain from the U.S. Census Bureau. Both two-year and four-year college campuses are heavily concentrated around the "Texas Triangle" – the region covering the metropolitan areas of Dallas-Fort Worth, Houston, San Antonio, and Austin. This region tends to have larger shares of Black and Asian populations, lower rates of child poverty, and a greater share of households with access to broadband internet. Consequently, students in this region have access to more college campuses within a short driving distance from their homes. In contrast, there are far fewer college campuses in the southern and western regions of the state where there are high concentrations of Hispanic

[13] We use students' high school because our data does not contain their home addresses. While this does introduce some measurement error in our distance calculations, we believe they are minimal. For example, data from the National Household Travel Survey (NHTS) indicate that the median high school student in Texas lives 15 minutes away from school, and driving times are comparable for those in urban vs. rural areas (Federal Highway Administration, 2017).

[14] For example, Dallas College – which enrolls over 120,000 students annually – reports data to IPEDS under one observation, which includes the address of its administrative office. However, it is clear from the college's website that it operates seven distinct campuses (see: https://www.dallascollege.edu/about/pages/locations.aspx), some of which are upwards of 30 miles from each other. We collect the locations of these types of campuses via our supplementary sources.

[15] Appendix Figure A.1 shows the locations of these additional community college campuses, which are scattered throughout the state, but tend to be located in urban and suburban areas.

youth, higher rates of childhood poverty, and a lower share of households with access to broadband internet.

Finally, with the geocoordinates of all Texas high schools and colleges in hand, we calculate the average driving time between each high school and each college in Texas using Open Route Services and QGIS (Open Route Services, 2024; QGIS, 2024). For each student, we create measures of the time it would take them to travel to the closest two-year and four-year college. We prefer the driving time measure to "as the crow flies" distance measures, since it more accurately captures students' time cost of transportation, but we note that the two measures are so highly correlated that it does not alter our main results and conclusions (see Appendix Figure A.2).

III. Summary Statistics

A. Sample Characteristics

Table 1 provides summary statistics on the demographic, academic, and geographic backgrounds of our analytic sample. We disaggregate these statistics by students' race-ethnicity, economic disadvantage status, and whether their high school is located in an urban, suburban, or town/rural area, as classified by the NCES. Panel A highlights the socioeconomic and racial-ethnic diversity of our sample: 47.3 percent of students are categorized as economically disadvantaged and no racial-ethnic group makes up more than 50 percent of the sample, with 47.7 percent of students being Hispanic, 33.2 percent being White, 12.7 percent being Black, and 4.3 percent being Asian. A unique feature of Texas' large and diverse population is that this diversity persists into rural areas, where 44.9 percent of students are economically disadvantaged and 47.3 percent are White, 40.5 percent are Hispanic, and 8.5 percent are Black. Consistent with national data, we see that Black and Hispanic students are much more likely to be classified as economically disadvantaged, compared to their White and Asian peers, and are also more likely to receive special education services. Meanwhile, Hispanic and Asian students are the most likely to be classified as Limited English Proficiency (LEP).

Panel B summarizes students' academic preparation, as measured by end-of-grade standardized test scores in eighth grade, and characteristics of the high schools they attend. Black and Hispanic students tend to score lower on the standardized exams than their White and Asian peers, and economically disadvantaged students tend to score lower than their non-disadvantaged peers. In addition, students in rural and suburban areas tend to score higher than students in urban areas. Across subgroups, students in Texas attend large high schools, with an average enrollment in our sample of over 1800 – compared to a U.S. average of 850 (National Center for Education Statistics, 2012) – and the majority (73.7 percent) of students attend schools that are eligible for Title I funding.

Finally, Panel C of Table 1 provides information on the geographic contexts in which students in our sample live and their local access to public postsecondary institutions. Approximately 39 percent of our sample attend high schools in urban areas, 33 percent in suburban areas, and 28 percent in rural areas. The average student has access to a public two-year college within an approximately 15-minute drive of their high school and to a public four-year college within an approximately 29-minute drive. There is some variation in this access across race and ethnicity, with Asian students living closest to public colleges and universities, followed by Black, then Hispanic, then White students. However, as expected, the largest disparities in local proximity to postsecondary institutions occur between rural and urban/suburban areas. Rural students, on average, need to travel about twice as far as their urban and suburban peers to reach college campuses: 25 minutes to a public two-year campus and 46 minutes to a public four-year campus. As a result, over 30 percent of rural students live in a community college desert – meaning they do not have a public community college within 30 minutes of their high school – and nearly 75 percent of rural students live in a four-year university desert – meaning they do not have access to a public four-year university within a 30-minute radius. In contrast, less than 2 percent of urban and suburban students live in community college deserts and only 11 percent and 31 percent, respectively, live in a four-year university desert.[16]

B. Postsecondary Outcomes

Table 2 summarizes students' enrollment, persistence, and degree attainment within the Texas public higher education sector, measured six years following high school graduation.[17] First, Panel A measures whether a student ever enrolls in a public two-year or four-year (or either)

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[16] See Appendix Figure A.3 for more information on the number of colleges within 30- or 60-minutes driving time by demographic group and locality.

[17] For the 2016 and 2017 cohorts, for whom we do not observe all outcomes six years following high school graduation, we measure our outcomes at the latest point at which we observe them in the THECB data. We observe enrollment and credit-taking for five years following high school graduation for the 2016 cohort and for four years for the 2017 cohort. We observe degree completion for six years following high school graduation for the 2016 cohort and for five years for the 2017 cohort. Thus, our summary statistics in Table 1 likely slightly understate the mean six-year enrollment, credit-taking, and completion outcomes for the overall sample.

institution in Texas within six years of high school graduation. Overall, 59 percent of high school graduates in our sample enroll at some point, with 46.7 percent enrolling in a two-year college and 30 percent enrolling in a four-year college.[18] These enrollment rates are substantially higher for White and Asian students than for Black and Hispanic students, particularly in the four-year sector: 36.1 percent of White and 52.6 percent of Asian students enroll in a public four-year university, while only 23.8 percent of Hispanic and 29.1 percent of Black students do. Economically disadvantaged students are also less likely than their non-disadvantaged peers to enroll in public two-year and four-year colleges.

The enrollment disparities in Panel A persist to credit accumulation (Panel B) and degree completion (Panel C) outcomes. On average, Black and Hispanic students accumulate fewer credits – particularly at four-year colleges – than their White and Asian peers, as do economically disadvantaged students. Less than 20 percent of Black and Hispanic students earn *any* postsecondary credential within six years of high school graduation, whereas 30.4 percent of White and 45 percent of Asian students do. Similarly, non-disadvantaged students in Texas are nearly twice as likely (31 percent) as their economically disadvantaged peers (16.6 percent) to complete a college degree within six years of high school graduation.

Figure 2 complements Table 2 by showing how enrollment, credit accumulation, and degree completion patterns evolve for students of different racial-ethnic groups. For enrollment (Panel A), racial and ethnic disparities appear immediately in the year following high school graduation – with White and Asian students more likely to matriculate to two-year and, especially, four-year colleges – and persist over time. For credit accumulation (Panel B), racial and ethnic disparities also grow over time, suggesting that, even when URM students enroll in college, they take and accumulate fewer credits. Similarly, racial and ethnic disparities in degree completion grow over time, particularly for bachelor's degree completion, indicating that URM students are not just less likely to earn degrees in a timely manner, but less likely to earn them at all.

[18] These two-year and four-year enrollment rates need not sum to the overall college enrollment rate as students may enroll in both two-year and four-year colleges, e.g., by transferring from a community college to a four-year university.

IV. Empirical Strategy

We investigate the relationship between students' college outcomes (enrollment, credit accumulation, and degree completion) and their proximity to nearby public postsecondary institutions by estimating a series of multivariate regression models. The regression equations take on the following general form:

$$Y_{ist} = \alpha + \boldsymbol{Distance}_s\boldsymbol{\Gamma} + \boldsymbol{X}_i\boldsymbol{\Pi} + \boldsymbol{Z}_{st}\boldsymbol{\Phi} + \theta_t + \varepsilon_{ist} \quad (1)$$

where Y_{ist} denotes an outcome of interest for student i, who graduated from high school s, in year t. $\boldsymbol{Distance}_s$ corresponds to a vector capturing the driving time between high school s and the nearest two-year and four-year college.[19] We first examine the relationship between college proximity and various postsecondary outcomes using a non-linear specification, estimating models where we measure driving time to the nearest college in 5-minute intervals. Informed by the findings from this specification, we define community college "deserts" – binary indicators equal to 1 for students who live more than 30 minutes from the nearest two-year public college – and run models estimating the relationship between college outcomes and living in a community college desert.[20] In all regressions, our parameters of interest correspond to estimates of the coefficients captured by the $\boldsymbol{\Gamma}$ vector.

We include a large set of control variables to account for observable differences in confounding factors that predict both postsecondary outcomes and proximity to colleges. Variables measured at the student-level, captured by $\boldsymbol{X}_i$, include indicators for sex, race-ethnicity, economic disadvantage, Limited English Proficiency status, and 8th-grade test scores in ELA and math state assessments. Time-varying school-level characteristics, captured by $\boldsymbol{Z}_{st}$, include characteristics of the student population (race-ethnicity and economic disadvantage), as well as measures of resources, such as the student-teacher ratio and a school's eligibility for Title I funding. Finally,

[19] We also run regression equations where we measure college proximity in miles, as simply the straight-line (i.e., "as the crow flies") distance. Results are consistent with those estimated using driving time and are available upon request.

[20] Results from the nonlinear specifications examining the relationship between distance to the nearest four-year institution and postsecondary outcomes do not show significant differences by race-ethnicity nor SES. Therefore, our analyses following the "desert" specification primarily focus on community college deserts. Nevertheless, we conduct analogous analyses on four-year college deserts and show those results in Appendix Tables A.1, A.2, and A.3 for completeness.

we include year of high school graduation fixed effects, captured by θ_t, to account for secular trends in college outcomes across cohorts.

Our primary aim is to examine differences in the relationship between proximity to postsecondary institutions and college outcomes across race-ethnicity and SES. Consequently, we estimate regressions of the forms described above stratified by demographic and economic characteristics limiting the sample to one of six groups: White, Black, Asian, and Hispanic students, as well as economically disadvantaged and non-disadvantaged students. We also explore specifications comparing outcomes across URM and non-URM students where the former captures Black, Hispanic, and "other race-ethnicity" students, and the latter corresponds to White and Asian students.

Moreover, we conduct exploratory analyses on the role of initial enrollment as a mediating factor explaining differences in credit accumulation and degree attainment across groups. We obtain these results from augmented regression models in which we separately control for enrollment in two-year and four-year colleges, while noting differences in our main coefficients of interest ($\hat{\boldsymbol{\Gamma}}$) following the inclusion of these variables.

Lastly, we conduct supplemental heterogeneity analyses by student's academic preparation to assess the extent to which our results are driven by systematic differences in student performance prior to college enrollment.[21]

In all specifications, our point estimates capture systematic differences in college persistence and degree attainment across students who live at varying driving distances from the nearest two-year and four-year colleges. We control for a rich set of both observable student- and school-level characteristics capturing information related to the quality of the high school a student attended as well as their academic preparation, which correlate strongly with postsecondary enrollment and completion. Nevertheless, we acknowledge that this selection-on-observables approach limits the causal interpretation of our results, as there may be unmeasured confounding factors (e.g., motivation, expectations of future returns to postsecondary education, etc.) that are correlated with both distance to nearby colleges and postsecondary outcomes. To the extent that these unmeasured factors are unevenly distributed, and/or affect outcomes differently, across demographic groups, our results should be interpreted as descriptive differences rather than causal

[21] Specifically, we stratify our sample based on whether their combined average reading and math scores in 8th grade fall in the top quartile or bottom quartile of test scores by cohort.

effects. However, we believe that our results provide key insights on the association between college proximity and educational attainment across race and SES which can lay the groundwork for future work addressing selection concerns.

V. RESULTS

A. College Enrollment

We begin by extending our main result from Acton, Cortes, and Morales (2024): that URM and low-SES students make different *initial* college enrollment decisions when they live far from public two-year colleges than their non-URM and high-SES peers do. In Figure 3, we present estimates of the **Γ** coefficients and 95 percent confidence intervals from equation (1) for the driving time (hereafter referred to as simply distance) to a student's nearest public two-year college campus, binned in 5-minute intervals. We estimate these coefficients separately for three outcomes of interest: enrollment in public two-year colleges, enrollment in public four-year colleges, and enrollment in any Texas public postsecondary institution, all measured within one year of high school graduation. Across specifications, we control for the distance to students' nearest public four-year colleges, binned in 5-minute intervals, as well as our student- and school-level controls described in Section IV.

Panel A presents our results separately for White, Black, and Hispanic students.[22] We see that, for all racial and ethnic groups, as students live further away from a public two-year college, they are less likely to enroll in one. The coefficients grow larger and become statistically significant at conventional levels around the 30-minute distance interval, which forms the basis for our community college desert threshold in later regression specifications. However, as White and, to some extent, Black students live further away from public two-year colleges, they become more likely to enroll in public four-year colleges; that is, they substitute enrollment from the two-year to the four-year sector. Notably, the same pattern does not hold for Hispanic students. Thus, as Hispanic and, to some extent, Black students live further away from public two-year colleges, their overall likelihood of enrolling in college within a year of high school graduation decreases. Panel B of Figure 3 presents analogous results for economically disadvantaged and non-disadvantaged students. Similar to the racial and ethnic enrollment disparities shown in Panel A,

[22] Some of our result tables and figures do not show findings obtained from the subsample of Asian students due to their relatively smaller sample size and limited variation in college proximity, resulting in noisy point estimates.

we observe that both groups of students become less likely to enroll in public two-year colleges as they live further away from public two-year colleges, but only non-disadvantaged students respond to this distance by substituting towards four-year colleges. In contrast, living further from two-year colleges reduces overall college-going for economically disadvantaged students. These results imply that when considering *any* college enrollment, URM and economically disadvantaged students are *more elastic* with respect to distance than their non-URM and non-disadvantaged peers.

