EFFECTS OF REDUCED COMMUNITY COLLEGE TUITION ON COLLEGE CHOICES AND DEGREE COMPLETION

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Abstract

Recent efforts to increase college access and completion concentrate on reducing tuition rates at community colleges, but researchers and policy makers 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 percent) and reduces enrollment at non-local community colleges, for-profit institutions, and other private, vocationally focused colleges, by 1.9 percentage points (15 percent). This shift in enrollment choices increases students' persistence in college, credit completion, and 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 percent of U.S. undergraduate students and are increasingly the focus of college access initiatives (NCES 2018).[1] These institutions offer a variety of educational programs, including vocationally focused certificates, two-year associate's 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 and are the first in their families to attend college (Ma and Baum 2016). In recent years, policy makers have capitalized on community colleges' commitment to access in their local communities by implementing programs that make community college low-cost or completely 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. Policy makers and researchers alike have 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 experience long-run earnings gains. 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's 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 percent of less-than-two-year certificates and nearly 20 percent of associate's degrees in the United States, despite having higher average tuition rates, and lower average completion rates and wage premiums than their public, not-for-profit counterparts (Deming, Goldin, and Katz 2012; Cellini and Turner 2019). Although there is some evidence that community colleges and for-profit colleges compete for students in the two-year college market, particularly in the presence of declines in state funding for public higher education (Cellini 2009; Goodman and Volz 2020) or local labor demand shocks (Armona, Charkarbarti, and Lovenheim 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' 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 annual community college tuition rate

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.

of $2,300 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, McCall, and Martorell (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, McCall, and Martorell (2018) show that precisely measuring community college tuition is important in determining its effects on college enrollment, but are unable to observe in which colleges students 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 percent of all postsecondary institutions in the United States, including several of the largest national for-profit colleges (NSC 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.

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 percent 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 percent of the mean). At the same time, this tuition decrease reduces enrollment in non-local community colleges by 1.6 percentage points (8 percent of the mean) and in for-profit and other private, vocationally focused colleges that offer two-year degrees by 0.4 percentage points (11 percent of the mean). The remainder of the increase in local community college attendance can be attributed to a 1.0 percentage point 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 percent more semesters of college, 2.7 percent more college credits, and to transfer to four-year colleges at a rate 6.5 percent higher than their peers who do not receive discounted tuition. This $1,000 tuition decrease also increases bachelor's degree completion by 1.1 percentage points (3.5 percent),

particularly in business majors and professional fields, such as teacher education and exercise science. These 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's degrees (which are designed to prepare students to transfer) rather than associate's 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, such as informational campaigns, mentoring programs, or the construction of 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 finding suggests that, despite the already low cost of most community colleges in the United States, students are responsive to the sticker prices advertised by community colleges and 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 Volz (2020) 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, on average, that 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). Community college attendance will make some students better off because they otherwise 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, Hurwitz, and Smith 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 2019). 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 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 ninety accredited colleges and universities in Michigan offering a wide range of academic programs, and over 90 percent of the state's high school graduates who enroll in college choose to attend one of them. There are 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 structure creates large differences in the tuition rates faced by students who reside on either side of a given boundary. Second, Michigan is home to a large private vocational college, Baker College, which has multiple 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 subsidizing community college tuition crowds out enrollment in similar private colleges.

Michigan's Community Colleges

Michigan is home to twenty-eight public community colleges that 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 agency governing the 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 percent of the community colleges' operating revenues. To supplement this funding, the colleges rely heavily on both tuition and fees (43 percent of operating revenues) and

local property taxes (35 percent of operating revenues). For each college, local property taxes may only be assessed on properties within its community college district (Zielak 2018).[2]

Community college district boundaries are governed by the trustees of each college and may be primarily composed of counties, public school districts, or public intermediate school districts (ISDs), which are administrative organizations that support multiple school districts.[3] 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, fifteen of the state's twenty-eight community college districts are composed primarily of counties, and thirteen are made up primarily of school districts or ISDs.[4] 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 students' 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, a sizable portion of Michigan high school students reside outside of any community college district and, therefore, face the higher, 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 percent 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

2. In 2015–16, the average millage rate for community colleges was 2.51, that is, $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.
3. More information about Michigan's ISDs is available here: https://www.gomaisa.org/value-of-isds/.
4. In table A.1, available in a separate online appendix on *Education Finance and Policy's* Web site at https://doi.org/10.1162/edfp_a_00313, I list the geographic areas that constitute each community college district. I gather this information from individual community college Web sites, course catalogs, and conversations with colleges' institutional research staff.
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.

