Effects of Reduced Community College Tuition on College Choices and Degree Completion

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Abstract

Recent efforts to increase college access concentrate on reducing the tuition at community colleges, but researchers and policymakers alike have expressed concern that such reductions may not lead to long-term gains in college completion. In this paper, I use detailed data on students' college enrollment and completion outcomes to study how community college tuition rates affect students' outcomes across both public and private colleges. By exploiting spatial variation in tuition rates, I find that reducing tuition at a student's local community college by $1,000 increases enrollment at the college by 3.5 percentage points (18%) and reduces enrollment at non-local community colleges, for-profit institutions, and other private, vocationally-focused colleges, by 1.9 percentage points (15%). This shift in enrollment choices increases students' persistence in college, as well as the probability that they transfer to and earn bachelor's degrees from four-year colleges.

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1 Introduction

Community colleges enroll nearly 40% of U.S. undergraduate students and are increasingly the focus of federal, state, and local college access initiatives (National Center for Education Statistics, 2018).[1] These institutions offer a variety of educational programs, including vocationally focused certificates, two-year associate degrees, and pathways to transfer to four-year colleges and universities. Moreover, community colleges offer these opportunities at a lower price than nearly all other postsecondary options, making them accessible to a large and diverse group of students, many of whom come from low-income backgrounds or are the first in their families to attend college (Ma and Buam, 2016). In recent years, policymakers have capitalized on community colleges' commitment to access in their local communities by implementing programs that make community college low-cost or tuition-free (Smith, 2017).

As these types of programs grow in popularity, so too do questions about their potential consequences for students' educational attainment and labor market outcomes. Policymakers and researchers alike have long expressed concern that reducing the price of community college may deter students from enrolling in four-year colleges, potentially decreasing the probability that they earn bachelor's degrees and receive wage premiums in the labor market. Notably absent from this discussion, however, is the possibility that reducing the price of community college could deter students from enrolling in *private* colleges that offer certificates and associate degrees —hereafter referred to as vocational colleges. These colleges primarily operate as for-profit entities, which have grown rapidly in the past two decades and now produce over 40% of less-than-two-year certificates and nearly 20% of associate degrees in the U.S., despite having higher average tuition rates, and lower average completion rates and wage premiums than their public, not-for-profit counterparts (Deming et al., 2012; Cellini and Turner, 2018; Armona et al., 2018). While there is some evidence that community colleges and for-profit colleges compete for students in the two-year college market,

[1] In this paper, I use the term "community college" to refer to any publicly funded college that primarily offers sub-baccalaureate credentials. These institutions are also sometimes referred to as junior colleges, technical colleges, or city colleges.

particularly in the presence of declines in state funding for public higher education (Cellini, 2009; Goodman and Henriques, 2015) or local labor demand shocks (Armona et al., 2018), there is currently no direct evidence on how tuition rates at public institutions alter students' enrollment decisions in private institutions in the two-year sector, or how such a substitution effect may impact students' longer-run educational outcomes.

In this paper, I empirically estimate the effects of community college tuition on students' college enrollment decisions and outcomes across different sectors of the postsecondary education market. To isolate exogenous variation in community college tuition rates, I exploit an institutional feature of Michigan's community college system in which students residing on either side of a "community college district" boundary face substantially different tuition rates at their local community college due to a locally provided tuition subsidy. This feature allows me to use a boundary fixed effects strategy that compares the college choices and outcomes of students who live just inside of a community college district and face an average community college tuition rate of $2,300 per year to their peers who live just outside of a community college district and face an average tuition rate of $4,100. While this approach is similar to that used by Denning (2017) and McFarlin et al. (2018) to study community college taxing districts in Texas, I am able to build upon both studies through the use of detailed, student-level administrative data from the Michigan Department of Education that contains students' precise census blocks of residence, as well as comprehensive college enrollment and completion records across public and private colleges.

Obtaining students' census blocks of residence enables me to very accurately determine whether students reside within community college districts and to avoid the potential measurement error induced by inferring in-district status from the schools they attend. McFarlin et al. (2018) show that precisely measuring community college tuition is important in determining its effects on college enrollment, but are unable to observe in which students college enroll due to their use of restricted-access Census data. Meanwhile, Denning (2017) observes detailed college enrollment and completion records but must proxy for in-district status with the location of a student's high school. By combining data on students' precise residences with specific college enrollment records, I am better able to identify the direct effect of a community college's tuition rate on a student's decision to enroll in the college. In addition, the detailed college records in my dataset come from the National Student Clearinghouse (NSC), which covers 97% of all postsecondary institutions in the U.S., and now covers several of the largest national for-profit colleges (National Student Clearinghouse Research Center, 2017). This coverage allows me to determine the underlying substitution effects that drive an increase in community college attendance, including whether reduced community college tuition crowds out enrollment in similar private colleges, which has not been considered in prior work.

Among students graduating from Michigan public high schools between 2009 and 2016, I find that reducing the tuition rate that a student faces at her local community college by $1,000 increases the probability of enrollment at the college within a year of high school graduation by 3.5 percentage points, about 18% of the mean enrollment rate. A portion of this increase can be attributed to students enrolling in their local community college who would not have initially enrolled in *any* postsecondary education program in the absence of the tuition reduction, as a $1,000 decrease in local community college tuition increases overall college enrollment by 0.7 percentage points (1% of the mean). At the same time, this tuition decrease causes students to reduce enrollment in non-local community colleges by 1.6 percentage points (8% of the mean) and in for-profit and other private, vocationally-focused colleges that offer two-year degrees by 0.4 percentage points (11% of the mean). The remainder of the increase in local community college attendance can be attributed to a 1.0pp decline in four-year college attendance; however, this estimate is statistically insignificant and is quite small compared to its mean.

Using longer-run data from cohorts who graduated high school between 2009 and 2011, I find further evidence that reduced community college tuition increases persistence in college and degree completion. A $1,000 decrease in local community college tuition induces students to complete 2.5% more semesters of college, 2.7% more college credits, and to transfer to four-year colleges at a rate 6.5% higher than their peers who do not receive discounted tuition. This $1,000 tuition decrease also increases bachelor's degree completion by 1.1pp (3.5%), particularly in business and professional fields such as education and exercise science. The improved outcomes are driven in part by students switching from higher-cost and lower-resourced vocational colleges that focus on labor market preparation to higher-resourced community colleges that promote transfer to four-year colleges. Consistent with this mechanism, I also find that reduced community college tuition induces students to earn general liberal arts associate degrees, which are designed to prepare students to transfer, rather than associate degrees in vocational subjects.

These results contribute to several strands of literature on college choice and the consequences of public subsidization of postsecondary education. First, the results add to a large body of empirical work on the effect of college costs on students' college enrollment decisions. Most previous analyses find approximately a 3-5 percentage point increase in the probability of enrollment for each $1,000 decrease in the cost of a college option (Deming and Dynarski, 2010; Page and Scott-Clayton, 2016), with potentially even larger effects at the community college level. However, recent estimates of students' sensitivity to community college costs come from large-scale policy changes, such as the introduction of free tuition policies Carruthers and Fox (2016) or the expansion of community college districts (Denning, 2017), which may affect students' choices and outcomes through multiple channels (e.g. informational campaigns, new college campuses). The results presented here isolate tuition variation by comparing observationally similar students who likely have similar exposure to college information, marketing, and campuses, and are very much in line with that of the broader literature. This suggests that, despite the already low cost of most community colleges in the U.S., students are responsive to the sticker prices advertised by community colleges and that policies that reduce advertised tuition rates by even small amounts may have meaningful impacts on students' educational and labor market outcomes.

Second, this research provides the first direct evidence that students substitute towards community colleges and away from similar private colleges, including those in the for-profit sector, when community college tuition is low. Cellini (2009) and Goodman and Henriques (2015) document a similar phenomenon in the context of changes in state funding for higher education, whereby increases in funding for public colleges deter students from attending for-profit institutions. In this paper, I find that this private-to-public enrollment shift also occurs as a direct result of a reduction in community college tuition and that the shift improves students' educational attainment. However, as in Denning (2017), I do not find that, on average, students forgo initially attending four-year colleges when they have access to a low cost community college or that students forgo opportunities to earn bachelor's degrees by attending community colleges. This finding comes in contrast to Carruthers and Fox (2016) who find that a broad, tuition-free community college program in Tennessee reduces four-year college enrollment, suggesting that the structure of community college tuition policies may play an important role in determining their effects on students' college choices and outcomes.

Finally, this work contributes to an expanding literature on the effects of community college attendance on educational and labor market outcomes. Because community colleges are uniquely situated between the labor market and four-year colleges, their impact on students' longer-term outcomes is often ambiguous and depends on students' counterfactual enrollment decisions (Rouse, 1995). Some students who attend community college may be made better off because in the absence of community colleges they would not have attended any college, while others may be made worse off because they are diverted from attending four-year colleges. Empirically, students who are deterred from attending four-year colleges tend to experience an educational attainment and labor market penalty (Reynolds, 2012; Goodman et al., 2017), while students who are induced to attend their local community college rather than not attending any college experience positive educational and labor market gains (Mountjoy, 2018). I find that students who are induced to attend their local community college rather than attending other predominantly two-year colleges are more likely to transfer to four-year colleges and earn bachelor's degrees. This result implies that gains from community college attendance can extend to a broader group of students than identified in prior work and suggests that policies that increase community college access without deterring students from attending four-year colleges could increase educational attainment and improve labor market outcomes.

2 Michigan's Postsecondary Education Market

The institutional setting for this analysis is the postsecondary education market in the state of Michigan. There are over 90 accredited colleges and universities in Michigan offering a wide range of academic programs, and over 90% of the state's high school graduates who enroll in college choose to attend one of them. There are also two key features of the market that make it an ideal setting in which to study the effects of community college costs on students' postsecondary enrollment decisions. First, Michigan has a largely decentralized community college system in which tuition rates are determined independently by each college and are based on a student's place of residence relative to specific geographic boundaries. This creates large differences in the tuition rates faced by otherwise observationally similar students who reside on either side of a given boundary. Second, Michigan is home to a large private vocational college, Baker College, which has thirteen locations throughout the state and enrolls over 25,000 students annually. Baker offers sub-baccalaureate academic programs similar to Michigan's community colleges but spends less per student on instruction and has much lower transfer rates than its public counterparts. The presence of this potential competitor in the two-year college market allows me to examine whether reducing community college tuition crowds out enrollment in similar private colleges.

2.1 Michigan's Community Colleges

Michigan is home to 28 public community colleges which together enroll over 300,000 students annually (Michigan Community College Association, 2019). Each college is designed to serve a distinct geographic area, known as a *community college district*, and is given substantial autonomy over its administration. There is no overarching state law nor agency governing the specific operations of community colleges and state intervention in their practices is rare (Hilliard, 2016). The state government does, however, provide annual appropriations funding to community colleges, which accounts for approximately 20% of the community colleges' operating revenues.[2] To supplement this funding, the colleges

[2]This funding is allocated based on a weighted performance funding model that takes into account prior-year funding, enrollment, and performance indicators, and rewards colleges for low administrative costs and adherence to

rely heavily on both tuition and fees (43% of operating revenues) and local property taxes (35% of operating revenues). For each college, local property taxes may only be assessed on properties within its community college district (Michigan House Fiscal Agency, 2017).[3]

Community college district boundaries are governed by the trustees of each college under state guidelines and may be primarily comprised of counties, public school districts, or public intermediate school districts (ISDs), which are administrative organizations that support multiple school districts.[4] Community college districts may also include or exclude specific cities, townships, or other geographic features, although any changes to boundaries must be voted on by residents of the district. Currently, 15 of the state's 28 community college districts are comprised primarily of counties and 13 are comprised primarily of school districts or ISDs. Based on conversations with state employees and community college staff members, it is my understanding that no community college boundaries changed during the time frame of the data, and that most have remained unchanged for several decades.

Community colleges offer tuition rates based on a student's place of residence relative to their community college district boundaries.[5] In exchange for property tax funding, students residing within the boundaries of a district are offered the lowest tuition rate at their district's community college, averaging approximately $90 per credit. Students residing within Michigan, but outside of the district, are offered the next lowest rate,[6] and students residing outside of the state are offered the highest rate.[7] Critically for the analysis at hand,

best practices for community engagement (Michigan House Fiscal Agency, 2017).

[3]In 2015-2016, the average millage rate for community colleges was 2.51, i.e. $2.51 per $1,000 of taxable property value (Michigan Center for Educational Performance & Information, 2017). This millage rate is assessed on all properties in a community college's district, in addition to any other local property taxes (e.g. county, school district, township, or municipality taxes). Using data on aggregate real estate taxes and home values at the census tract level from the American Community Survey, I estimate that in-district areas in Michigan have an average total millage rate of 17.4, while out-of-district areas have an average total millage rate of 12.3.

[4]More information about Michigan's ISDs is available here: `https://www.gomaisa.org/value-of-isds/`.

[5]Tuition rates are set based on students' residences regardless of whether students enroll in courses in-person or online. However, students who reside within a community college district are also able to enroll in online courses offered by other community colleges at a discounted rate (`https://www.micollegesonline.org/courses.html`). If anything, this feature should attenuate the estimates that follow as it reduces the incentive for in-district students to enroll in their local community college.

[6]Macomb Community College also offers an "affiliate" tuition rate to students who reside outside of their district but in areas near their boundaries, which I incorporate in the empirical analysis. Results are also robust to treating this area as out-of-district.

[7]Michigan's community colleges differ in how long a student must be a resident of the district to qualify for in-district tuition. However, most require several months of residency, which makes it unlikely that students who do not reside in a district while attending high school would be able to claim in-district residency upon initial enrollment.

a sizable portion of students reside outside of *any* community college district and face the out-of-district tuition rate at any community college they wish to attend. Using data on students' census blocks of residence, I estimate that approximately 23% of Michigan's high school graduates reside in an area that is not part of any community college district. On average, these students face tuition rates at their local community college —the college whose district area they reside closest to —that are 65% higher than those faced by their peers who live within the community college's district boundaries.[8] This equates to an average annual cost difference of nearly $1,500 for a student taking a course load of 12 credits per semester. Given that the annual median family income of Michigan's community college students is approximately $60,000 (Chetty et al., 2017), this represents a difference of approximately 2.5% of annual median family income. Table 1 provides summary statistics on the average in-district and out-of-district tuition rates between 2008 and 2016, measured in 2016 dollars. Following the previous literature (e.g. Denning, 2017), I calculate semester tuition as the tuition rate for 12 credits and annual tuition as the tuition rate for 24 credits.