In Appendix Figure A.4, we present an analogous version of these results that estimates the effect of living further from public *four-year* colleges, while controlling for the distance to a student's nearest public two-year college, binned in 5-minute intervals. In contrast to the results in Figure 3, we observe that URM and non-URM (Panel A) and economically disadvantaged and non-disadvantaged (Panel B) students tend to respond similarly to living far from four-year colleges. All students are somewhat less likely to attend four-year colleges and somewhat more likely to attend two-year colleges when they live far from four-year colleges. Given that we are interested in understanding different responses to distance between racial-ethnic and socioeconomic groups, we concentrate the remainder of our results and discussion on community college deserts, but results for four-year college deserts are provided in the Appendix.

Next, Table 3 summarizes the magnitude of the relationships shown in Figure 3 by estimating how living in a community college desert (i.e., more than 30 minutes driving time away from the nearest public two-year college) affects initial college enrollment, first for the full sample (column 1) and then separately by URM (columns 2 and 3) and economic disadvantage (columns 4 and 5) status.[23][24] Panel A shows that living in a community college desert is associated with a 4-6 percentage point reduction in initial two-year college enrollment for all students, with somewhat larger magnitudes for URM and economically disadvantaged students. Panel B shows that non-URM and non-disadvantaged students who live in community college deserts substitute towards four-year colleges, increasing their enrollment by 4.4 and 3.7 percentage points, respectively. In contrast, URM and economically disadvantaged students do not; we estimate precise null effects

[23] Appendix Table A.1 presents analogous specifications for four-year college deserts. Consistent with our results in Appendix Figure A.4, we find that – for all subgroups – living in a four-year college desert is associated with a decreased probability of enrollment in four-year colleges and an increased probability of enrollment in two-year colleges, with little effect on overall college enrollment.

[24] The total number of observations does not match those in Table 1 because a few schools are missing data on the student-teacher ratios.

of living in a community college desert on their likelihood of enrolling in a public four-year college within a year of high school graduation. Thus, in Panel C, we see that living in a community college desert is associated with a 3.2 percentage point (6.5 percent of the mean) reduction in any college enrollment within a year of high school graduation for the sample overall, but this effect is largely driven by URM and economically disadvantaged students, for whom living in a community college desert is associated with a 5.9 and 5.4 percentage point reduction, respectively, in overall college enrollment.

Finally, Figure 4 presents our estimates of how the relationship between living in a community college desert and enrolling in college changes over time in the years following students' high school graduation. In Panel A, we see that the decrease in two-year and overall college enrollment for URM students – as well as the increase in four-year college enrollment for non-URM students – does not change substantially in magnitude in the years following high school graduation. Similarly, in Panel B, the decrease in two-year and overall college enrollment for economically disadvantaged students, and the increase in four-year college enrollment for non-disadvantaged students, is relatively stable from 1 to 7 years following high school graduation. That is, racial-ethnic and SES differences in *enrollment elasticity* with respect to living in a community college desert are persistent: URM and economically disadvantaged students do not "catch up" in later years to the enrollment levels of their non-URM and non-disadvantaged peers.

B. Credit-Taking Behavior

Having established differences in enrollment patterns between URM and non-URM and economically disadvantaged and non-disadvantaged students who live far away from public two-year colleges, we now estimate how distance to a student's nearest public two-year college affects progress through college, as measured by credit-taking behavior. First, we estimate how distance to the nearest public two-year college – binned in 5-minute intervals – affects the total number of credits a student attempts in the six years following high school graduation. We measure credits separately by those attempted at public two-year versus four-year colleges, as well as overall across the two sectors. In all regression specifications, we continue to control for the distance to a student's nearest public four-year college, binned in 5-minute intervals, and our preferred set of student- and school-level controls.

Figure 5 presents these results. In Panel A, we see that White, Black, and Hispanic students all accumulate fewer credits at two-year colleges as they live further away from them. This decrease in credit accumulation magnifies when students live more than 30 minutes from their nearest community college, which aligns with our definition of a community college desert. We then see that White and, to some extent, Black students respond to living further away from community colleges by accumulating more credits at public four-year colleges. However, Hispanic students do not make this substitution. As a result, Hispanic students accumulate fewer credits overall as they live further from community colleges, whereas White students do not.[25] Panel B shows analogous results splitting the sample by economic disadvantage status. Both economically disadvantaged and non-disadvantaged students accumulate fewer credits as they live further from community colleges, but only *non*-disadvantaged students substitute towards accumulating more credits at four-year colleges. These heterogeneous effects by race-ethnicity and SES are not present when we estimate the effects of living further from public four-year colleges, which we present in Appendix Figure A.5.

Table 4 summarizes the magnitude of the effects shown in Figure 5 by estimating how living in a community college desert affects credit accumulation six years following high school graduation, first for the full sample (column 1) and then separately by URM (columns 2 and 3) and economic disadvantage (columns 4 and 5) status.[26] Panel A shows that living in a community college desert is associated with a 3-4 credit (approximately 20 percent of the mean) reduction in six-year credit accumulation for all groups of students.[27] Panel B then shows that non-URM and non-disadvantaged students make up for that credit reduction by increasing credit accumulation at four-year colleges by 3-4 credits. However, URM and economically disadvantaged students do not make up for the credit reduction. If anything, for these students, living in a community college desert is associated with accumulating fewer credits at four-year colleges, though these estimates are noisy and not statistically different from zero at conventional levels. Lastly, Panel C shows that living in a community college desert does not meaningfully affect overall credit accumulation

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[25] There is no clear pattern for Black students, for whom we see some negative point estimates but wide confidence intervals that include zero.

[26] Appendix Table A.2 provides analogous results for four-year college deserts, showing that living in a four-year college desert is associated with reduced credit accumulation at four-year colleges and increased two-year credit accumulation. These effects are modest and of similar direction and magnitude across student subgroups.

[27] Note that mean credit accumulation includes students who accumulate zero credits, so the mean is lower than the credit accumulation of a typical enrolled student.

for non-URM and non-disadvantaged students but reduces accumulation by 4.76 credits (13.1 percent of mean) and 3.91 (12.2 percent of mean) credits for URM and economically disadvantaged students, respectively.

Finally, Figure 6 traces the effect of living in a community college desert on credit accumulation 1-7 years following high school graduation. In Panel A, we see that the decrease in two-year and overall credit accumulation for URM students – as well as the increase in four-year credits for non-URM students – begins immediately following high school graduation and grows in magnitude until 4-5 years following graduation, where it flattens out. Panel B shows the same trends in effect sizes for economically disadvantaged versus non-disadvantaged students.

C. Degree Attainment

So far, our results indicate that when URM and economically disadvantaged students live far away from community colleges, they are less likely to enroll in college and accumulate fewer college credits. We now assess how living further from community colleges affects students' longer-run educational attainment, as measured by degree completion. In Figure 7, we present the effects of distance, binned in 5-minute intervals, on degree completion six years following high school graduation, separately by race and ethnicity (Panel A) and economic disadvantage status (Panel B), continuing to control for the distance to a student's nearest public four-year college and our rich set of student- and school-level control variables.

Panel A first shows that, as students live further from community colleges, they are less likely to complete an associate's degree, with little heterogeneity across race and ethnicity. White and, to some extent, Black students, however, are more likely to complete bachelor's degrees as they live further from community colleges. Hispanic students are not. As a result, Hispanic and, to some extent, Black students who live further from community colleges, are less likely to complete *any* postsecondary degree within six years of high school graduation. Stated differently, living near a community college is an important predictor of overall degree attainment for URM students, in a way that it is not for White students. Panel B of Figure 7 provides analogous results for economically disadvantaged and non-disadvantaged students. We see that, while all students are less likely to complete associate's degrees when they live further from community colleges, only non-disadvantaged students are more likely to complete a bachelor's degree in response. Once again, these heterogeneous effects are not present when we consider distance to four-year colleges, which we show in Appendix Figure A.6.

Table 5 summarizes the results shown in Figure 7 by estimating the effect of living in a community college desert on six-year degree completion outcomes.[28] Panel A shows that, across all subgroups of students, living in a community college desert is associated with a 2.3-2.9 percentage point reduction in the likelihood of obtaining an associate's degree. These effects are large relative to the mean associate's degree completion rates, representing a reduction of 31 percent of the mean in the overall sample. Panel B then shows that living in a community college desert is associated with a 1.3-2.2 percentage point *increase* in bachelor's degree completion for non-disadvantaged and non-URM students, but a 1.1-1.4 percentage point *decrease* in bachelor's degree completion for URM and economically disadvantaged students. This contrast is striking: not only are White and non-disadvantaged students more likely to complete bachelor's degrees when they live in community college deserts, but Black, Hispanic, and disadvantaged students are *less* likely to do so. This finding suggests that access to community colleges and the transfer opportunities these institutions provide are a particularly important pathway to bachelor's degree completion for URM and lower SES students.[29]

Panel C of Table 5 shows the effect of living in a community college desert on the likelihood that a student earns any degree (i.e., associate's or bachelor's degree). Overall, students who live in a community college desert are 1.5 percentage points (6.2 percent of mean) less likely to complete *any* postsecondary credential. However, this effect is completely driven by URM and economically disadvantaged students who are 3.3 percentage points (16.9 percent of mean) and 2.6 percentage points (15.7 percent of mean), respectively, less likely to complete a degree when they live in a community college desert.

One potential explanation for the results in Table 5 is that URM and economically disadvantaged students, on average, have lower test scores than their White and non-disadvantaged peers (see Table 1) and students with lower levels of academic preparation may respond differently

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[28] Appendix Table A.3 estimates analogous effects of living in four-year college deserts on degree completion. Living in a four-year college desert is associated with increased associate's degree attainment, with slightly larger effects for URM and economically disadvantaged students, but has little to no effect on bachelor's degree or overall degree attainment across groups.

[29] We note that while increases in transfer opportunities likely increase bachelor's degree completion rates, they may not translate to positive longer-term outcomes. Miller (2024) finds that among academically marginal two-year college students who apply to transfer to four-year colleges, those who are admitted and transfer earn less 11-15 years later than those who are denied admission.

to living far from community colleges than their more academically prepared peers. While we control linearly for students' test scores across specifications, if test scores have non-linear relationships with our outcomes that vary by race-ethnicity and SES, our results in Table 5 may reflect differences between academically prepared and less prepared students, rather than differences across race-ethnicity and SES. We assess the role of this potential confounding factor in Figure 8, where we split the sample not only by URM and economic disadvantage status but also by test score quartile. We then present the effects of living in a community college desert on degree completion for URM/non-URM and economically disadvantaged/non-disadvantaged students in the top and bottom quartile of the test score distribution. Our results show that after splitting the sample by URM or economic disadvantage status, there are no statistically significant differences in how students in the bottom versus the top of the test score distribution students respond to living in a community college desert: URM and low-income students, regardless of academic preparation, are less likely to earn *any* degree when they live in a community college desert, whereas White and higher-income students, both in the bottom and top test score quartile, are more likely to earn bachelor's degrees when they do. This implies that our main finding of larger negative effects of living in a community college desert on degree completion for URM and economically disadvantaged students compared to their White and non-disadvantaged peers is *not* driven by differences in academic preparedness as measured by standardized test scores, but rather Black, Hispanic, and economically disadvantaged students' *sensitivity* to distance to postsecondary institutions.

Our final set of degree completion results reported in Figure 9 shows the dynamic effects of living in a community college desert, 1 to 8 years following high school graduation. In both Panels A and B, we see that for all students, the negative effect of living in a community college desert on associate's degree completion begins 2 years following high school graduation, grows in magnitude until about 4 years following graduation, and then remains stable up to 8 years following graduation. For non-URM and non-disadvantaged students, we see the positive effect of living in a community college desert on bachelor's degree completion appear 4 years following graduation and grows modestly to six years following graduation. For URM and economically disadvantaged students, the negative effect on degree completion evolves analogously. The overall degree completion results reflect the different dynamics for associate's and bachelor's degree completion: initially, both URM and non-URM and economically disadvantaged and non-disadvantaged students are less likely to earn postsecondary degrees when they live in community college deserts. However, beginning 4 years following high school graduation, non-URM and non-disadvantaged students begin earning bachelor's degrees, bringing their overall effect on degree completion towards zero. This pattern makes sense since earning a bachelor's degree typically takes four years whereas an associate's degree can be completed in two years. Meanwhile, for URM and economically disadvantaged students, the negative effect of living in a community college desert on overall degree completion continues to grow in magnitude until about six years following high school graduation.

D. Mechanisms: Initial Enrollment vs. Persistence

Taken together, our results show that when URM and economically disadvantaged students live in community college deserts, they are less likely to enroll in college, accumulate credits, and earn degrees. From a policy perspective, it may be useful to understand how much of these degree completion effects can be explained by students' initial enrollment choices versus students' persistence towards degree attainment following initial college enrollment. For example, if the gaps in degree attainment are largely explained by initial enrollment choices, policymakers can target interventions towards high school students that may boost college enrollment, whereas if the gaps in degree attainment are driven by differences in progress in college post-enrollment, policymakers may wish to concentrate interventions towards college students themselves.

To decompose the degree attainment results from Table 5 into a component that can be explained by initial enrollment choices, and a component that cannot (e.g., a persistence component), we estimate alternative regression specifications that explicitly control for students' initial enrollment choices, within two years of high school graduation.[30] We then compare the community college desert effect in these alternative specifications to our main effects in Table 5, attributing any change in the coefficient to the role of initial enrollment choices. We note that these results should not be interpreted causally, not only because of the caveats about confounding factors mentioned in Section IV, but also because we are now conditioning on an endogenous variable (initial enrollment). As such, we do not claim that our results tell us what would happen to degree attainment if we changed students' initial enrollment choices. Rather, we view these

[30] As Figure 2 demonstrates, college enrollment rates tend to flatten out two years following high school graduation. Thus, our enrollment controls largely capture students' overall college enrollment in the years following high school graduation.

results as indicative of how much of the overall degree attainment effect is coming through the enrollment channel.