Table 1. Mean Tuition Rates at Michigan Community Colleges, 2008–16

	Per Credit	Per Semester	Per Year	Annual/Income
In-district	$94.44	$1,133.28	$2,266.56	3.78%
Out-of-district	$155.39	$1,864.68	$3,729.36	6.22%
Difference	$60.95	$731.40	$1,462.80	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 2008–09 to 2015–16. "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).

district area they reside nearest) that are 65 percent 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 enrolled in 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 percent 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 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 timeframe 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. This range means that, 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 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.

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 NCES's Integrated Postsecondary Education Data System (IPEDS) indicates that the average net price for in-district students is approximately 80 percent lower than the average net price for out-of-district students.

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 percent of its degrees at the associate's degree level and accepts 90 percent or more of its 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. Community and vocational colleges also tend to offer degrees in similar fields, and both have an emphasis on health and business subjects. Table A.2 in the online appendix highlights this point by comparing the types of associate's degrees offered by the community and vocational colleges attended by Michigan's high school graduates. Given the overlap in program offerings, it is reasonable to believe these vocational institutions 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 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 nondegree 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. As such, my results should be interpreted as an upper bound of the effect of reduced community college tuition on overall college enrollment and a lower bound of the effect of reduced tuition on substitution away from vocational colleges.

The most popular private vocational institution among Michigan's high school graduates is Baker College, which has twelve campuses throughout the state and enrolls over 70 percent of Michigan's vocational students.[12] Baker is a private, not-for-profit

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 timeframe 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 between on-campus and online enrollment within an institution.
11. In 2017, the NSC reported coverage of 78 percent of multi-state for-profit institutions but 0 percent coverage of for-profits operating only in Michigan (NSC Research Center 2017).
12. Because of this large market share, my results are robust to any definition of vocational colleges that includes Baker College.

institution that primarily offers degree programs designed to take two years or less. Such institutions are not common in the United States. For example, according to the 2016 College Scorecard, there are 369 private predominantly associate- or certificate-degree granting institutions in the United States, 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. Table A.3 in the online appendix compares Baker to the universe of private colleges that predominantly grant associate's degrees and certificates. Across several measures of institutional quality and outcomes, Baker appears more similar to its for-profit counterparts than its not-for-profit peers. Given these similarities, the results from this paper should provide suggestive evidence on how reductions in local community college tuition may affect enrollment at for-profit colleges generally.

Other Postsecondary Options

The remainder of undergraduate, degree-granting postsecondary institutions in Michigan are either public or private traditional four-year colleges. 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 percent of the universities' operating budgets (Zielak 2018). 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. 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. Table A.4 in the online appendix 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).

3. DATA AND SAMPLE

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.[13] The college link provided through the NSC and STARR contains all dates and records of students' enrollments in colleges covered by either database. The data also include information on the academic programs in which they enroll, using six-digit Classification of Instructional Program (CIP) codes, the credits they complete, and the awards they receive. I match these data to postsecondary institutional information, including campus latitudes and longitudes, from 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.

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 have formed 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 near a community college district boundary and use fixed effects to compare the outcomes of students who reside in geographic proximity to one another and graduate from high school in the same year but differ in their in-district status at the local community college.[14]

To implement this empirical strategy, I first identify the census blocks that are located within each community college district. 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

13. This feature of the data is a particular advantage in Michigan because the state has generous school choice policies and nearly 6 percent of K–12 students attend a school other than that to which they are assigned (either within or outside their school district of residence). An additional 7 percent of students attend a charter school (Cowen, Creed, and Kessler 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.

14. In my main specifications, I restrict the sample to students residing within two miles of a community college district boundary 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 online appendix and discussed in section 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).