In addition to the tuition variation induced by community college district boundaries, students residing in different areas of the state and graduating in different years may also face substantially different local community college tuition rates. Without government oversight of tuition-setting policies, individual community colleges are free to differ in their relative in-district and out-of-district rates and may update these rates annually. Over the time frame of the data, real mean in-district tuition (measured in 2016 dollars) ranged from $76.90 per credit at Oakland Community College to $114.89 per credit at Mott Community College. Real mean out-of-district tuition ranged from $114.05 per credit at Wayne Community College to $221.22 per credit at Grand Rapids Community College. That is, on average between 2008 and 2016, it was less costly to be an out-of-district student at Wayne Community College than to be an in-district student at Mott Community College. Community college tuition rates, particularly for out-of-district students, have also steadily increased over the

[8] The tuition prices used in this paper are the colleges' advertised tuition prices, also known as sticker prices. Both in-district and out-of-district students may qualify for federal, state, local, or institutional financial aid that will reduce their net price of attendance. Across Michigan's community colleges, data from IPEDS indicates that the average net price for in-district students is approximately 80% lower than the average net price for out-of-district students.

past decade. For the graduating high school class of 2008, the real average in-district tuition rate per credit was \$82.47 and the average out-of-district rate was \$134.46. By 2016, these average rates had increased to \$106.10 and \$176.58, respectively.

2.2 Private Competitors to Community Colleges

Michigan's other postsecondary institutions may be grouped into two mutually exclusive categories: vocational colleges, which predominantly offer sub-baccalaureate degree programs, and traditional four-year colleges, which predominantly offer bachelor's and graduate degrees. I define a vocational college as a private institution that is either (1) a for-profit institution or (2) a not-for-profit institution that offers more than 25% of its degrees at the associate's degree level and accepts 90% or more of applicants. These colleges are similar to the state's community colleges in that they provide access to a vast majority of interested students and offer academic programs that can be completed in two years or less, namely associate's degrees and short-term certificates. Moreover, community and vocational colleges tend to offer degrees in similar fields and both have an emphasis on health and business subjects. Appendix Table A.7 highlights this point by comparing the types of associate degrees offered by the community and vocational colleges attended by Michigan's high school graduates. As such, it is reasonable to believe that they compete with community colleges in the market for sub-baccalaureate education.

In Michigan, the colleges identified under this vocational college criteria and available in the NSC data are: Baker College (not-for-profit), Davenport University (not-for-profit), Everest Institute (for-profit), ITT Technical Institute (for-profit), and The International Academy of Design & Technology (for-profit).[9] I also observe enrollment in other large national for-profit chains, such as the University of Phoenix, DeVry University, and Kaplan University, although these institutions do not report in which campus a student is enrolled so I am unable to observe whether students enroll in Michigan, online, or elsewhere in the country.[10] However, I do not observe enrollment in any smaller for-profit institutions located

[9] The three for-profit colleges in this list (Everest, ITT, and The International Academy of Design & Technology) shut down operations within Michigan during the time frame of the data. To my knowledge, no new colleges opened.

[10] Students who enroll in exclusively online programs are included in the NSC data, but I am unable to distinguish

within Michigan, such as cosmetology schools.[11] This lack of coverage includes institutions that do not participate in federal financial aid programs, which Cellini and Goldin (2014) show account for over half of for-profit enrollment in Michigan. It is not obvious that these types of non-degree granting institutions would be popular among recent high school graduates, but to the extent that they are, I will overestimate the share of students not enrolling in college and will underestimate the share enrolling in vocational colleges.

The most popular private vocational institution among Michigan's high school graduates is Baker College, which has thirteen campuses throughout the state and enrolls over 70% of Michigan's vocational students.[12] Baker is a private, not-for-profit institution, that primarily offers degree programs designed to take two years or less. Such institutions are not common in the U.S. For example, according to the 2016 College Scorecard, there are 369 private, predominantly associate- or certificate-degree granting institutions in the U.S. but 2,587 for-profit private institutions offering the same types of degrees. However, in many ways, Baker College operates similarly to the more popular model of a private, for-profit two-year college. Appendix Table A.1 compares Baker to the universe of private colleges that predominantly grant associate degrees and certificates using data from the U.S Department of Education's College Scorecard. Across several measures of institutional quality and outcomes, Baker appears more similar to its for-profit counterparts rather than its not-for-profit peers. For example, Baker spends \$4,010 per student on instruction, similar to the for-profit average of \$3,908, but much below the not-for-profit average of \$7,525. Similarly, the median earnings of Baker attendees after ten years is \$26,880, which is much closer to the for-profit average of \$24,512 than the not-for-profit average of \$35,725. While not all states have a large, multi-campus, not-for-profit vocational institution like Baker, most states do have a large number of students who choose to enroll in private vocational colleges, often within the for-profit sector. Given that Baker appears to operate similarly to these schools, the results from this paper should provide suggestive evidence on how reductions in local community college

between on-campus and online enrollment within an institution.

[11] The NSC reports coverage of over 70% of multi-state for-profit institutions but 0% coverage of for-profits operating only in Michigan (National Student Clearinghouse Research Center, 2017).

[12] Because of this large market share, my results are robust to any definition of vocational colleges that includes Baker College.

tuition may affect enrollment at for-profit vocational colleges.

2.3 Other Postsecondary Options

The remainder of undergraduate, degree-granting postsecondary institutions in Michigan are either public or private traditional four-year colleges. On the public side, Michigan has two flagship research universities, the University of Michigan-Ann Arbor and Michigan State University, and thirteen additional state universities. In recent years, public universities have primarily relied on students' tuition payments for operating expenses as state appropriations have declined and now account for only 21% of the universities' operating budgets (Michigan House Fiscal Agency, 2017). Similar to the state's community colleges, there is little government oversight of the universities' practices and, as a result, there is a substantial amount of heterogeneity in tuition rates, expenditures, and program offerings among them. However, in contrast to community colleges, all public universities offer the same tuition rate to all in-state students regardless of their location of residence. On average, the flagship universities provide a higher level of educational quality in terms of instructional expenditures and graduation rates but are also more expensive and more selective than the other public universities.

Michigan also has several private four-year institutions, which finance their operating expenditures with students' tuition payments, private donations, and endowments as they receive minimal support from the state. They tend to be much smaller and somewhat more expensive than the state's public universities and, overall, make up a small share of the postsecondary education market. Appendix Table A.2 provides summary statistics on these institutional attributes across the public and private sectors.

Students who choose not to enroll in community, vocational, or traditional four-year colleges generally enter the state's low-skill labor market. In the years following the Great Recession, young adults who have chosen this option in Michigan have faced high rates of unemployment and underemployment. Those who are employed are most likely to work in service and retail occupations, which have low median wages and minimal opportunities for advancement (Bureau of Labor Market Information and Strategic Initiatives, 2014).[13]

3 Data and Sample

3.1 Data Sources

The data used in this paper primarily come from a student-level, administrative dataset provided by the Michigan Department of Education (MDE) and the state's Center for Education Performance and Information (CEPI). This dataset contains academic records for all students enrolled in grades 9-12 in Michigan's public schools between 2007 and 2017 and further links these students to college enrollment and completion records from the NSC and a state-run data repository (STARR). The high school academic records provide rich information on students' demographic characteristics, including race/ethnicity, gender, free and/or reduced price lunch (FRPL) eligibility, English language learner (ELL) status, and special education enrollment; academic performance, including math and reading tests scores on a state standardized test administered in eleventh grade; and place of residence measured at the census block level. The final component is a key advantage of the MDE/CEPI dataset as it allows me to very accurately determine whether a student resides within a community college district.[14] The college link provided through the NSC and STARR contains all dates and records of students' enrollments in colleges covered by either database, as well as information on the academic programs in which they enroll, the credits they complete, and the awards they receive. I match these data to postsecondary institutional information, including campus latitudes and longitudes, from the NCES' Integrated Postsecondary Education Data System (IPEDS). I also gather annual in-district and out-of-district tuition rates at each of Michigan's community colleges from Michigan's Workforce Development Agency.

[13] A small number of high school graduates are also able to secure on-the-job training opportunities, such as apprenticeships. However, only about 5,000 individuals begin such programs each year, making it a small component of the postsecondary education market (Bureau of Labor Market Information and Strategic Initiatives, 2016).

[14] This feature of the data is a particular advantage in Michigan because the state has generous school choice policies and nearly 6% of K-12 students to attend a school other than that to which they are assigned (either within or outside their school district of residence). An additional 7% of students attend a charter school (Cowen et al., 2015). Thus, using the location of a student's high school to proxy for her place of residence —as is common in other settings with spatial variation (e.g. Denning, 2017) —would likely introduce measurement error to the estimation procedure.

3.2 Sample Construction

The goal of this paper is to estimate the causal effect of the tuition rate a student faces at her local community college on her postsecondary enrollment decisions and outcomes. To do so, I exploit the fact that students who live inside one of Michigan's community college districts face a substantially discounted tuition rate at their local community college. The challenge of this approach is that community college district areas may be spatially correlated with unobservable determinants of college choice. For example, community colleges may form their districts in geographic areas that have strong preferences for community college education, which would then bias any estimates of the effect of in-district status on college enrollment or outcomes. To mitigate this type of bias, I limit the sample to students who reside within two miles of a community college district boundary segment and use fixed effects to compare the outcomes of students who reside in close geographic proximity and graduate from high school in the same year but differ in their in-district status at the local community college.[15]

To implement this empirical strategy, I first identify census blocks that are located within community college districts.[16] For community college districts consisting solely of counties, this is straightforward: I assign a census block to the community college district if the census block is contained within the county of interest. For community college districts that include public K-12 school districts, I first calculate the amount of geographic overlap between each census block and all overlapping school districts. I then match a census block to the school district with which it shares the most overlap and assign it to the community college district of that school district.[17] Once I have mapped all census blocks to their corresponding

[15]The two mile bandwidth is chosen to maximize sample size and minimize observed differences between adjacent in-district and out-of-district students. Results using alternative bandwidths are included in the appendix and discussed in Section 5.5. Note that this approach is similar in spirit to regression discontinuity (RD) designs that exploit geographically-discontinuous treatments. However, because I do not observe students' exact addresses and must aggregate to the census block level, there is a mass point in the running variable at the geographic discontinuity and I cannot use standard RD inference techniques that rely on a smooth distribution of individuals at the discontinuity (Keele et al., 2017).

[16]I gather information on community college district boundaries from individual community college websites, course catalogs, and conversations with colleges' institutional research staff. Appendix A.2 lists the geographic areas that comprise each community college district.

[17]Less than 1% of census blocks cannot be perfectly assigned to a community college district based on either their county or a single overlapping school district.

community college districts, I identify community college district boundaries that divide a collection of census blocks that are contained within a given community college district from a collection of census blocks that are not contained within any community college districts. Figure 1 displays all 28 community college districts and highlights the boundary areas in red.[18]

To limit the analysis to students who differ in their in-district status, but reside within a small distance of one another, I divide each identified boundary into equal segments, each of which is no more than 5 miles long. Throughout the remainder of the text, I refer to these segments as "boundary segments." I next calculate the distance from the centroid of each student's census block to the nearest boundary segment and restrict the sample to students residing within two miles of their nearest boundary segment.[19] An example of this sample restriction for the Washtenaw Community College district area is provided in Figure 2. Each dot represents a single census block centroid that is no more than two miles from the nearest boundary segment, and dots displayed in the same color are located closest to the same boundary segment. Intuitively, the empirical strategy compares the outcomes of students who live in census blocks shown in the same color, but reside inside or outside of the community college district.[20]

Figure 3 presents visual evidence on the differences in local community college tuition rates among students residing on either side of the identified boundary segments. Panel A provides the distribution of in-district vs. out-of-district tuition differentials across all border-year pairs. The average difference in tuition between in-district and out-of-district students is $1,617, which is only slightly higher than the average college-level difference of $1,463 (see

[18] Both Bay de Noc Community College and Glen Oaks Community College have "service districts" in which students face tuition rates that are greater than the in-district but lower than the out-of-district rate. I do not include boundaries that divide these areas from areas not in any community college district as they are less salient than the true community college district boundaries.

[19] In order to only include students who are likely to be affected by the local community college's listed tuition rate, I further exclude 6,687 students who are eligible for place-based promise scholarships upon high school graduation, or whose area of residence becomes eligible for a promise scholarship during the time frame of the data. I identify areas that are eligible for promise scholarships from the Upjohn Institute's Promise Database: `https://www.upjohn.org/promise/database/`.

[20] I do not consider boundaries that divide two distinct community college districts, so students residing outside of a community college district of interest do not reside within any community college district. These boundaries are difficult to include in the current empirical framework because all students reside within a community college district and, therefore, there is not a clear distinction between in-district students (who have access to low-tuition community college) and out-of-district students (who do not).

Table 1). However, there is some variation in this differential, with the interquartile range stretching from \$1,315 to \$2,036. To further explore this variation, Figure 4 plots the tuition differentials against various demographic characteristics. There is no identifiable relationship between a border-year pair's tuition differential the share of economically disadvantaged students, the median household income of the area, or students' average test scores. This finding suggests that the variation in tuition differentials likely come from different tuition-setting policies and practices at colleges throughout the state rather than differences in local economies or preferences for education.