Table 6 presents our results. First, in columns (1) and (2) of Panel A, we see that, for the overall sample, the community college desert effect on associate's degree completion reduces in magnitude from 2.7 to 1.4 percentage points when we control for students' initial enrollment decisions. Thus, differences in initial enrollment between students who do and do not live in community college deserts explain approximately 48 percent of the community college desert effect on associate's degree completion. This decomposition is similar when we look solely at URM (columns 3 and 4) or economically disadvantaged (columns 5 and 6) students, where initial enrollment decisions explain about 50 percent and 56.5 percent of the overall community desert effect. Our findings align closely with prior research demonstrating that disparities in college enrollment rates by income explain roughly half the gap in degree completion, attributing the remaining half to differences in persistence across groups (Duncan and Murnane, 2011).

In Panel B, we see that initial enrollment choices explain much less of the negative community college desert effect on bachelor's degree completion for URM and economically disadvantaged students. For URM students, the negative effect of living in a community college desert on a bachelor's degree reduces in magnitude from 1.4 to 1.1 percentage points when controlling for initial enrollment decisions, implying that initial enrollment explains approximately 28.6 percent of the effect. For economically disadvantaged students, the effect decreases from 1.1 to 0.8 percentage points when controlling for initial enrollment, implying a 27.3 percent explanation.

Finally, Panel C decomposes the community college desert effect on overall degree completion into a component that can be explained by initial enrollment and a component that cannot. For the sample overall, 20 percent of the difference in degree completion between students who do and do not live in community college deserts can be explained by initial enrollment choices. However, for URM and economically disadvantaged students, 42.4 percent to 46.4 percent of this gap can be explained by initial enrollment.

VI. CONCLUSION

Our study highlights a novel finding: that the distance to community colleges impacts enrollment and degree completion differently across race-ethnicity and SES. For URM and low-

SES students, proximity to community colleges is a strong predictor of whether they complete any postsecondary degree (extensive margin). Put differently, when considering *overall* college enrollment and degree completion, URM and economically disadvantaged students are more elastic with respect to distance than their non-URM and non-disadvantaged counterparts. This finding suggests that access to nearby community colleges plays a crucial role in facilitating higher education opportunities for these students, likely due to the affordability and accessibility that community colleges provide. On the other hand, for White and higher-income students, the distance to community colleges influences degree completion at the intensive margin. Specifically, when these students live farther from community colleges, they are more likely to complete a bachelor's degree, as they tend to substitute enrollment in community colleges with enrollment in four-year institutions. This substitution effect increases their likelihood of completing more education and bachelor's, rather than associate's degrees (intensive margin). While previous researchers have studied in isolation both the demand- and supply-side determinants of college enrollment and degree attainment, we are the first to theoretically integrate and document empirically both of these determinants with regards to how college proximity shapes disparities in enrollment and degree attainment by demographic groups. Specifically, differences by race-ethnicity and SES in both *access* to local college options and students' *sensitivity* to distance can influence postsecondary outcomes at the extensive and intensive margins.

These findings also underscore the importance of considering geographic accessibility in educational policy, particularly when aiming to reduce racial-ethnic and socioeconomic disparities in degree attainment in the U.S. Thus, policies that enhance access to community colleges for URM and low-income students could have a significant impact on increasing overall degree completion rates among these groups. For example, the placement (or openings) of community colleges within racially and economically diverse areas of a state is potentially a powerful policy-lever in mitigating the existing inequalities in both college attendance and degree completion for URM and low-income students. Prior work studying community college openings in Texas has found that even small changes in the distance students must travel to the nearest community colleges can make a difference: Miller (2023) focuses on recent community college openings in suburban Texas and finds increases in associate's degree completion rates for students whose driving distance to their nearest college decreases by about 10 minutes. However, more research is needed to understand the potential effects of changes in community college access on students in rural areas (where there have not been recent openings).

Our findings also suggest different policy interventions are needed *either* targeting high school or college students or *both* depending on the policy objective of the region or state. For example, if a policymaker's goal is to increase the number of URM and low-income students at four-year colleges then a hybrid intervention that targets both high school students at the stage of application (e.g., outreach and awareness campaigns) in combination with a post-enrollment retention strategy (e.g., strengthen persistence programs within the university) might generate the desired policy outcome. In Texas, for example, under the Top 10% Plan, the selective flagship institutions – Texas A&M University (TAMU) and UT-Austin (UT) – implemented the Century Scholars (CS) Program at TAMU, and the Longhorn Opportunity Scholarship (LOS) Program at UT to recruit and retain high achieving low-income students across the state. Specifically, the goal of the CS program was to enroll and retain top students from underrepresented Texas high schools. The CS program provided both scholarship funds as well as support systems via learning communities at TAMU. Similarly, LOS program at UT offered financial assistance, mentoring and tutoring support services to students from high schools that did not historically place many students at UT. Andrews, Imberman, and Lovenheim (2020) conduct a thorough analysis of both programs. They find that while the CS program did not affect enrollment at TAMU, the LOS program at UT did show promising effects on both enrollment and graduation at UT. Their findings suggest that a well-designed program that includes effective outreach efforts in combination with adequate campus supports can achieve the intended policy goal. A similar intervention that targets barriers faced by URM and low-income students who live in a community college desert (for example, by offering free transportation to local colleges) could be worthwhile.

Lastly, future research could explore the long-term effects of these enrollment patterns on employment and earnings, as well as the role of college proximity in students' varied pathways through college (Andrews, Li, and Lovenheim, 2014). Future work may also consider how the impact of college proximity might change as two-year and four-year institutions continue to evolve their degree offerings (Field, 2024). Additionally, targeted interventions, possibly through randomized controlled trials, could provide further insights into effective strategies for mitigating the impact of distance on degree completion.

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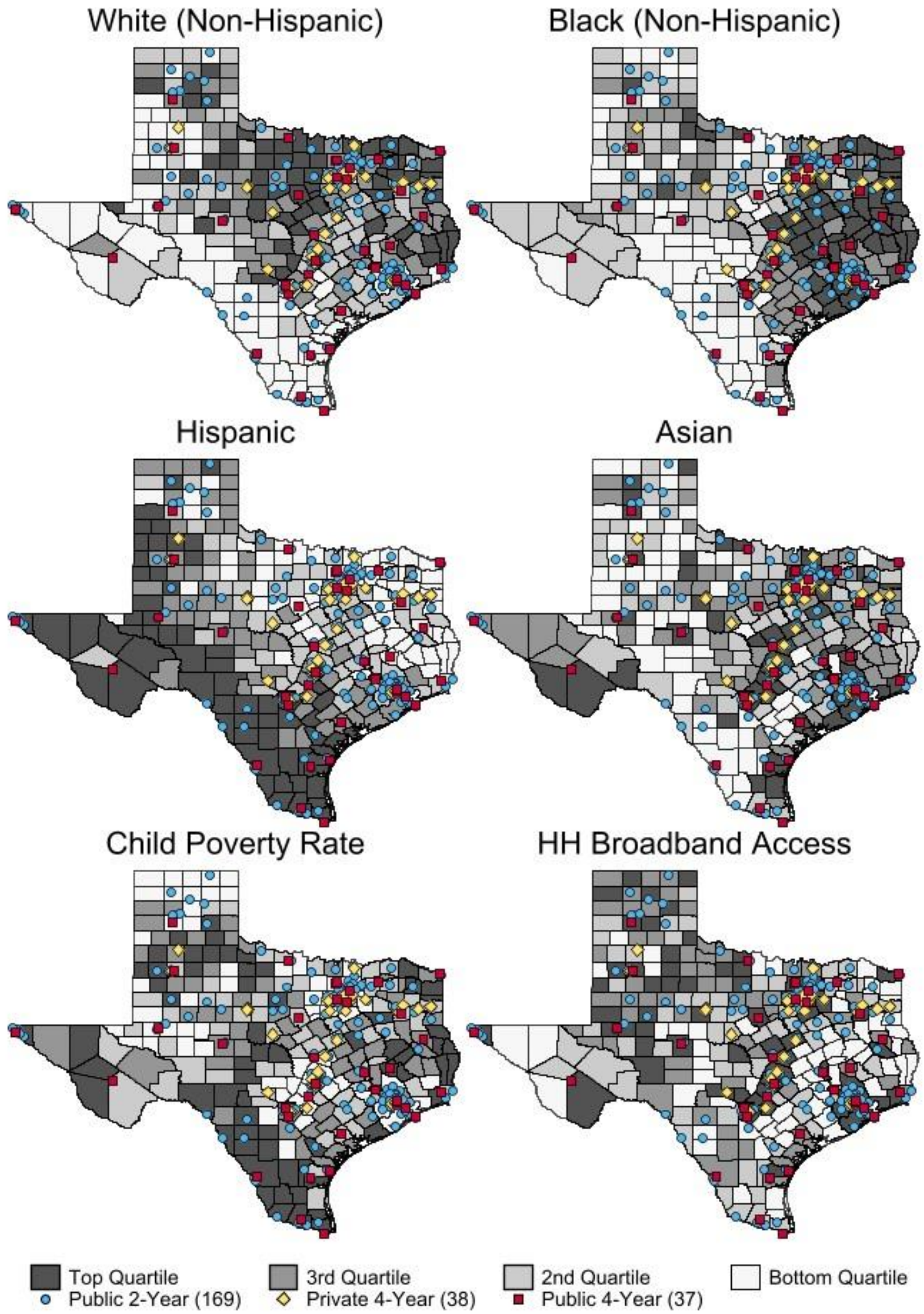
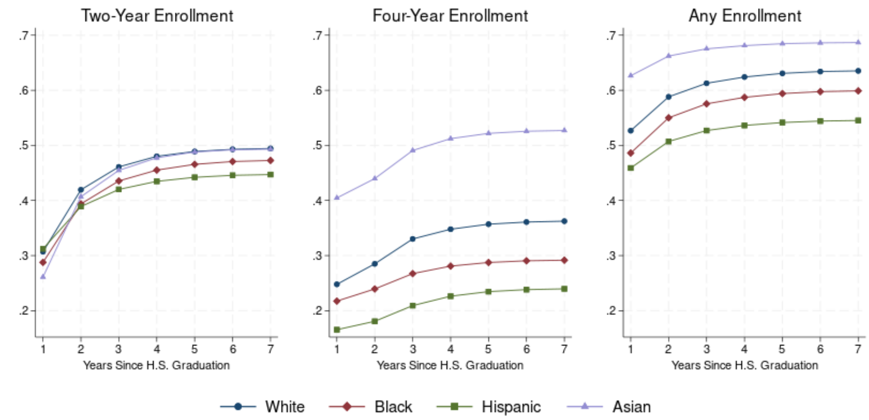
Figure 1: Spatial Distribution of Texas Higher Education Institutions



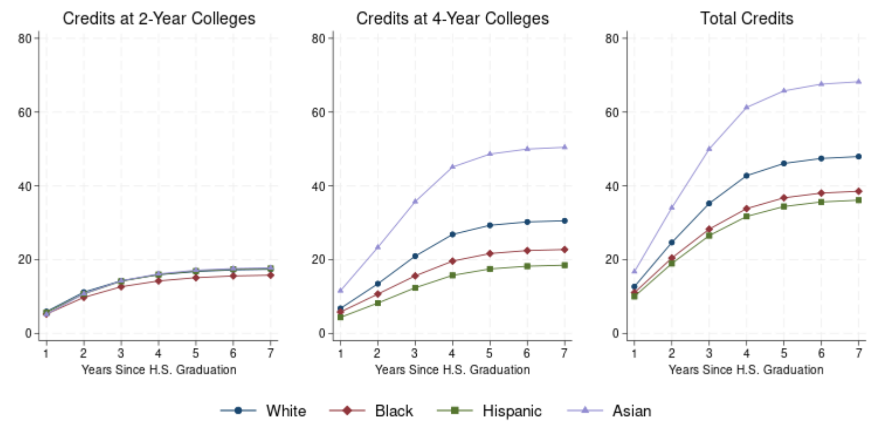
Notes: This figure plots the location of each public two-year, public four-year, and private four-year postsecondary institution campus in Texas. Each subfigure overlays the locations on various county characteristics (share of youth population by race-ethnicity, child poverty rate, and percent of households with broadband access), which we measure in quartiles.

Figure 2: Evolution of College Outcomes After High School, by Race-Ethnicity

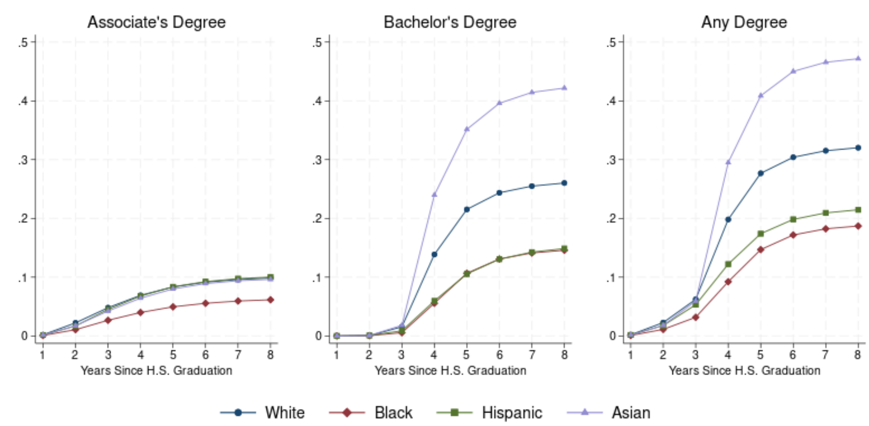
Panel A. Enrollment



Panel B. Credit Accumulation



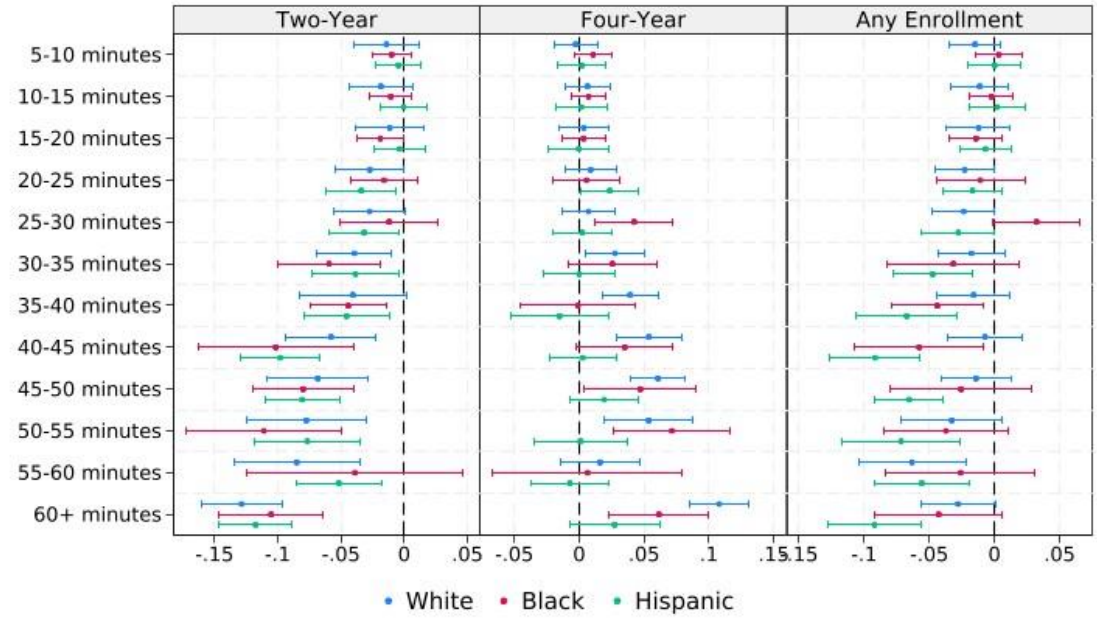
Panel C. Degree Completion



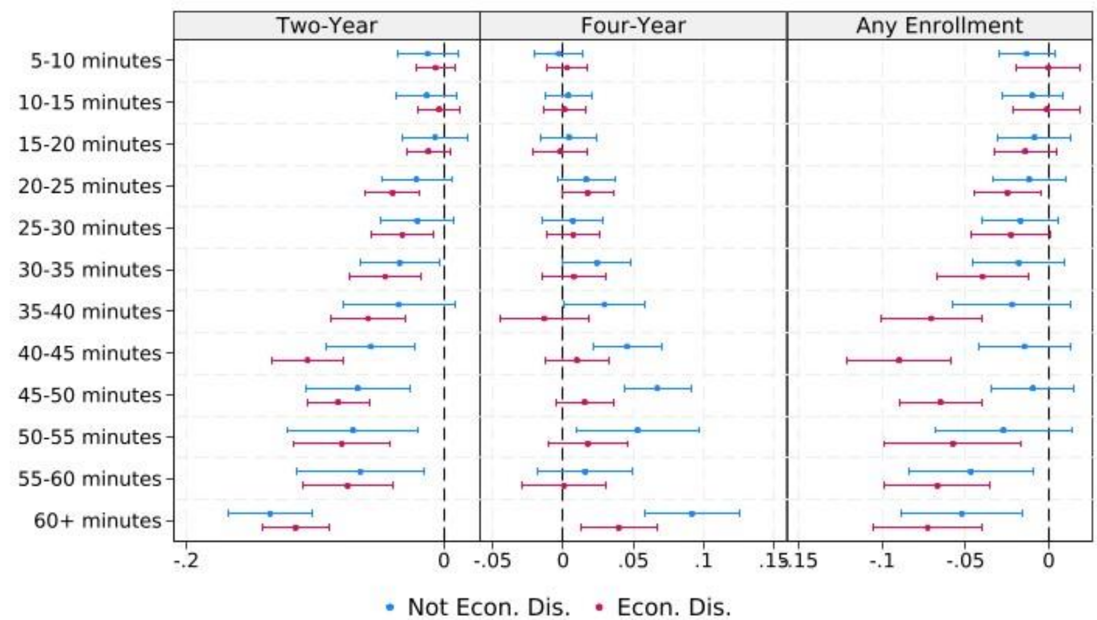
Notes: Variables are summarized over our sample of 2013-2017 Texas high school graduates. We exclude students classified as “other race/ethnicity"

Figure 3: Two-Year College Distance and Initial College Enrollment

Panel A. By Race-Ethnicity



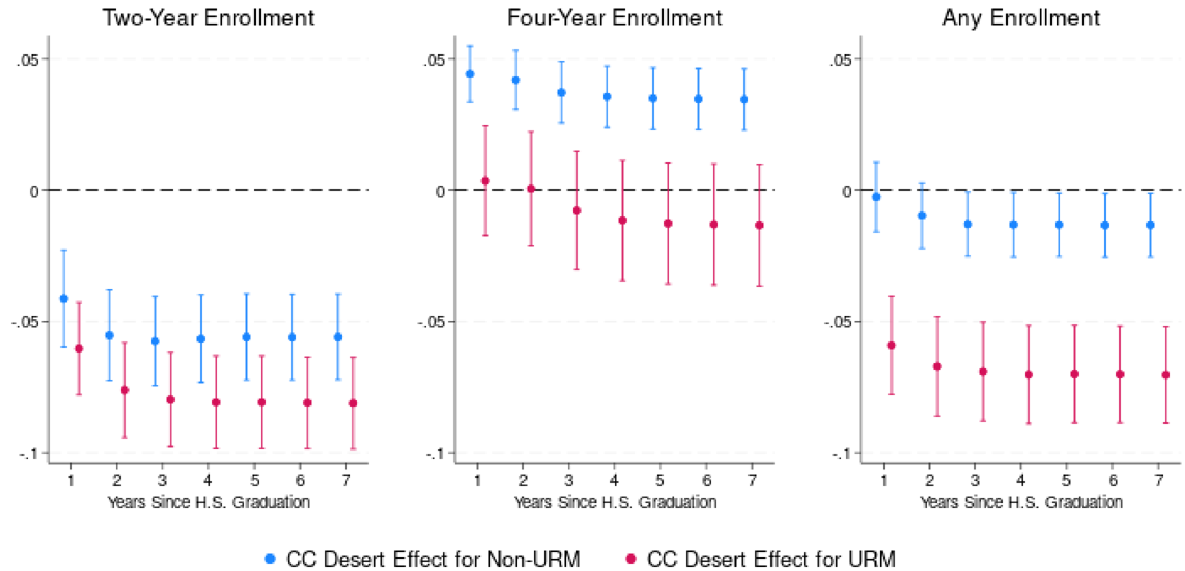
Panel B. By Economic Disadvantage Status



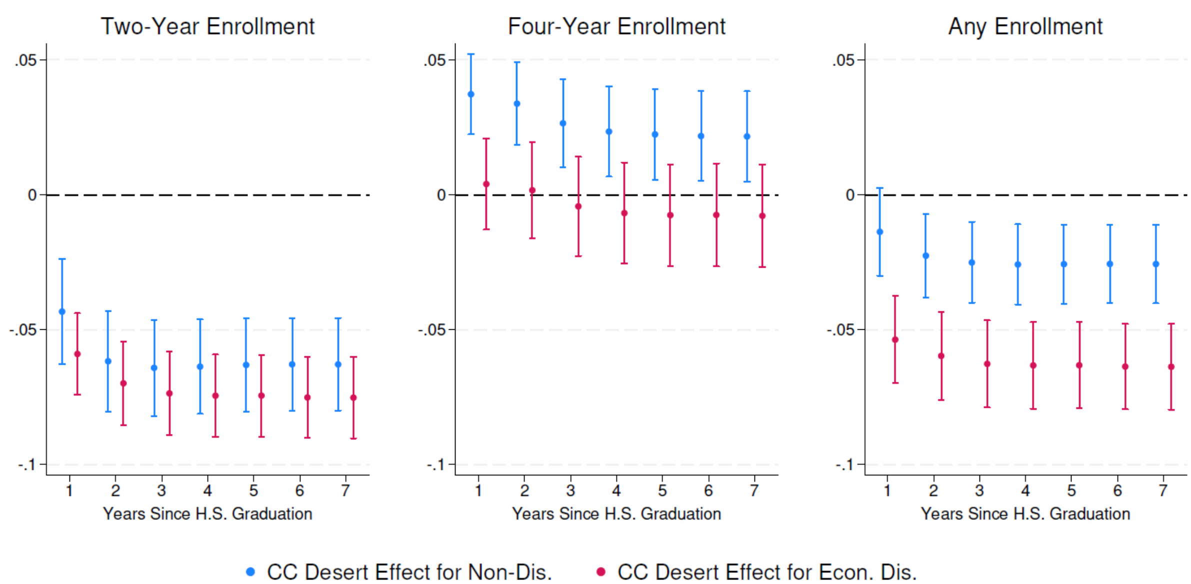
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public two-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Figure 4: Effect of Living in a Community College Desert on College Enrollment

Panel A. By URM Status



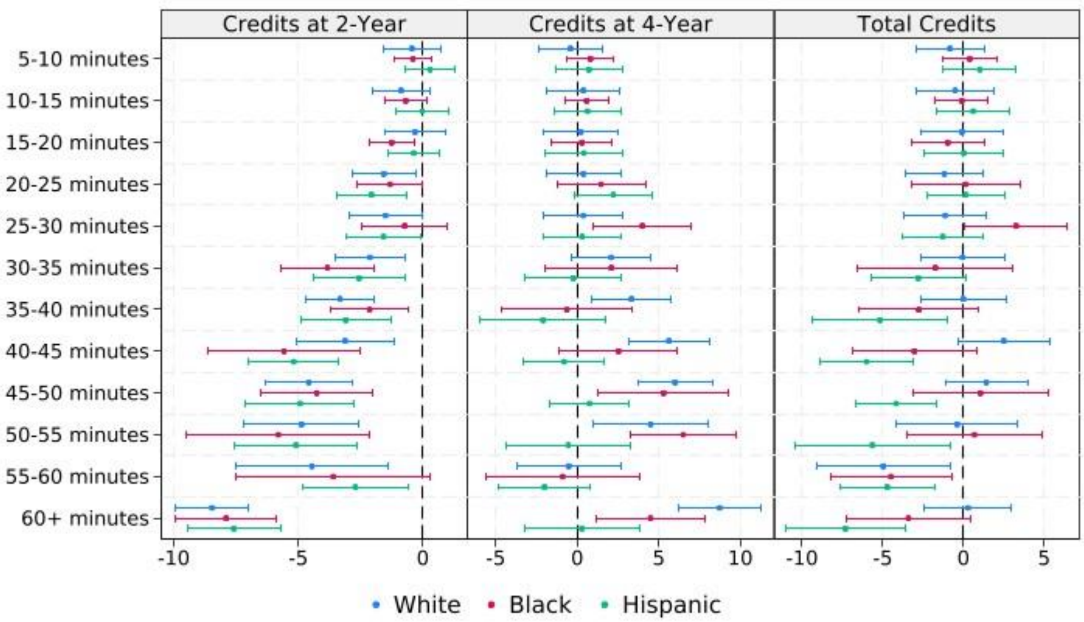
Panel B. By Economic Disadvantage Status



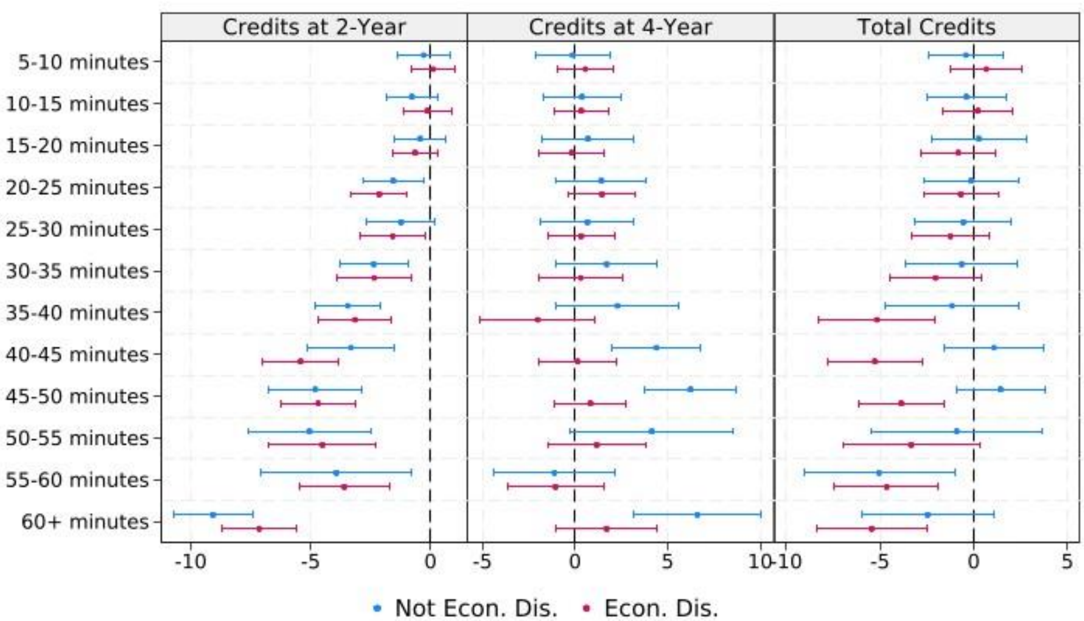
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students. Non-URM students include White and Asian students. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student’s nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Figure 5: Two-Year College Distance and Six-Year Credit Accumulation