Table 2 then provides descriptive statistics on the entire sample of students who graduate from Michigan public high schools between 2009 and 2016, and on the analysis sample who live within two miles of their nearest boundary segment.[21] I also present separate means for in-district and out-of-district students in each sample. All variables are measured when a student takes the Michigan Merit Exam (MME), a required standardized test that is typically administered during a student's junior year of high school. Panel A shows that there are some differences in demographic characteristics between in-district and out-of-district students. For example, in-district students are less likely to be white and are more likely to be English language learners (ELL). This is not surprising since community college districts tend to be located in more urban and diverse areas of the state. Panel B then shows that in-district students score slightly lower on their state standardized tests than their out-of-district peers.

Panel C reports college enrollment outcomes for the first year following a student's graduation from high school. I maintain all college enrollment spells that occur within this time frame, which may include enrollment at multiple institutions. As a result, the sum of enrollment in different college types is slightly larger than the total number of students who enroll in some form of postsecondary education. In both samples, about 30% of high school graduates enroll in a community college, with more in-district students doing so than out-of-district students, especially in the all students sample. About 3% enroll in vocational

[21] Students who graduate before 2009 or after 2016 are dropped from the sample due to incomplete college enrollment and completion data collection. Students enrolled in juvenile detention centers, adult education, or alternative education programs, as well as those missing academic or demographic variables, are also dropped from the sample.

colleges, with less in-district students doing so than out-of-district students. In the sample of all students, about 41% of graduates enroll in a four-year college, while about 38% do so in the analysis sample. There are little differences in this rate between in-district and out-of-district students. In total, about 70% of all Michigan public high school graduates enroll in college within one year, while about 67% of the analysis sample does.

4 Empirical Strategy

The boundary fixed effects approach, as outlined in Figure 2, naturally lends itself to the following reduced form estimating equation:

$$Y_{ibt} = \gamma + \delta District_i + \mathbf{X}_i \mathbf{\Psi} + \mu_{bt} + \nu_{ibt}, \tag{1}$$

where Y_{ibt} is a binary outcome of interest for student i who resides along boundary segment b and graduates from high school in year t. For example, Y_{ibt} may be a binary variable representing enrollment in the local community college or completion of a bachelor's degree. $District_i$ is a dummy variable equal to 1 if student i resides in a community college district and equal to 0 otherwise. $\mathbf{X}_i$ is a vector of individual control variables that may affect college enrollment choices, such as a student's socioeconomic background and academic aptitude. μ_{bt} is a full set of boundary segment by year fixed effects, which will hold constant any factors affecting graduates who live in the same area along a community college boundary segment, such as local economic conditions or changing preferences for higher education. ε_{ibt} is an idiosyncratic error term. The coefficient of interest is δ, which represents the effect of residing in a community college district on Y_{ibt}.

Then, to estimate how community college tuition itself affects students' choices and outcomes, I use a two-stage least squares approach similar to Denning (2017). I choose to use this approach because it is a straightforward way to scale the results by the mean difference between in-district and out-of-district tuition rates. The first stage equation is:

$$Tuition_{ibt} = \zeta + \lambda District_{ib} + \mathbf{X}_i \mathbf{\Phi} + \mu_{bt} + \upsilon_{ibt} \tag{2}$$

and the second stage equation is:

$$Y_{ibt} = \alpha + \beta \widehat{Tuition}_{ibt} + \mathbf{X}_i \mathbf{\Gamma} + \mu_{bt} + \varepsilon_{ibt} \tag{3}$$

where $\widehat{Tuition}_{ibt}$ is predicted from the first stage, and the remainder of the variables are defined as in previous equations.

In order for β to represent the causal effect of local community college tuition in the 2SLS approach outlined above, it must be the case that (1) $Cov(District_{ib}, Tuition_{ibt}|\mathbf{X}_i, \mu_{bt}) \neq 0$ and that (2) $Cov(District_{ib}, \varepsilon_{ibt}|\mathbf{X}_i, \mu_{bt}) = 0$. The first assumption states that, within a narrowly defined geographic area and graduation year, and after controlling for observable characteristics, a student's in-district status is related to the tuition rate he or she faces at the local community college. That is, there must be a price differential between in-district and out-of-district students residing along a community college district border, and this price differential must not be entirely explained by differences in observable characteristics. Given that all community colleges in Michigan set different tuition rates for in-district and out-of-district students, and that these tuition rates are set for the entire in-district and out-of-district areas (not just the students on the boundaries), this assumption should hold. However, it is also directly testable in the data.

Table 3 presents the estimated first stage value of λ in three specifications of equation (4): including no control variables, including only distance-related control variables, and including a full set of distance and student control variables.[22] The estimated values are quite stable across the different specifications and indicate that in-district students face a local community college tuition rate that is approximately $1,800 lower than that of their out-of-district peers.[23] All three estimates also have F-statistics greater than 45, limiting the probability that the 2SLS estimates suffer from weak instrument bias.

The second assumption states that, within a narrowly defined geographic area and grad-

[22]The distance-related variables are the distance between a student's census block of residence and the local community college, the nearest vocational college, the nearest public university, and the nearest private four-year college. The student control variables are: a student's race (white, black, or Hispanic), gender, FRPL status, special education participation, ELL status, math and reading test scores, school of choice participation, on-time graduation status, and dual enrollment experience.

[23]Note that this difference is slightly larger than the average border-year tuition differential noted in Section 3.2 ($1,617) because students are not equally distributed across all border-year pairs.

uation year, and after controlling for observable characteristics, a student's in-district status is uncorrelated with unobservable determinants of college choices or outcomes. This is also the assumption needed for the identification of δ in the reduced form equation. This assumption rules out the possibility that, for example, families choose to live in community college districts due to unobserved preferences for community college attendance. This is inherently untestable. However, there are several reasons to believe that this assumption is likely to hold. First, community college district boundaries are not well-publicized by the state of Michigan. The state does not maintain any publicly-available record of community college district boundaries and each community college has discretion over whether and how they make this information available to potential students and families. Thus, it is possible that a family could select a place of residence without knowing whether or not it is contained within a community college district.[24]

Second, very few students move into community college districts between 9th and 12th grade. This suggests that families do not anticipate community college attendance and move to take advantage of the subsidized tuition rates offered to in-district students. While nearly 14% of all students move census blocks during high school, less than 1% move from an out-of-district census block to an in-district census block.[25] Moreover, conditional on beginning high school in a community college district, a student has a probability of finishing high school in a community college district of 99%. In contrast, conditional on beginning high school outside of a community college district, a student has a probability of finishing high school in a community college district of 4%. While I do not observe students' residences after they graduate from high school, I restrict outcomes to students' enrollment choices within one year of high school graduation to avoid the possibility that students move into community college districts as adults.

Third, students residing on either side of a community college district boundary appear quite similar across observable characteristics. To assess the balance between peers residing

[24] Property taxes for the local community college are displayed on the tax bills of property owners who reside within community college districts, but there is no indication of in-district status, nor tuition rates, on these bills.

[25] Author's own calculation based on a sample of students who have records for all grades 9-12 and non-missing census block information in at least two of those grades.

on either side of boundaries, I estimate regressions of the form:

$$X_{ibt} = \gamma + \delta District_i + \mu_{bt} + \upsilon_{ibt}. \tag{4}$$

Here, the coefficient δ represents the average difference in an observable characteristic, X, between in-district and out-of-district students who reside along a given boundary segment and graduate from high school in the same year.[26] I also estimate equation (4) using predicted community college enrollment as the dependent variable, where I predict enrollment on the full sample of high school graduates using a probit equation that includes the observable characteristics of the other balance tests. Specifically, I estimate enrollment as a function of a student's race, gender, FRPL eligibility, special education status, ELL status, math test score, reading test score, on-time graduation status, and dual enrollment status. This approach explicitly tests for differences in observable characteristics that are correlated with community college attendance. In all specifications, I cluster standard errors at the boundary segment level to account for systematic correlation in the error term among students who reside near one another.

Table 4 reports estimates of δ across observable student characteristics and predicted community college enrollment. The results indicate that students residing near one another, but on opposite sides of a community college district boundary, are quite similar. These students are similarly likely to be white, to be eligible for free or reduced price lunch, and to be English language learners. They also score similarly on standardized tests, graduate on-time from high school at similar rates, and have equal predicted community college attendance rates. The only attributes across which the two groups differ are special education status and dual enrollment participation: in-district students are both less likely to be classified as special education students and slightly less likely to dual enroll in a college course while in high school, although the latter result is only marginally statistically significant.[27]

[26] Additional regressions of an indicator for high school graduation on in-district status reveal that in-district and out-of-district students on either side of community college district boundaries graduate from high school at statistically the same rates.

[27] Additional analyses suggest that in-district students are also less likely to be school of choice students, but this is unsurprising given that in-district school districts tend to be larger and more suburban and students residing in rural areas are more likely to choice in to suburban school districts than suburban students are to choice in to rural

To provide more evidence on the similarity between in-district and out-of-district students, Appendix Table A.3 provides estimates of δ for demographic characteristics at the census tract level from the Equality of Opportunity Project [28] There are no statistically significant differences in any of the variables, including median household income and 2004-2013 job growth. Appendix Table A.5 then estimates the difference in distance to postsecondary institutions for students residing on either side of community college district boundaries. Unsurprisingly, students residing within community college districts live closer to their local community college. However, given the two mile bandwidth restriction, this difference is quite small —only 1.4 miles. In-district students also live slightly closer (0.9 miles) to their nearest private four-year college but no closer to public universities nor vocational colleges, indicating that students residing on either side of community college district boundaries face only small differences in travel costs to postsecondary opportunities.

Despite these mitigating factors, the largest threat to identification is the fact that community college district boundaries are often congruent with either county or school district boundaries, inducing compound treatments at the cutoff points (Keele et al., 2017).[29] To my knowledge, there are no other specific community college policies that are discontinuously applied along community college district boundaries; however, the overlap of school districts and community college districts is concerning for two reasons. First, school districts may provide different college information and guidance to students, and second, families often select where to live based on school district attributes (Caetano and Macartney, 2014) —one of which could be the quality of the school district's college advising. A related concern is that families choose where to live based on preferences for other types of taxes or public goods, which may be correlated with their preferences for education more generally. How-

districts.

[28]Census tracts are larger geographic areas than census blocks and may extend more than two miles from a community college district border. As such, these balance tests should be interpreted as differences in the demographics of students' surrounding areas, and not necessarily differences in students' characteristics nor the characteristics of their families.

[29]The overlap of counties and community college districts is less concerning as the vast majority of college advising and implementation of college access policies occurs at the school, school district, or intermediate school district level, rather than the county level. Moreover, specifications that include county fixed-effects produce qualitatively similar results, indicating that, among students residing along community college district boundaries, there are not unobserved differences in preference for higher education institutions along county lines. These results are available from the author upon request.

ever, I find that, along the boundaries, in-district residents face an average millage rate of 15.4, while out-of-district residents face an average rate of 12.3. Given that the average community college millage rate is about 2.5, this suggests that there is only about a 0.6 millage difference (i.e., 0.60 per $1,000$ of taxable value) attributable to other types of taxes, which is rather small and unlikely to explain residential choices.

To address potential sorting into school districts, in Section 5.5, I repeat the analysis using a subset of students who live in school districts which are bisected by a community college district boundary. Students in this sample come from families who chose to live within the school district's boundaries, and therefore likely have similar preferences for education, and overwhelmingly attend the same high school, and therefore likely receive similar college counseling. However, only a fraction of the students live within the local community college's district. I find very similar effects of in-district status using this subsample of students, suggesting that neither residential sorting nor school-level policies are likely driving my main results.

5 Results

I estimate the boundary fixed effect models for a variety of college enrollment and completion outcomes. For each outcome of interest, I first present reduced form results that estimate the "in-district effect" of residing in a community college district: δ in equation (1). I then present estimates of the "tuition effect" of reducing a student's local community college tuition rate by \$1,000: $-\beta * 1000$, where β is defined as in equation (3). For college enrollment outcomes, I include the full sample of students who graduated from high school between 2009 and 2016 to maximize the sample size. However, for college completion outcomes, I restrict the sample to students who graduated from high school between 2009 and 2011 as these students have had sufficient time to complete college credentials. To ensure comparability between the enrollment and completion outcomes, I also present enrollment results for this smaller sample. Unless otherwise indicated, all regressions include the full set control variables available in the MDE/CEPI data: a student's race/ethnicity (white, black, Hispanic, or other), gender, FRPL status, special education participation, ELL status, math and reading test scores, school of choice participation, on-time graduation, and dual enrollment experience, as well as the distance between the centroid of a student's census block of residence and the nearest campus of the local community college, the nearest vocational college, the nearest in-state public university, and the nearest in-state private four-year college. These variables are designed to control for socioeconomic and academic factors that may affect students' preferences over postsecondary choices, as well as the local availability of various college options.

5.1 College Enrollment

Table 5 presents the reduced form and 2SLS estimates for student's college enrollment choices within one year of high school graduation. The first four columns present estimates for four mutually exclusive college categories —the local community college (that at which in-district students receive reduced tuition), non-local community colleges (both in Michigan and in other states), private vocational colleges, and four-year colleges. However, students may enroll in more than one type of college within their first year following high school graduation, such that the sum of these estimates need not exactly equal the overall college enrollment effect presented in column (5). Panel A presents estimates for all cohorts of students, while Panel B presents estimates only using the 2009-2011 cohorts who will be used for analyses of college completion.

The first row of each panel presents the reduced form effects of residing in a community college district. For the "all cohorts" sample, residing in a community college district increases enrollment in the local community college within one year of high school graduation by 6.4pp (31%), while decreasing enrollment in non-local community colleges by 2.8pp (31%) and in private vocational colleges by 0.7pp (20%). All three of these estimates are statistically significant at the 99% confidence level. That is, students shift enrollment away from other two-year colleges and towards their local community college when they reside in a community college district. In contrast, there is no statistically significant effect of in-district status on enrollment in four-year colleges, and the point estimate is quite small: -1pp, or

2.7% of the mean enrollment rate. On net, these enrollment effects increase overall college enrollment within one year of high school graduation by 1.3pp, or approximately 1.9% of the mean enrollment rate of 67.3%. The community college and vocational college enrollment effects are qualitatively similar for the 2009-2011 cohorts, however, the overall college enrollment effect for this subsample is much smaller (0.6pp) and not statistically different from zero.[30] All changes in enrollment behavior for these cohorts come from switching out of non-local community colleges and vocational colleges.