Panel A. By Race-Ethnicity



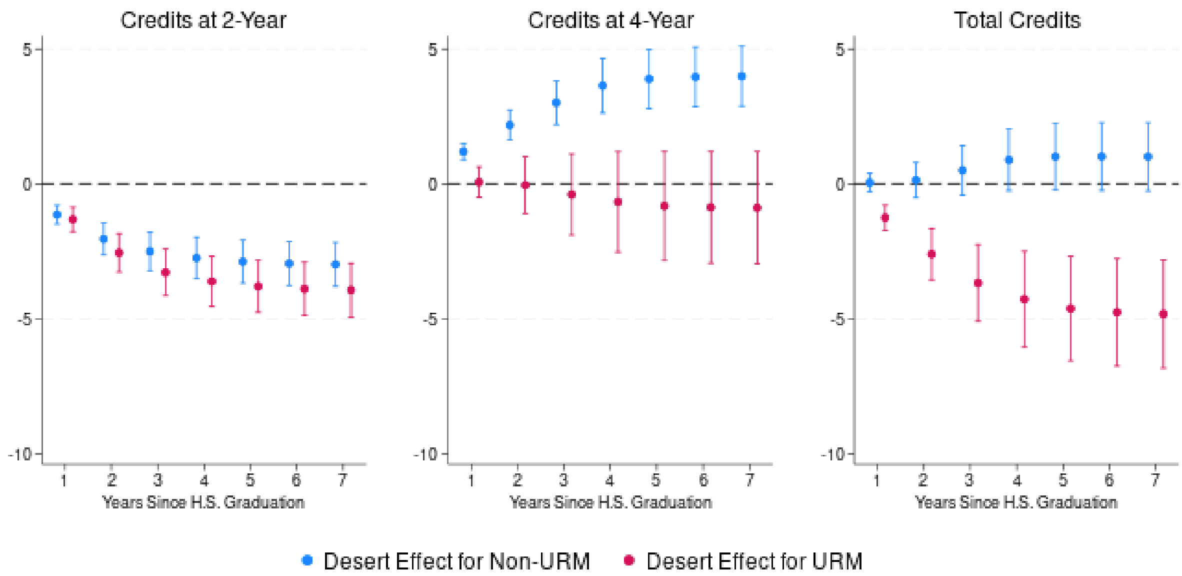
Panel B. By Economic Disadvantage Status



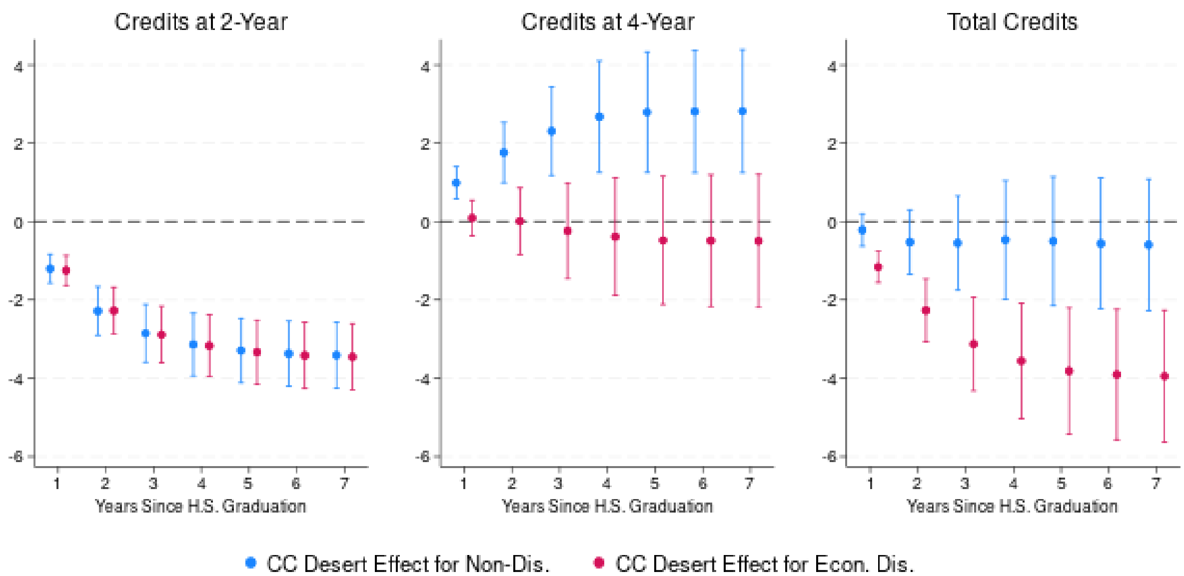
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public two-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Figure 6: Effect of Living in Community College Desert on Credit Accumulation

Panel A. By URM Status



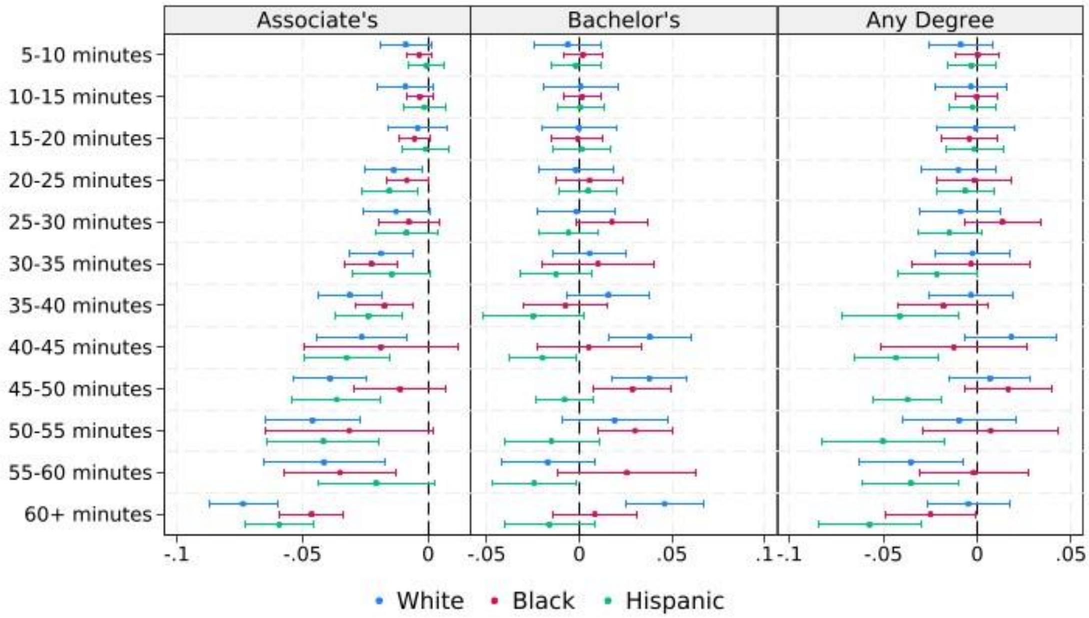
Panel B. By Economic Disadvantage Status



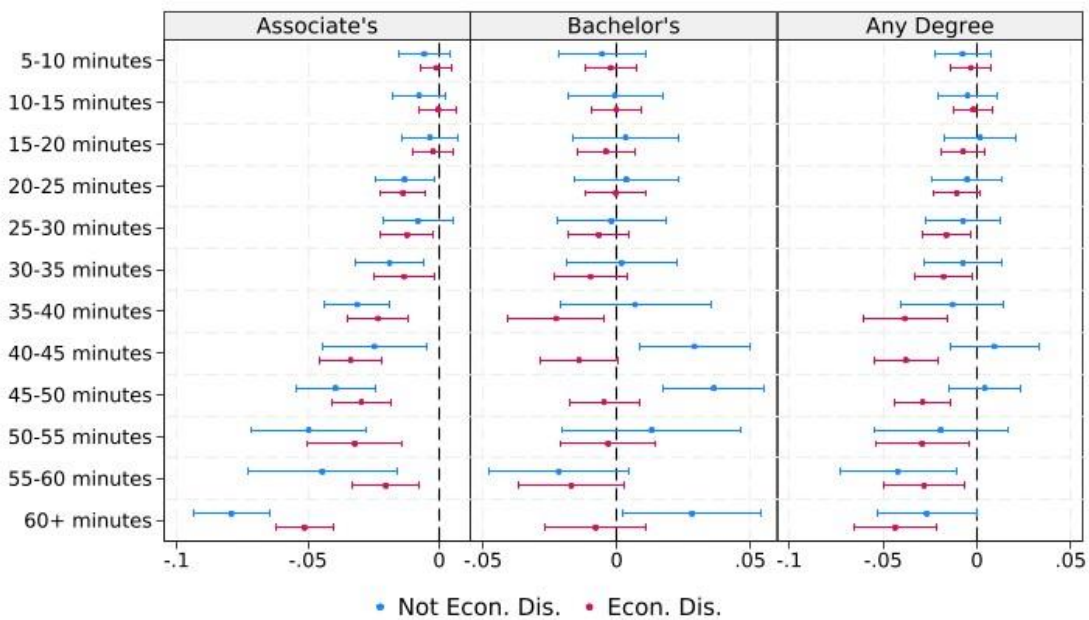
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students. Non-URM students include White and Asian students. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables Standard errors are clustered at the high school district level.

Figure 7: Two-Year College Distance and Six-Year Degree Completion

Panel A. By Race-Ethnicity



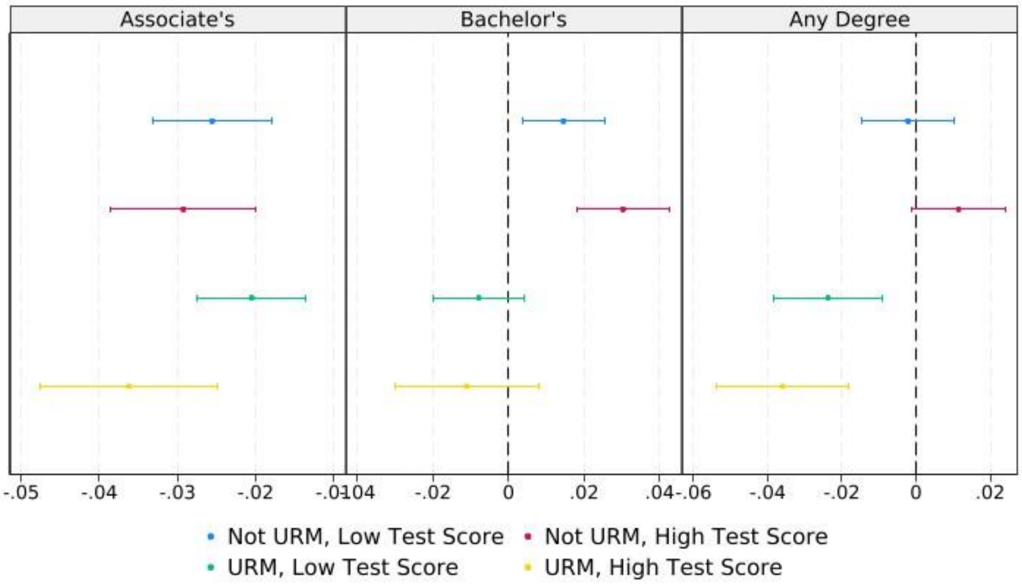
Panel B. By Economic Disadvantage Status



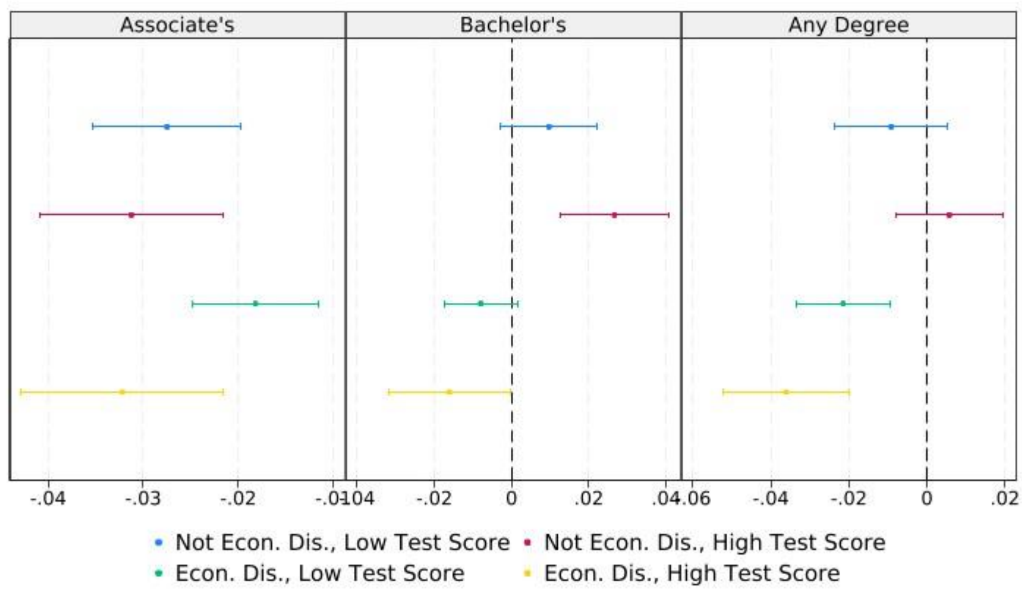
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public two-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Figure 8: Heterogeneous Effects of Living in a Community College Desert on Six-Year Degree Completion

Panel A. By URM Status and Test Score



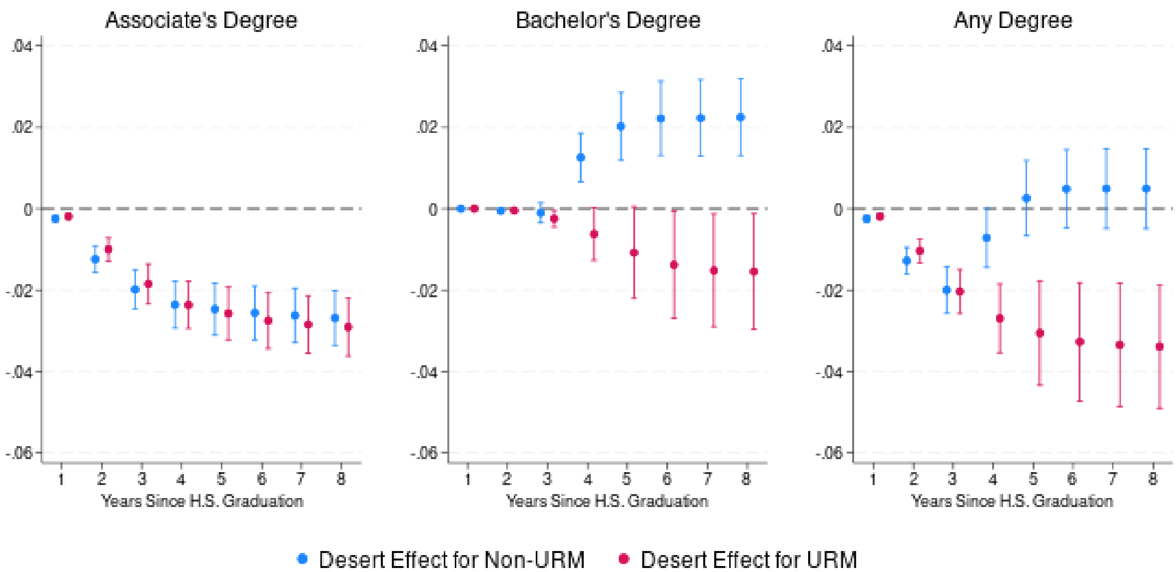
Panel B. By Economic Disadvantaged Status and Test Score



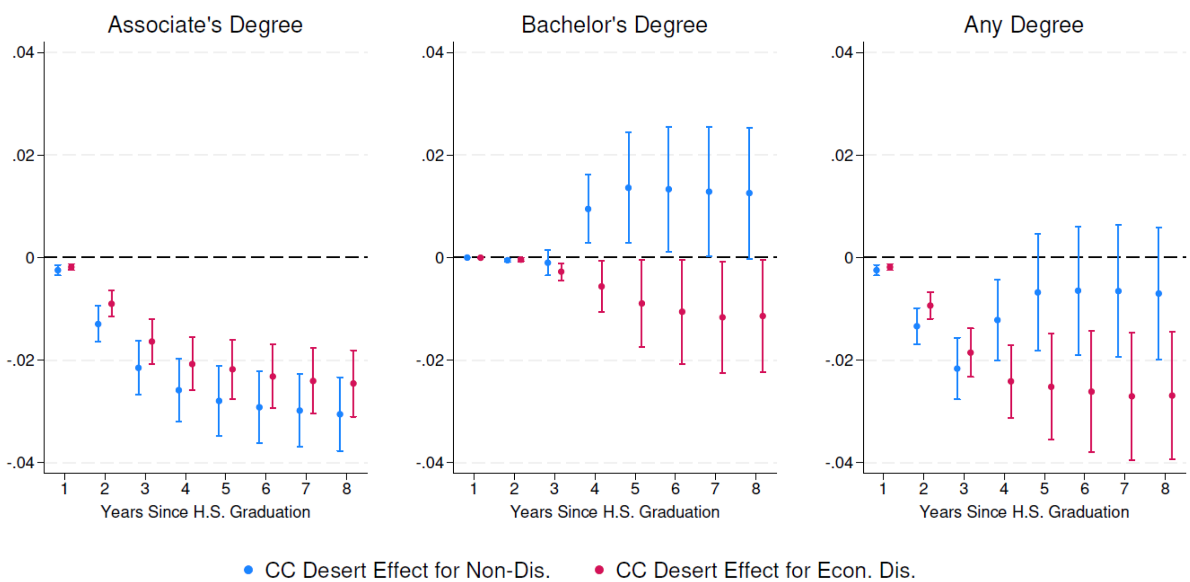
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students. "Not URM students include White and Asian students. “High” and “Low” test score groups correspond to the top and bottom quartile of a cohort’s 8th grade combined math and ELA test score distribution. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student’s nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Figure 9: Effect of Living in Community College Desert on Degree Attainment

Panel A. By URM Status



Panel B. By Economic Disadvantage Status



Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students. Non-URM students include White and Asian students. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student’s nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Table 1: Demographic, Academic, and Geographic Characteristics

	(1) All	(2) White	(3) Black	(4) Hispanic	(5) Asian	(6) Econ. Dis.	(7) Not Econ. Dis.	(8) Urban	(9) Suburban	(10) Town/ Rural
Panel A: Demographic Characteristics										
Economically Disadvantaged	0.473	0.187	0.595	0.661	0.310	1.000	0.000	0.541	0.412	0.449
White	0.332	1.000	0.000	0.000	0.000	0.131	0.512	0.217	0.349	0.473
Black	0.127	0.000	1.000	0.000	0.000	0.159	0.097	0.139	0.147	0.085
Hispanic	0.477	0.000	0.000	1.000	0.000	0.667	0.307	0.578	0.418	0.405
Asian	0.043	0.000	0.000	0.000	1.000	0.028	0.056	0.047	0.061	0.015
Other Race	0.021	0.000	0.000	0.000	0.000	0.015	0.027	0.019	0.025	0.022
Limited English Proficiency (LEP)	0.057	0.005	0.009	0.103	0.109	0.096	0.022	0.077	0.052	0.034
Special Education	0.081	0.075	0.123	0.079	0.025	0.102	0.061	0.081	0.072	0.090
Panel B: Academic Background										
Reading Test Score (8th grade)	0.114	0.247	0.022	0.030	0.233	0.003	0.213	0.071	0.150	0.132
Math Test Score (8th grade)	0.059	0.194	-0.103	-0.011	0.242	-0.034	0.142	0.015	0.087	0.089
H.S. Enrollment	1886	1751	1979	1905	2417	1789	1973	2019	2369	1142
H.S. Student/Teacher Ratio	15.63	15.22	15.87	15.74	16.72	15.46	15.77	16.34	16.42	13.72
H.S. is Title I School	0.737	0.556	0.823	0.865	0.514	0.896	0.594	0.775	0.629	0.809
Panel C: Geographic Context										
Urban	0.392	0.256	0.431	0.475	0.435	0.448	0.341	1.000	0.000	0.000
Suburban	0.326	0.343	0.379	0.286	0.465	0.284	0.364	0.000	1.000	0.000
Town/Rural	0.282	0.402	0.190	0.239	0.100	0.268	0.295	0.000	0.000	1.000
Minutes to Public Two-Year	15.23	18.12	13.07	14.02	12.60	14.58	15.82	10.34	12.31	25.43
Minutes to Public Four-Year	29.28	33.98	25.89	27.19	25.52	28.17	30.27	19.54	26.72	45.79
Public Two-Year in 30 min.	0.906	0.852	0.950	0.925	0.981	0.913	0.900	0.986	0.995	0.692
Public Four-Year in 30 min.	0.647	0.496	0.732	0.726	0.715	0.700	0.599	0.889	0.685	0.266
Observations	1,563,036	518,984	197,844	745,834	66,787	739,326	823,710	612,667	509,801	440,568

Notes: Variables are summarized over our sample of 2013-2017 Texas high school graduates, as measured in their final year of high school. The number of observations shown in columns (2) - (5) do not add up to the number in column (1) because we exclude the "Other race/ethnicity" column (N=33,587).

Table 2: Six-Year Educational Outcomes by Student and High School Characteristics

	(1) All	(2) White	(3) Black	(4) Hispanic	(5) Asian	(6) Econ. Dis.	(7) Not Econ. Dis.	(8) Urban	(9) Suburban	(10) Town/ Rural
Panel A: Enrollment										
Public Two-Year	0.467	0.493	0.471	0.446	0.492	0.422	0.507	0.449	0.491	0.465
Public Four-Year	0.300	0.361	0.291	0.238	0.526	0.214	0.376	0.292	0.317	0.290
Any Public Institution	0.588	0.634	0.598	0.544	0.686	0.516	0.653	0.572	0.611	0.585
Panel B: Credit Accumulation										
Public Two-Year	17.11	17.21	15.59	17.42	17.60	16.04	18.06	16.07	18.09	17.41
Public Four-Year	24.27	30.23	22.47	18.23	49.99	16.08	31.63	23.61	26.18	22.99
Any Public Institution	41.38	47.45	38.06	35.65	67.59	32.12	49.69	39.68	44.27	40.40
Panel C: Degree Completion										
Associate's Degree	0.087	0.091	0.055	0.092	0.089	0.079	0.094	0.078	0.090	0.095
Bachelor's Degree	0.181	0.244	0.131	0.131	0.396	0.107	0.247	0.169	0.199	0.176
Any Degree	0.242	0.304	0.172	0.198	0.450	0.166	0.310	0.225	0.262	0.243
Observations	1,563,036	518,984	197,844	745,834	66,787	739,326	823,710	612,667	509,801	440,568

Notes: Variables are summarized over our sample of 2013-2017 Texas high school graduates, as measured in their final year of high school. The number of observations shown in columns (2) - (5) do not add up to the number in column (1) because we exclude the "Other race/ethnicity" column (N=33,587).

Table 3: Effects of Living in a Community College Desert on Initial College Enrollment

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Enrollment in Public Two-Years		
Community College Desert	-0.050***	-0.041***	-0.060***	-0.043***	-0.059***
	(0.008)	(0.009)	(0.009)	(0.010)	(0.008)
Mean: y-var	0.305	0.302	0.306	0.316	0.292
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Enrollment in Public Four-Years		
Community College Desert	0.023***	0.044***	0.004	0.037***	0.004
	(0.008)	(0.005)	(0.011)	(0.008)	(0.009)
Mean: y-var	0.211	0.266	0.178	0.262	0.154
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Overall Enrollment		
Community College Desert	-0.032***	-0.003	-0.059***	-0.014*	-0.054***
	(0.008)	(0.007)	(0.010)	(0.008)	(0.008)
Mean: y-var	0.493	0.538	0.466	0.548	0.431
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics (economic disadvantage, race and ethnicity, at-risk for dropout, gifted, immigrant status, LEP status, sex, special education, CTE enrollment), 8th grade standardized math and ELA test scores, high school characteristics (total enrollment, % of each race and ethnicity, % economic disadvantage, % at-risk for dropout, % gifted, % immigrant, % LEP, % special education, % CTE enrollment, city/suburb/rural indicator, student/teacher ratio, charter dummy, magnet dummy, Title I dummy), and the driving distance to a student's nearest public four-year university in 5-minute bins. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

Table 4: Effects of Living in a Community College Desert on Six-Year Credit Accumulation

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Credits at Public Two-Years		
Community College Desert	-3.455***	-2.953***	-3.892***	-3.374***	-3.421***
	(0.392)	(0.411)	(0.502)	(0.425)	(0.427)
Mean: y-var	17.11	17.26	17.02	18.06	16.04
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Credits at Public Four-Years		
Community College Desert	1.432*	3.963***	-0.868	2.812***	-0.488
	(0.772)	(0.564)	(1.053)	(0.798)	(0.858)
Mean: y-var	24.27	32.49	19.35	31.63	16.07
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Total Credits		
Community College Desert	-2.023**	1.010	-4.760***	-0.562	-3.909***
	(0.804)	(0.642)	(1.013)	(0.853)	(0.848)
Mean: y-var	41.38	49.74	36.37	49.69	32.12
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

Table 5: Effects of Living in a Community College Desert on Six-Year Degree Completion

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Associate's Degree		
Community College Desert	-0.027***	-0.026***	-0.028***	-0.029***	-0.023***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Mean: y-var	0.087	0.091	0.084	0.094	0.079
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Bachelor's Degree		
Community College Desert	0.003	0.022***	-0.014**	0.013**	-0.011**
	(0.005)	(0.005)	(0.007)	(0.006)	(0.005)
Mean: y-var	0.181	0.261	0.133	0.247	0.107
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Any Degree		
Community College Desert	-0.015**	0.005	-0.033***	-0.006	-0.026***
	(0.006)	(0.005)	(0.007)	(0.006)	(0.006)
Mean: y-var	0.242	0.321	0.195	0.310	0.166
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

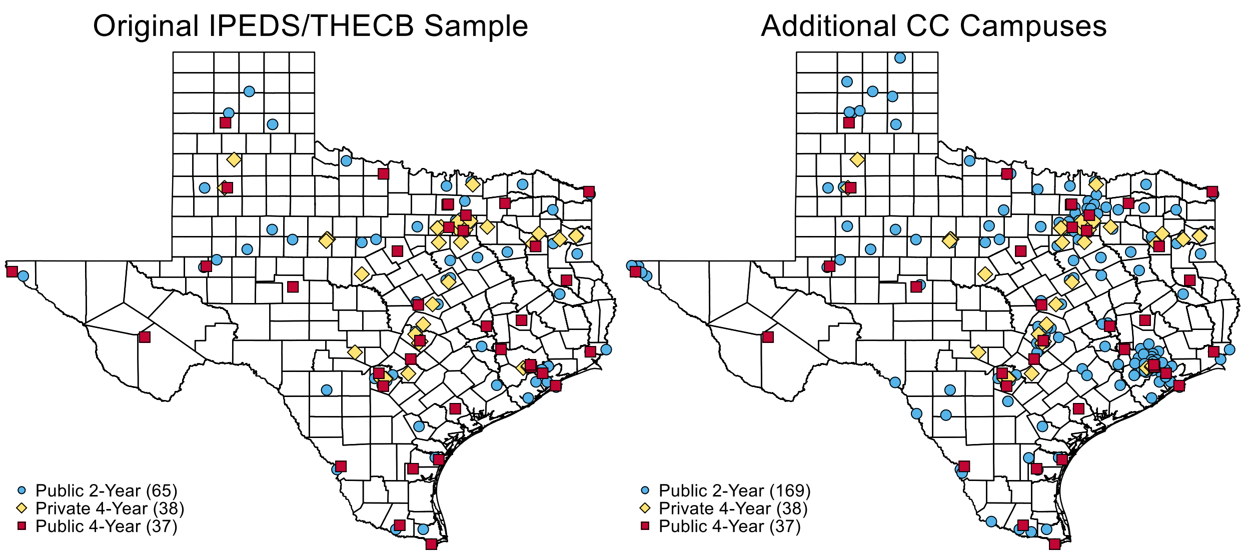
Table 6: Effects of Living in a Community College Desert on Six-Year Degree Completion, Controlling for Initial Enrollment