The second row of each panel presents the 2SLS estimates of the effect of reducing the tuition rate at a student's community college by $1,000. Across all students, this reduction in tuition increases enrollment at the local community college by 3.5pp (18%) and is primarily driven by a 1.5pp (17%) decrease in enrollment in non-local community colleges and a 0.4pp decrease in enrollment in private vocational colleges (11%). Again, these estimates are all statistically significant. As in the reduced form specifications, there is no statistically significant decrease in four-year college enrollment as a result of this tuition reduction, and the point estimate is quite small, representing only about 1% of the mean enrollment rate. Taken together, these enrollment effects increase overall college enrollment in the year following high school graduation by a statistically significant amount of 0.7pp, or approximately 1% of the mean enrollment rate of 67.3%. Again, the community college and vocational college enrollment effects are qualitatively similar using the 2009-2011 subsample, but the overall enrollment effect is smaller (0.4pp) and statistically insignificant.

5.2 College Completion

The college enrollment results indicate that reduced community college tuition increases community college enrollment and shifts students away from attending private vocational colleges. Such a shift in enrollment might affect students' longer-run outcomes by inducing them to attend higher-quality colleges that promote transfer to four-year colleges. To see the

[30] In Appendix Table A.4 I estimate the main specification including an interaction term between the in-district dummy variable and a dummy variable for being in the 2009-2011 cohorts. I find that the effects for local community college, vocational college, and four-year college are statistically no different for the 2009-2011 cohorts, compared to the 2012-2016 cohorts. However, the effects for non-local community college and overall college enrollment are statistically different between the two groups.

differences in quality and focus between community and vocational colleges, Table 6 presents summary statistics on Michigan's community colleges and the vocational colleges attended by recent high school graduates. Community colleges spend about $1,166 more per student on instruction than vocational colleges and also award a large share of their degrees in general liberal arts fields (two-digit CIP code 24). In contrast, vocational colleges rarely award degrees in this area. Given that these degrees are generally intended for students transferring to four-year colleges, it is not surprising that community colleges also have substantially higher rates of transfer than vocational colleges: 36% compared to 11%. Together, this evidence indicates that students who are induced to attend community colleges because of reduced tuition will likely experience more resources and a greater focus on transfer than if they attended vocational colleges.

Table 7 then estimates how residing in a community college district affects longer-run educational outcomes for the 2009-2011 cohorts. The first row of the table presents reduced form effects. In-district status significantly increases the total number of college semesters students complete by 0.344 (4.2%) and the total number of credits students complete by 3.46 (4.5%), indicating that students increase their educational attainment when they have access to low-cost local community college. Residing in a community college district also increases the probability that a student will transfer to a four-year college by 1.1pp (9.6%), where transfer is defined as a student beginning college at a community or vocational college but later enrolling in a four-year college. Moving on to degree completion outcomes, columns (4) and (5) show that residing in a community college district does not significantly affect students' completion of certificates nor associate degrees, although the coefficient for associate degree completion is positive. However, in-district status increases bachelor's degree completion by a statistically significant amount of 1.8pp (5.7%). The 2SLS results in the second row indicate that reducing a student's local community college tuition rate by $1,000 increases the number of semesters of college she completes by 0.206 (2.5%), the number of credits she completes by 2.07 (2.7%), her probability of transferring from to a four-year college by 0.7pp (6.5%), and her probability of completing a bachelor's degree by 1.1pp (3.5%).

To further understand the degree completion outcomes, Table 8 reports the distribution of associate and bachelor's degree increases across seven categories of majors. The categories are (1) general studies, which primarily consists of pre-transfer programs at community colleges; (2) liberal arts and sciences; (3) health; (4) business; (5) technical fields, such as engineering and technology programs; (6) professional fields, such as education, criminal justice, and journalism; and (7) other or unspecified fields, which primarily consists of degrees awarded without a major recorded in the data.[31] For each estimate, the outcome of interest is whether a student completes a given degree in a given field. These outcomes are mutually exclusive such that the sum of their coefficients must equal the overall degree completion increases presented in Table 7.[32]

Panel A reports the reduced form and 2SLS results for associate degree completion by field, indicating that a \$1,000 decrease in a student's local community college tuition rate increases her probability of earning a general studies associate degree by 0.6pp (17.1%) and an associate degree in other or unspecified fields by 0.2pp (12.5%). The general studies degree estimate is statistically significant at the 99% confidence level, while the other major degree estimate is statistically significant at the 90% confidence level. These estimates indicate that, while reduced local community college tuition does not statistically significantly increase overall associate degree completion, it shifts the fields in which students earn associate degrees. Specifically, students are more likely to earn degrees that enable transfer to four-year colleges than degrees which lead to labor market entry. This effect is likely driven by community colleges' commitment to providing students with transfer pathways and also further helps to explain why students are more likely to transfer to four-year colleges and ultimately complete bachelor's degrees when they have access to low-cost local community college.

Panel B reports changes in bachelor's degree completion by field. The increase in bachelor's degree completion reported in Table 7 is primarily driven by increases in bachelor's

[31] For all students who enroll in a postsecondary institution covered by the NSC, the MDE/CEPI dataset records the six-digit federal Classification of Instructional Program (CIP) code of the programs in which students enroll. I define a student as earning a degree in a given field of study if the student is enrolled in the field of study when she earns her degree. Appendix Table A.6 lists the set of two-digit CIP codes included in each category.

[32] If a student earns more than one degree of the same type (e.g. multiple associate degrees), only the field of study for her first degree is considered in this analysis.

degree completion in business and professional fields of study. Specifically, a $1,000 decrease in a student's local community college tuition rate increases her probability of earning a business bachelor's degree by 0.4pp (7.8%) and earning a bachelor's degree in a professional field by 0.7pp (8.0%). Both estimates are statistically significant. Given that business majors experience substantial earnings gains in the labor market (Andrews et al., 2017), this increase in degree completion is likely to have longer-term payoffs for students. To further explore the increase in professional fields, Appendix Table A.8 presents separate estimates for disaggregated majors contained within this category. The results indicate that the increase is driven by more students completing degrees in education majors and parks, recreation, leisure, and fitness studies majors. The largest majors in the latter category are exercise science (CIP 31.0505) and sports administration (CIP 31.0504). It is not obvious why the degree increases are largest in these fields as community colleges in Michigan have transfer programs for a wide variety of majors; future work could explore further reasons why students primarily choose these pathways.

5.3 Heterogeneity

Table 9 reports heterogeneous treatment effects by a student's FRPL eligibility, gender, and academic achievement for select college enrollment and completion outcomes.[33] Panel A shows that FRPL eligible and ineligible students respond similarly to residing in a community college district with regards to local community college enrollment, but their substitution patterns are different. FRPL ineligible students, who come from higher-income families, respond to living in a community college district by changing *which* community college they attend: they are 3.3pp less likely to enroll in a non-local community college and 6.7pp more likely to enroll in their local community college. In contrast, FRPL eligible students respond to in-district status by reducing non-local community college enrollment by only 1.5pp. These students also decrease enrollment in vocational colleges by 0.8pp and increase

[33] For the binary FRPL status and gender variables, I extend equation (1) to include an interaction term between $District_i$ and the demographic variable of interest. For the test score variable, students are assigned to score quartiles among all students who took the MME exam in the same year based on their combined scores on the math and reading exams. I then modify equation (1) to include a dummy variable for the middle two quartiles, a dummy variable for the top quartile, and interaction terms with these dummy variables and $District_i$.

overall college enrollment by 1.8pp. This indicates that having access to a low-tuition local community college option is particularly important for overall college enrollment for lower income students, despite their eligibility for Pell grants and other need-based financial aid programs. However, FRPL eligible and ineligible students earn associate and bachelor's degrees at comparable rates.

Panel B shows that male students are more responsive to in-district status than female students: they are 7.2pp more likely to attend the local community college than their out-of-district peers, whereas female students are 5.6pp more likely to do so. The underlying substitution effects are also different by gender. Female students respond to in-district status by significantly reducing enrollment in non-local community colleges and vocational colleges, while male students only somewhat reduce enrollment in non-local community colleges and also reduce enrollment in four-year colleges. This difference in substitution patterns may come from the fact that vocational colleges tend to offer degrees in female-dominated fields. In particular, about two-thirds of Baker College's students are female and over 40% enroll in healthcare fields. As such, there may be more room for female students to substitute away from vocational colleges, whereas male students are less likely to attend these institutions in general. Nevertheless, as in the case of FRPL eligible and ineligible students, these differences do not persist when looking at completion outcomes. Residing in a community college district increases associate and bachelor's degree completion similarly for male and female students, suggesting that male students who are induced to attend their local community college rather than a four-year college are not forgoing opportunities to earn bachelor's degrees.

Lastly, Panel C reports the estimated effects by students' test scores. Students from the bottom three test score quartiles are very responsive to residing in a community college district: it increases their probability of enrolling in the local community college by 7.4-7.5pp. In contrast, students from the top quartile respond to in-district status by increasing their enrollment in the local community college by only 2.9pp. There are also differences among these groups when considering substitution effects. Students from bottom quartile forgo enrollment in non-local community colleges, vocational colleges, and four-year colleges, whereas students from the middle quartiles primarily forgo enrollment in other community colleges. However, there are no decreases in bachelor's degree attainment among any group of students, which again suggests that the students who are deterred from attending four-year colleges do not forgo opportunities to earn bachelor's degrees. These students may even experience welfare improvements given the low loan repayment rates of students who enroll in colleges but do not complete degrees (Itzkowitz, 2018).

5.4 Robustness Checks

The reduced form and 2SLS results both rely on the assumption that there are no unobservable differences between students residing on either side of a community college district boundary that affect their college choices and outcomes. One threat to this assumption is that the two mile bandwidth does not create appropriate treatment and control groups because individual students may live several miles from one another, and therefore, may have different preferences over postsecondary education options or may be exposed to different social networks and information about college.[34] To test whether the results hold across comparisons of students who reside farther from or closer to one another, I re-run the reduced form analysis for local community college enrollment using varying bandwidths from 0.1 miles to 4 miles, in 0.1 mile intervals. Figure A.2 presents the estimates from these specifications, which range from 2.5pp to 8.0pp and are all statistically significant at the 90% level or greater. Moreover, the 90% confidence intervals of all of the point estimates contain the 6.4pp estimate from the main specification, indicating that the two mile bandwidth selection is not the main driver of the results.

The greatest threat to the identifying assumption, however, is the fact that community college district boundaries are often congruent with school district boundaries, and a non-trivial share of families choose where to live based on school district characteristics. To test whether differences in school districts drive the college enrollment and completion results, I provide an alternative specification that compares the college choices and outcomes of students who reside in the same school district but live on opposite sides of a community

[34] Observed differences in student characteristics do not necessarily decrease as the bandwidth is narrowed, and in some cases, actually increase. Appendix Table A.9 documents this fact by providing the balance tests from Table 4 for varying bandwidths.

college district boundary. Since Michigan's community college districts may be comprised of a variety of geographic features, there are areas in which a school district is not located entirely within or outside of a community college district. This occurs when a community college district is congruent with a county (or multiple counties), but school districts in the area span more than one county. There are twenty-five such school districts in the state in which at least 10% of the high school residents reside within the community college district and at least 10% reside outside. Appendix Figure A.1 identifies these school districts in gray, and Appendix Table A.10 lists their names and associated community college districts. Using these school districts as the analysis sample eliminates the concern that families sort into more desirable school districts that are located in community college districts. In addition, it holds constant college counseling information provided by the school district as the majority of students residing within one of these school districts attend the same high school: twenty-four of these twenty-five school districts contain only one high school, and 92% of students attend a high school that is located within their district of residence.

I repeat the reduced form and 2SLS analyses on this selected sample, but replace the boundary segment by year fixed effect with a school district of residence by year fixed effect. I continue to drop students eligible for promise scholarship and include the same set of control variables as in the main specification. Table 10 presents results from this analysis for enrollment in the local community college for the 2009-2016 cohorts and bachelor's degree completion for the 2009-2011 cohorts. The first column of the table presents the local community college enrollment results from the main specification. The second column presents results from the within school district specification. Using this sample and specification, residing in-district increases enrollment at the local community college by 5.0pp, and reducing the tuition rate by $1,000 increases enrollment by 3.2pp. Neither of these estimates is statistically different from the analogous estimates produced by the main specification.[35] The third and fourth columns repeat this comparison for bachelor's degree completion. The reduced form and 2SLS results are both statistically insignificant, but the point estimates are very

[35] Appendix Table A.11 contains estimates for all one-year enrollment outcomes using this alternative specification. Given the reduced sample size, these estimates lack precision but are qualitatively similar to those produced by the main specification.

close to, and statistically indistinguishable from, those produced by the main specification. Taken together, these comparisons suggest that the main specification's college enrollment and completion results are unlikely to be driven by selection into particular school districts, nor college information provided by school districts.

Another way to check the robustness of the main results is to examine whether college enrollment choices and completion outcomes discontinuously change along geographic boundaries other than community college districts. If the differences in college outcomes between in-district and out-of-district students residing along a community college district border are truly driven by differences in tuition rates, then there should be no differences in college choices nor outcomes along borders where tuition rates do not differ and there are not other related policies in place. To test whether this is true, I conduct two different placebo tests. First, I contract all community college district perimeters by two miles and compare the college choices of students residing within two miles of the new placebo boundary. This approach compares the choices and outcomes of students who all live within the same community college district, and face the same low tuition rate, but differ in how close they live to the center of the community college district. Second, I expand all community college district perimeters by two miles and compare the college choices of students residing within two miles of the new placebo boundary. In this approach, I compare students who live outside of a community college district but differ in how close they live to the nearest community college district boundary. In both approaches, I follow my main specification and divide the boundaries into equal boundary segments that are each no more than 5 miles in length.