	All (1)	**All** (2)	***% Explained by Enrollment***	**URM** (3)	**URM** (4)	***% Explained by Enrollment***	**Econ. Dis.** (5)	**Econ. Dis.** (6)	***% Explained by Enrollment***
Panel A: Associate's Degree									
Community College Desert	-0.027***	-0.014***	***48.1%***	-0.028***	-0.014***	***50.0%***	-0.023***	-0.010***	***56.5%***
	(0.003)	(0.002)		(0.003)	(0.003)		(0.003)	(0.003)	
Enrolls in Public Two-Year		0.185***			0.184***			0.185***	
		(0.003)			(0.004)			(0.004)	
Enrolls in Public Four-Year		-0.045***			-0.037***			-0.030***	
		(0.002)			(0.002)			(0.002)	
Mean: y-var	0.087	0.087		0.084	0.084		0.079	0.079	
Observations	1,556,381	1,556,381		972,792	972,792		735,732	735,732	
Panel B: Bachelor's Degree									
Community College Desert	0.003	-0.003	---	-0.014**	-0.010***	***28.6%***	-0.011**	-0.008***	***27.3%***
	(0.005)	(0.002)		(0.007)	(0.003)		(0.005)	(0.002)	
Enrolls in Public Two-Year		0.068***			0.053***			0.049***	
		(0.002)			(0.002)			(0.002)	
Enrolls in Public Four-Year		0.544***			0.477***			0.449***	
		(0.008)			(0.007)			(0.006)	
Mean: y-var	0.181	0.181		0.133	0.133		0.107	0.107	
Observations	1,556,381	1,556,381		972,792	972,792		735,732	735,732	
Panel C: Any Degree									
Community College Desert	-0.015**	-0.012***	***20.0%***	-0.033***	-0.019***	***42.4%***	-0.026***	-0.014***	***46.2%***
	(0.006)	(0.003)		(0.007)	(0.004)		(0.006)	(0.003)	
Enrolls in Public Two-Year		0.197***			0.187***			0.187***	
		(0.003)			(0.004)			(0.003)	
Enrolls in Public Four-Year		0.499***			0.440***			0.418***	
		(0.007)			(0.006)			(0.005)	
Mean: y-var	0.242	0.242		0.195	0.195		0.166	0.166	
Observations	1,556,381	1,556,381		972,792	972,792		735,732	735,732	

Notes: Students are classified as living in a "community college desert" if there is no public two-year college within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public four-year university in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Columns (2), (4), and (6) additionally control for whether a student enrolls in a public two-year or four-year college within two years of high school graduation. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

APPENDIX FIGURES & TABLES

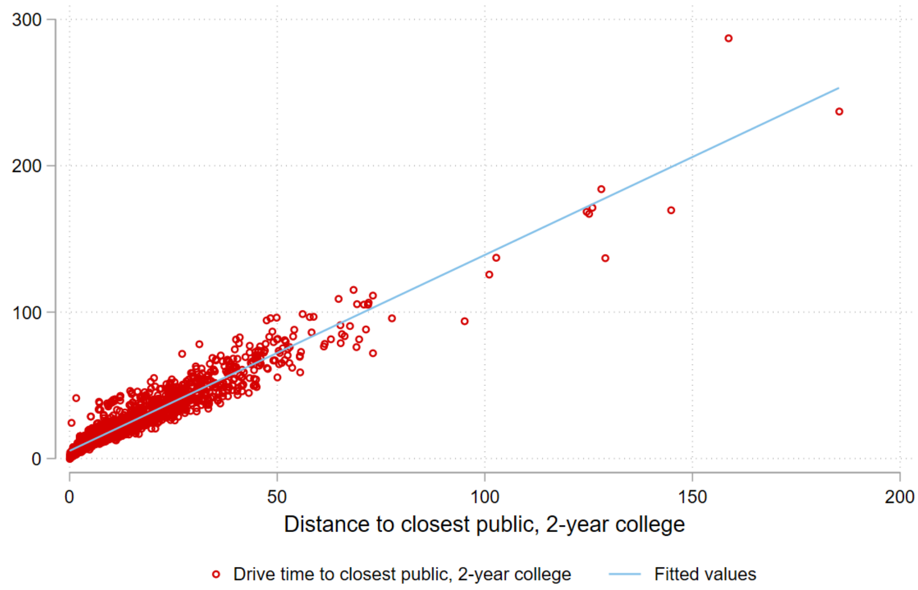
Appendix Figure A.1: Additional Community College Campuses



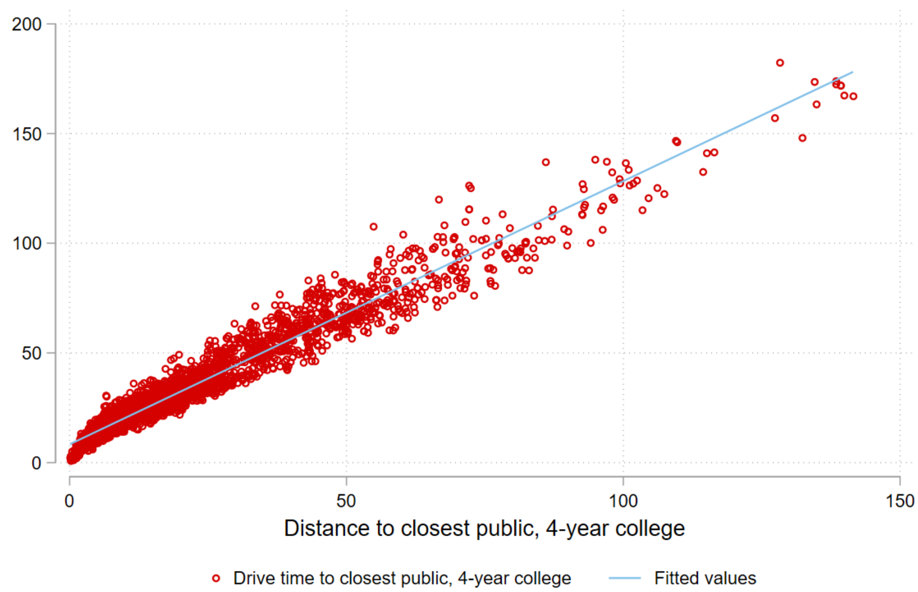
Notes: These figures show the locations of public two-year, public four-year, and private four-year college campuses in Texas. The figure on the left only uses geographic information in the Integrated Postsecondary Education System (IPEDS), while the panel on the right uses additional supplementary sources described in the text.

Appendix Figure A.2: Correlation Between Linear Distance and Driving Time

Pane A. Distance to Nearest Public Two-Year College



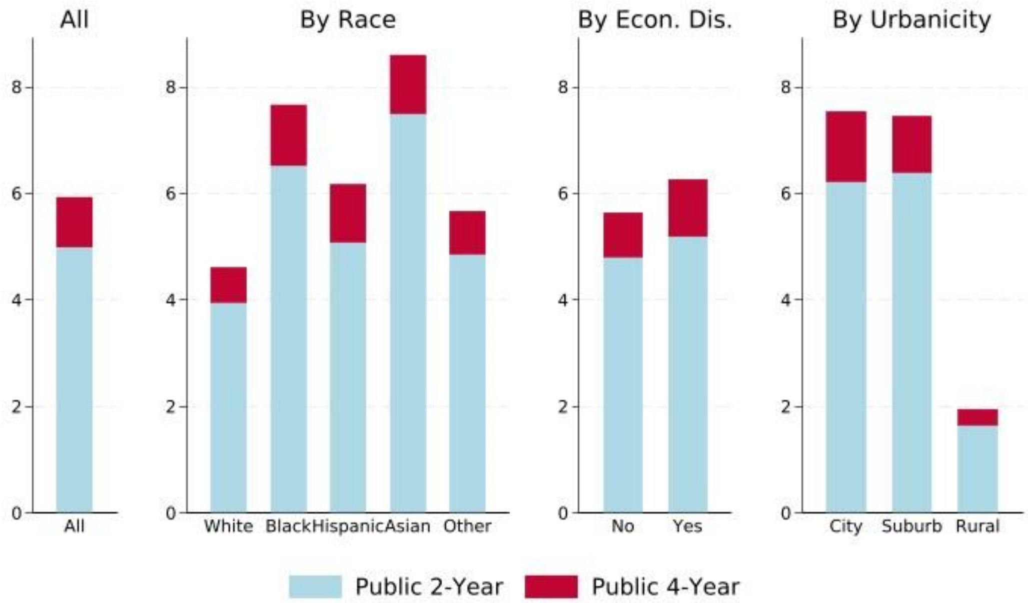
Panel B. Distance to Nearest Public Four-Year College



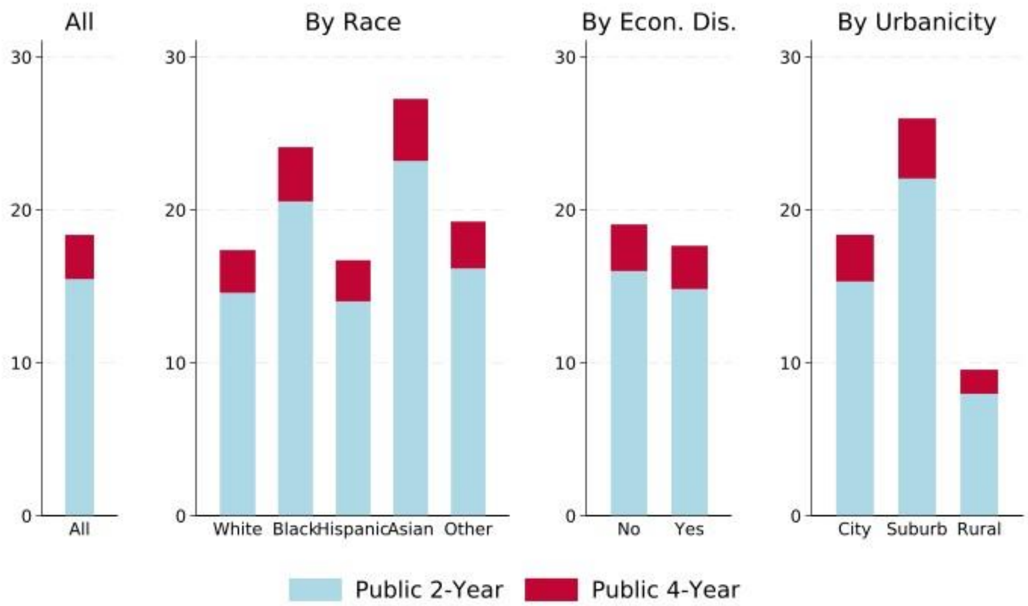
Notes: These figures show the distance from each Texas high school to its nearest public two-year (Panel A) and public four-year (Panel B) college campus, measured in straight ("as the crow flies") miles on the x-axis and, our preferred measure, driving time in minutes, on the y-axis. The correlation in Panel A is 0.964 and the correlation in Panel B is 0.975.

Appendix Figure A.3: Number of Proximate Colleges by Demographic Characteristics

Panel A. Colleges Within 30 Minutes Driving Time



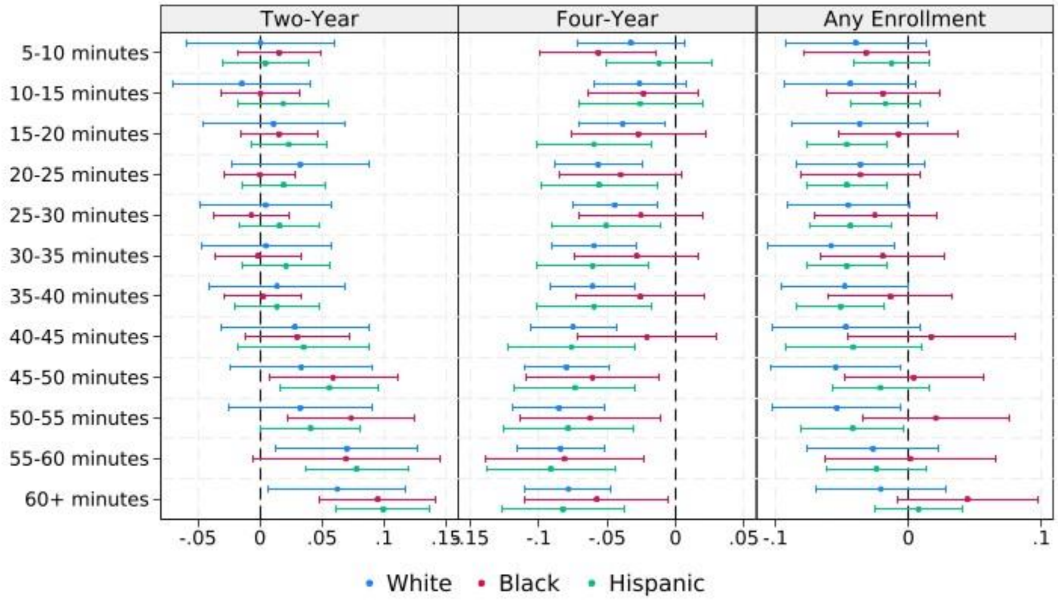
Panel B. Colleges Within 60 Minutes Driving Time



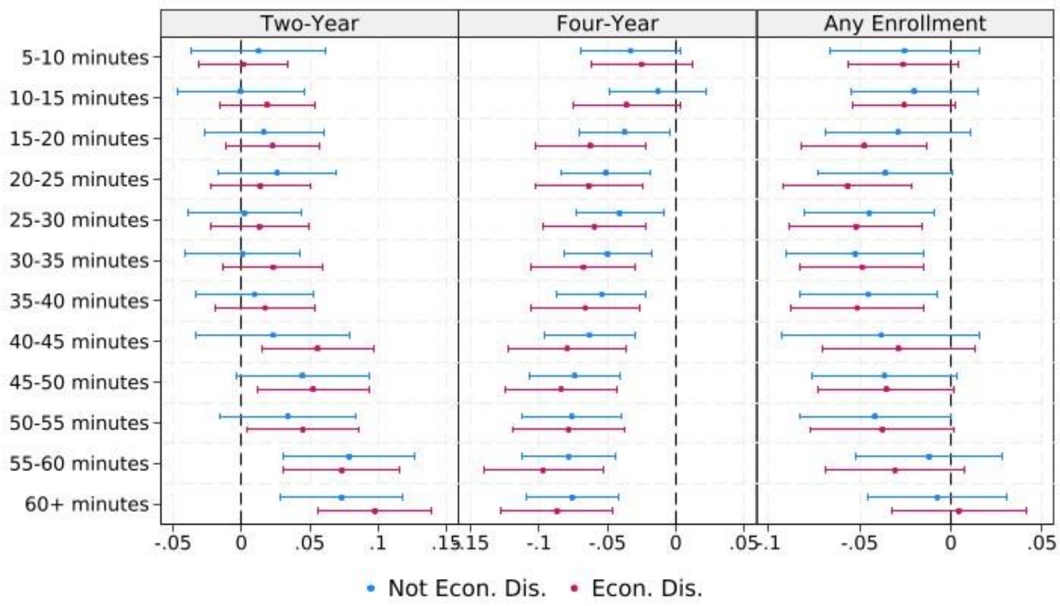
Notes: These figures summarize the number of public two-year and public four-year college campuses within 30 (Panel A) or 60 (Panel B) minutes driving time of a student's high school, averaged over all students and all students of a particular demographic group.