The results from these approaches for local community college enrollment and bachelor's degree completion are presented in Table 11. The first column indicates that students residing within a community college district, but on either side of the contracted placebo boundary, do not differ in their likelihood of attending the local community college. The second column shows that students residing outside of a community college district, but on the side of the expanded placebo boundary that is closer to the true community college district are slightly more likely to attend the local community college. However, this estimate (0.7pp) is quite small compared to the estimate of 6.4pp along the true community college district boundaries and is only marginally significant. The third column indicates that students who reside within a community college district, but inside the contracted placebo boundary, are slightly less likely to obtain bachelor's degrees, while the fourth column indicates that out-of-district students living on either side of the expanded placebo boundary are equally likely to obtain a bachelor's degree. Both sets of results indicate that enrollment and completion outcomes do not change in meaningful ways along non-community college district boundaries, providing additional validation that the main results capture the effect of reduced community college tuition.

6 Conclusion

Community colleges serve millions of undergraduate students each year and are increasingly the focus of college access policies, making it critical to understand how students respond to their costs. In this paper, I provide new evidence on the effect of community college tuition rates on students' college enrollment decisions, persistence in college, and degree completion. To do so, I exploit the fact that Michigan's community colleges offer students different tuition rates depending on whether they live within our outside a college's district boundaries, as well as the fact that nearly one-quarter of Michigan's high school graduates do not live within the boundaries of any community college district. This geographic variation allows me to use a boundary fixed effects design that compares the outcomes of students who reside on either side of a community college district but who are otherwise observationally similar. I combine this approach with detailed administrative records from the Michigan Department of Education to track students' residences, college enrollment choices, and college completion outcomes over time.

Among students graduating from Michigan public high schools between 2009 and 2016, I find that a $1,000 decrease in the advertised tuition rate at a student's local community college upon graduating high school increases the probability of enrollment at the college by 3.5pp, or about 18%. This increase in local community college enrollment can be partially attributed to an increase in overall college enrollment but is also due to a decrease in enrollment at non-local community colleges and at private vocationally-focused colleges who offer similar degree programs to community colleges. However, I find little evidence that students forgo attending four-year colleges or decrease their overall educational attainment in response to a low community college tuition rate. Instead, for students who graduate from high school between 2009 and 2011, I find an increase in persistence in college, transfer to four-year colleges, and bachelor's degree completion. These improved outcomes may be attributed to the substitution towards local community colleges and away from non-local community colleges and vocational colleges, as overall college enrollment is not affected by reduced community college tuition for this subset of students. This finding suggests that gains from community college attendance can extend to more students than identified in prior work (Rouse, 1995; Reynolds, 2012; Mountjoy, 2018), namely students who would attend a private vocational college in the absence of a community college.

These results have meaningful policy implications, both for Michigan and for community college policies throughout the country. Approximately 100,000 students graduate from Michigan public high schools in a given year; of these, about 23,000 do not live within a community college district. Based on this paper's estimates, reducing local community college tuition by $1,000 for these students would induce 253 more students to earn bachelor's degrees.[36] Given that the average discounted lifetime premium to earning a bachelor's degree is about $300,000-$600,000 (Hershbein and Kearney, 2014), the total discounted earnings benefits to students under such a policy would be between $76 million and $152 million. These figures far exceed the $5-$6 million cost of reducing tuition by $1,000 for all out-of-district students who attend community colleges.[37] In fact, the income tax gains alone (assuming students continue to reside in Michigan) would total $3-6 million under Michigan's current state income tax rate of 4.25%. Other policies that induce students to attend community

[36] Currently, about 6,828 (29.7%) out-of-district students in each cohort earn a bachelor's degree. Increasing this percentage by 1.1pp (estimated increase in overall community college enrollment) to 30.8% would mean 7,081 students would complete a bachelor's degree —a difference of 253 students.

[37] About 5,267 (22.9%) out-of-district students attend community colleges each year. Increasing this percent to 24.9% would bring the total to about 5,727. At $1,000 per student, the cost of implementing the proposed policy would be $5,727,000 plus administrative costs.

colleges rather than not pursuing postsecondary education or attending lower quality private colleges, including the regulation of the for-profit industry and funding for new community college campuses, are likely to be similarly cost-effective and should continue to be a focus of education policy research.

However, the findings of this paper are not without limitations. One limitation of this study is that the results are estimated from an empirical design that compares students living very near one another, and thus, does not address the role of distance in college choices. Given the documented relationship between college proximity and college attendance (Card, 1995; Currie and Moretti, 2003; Lapid, 2017), it is likely that rural students who live far from colleges face additional challenges in accessing higher education and may not respond to reduced tuition as strongly as their non-rural peers. Future work should also seek to identify how reduced tuition policies differentially affect rural students and should investigate alternative policy interventions to increase college-going behavior among this population. Second, the tuition reduction studied in this paper does not include changes in marketing, mentoring, or college campuses. Policies that include such factors, such as broad free-tuition programs or the expansion of community college districts, may influence students in different ways and should continue to be rigorously evaluated as they are implemented.

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Figure 1: Identified Community College District Boundaries

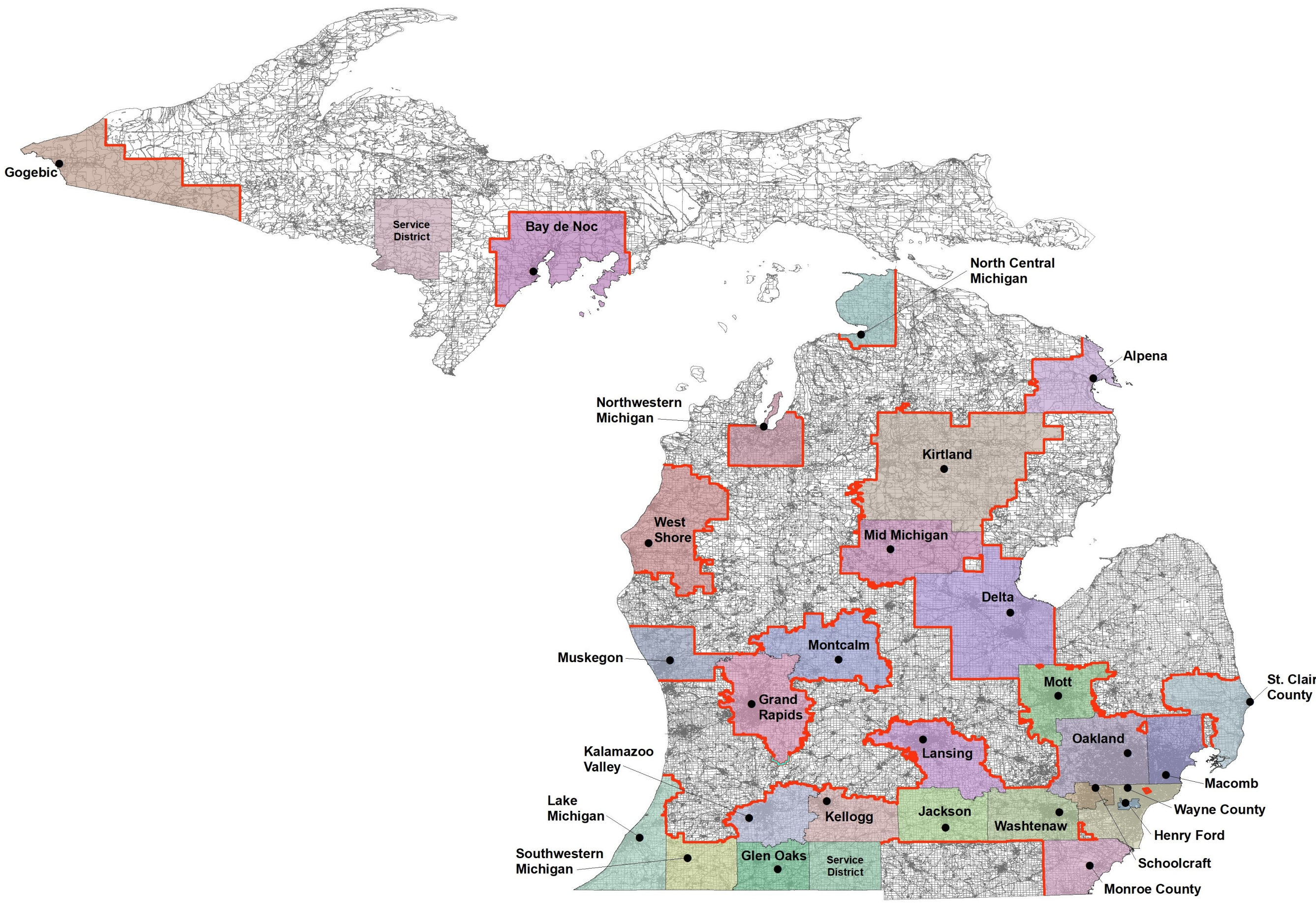


Figure 2: Washtenaw Community College District Analysis Sample

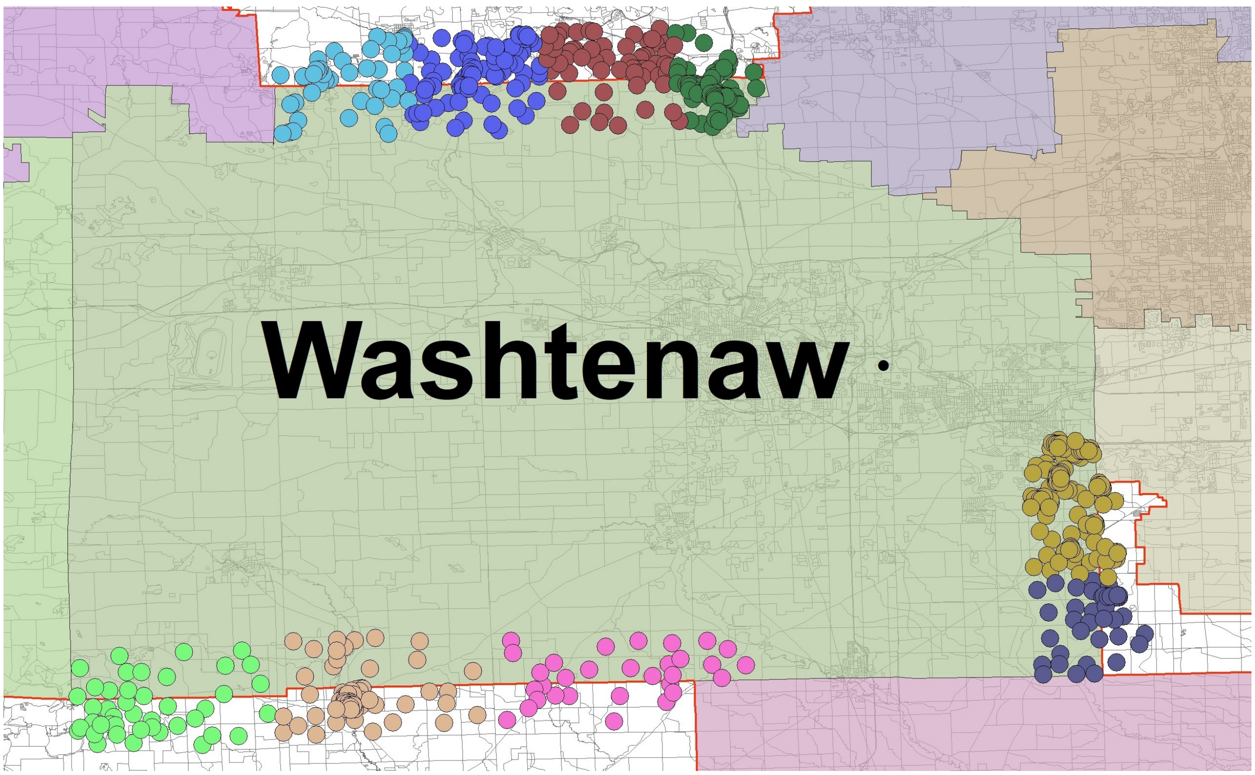


Figure 3: Distribution of Border Pair Tuition Differentials

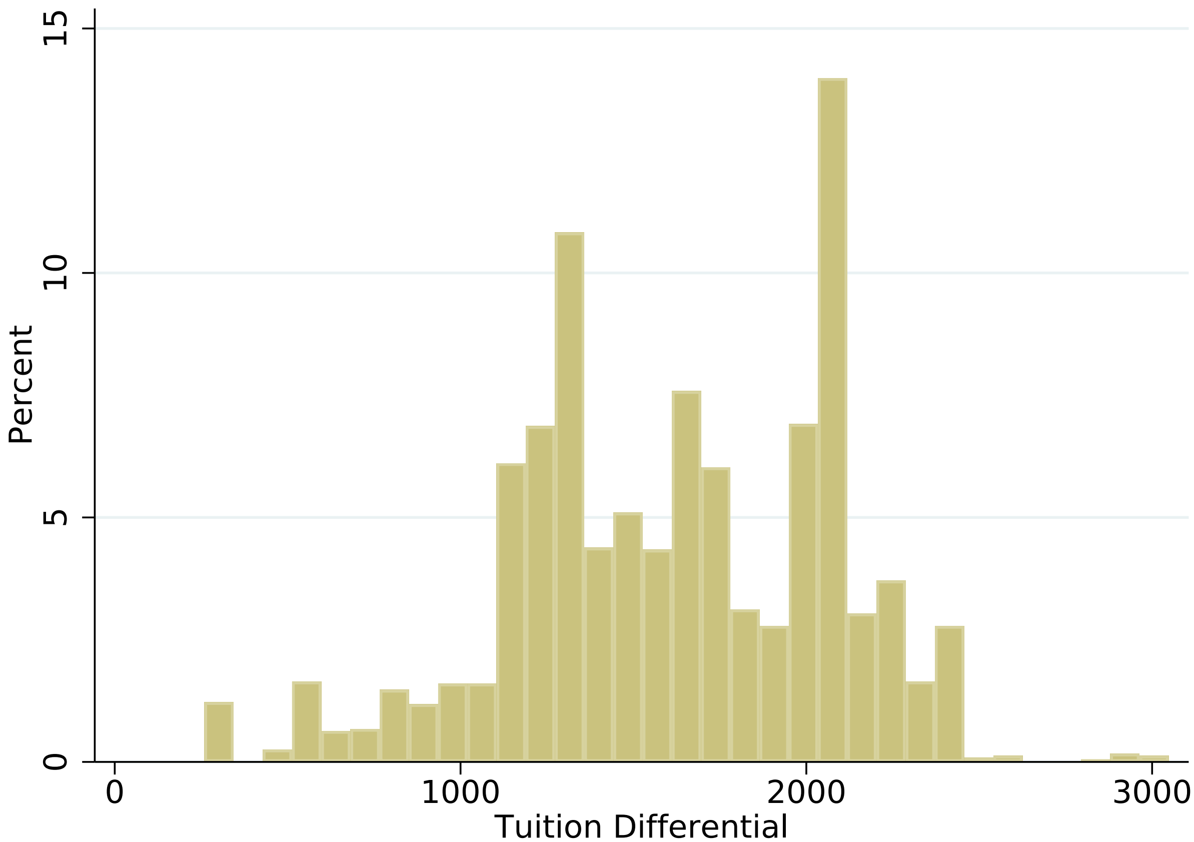
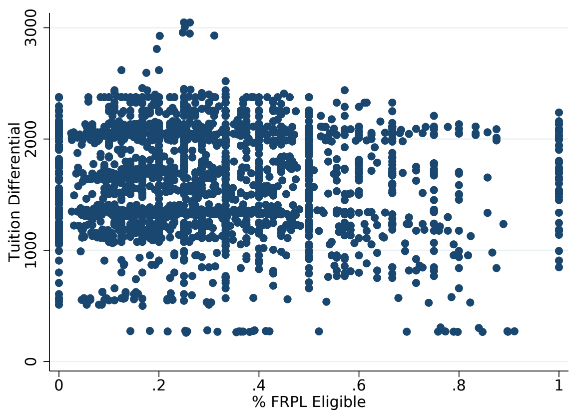
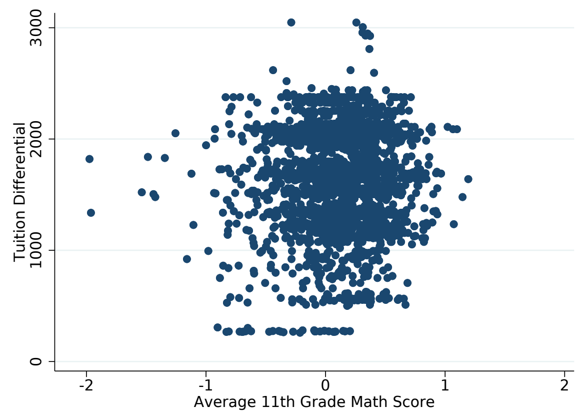


Figure 4: Correlation Between Tuition Differentials and Area Characteristics

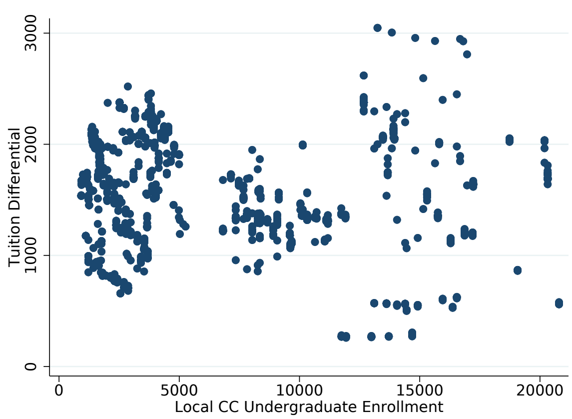
(a) % Economically Disadvantaged



(b) Math Test Scores



(c) Local CC Size



(d) Local CC Quality

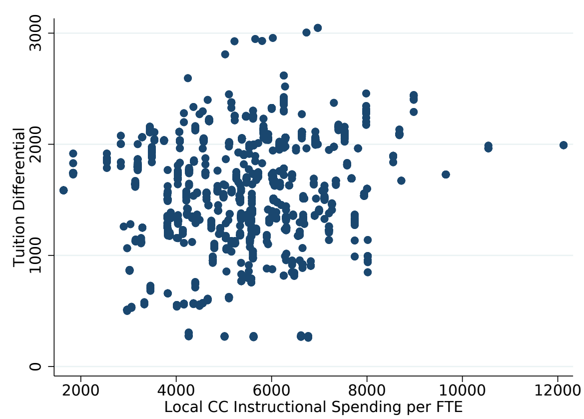


Table 1: Mean Tuition Rates at Michigan Community Colleges, 2008-2016

	Per Credit	**Per Semester**	**Per Year**	**Annual/Income**
In-District	\$94.44	\$1133.28	\$2266.56	3.78%
Out-of-District	\$155.39	\$1864.68	\$3729.36	6.22%
Difference	\$60.95	\$731.40	\$1462.80	2.44%

Notes: Tuition rates are provided by Michigan's Workforce Development Agency and converted into real 2016 dollars. All amounts are averaged across academic years 2008-2009 to 2015-2016. "Per semester" rates are calculated as the cost of 12 credits and "per year" rates are calculated as the cost per 24 credits. The final column "Annual/Income" presents the "per year" estimates divided by 60,000, the approximate median household income of students attending Michigan's community colleges (Chetty et al., 2017).

Table 2: Descriptive Statistics, 2009-2016 High School Graduates

Variable	**All Students**			**Analysis Sample**		
	All	**In**	**Out**	**All**	**In**	**Out**
Panel A. Demographics						
White	0.760	0.719	0.906	0.851	0.814	0.911
Black	0.150	0.189	0.015	0.081	0.110	0.034
Hispanic	0.041	0.041	0.043	0.029	0.029	0.030
Male	0.490	0.488	0.498	0.499	0.497	0.503
FRPL eligible	0.333	0.337	0.320	0.300	0.315	0.278
Special education	0.082	0.082	0.085	0.081	0.078	0.086
English language learner	0.025	0.030	0.010	0.021	0.029	0.007
Resides in CC district	0.779	1.000	0.000	0.616	1.000	0.000
Panel B. High School Academics						
Math standardized score	0.095	0.075	0.169	0.120	0.090	0.168
Reading standardized score	0.087	0.071	0.141	0.104	0.078	0.144
School of choice	0.096	0.094	0.104	0.124	0.120	0.130
On-time graduation	0.966	0.965	0.972	0.970	0.968	0.974
Dual enrollment in HS	0.095	0.088	0.121	0.108	0.102	0.117
Panel C. One-Year College Enrollment						
Community college	0.294	0.314	0.226	0.295	0.314	0.265
Vocational college	0.031	0.027	0.046	0.035	0.031	0.043
Four-year college	0.407	0.411	0.393	0.375	0.373	0.378
Any college	0.697	0.712	0.642	0.674	0.684	0.658
Observations	734,928	572,581	162,347	64,667	39,814	24,853

Notes: The "All Students" sample include all students who graduate from a traditional public high school in Michigan between 2009 and 2016, take the Michigan Merit Exam (MME), and have non-missing geographic and test score information. The "Analysis Sample" further restricts the sample to students who reside within two miles of a community college district boundary. Students who attend alternative education high schools or juvenile detention centers are not included in either sample.

Table 3: First Stage Estimate of In-District Status on Tuition

Variable	**No Controls**	**Distance Controls**	**All Controls**
In-District Status	-1,847***	-1,827***	-1,829***
	(259.1)	(231.1)	(230.1)
N	64,667	64,667	64,667
Partial F	50.83	62.60	63.23
Adj. R2	0.910	0.914	0.915

Notes: Each coefficient is estimated from a single regression and corresponds to λ in equation (2), representing the difference in local community college tuition faced by students residing inside of a community college district, as compared to students residing outside of a community college district. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4: Balance Tests of Student Characteristics

Outcome	**White (1)**	**Male (2)**	**FRPL (3)**	**SPED (4)**	**ELL (5)**
In-District Effect	0.001	-0.004	-0.015	-0.009***	0.006
	(0.010)	(0.005)	(0.012)	(0.003)	(0.006)
Observations	64,667	64,667	64,667	64,667	64,667
Mean	0.851	0.499	0.300	0.081	0.021
Outcome	**Math Score (6)**	**Reading Score (7)**	**On-Time Grad (8)**	**Dual Enroll (9)**	**Pred. CC Enrollment (10)**
In-District Effect	0.012	0.015	-0.001	-0.008*	0.002
	(0.013)	(0.012)	(0.003)	(0.004)	(0.001)
Observations	64,667	64,667	64,667	64,667	64,667
Mean	0.120	0.104	0.970	0.108	0.295

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression and corresponds to δ in equation (4). The coefficients represent the average difference in characteristics among students who reside within two miles of the same community college district boundary and graduate from high school in the same year. All standard errors are clustered at the boundary segment level. ${}^{*}p < 0.10$, ${}^{**}p < 0.05$, ${}^{***}p < 0.01$.

Table 5: Effect of In-District Status and Reduced Tuition on College Enrollment

Outcome	**Local CC (1)**	**Non-Local CC (2)**	**Vocational College (3)**	**Four-Year College (4)**	**Any College (5)**
Panel A. All Cohorts					
In-District Effect	0.064***	-0.028***	-0.007***	-0.010	0.013**
	(0.007)	(0.006)	(0.002)	(0.007)	(0.005)
Tuition Effect	0.035***	-0.015***	-0.004***	-0.005	0.007**
	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)
Observations	64,667	64,667	64,667	64,667	64,667
Mean	0.209	0.089	0.035	0.375	0.674
Panel B. 2009-2011 Cohorts					
In-District Effect	0.060***	-0.035***	-0.007**	-0.005	0.006
	(0.010)	(0.007)	(0.003)	(0.008)	(0.008)
Tuition Effect	0.036***	-0.021***	-0.004***	-0.003	0.004
	(0.006)	(0.006)	(0.001)	(0.005)	(0.004)
Observations	23,734	23,734	23,734	23,734	23,734
Mean	0.225	0.096	0.040	0.368	0.691

Notes: The sample in Panel A consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Panel B further restricts the sample to students who graduated from high school between 2009 and 2011. In both panels, each coefficient is estimated from a single regression. The coefficients in the "in-district effect" rows correspond to δ in equation (1), representing the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the "tuition effect" rows correspond to $-\beta * 1000$, where β is defined as in equation (3). These coefficients represent the estimate change in the probability of an outcome due to a $1,000 decrease in the annual tuition rate at a student's local community college. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6: Characteristics of Community and Vocational Colleges

Variable	MI Community Colleges (1)	Vocational Colleges (2)	Difference (3)
Avg. Net Price	$5,325.38	$14,004.62	-$8,679.24
Instruction $ per FTE	$4,993.05	$3,897.80	$1,095.25
% Full-Time Faculty	0.400	0.213	0.188
200% Graduation Rate	0.135	0.196	-0.061
% Liberal Arts Degrees	0.349	0.006	0.343
Transfer Rate*	0.360	0.111	0.249
Median Earnings	$29,326.50	$29,018.95	$307.55
Median Debt	$4,211.58	$8,867.49	-$4,655.91
Students	191,394	21,720	-
Institutions	28	144	-

Notes: All data comes from the U.S. Department of Education's College Scorecard, except for the transfer rate variable which is calculated on the full sample of Michigan's 2009-2011 high school graduates who enroll in community or vocational colleges within one year of high school graduation. All variables are averaged across all 2009-2016 high school graduates who enroll in college within one year of high school graduation to reflect the characteristics of the colleges that students attend.

Table 7: Effect of In-District Status and Reduced Tuition on College Completion

Outcome	**Semesters of College (1)**	**Credits Completed (2)**	**Transfer to Four-Year (3)**	**Certificate Completion (4)**	**Associate Completion (5)**	**Bachelor's Completion (6)**
In-District Effect	0.344***	3.463***	0.011**	-0.003	0.005	0.018**
	(0.097)	(1.302)	(0.005)	(0.004)	(0.005)	(0.008)
Tuition Effect	0.206***	2.069***	0.007**	-0.002	0.003	0.011**
	(0.062)	(0.656)	(0.003)	(0.003)	(0.002)	(0.005)
Observations	23,734	23,734	23,734	23,734	23,734	23,734
Mean	8.133	76.46	0.115	0.055	0.126	0.316

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2011. Each coefficient is estimated from a single regression. The coefficients in the "in-district effect" rows correspond to δ in equation (1), representing the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the "tuition effect" rows correspond to $-\beta * 1000$, where β is defined as in equation (3). These coefficients represent the estimate change in the probability of an outcome due to a $1,000 decrease in the annual tuition rate at a student's local community college. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 8: Distribution of Degree Completion Increases Across Majors

Outcome	**General Studies (1)**	**Liberal Arts (2)**	**Health (3)**	**Business (4)**	**Technical (5)**	**Prof. (6)**	**Other (7)**
Panel A. Associate Degree							
In-District Effect	0.010***	-0.000	-0.002	-0.001	-0.002	-0.002	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Tuition Effect	0.006***	-0.000	-0.001	-0.001	-0.001	-0.001	0.002*
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	23,734	23,734	23,734	23,734	23,734	23,734	23,734
Mean	0.033	0.010	0.023	0.013	0.016	0.016	0.016
Panel B. Bachelor's Degree							
In-District Effect	0.002**	0.001	0.001	0.007*	-0.002	0.009**	0.001
	(0.001)	(0.005)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Tuition Effect	0.001**	0.000	0.001	0.004*	-0.001	0.005***	0.001
	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Observations	23,734	23,734	23,734	23,734	23,734	23,734	23,734
Mean	0.003	0.100	0.034	0.051	0.038	0.067	0.022

Notes: In both panels, the sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2011. Each coefficient is estimated from a single regression. The coefficients in the "in-district effect" rows correspond to δ in equation (1), representing the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the "tuition effect" rows correspond to $-\beta * 1000$, where β is defined as in equation (3). These coefficients represent the estimate change in the probability of an outcome due to a $1,000 decrease in the annual tuition rate at a student's local community college. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 9: Heterogeneity by Student Characteristics