Appendix Figure A.4: Four-Year College Distance and Initial College Enrollment

Panel A. By Race-Ethnicity



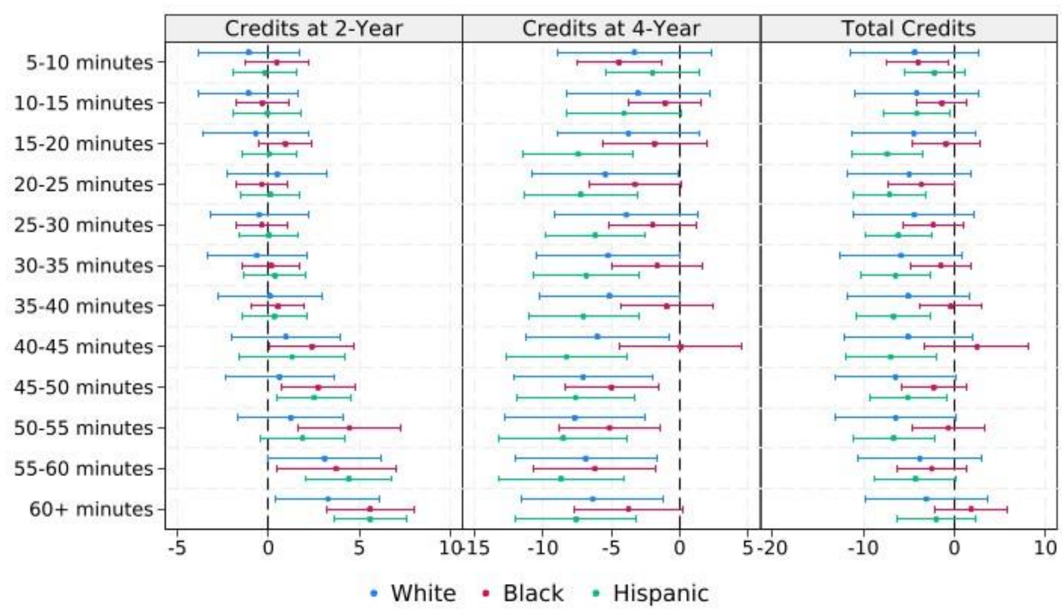
Panel B. By Economic Disadvantage Status



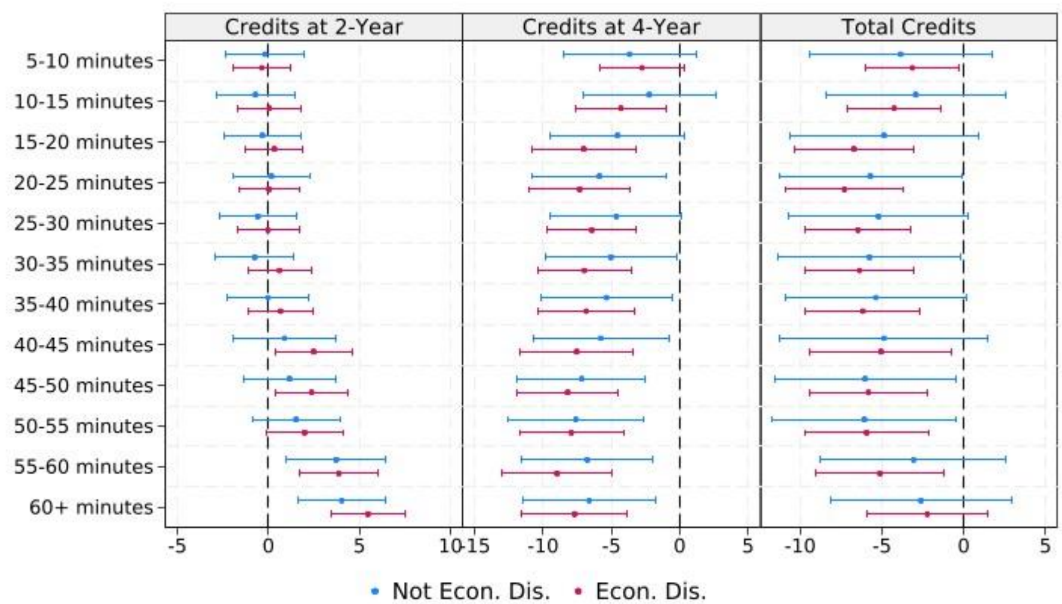
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public four-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Appendix Figure A.5: Four-Year College Distance and Six-Year Credit Accumulation

Panel A. By Race-Ethnicity



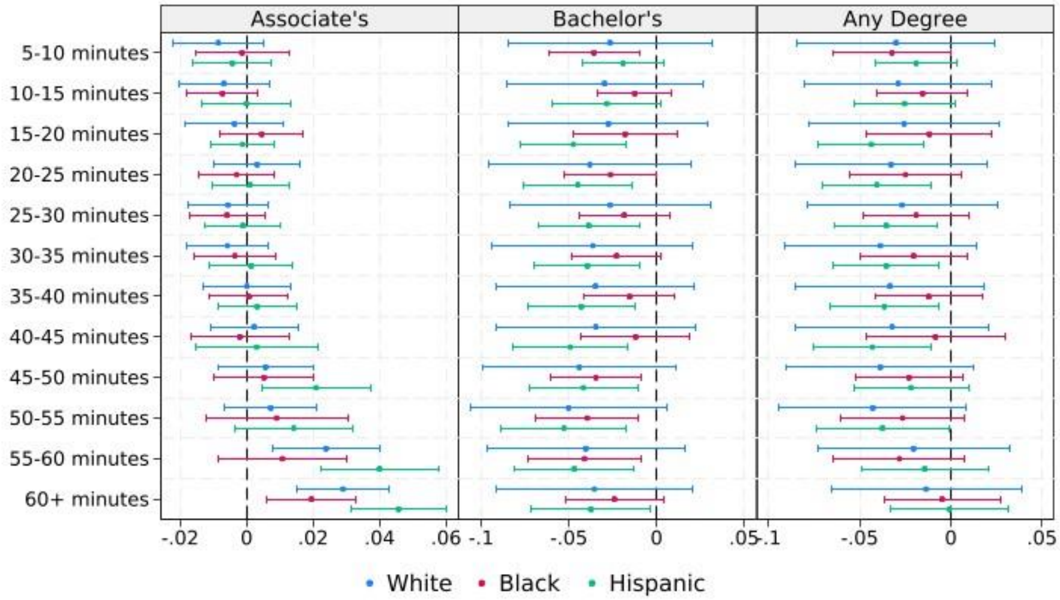
Panel B. By Economic Disadvantage



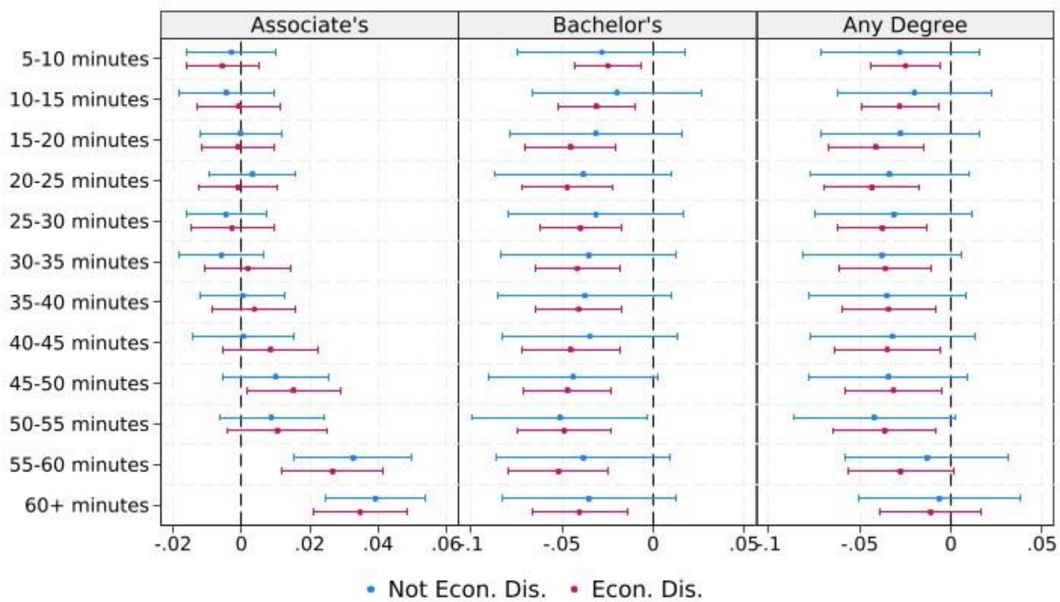
Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public four-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Appendix Figure A.6: Four-Year College Distance and Six-Year Degree Completion

Panel A. By Race-Ethnicity



Panel B. By Economic Disadvantage Status



Notes: These figures plot the estimated coefficients and 95% confidence intervals from equation (1), where we measure driving distance to public four-year colleges in 5-minute intervals. Each regression controls for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors are clustered at the high school district level.

Appendix Table A.1: Effects of Living in a Four-Year College Desert on Initial College Enrollment

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Enrollment in Public Two-Years		
Four-Year College Desert	0.014*	0.011	0.019**	0.008	0.027***
	(0.008)	(0.009)	(0.008)	(0.009)	(0.007)
Mean: y-var	0.305	0.302	0.306	0.316	0.292
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Enrollment in Public Four-Years		
Four-Year College Desert	-0.019***	-0.022***	-0.016***	-0.019***	-0.021***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Mean: y-var	0.211	0.266	0.178	0.262	0.154
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Overall Enrollment		
Four-Year College Desert	-0.001	-0.006	0.005	-0.007	0.008
	(0.008)	(0.009)	(0.008)	(0.009)	(0.007)
Mean: y-var	0.493	0.538	0.466	0.548	0.431
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "four-year college desert" if there is no public four-year university within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

Appendix Table A.2: Effects of Living in a Four-Year College Desert on Six-Year Credit Accumulation

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Credits at Public Two-Years		
Four-Year College Desert	1.125**	0.897*	1.464***	0.773	1.852***
	(0.470)	(0.462)	(0.495)	(0.481)	(0.461)
Mean: y-var	17.11	17.26	17.02	18.06	16.04
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Credits at Public Four-Years		
Four-Year College Desert	-1.064*	-1.302*	-0.934	-1.055	-1.321**
	(0.624)	(0.765)	(0.636)	(0.750)	(0.620)
Mean: y-var	24.27	32.49	19.35	31.63	16.07
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Total Credits		
Four-Year College Desert	0.062	-0.405	0.530	-0.282	0.531
	(0.784)	(0.940)	(0.729)	(0.936)	(0.695)
Mean: y-var	41.38	49.74	36.37	49.69	32.12
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "four-year college desert" if there is no public four-year university within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.

Appendix Table A.3: Effects of Living in a Four-Year College Desert on Six-Year Degree Completion

	All (1)	Not URM (2)	URM (3)	Not Econ. Dis. (4)	Econ. Dis. (5)
			Panel A: Associate's Degree		
Four-Year College Desert	0.008**	0.006*	0.011***	0.006	0.013***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Mean: y-var	0.087	0.091	0.084	0.094	0.079
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel B: Bachelor's Degree		
Four-Year College Desert	-0.004	-0.006	-0.003	-0.006	-0.003
	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)
Mean: y-var	0.181	0.261	0.133	0.247	0.107
Observations	1,556,381	583,589	972,792	820,649	735,732
			Panel C: Any Degree		
Four-Year College Desert	0.001	-0.003	0.005	-0.003	0.006
	(0.005)	(0.006)	(0.005)	(0.006)	(0.004)
Mean: y-var	0.242	0.321	0.195	0.310	0.166
Observations	1,556,381	583,589	972,792	820,649	735,732

Notes: Students are classified as living in a "four-year college desert" if there is no public four-year university within 30 minutes driving time of their high school. Underrepresented Minority (URM) students include all Black, Hispanic, and "other race/ethnicity" students; Not URM students include White and Asian students. All regressions control for cohort fixed effects (2013-2017), demographic student-level characteristics, 8th grade standardized math and ELA test scores, high school characteristics, and the driving distance to a student's nearest public two-year college in 5-minute bins. See the notes in Table 3 for a full list of these control variables. Standard errors shown in parentheses are clustered at the school district level. * p<0.10, ** p<0.05, *** p<0.010.