	One year enrollment:					Completion:	
Outcome	**Local**	**Non-Local**	**Voc.**	**Four-Year**	**Any**	**Assoc.**	**Bach.**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Overall effect	0.064***	-0.028***	-0.007***	-0.010	0.013***	0.005	0.018**
	(0.007)	(0.006)	(0.002)	(0.007)	(0.005)	(0.005)	(0.008)
Panel A. FRPL Eligibility							
Ineligible	0.067***	-0.033***	-0.007***	-0.010	0.010	0.006	0.015
	(0.008)	(0.007)	(0.002)	(0.008)	(0.006)	(0.005)	(0.009)
Eligible	0.056***	-0.015**	-0.009**	-0.008	0.019***	0.002	0.028**
	(0.009)	(0.006)	(0.003)	(0.008)	(0.007)	(0.009)	(0.013)
Ineligible = eligible?	0.244	0.026	0.647	0.859	0.312	0.686	0.436
Panel B. Gender							
Female	0.056***	-0.034***	-0.011***	-0.005	-0.001	0.004	0.019*
	(0.008)	(0.007)	(0.003)	(0.007)	(0.009)	(0.008)	(0.011)
Male	0.072***	-0.022***	-0.004*	-0.014*	0.026***	0.006	0.017*
	(0.008)	(0.008)	(0.002)	(0.008)	(0.007)	(0.006)	(0.010)
Female = male?	0.008	0.138	0.033	0.206	0.017	0.832	0.913
Panel C. Test Score							
Bottom quartile	0.074***	-0.018**	-0.011***	-0.023**	0.021**	0.012	0.008
	(0.011)	(0.009)	(0.004)	(0.009)	(0.011)	(0.010)	(0.011)
Middle two quartiles	0.075***	-0.036***	-0.009***	-0.003	0.017***	-0.001	0.026**
	(0.008)	(0.007)	(0.003)	(0.007)	(0.007)	(0.007)	(0.011)
Top quartile	0.029***	-0.19**	0.001	-0.008	-0.004	0.011	0.014
	(0.010)	(0.008)	(0.003)	(0.015)	(0.008)	(0.0010)	(0.014)
Bottom = middle?	0.934	0.031	0.677	0.061	0.730	0.363	0.150
Top = middle?	0.000	0.017	0.022	0.702	0.029	0.288	0.488
N	64,667	64,667	64,667	64,667	64,667	23,734	23,734

Notes: For outcomes (1)-(5), the sample consists of all students who reside within two miles of the nearest community college district boundary segment, graduated from high school between 2009 and 2016. For outcomes (6) and (7), the sample is further restricted to students who graduated from high school between 2009 and 2011, and students who earn postsecondary degrees in high school are dropped from the sample. Coefficients are estimated from regressions with interaction terms, as described in section 5.4. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 10: Local Community College Enrollment Results, Within Same School District

	Local CC Enrollment		**Bachelor's Degree**	
	Main Strategy	**School District**	**Main Strategy**	**School District**
	(1)	**(2)**	**(3)**	**(4)**
In-District Effect	0.064***	0.050***	0.018**	0.015
	(0.007)	(0.014)	(0.008)	(0.022)
Tuition Effect	0.035***	0.032***	0.011**	0.011
	(0.004)	(0.011)	(0.005)	(0.015)
Observations	64,667	17,783	23,734	6,946
Mean	0.209	0.233	0.316	0.292

Notes: Columns (1) and (3) repeat the estimates for local community college enrollment and bachelor's degree completion presented in Tables 5 and 7, respectively. Here, the sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Standard errors are cluster at the boundary segment level. Columns (2) and (4) present reduced form and 2SLS estimates on the sample of school districts that overlap community college districts (see Section 5.5). The sample consists of all students who reside in one of the overlapping school districts and graduated from high school between 2009 and 2016. In these columns, standard errors are clustered at the school district level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 11: Placebo Tests

	Local CC Enrollment		**Bachelor's Degree**	
	Further In	**Further Out**	**Further In**	**Further Out**
	(1)	**(2)**	**(3)**	**(4)**
Estimate	0.005	0.007*	-0.012*	-0.004
	(0.007)	(0.004)	(0.007)	(0.008)
Observations	94,582	50,527	33,676	19,390
Mean	0.242	0.159	0.318	0.314

Notes: Each column reports the estimates of a placebo test that alters the boundaries of the community college districts. Columns (1) and (3) contract all community college districts by 2 miles; columns (2) and (4) expand all community college districts by 2 miles. Each sample consists of all students who reside within two miles of the nearest placebo community college district boundary segment and graduated from high school between 2009 and 2016. Each column then estimates δ from equation (1) using the constructed placebo community college district boundaries. All standard errors are clustered at the placebo boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

A Online Appendix

A.1 Additional Figures and Tables

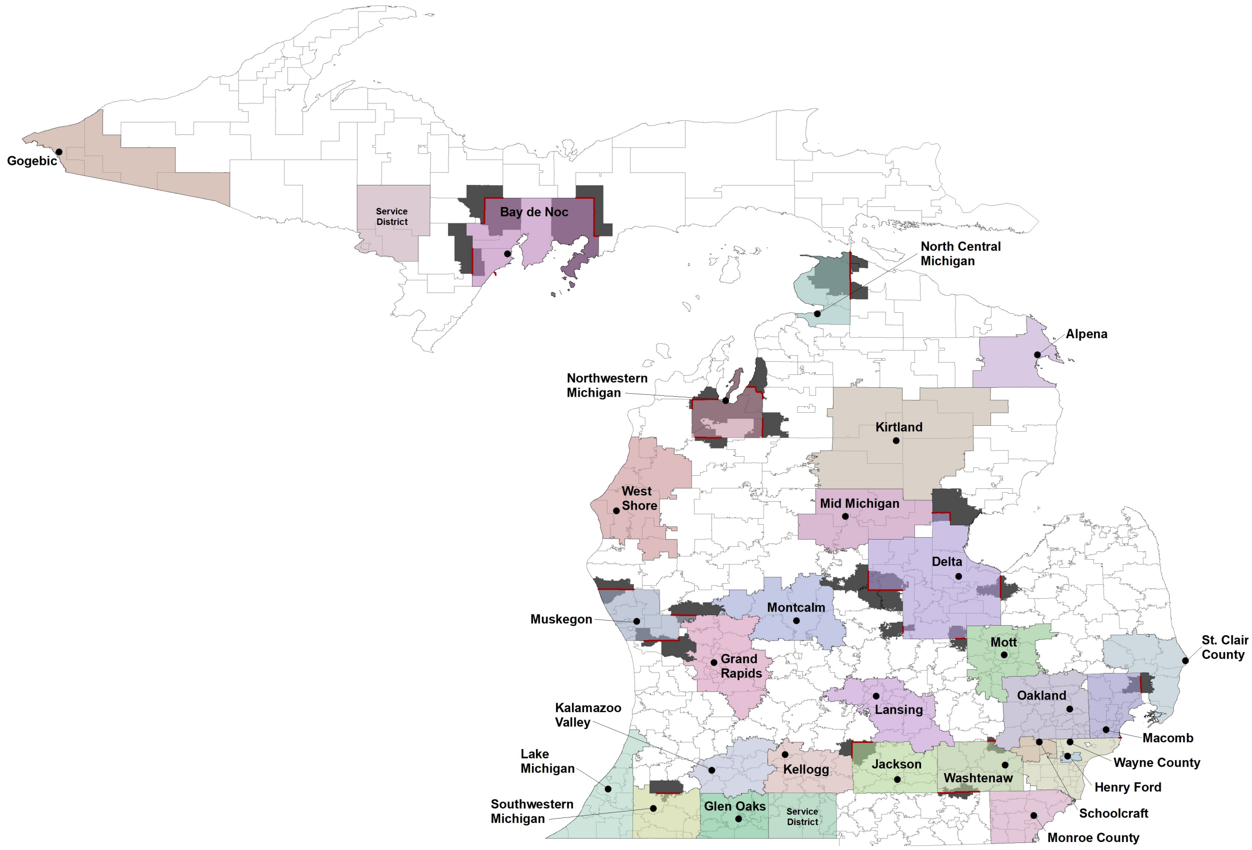


Figure A.1: School Districts Overlapping Community College Districts

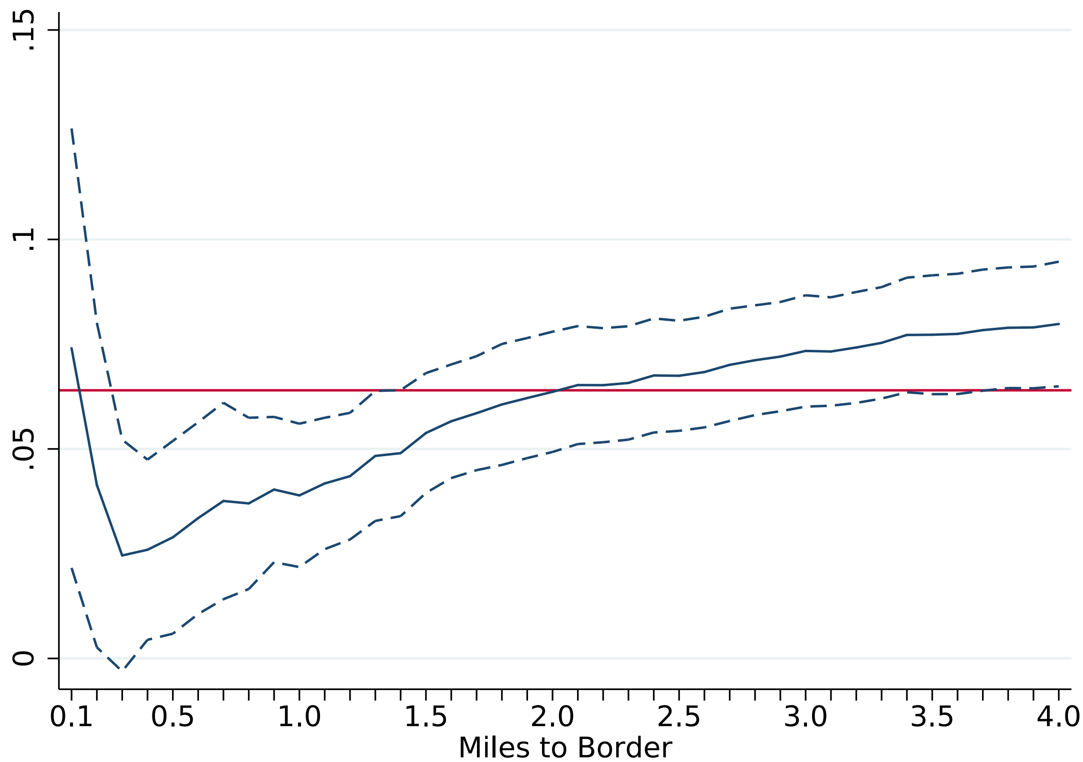


Figure A.2: Reduced Form Estimates with Alternative Bandwidths

Table A.1: Baker College vs. Private Two-Year Colleges

Variable:	**Baker College (1)**	**All Private Two-Years (2)**	**For-Profit (3)**	**Not-For-Profit (4)**
Avg. Net Price	$12,333	$16,320	$16,200	$17,172
Instruction $ per FTE	$4,010	$4,361	$3,908	$7,525
% Full-Time Faculty	0.103	0.481	0.457	0.580
200% Graduation Rate	0.168	0.682	0.688	0.635
% Liberal Arts Degrees	0.003	0.007	0.000	0.058
Median Earnings	$26,880	$26,129	$24,512	$35,725
Median Debt	$8,447	$8,927	$8,673	$10,637
Institutions	1	2,092	1,838	336

Notes: Data comes from the College Scorecard, averaged over all years 2009-2016.

Table A.2: Michigan's Traditional Four-Year Colleges

Variable:	**Flagships** **(1)**	**Other Public** **(2)**	**Private** **(3)**
Undergraduates	32,475	12,522	1,669
Avg. Net Price	$15,477	$13,245	$18,995
Instruction $ per FTE	$17,943	$8,448	$8,430
% Full-Time Faculty	0.840	0.640	0.685
200% Graduation Rate	0.850	0.512	0.521
Median Earnings	$55,220	$42,229	$41,938
Median Debt	$18,771	$14,170	$16,106
Institutions	2	13	26

Notes: Data comes from the College Scorecard, averaged over all years 2009-2016.

Table A.3: Balance Tests of Census Tract Characteristics

Outcome	**Median HH Income (1)**	**Poverty Share (2)**	**Mean 3rd Grade Math Score (3)**	**2 Bedroom Rental Price (4)**
In-District Effect	1,427	-0.003	-0.077	13.08
	(1,065)	(0.005)	(0.116)	(12.69)
Observations	64,645	64,667	64,653	46,927
Mean	59,505	0.118	2.976	748.58
Outcome	**Single Parent Share (5)**	**Non-White Share (6)**	**High-Paying Job Share (7)**	**Job Growth 2004-2013 (8)**
In-District Effect	0.001	0.001	0.008	0.004
	(0.011)	(0.001)	(0.006)	(0.009)
Observations	64,667	64,667	64,667	64,667
Mean	0.245	0.142	0.387	0.006

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression and corresponds to δ in equation (4). The coefficients represent the average difference in census tract characteristics among students who reside within two miles of the same community college district boundary and graduate from high school in the same year. All data comes from the Equality of Opportunity Project and is publicly available at: `https://opportunityinsights.org/data/`. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.4: Heterogeneous Effects by Graduation Year

Variable:	**Local CC (1)**	**Non-Local CC (2)**	**Vocational College (3)**	**Four-Year College (4)**	**Any College (5)**
In-District Effect	0.066***	-0.024***	-0.007***	-0.009	0.019***
	(0.008)	(0.006)	(0.002)	(0.007)	(0.006)
In-District x 2009-2011 Grad	-0.005	-0.010**	-0.001	-0.001	-0.017**
	(0.008)	(0.004)	(0.003)	(0.007)	(0.007)
Observations	64,667	64,667	64,667	64,667	64,667
Mean	0.209	0.089	0.035	0.375	0.674

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. The coefficients in the "in-district effect" rows correspond to δ in equation (1) for the 2012-2016 cohorts, representing the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the second row represent the difference in the in-district effect between the 2009-2011 cohorts and the 2012-2016 cohorts. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.5: Balance Tests of Distance to Postsecondary Institutions

Outcome	**Local CC (1)**	**Public Four-Year (2)**	**Private Four-Year (3)**	**Private Vocational (4)**
In-District Effect	-1.462***	0.023	-0.929**	-0.717
	(0.178)	(0.432)	(0.442)	(0.468)
Observations	64,667	64,667	64,667	64,667
Mean	10.30	19.50	23.73	19.93

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression and corresponds to δ in equation (4). The coefficients represent the average difference in census tract characteristics among students who reside within two miles of the same community college district boundary and graduate from high school in the same year. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.6: Academic Program Categories

Major Group	**Two-Digit CIP Code**	**CIP Title**
General Studies	24	Liberal Arts and Sciences, General Studies and Humanities
Liberal Arts	1	Agriculture, Agriculture Operations, and Related Sciences
	3	Natural Resources and Conservation
	5	Area, Ethnic, Cultural, and Gender Studies
	16	Foreign Languages, Literatures, and Linguistics
	23	English Language and Literatures
	26	Biological and Biomedical Sciences
	27	Mathematics and Statistics
	30	Multi/Interdisciplinary Studies
	38	Philosophy and Religious Studies
	40	Physical Sciences
	42	Psychology
	45	Social Sciences
	50	Visual and Performing Arts
	54	History
Health	51	Health Professions and Related Clinical Sciences
Business	52	Business, Management, Marketing, and Related Support Services
Technical	4	Architecture and Related Services
	10	Communications Technologies/Technicians and Support Services
	11	Computer and Information Sciences and Support Services
	14	Engineering
	15	Engineering Technologies/Technicians
	41	Science Technologies/Technicians
	46	Construction Trades
	47	Mechanic and Repair Technologies/Technicians
	48	Precision Production
	49	Transportation and Materials Moving
Professional	9	Communication, Journalism, and Related Programs
	12	Personal and Culinary Services
	13	Education
	19	Family and Consumer Sciences/Human Sciences
	22	Legal Professions and Studies
	25	Library Science
	31	Parks, Recreation, Leisue, and Fitness Studies
	43	Security and Protective Services
	44	Public Administration and Social Service Professions

Table A.7: Associate Degree Programs Offered by Baker College & MI Community Colleges

CIP Code	CIP Title	MI Comm. Colleges	Vocational Colleges	Diff.
1	Agriculture, Agriculture Operations, and Related	0.342	0.198	0.144
3	Natural Resources and Conservation	0.258	0.006	0.252
4	Architecture and Related Services	0.249	0.001	0.248
5	Area, Ethnic, Cultural, and Gender Studies	0.097	0.000	0.097
9	Communication, Journalism, and Related	0.536	0.726	-0.191
10	Communications Technologies/Technicians and Support	0.615	0.724	-0.109
11	Computer and Information Sciences and Support	0.996	0.957	0.039
12	Personal and Culinary Services	0.723	0.130	0.593
13	Education	0.864	0.735	0.129
14	Engineering	0.750	0.427	0.323
15	Engineering Technologies/Technicians	0.999	0.778	0.221
16	Foreign Languages, Literatures, and Linguistics	0.371	0.302	0.069
19	Family and Consumer Sciences/Human Sciences	0.838	0.725	0.112
22	Legal Professions and Studies	0.782	0.343	0.440
23	English Language and Literature/Letters	0.346	0.006	0.339
24	Liberal Arts and Sciences, General Studies, Humanities	1.000	0.084	0.916
25	Library Science	0.191	0.000	0.190
26	Biological and Biomedical Sciences	0.585	0.056	0.529
27	Mathematics and Statistics	0.377	0.006	0.372
29	Military Technologies	0.000	0.001	-0.001
30	Multi/Interdisciplinary Studies	0.429	0.007	0.422
31	Parks, Recreation, Leisure, and Fitness Studies	0.381	0.115	0.266
38	Philosophy and Religious Studies	0.185	0.000	0.185
39	Theology and Religious Vocations	0.018	0.000	0.017
40	Physical Sciences	0.416	0.006	0.411
41	Science Technologies/Technicians	0.439	0.000	0.438
42	Psychology	0.397	0.007	0.389
43	Security and Protective Services	0.996	0.939	0.056
44	Public Administration and Social Service Professions	0.483	0.010	0.473
45	Social Sciences	0.284	0.008	0.276
46	Construction Trades	0.567	0.016	0.551
47	Mechanic and Repair Technologies/Technicians	0.931	0.802	0.129
48	Precision Production	0.842	0.421	0.421
49	Transportation and Materials Moving	0.264	0.745	-0.482
50	Visual and Performing Arts	0.930	0.765	0.165
51	Health Professions and Related Clinical Sciences	1.000	0.945	0.055
52	Business, Management, Marketing, and Related	1.000	0.962	0.038
54	History	0.231	0.011	0.220

Notes: All data comes from the U.S. Department of Education's College Scorecard. All variables are averaged across all 2009-2016 high school graduates who enroll in college within one year of high school graduation to reflect the characteristics of the colleges that students attend.

Table A.8: Distribution of Bachelor's Degree Increases Across Professional Majors

Outcome	**Protective Service** (1)	**Family & Consumer Sciences** (2)	**Personal Care & Culinary** (3)	**Legal Studies** (4)	**Education & Library Science** (5)	**Comm. & Journalism** (6)	**Public Admin.** (7)	**Parks, Rec., Leisure, & Fitness** (8)
In-District Effect	0.001	-0.001	0.000	0.000	0.004**	-0.000	0.002*	0.003**
	(0.002)	(0.001)	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Tuition Effect	0.001	-0.001	0.000	0.000	0.002**	-0.000	0.001	0.002*
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	23,734	23,734	23,734	23,734	23,734	23,734	23,734	23,734
Mean	0.008	0.004	0.0002	0.001	0.018	0.017	0.008	0.011

Notes: The sample consists of all students who reside within two miles of the nearest community college district boundary segment and graduated from high school between 2009 and 2011. Each coefficient is estimated from a single regression. The coefficients in the "in-district effect" rows correspond to δ in equation (1), representing the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the "tuition effect" rows correspond to $-\beta * 1000$, where β is defined as in equation (3). These coefficients represent the estimate change in the probability of an outcome due to a $1,000 decrease in the annual tuition rate at a student's local community college. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.9: Balance Tests of Student Characteristics, Varying Bandwidths

Bandwidth:	**White (1)**	**Male (2)**	**FRPL (3)**	**SPED (4)**	**ELL (5)**	**Math (6)**	**Reading (7)**	**On-Time (8)**	**Dual (9)**
4 Miles	-0.015	0.001	-0.009	-0.008*	0.004	0.018	0.026**	-0.001	-0.007
(N=145,775)	(0.013)	(0.003)	(0.016)	(0.004)	(0.003)	(0.016)	(0.012)	(0.003)	(0.006)
3 Miles	-0.008	-0.000	-0.012	-0.009**	0.004	0.022*	0.023**	-0.001	-0.007*
(N=102,791)	(0.009)	(0.004)	(0.012)	(0.004)	(0.004)	(0.013)	(0.011)	(0.002)	(0.004)
2 Miles	0.001	-0.004	-0.015	-0.009***	0.006	0.012	0.015	-0.001	-0.008*
(N=64,667)	(0.010)	(0.005)	(0.012)	(0.003)	(0.006)	(0.013)	(0.012)	(0.003)	(0.004)
1 Mile	0.016	0.004	-0.023	-0.010**	0.010	0.020	0.008	-0.002	-0.011*
(N=31,541)	(0.013)	(0.007)	(0.019)	(0.005)	(0.010)	(0.016)	(0.015)	(0.003)	(0.006)
0.5 Miles	0.020	0.005	-0.032	-0.009	0.008	0.017	0.026	-0.003	-0.014*
(N=15,185)	(0.014)	(0.009)	(0.025)	(0.007)	(0.010)	(0.020)	(0.022)	(0.006)	(0.008)
0.1 Miles	-0.014	0.054**	0.051**	-0.011	0.001	-0.015	0.020	-0.015	-0.023
(N=1,136)	(0.022)	(0.025)	(0.023)	(0.018)	(0.003)	(0.052)	(0.070)	(0.024)	(0.028)

Notes: The sample consists of all students who reside within the specified distance of the nearest community college district boundary segment and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression and corresponds to δ in equation (4). The coefficients represent the average difference in characteristics among students who reside within the given bandwidth of the same community college district boundary and graduate from high school in the same year. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.10: School Districts Overlapping Community College Districts

School District	**Community College District**	**High Schools**
Bark River-Harris School District	Bay de Noc	1
Big Bay De Noc School District	Bay de Noc	1
Mid Peninsula School District	Bay de Noc	1
Ashley Community Schools	Delta	1
Breckenridge Community Schools	Delta	1
New Lothrop Area Public Schools	Delta	1
Reese Public Schools	Delta	1
Shepherd Public Schools	Delta	1
St. Louis Public Schools	Delta	1
Standish-Sterling Community Schools	Delta	1
Springport Public Schools	Jackson	1
Richmond Community Schools	Macomb	1
Coopersville Area Public School District	Muskegon	1
Fruitport Community Schools	Muskegon	1
Grant Public School District	Muskegon	1
Montague Area Public Schools	Muskegon	1
Mackinaw City Public Schools	North Central Michigan	1
Pellston Public Schools	North Central Michigan	1
Buckley Community Schools	Northwestern Michigan	1
Elk Rapids Schools	Northwestern Michigan	1
Forest Area Community Schools	Northwestern Michigan	1
Traverse City Area Public Schools	Northwestern Michigan	2
Decatur Public Schools	Southwestern Michigan	1
Clinton Community Schools	Washtenaw	1
Whitmore Lake Public School District	Washtenaw	1

Table A.11: Full Enrollment Results for Within Same School District Sample

Outcome	**Local CC (1)**	**Non-Local CC (2)**	**Vocational College (3)**	**Four-Year College (4)**	**Any College (5)**
In-District Effect	0.050***	-0.020*	-0.001	-0.016	0.014
	(0.014)	(0.012)	(0.005)	(0.018)	(0.016)
Tuition Effect	0.032***	-0.013	-0.001	-0.010	0.009
	(0.011)	(0.008)	(0.003)	(0.012)	(0.010)
Observations	17,783	17,783	17,783	17,783	17,783
Mean	0.233	0.067	0.035	0.336	0.643

Notes: The sample consists of all students who reside within a school district that intersects a community college district and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression that includes a full set of school district by graduation year fixed effects. The coefficients in the "policy effect" represent the estimated change in the probability of an outcome due to a student residing in a community college district. The coefficients in the "tuition effect" row represent the estimate change in the probability of an outcome due to a $1,000 decrease in the annual tuition rate at a student's local community college. All standard errors are clustered at the boundary segment level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

A.2 Community College District Boundaries

* Denotes service area locale

Community College	Counties	School Districts	Cities/Townships
Alpena		Alpena	
Bay de Noc	Delta Dickinson*		
Delta	Bay Midland Saginaw		
Glen Oaks	Branch* St. Joseph		
Gogebic	Gogebic		
Grand Rapids		Kent ISD: Byron Center, Caledonia, Cedar Springs, Comstock Park, East Grand Rapids, Forest Hills, Godfrey Lee, Godwin Heights, Grand Rapids, Grandville, Kelloggsville, Kenowa Hills, Kent City, Kentwood, Lowell, Northview, Rockford, Sparta, Thornapple Kellogg, Wyoming	
Henry Ford		Dearborn	
Jackson	Jackson		
Kalamazoo Valley		Climax-Scotts, Comstock, Galesburg-Augusta, Gull Lake, Kalamazoo, Mattawan, Parchment, Portage, Schoolcraft, Vicksburg	
Kellogg		Albion, Athens, Battle Creek, Harper Creek, Homer, Lakeview, Mar-Lee, Marshall, Pennfield, Tekonsha, Union City	
Kirtland		C.O.O.R. ISD: Crawford-AuSable, Fairview Area, Houghton Lake, Mio-AuSable, Roscommon Area, West Branch-Rose City	
Lake Michigan	Berrien	South Haven	Covert
Lansing		Bath, Dansville, Dewitt, East Lansing, Grand Ledge, Haslett, Holt/Diamondale, Lansing, Leslie, Mason, Okemos, Stockbridge, Waverly, Webberville, Williamston	
Macomb	Macomb		
Mid Michigan		Clare-Gladwin RESA: Beaverton Clare, Farwell, Gladwin, Harrison	
Monroe County	Monroe		

Montcalm		Montcalm Area ISD: Carson City-Crystal, Central Montcalm, Greenville, Lakeview, Montabella, Tri County, Vestaburg	
Mott		Genesee ISD: Atherton, Beecher, Bendle, Bentley, Carman-Ainsworth, Clio, Davison, Fenton, Flint, Flushing, Genesee, Goodrich, Grand Blanc, Kearsley, Lake Fenton, Lakeville, Linden, Montrose, Mt. Morris, Swartz Creek, Westwood Heights	
Muskegon	Muskegon		
North Central Michigan	Emmet		
Northwestern Michigan	Grand Traverse		
Oakland	Oakland		
Schoolcraft		Clarenceville, Garden City, Livonia, Northville, Novi (part), Plymouth-Canton	
Southwestern Michigan	Cass		Keeler, Hamilton
St. Clair County		Algonac, Capac, East China, Marysville, Memphis, Port Huron, Yale	
Washtenaw	Washtenaw		
Wayne County	Wayne		NOT INCLUDED: Dearborn, Garden City, Highland Park, Livonia, Northville, Plymouth, Canton (part)
West Shore		Bear Lake, Free Soil, Kaleva-Norman-Dickson, Ludington, Manistee, Mason County Central, Mason County Eastern, Onekama, Walkerville	Crystal, Elbridge, Weare