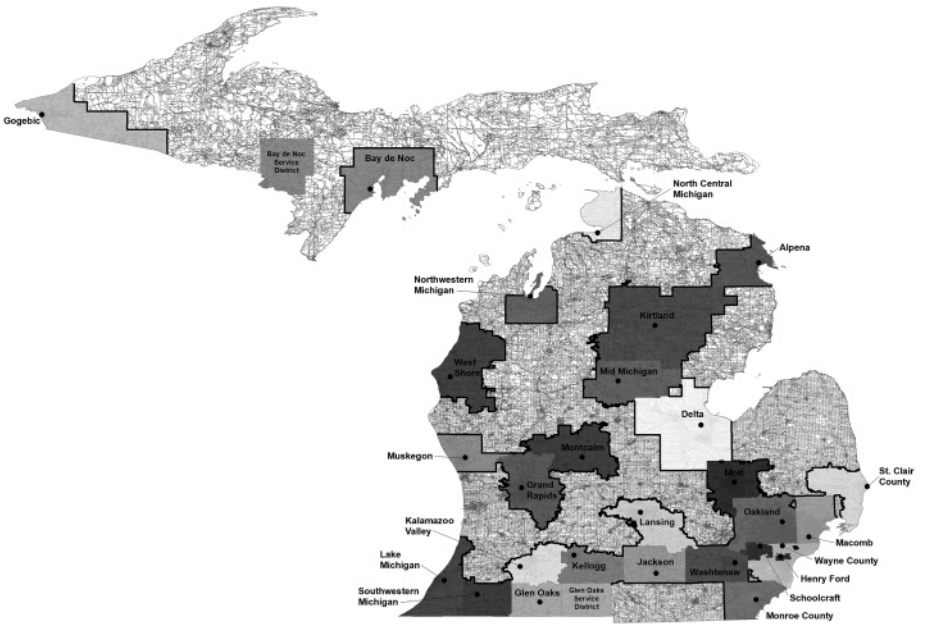

Figure 1. Community College District Boundaries

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.

Once I have mapped all census blocks to their corresponding 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 twenty-eight community college districts and includes in bold the district boundaries used in the analysis.[15]

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 five 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, in my main empirical specification, restrict the sample to students residing within two miles of their nearest boundary segment.[16] An example of this sample restriction for the

15. 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.

16. In order to only include students who, upon high school graduation, 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, 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/promiseSearch.html.

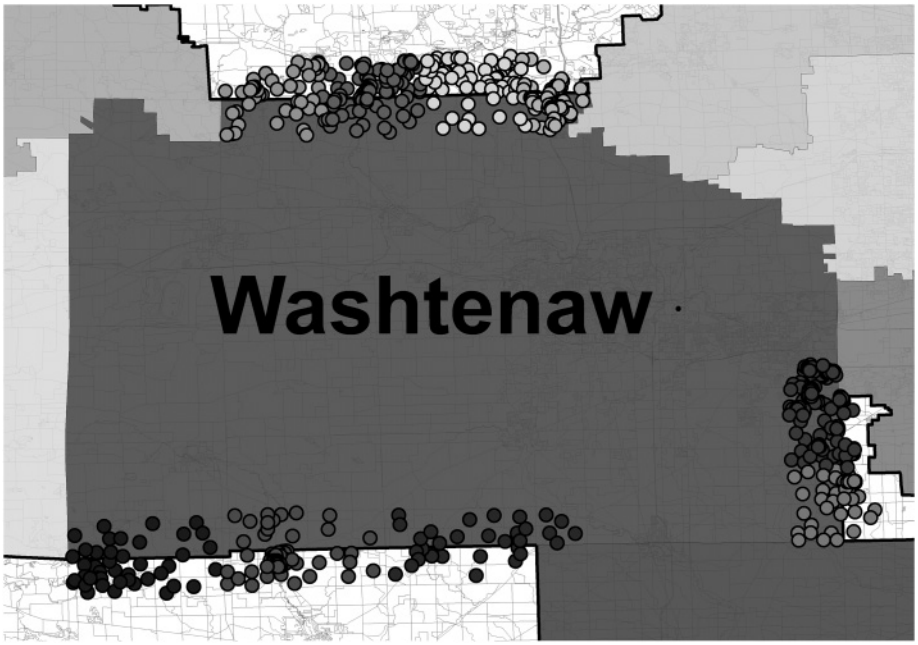

Figure 2. Washtenaw Community College District Analysis Sample

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 shade 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 shade, but reside on either side of the community college district boundary segment.[17]

By plotting the distribution of in-district versus out-of-district tuition differentials across all border-year pairs, figure A.1 in the online appendix presents visual evidence on the differences in local community college tuition rates among students residing on either side of the identified boundary segments. 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 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 A.2 in the online appendix plots the tuition differentials against various demographic characteristics. There is no identifiable relationship between a border-year pair's tuition differential and the share of economically disadvantaged students, the median household income of the area, or students' average test scores. This finding suggests the variation in tuition differentials likely comes from different tuition-setting policies and practices at colleges throughout the state rather than differences in local economies or preferences for education.

Table 2 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

17. 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.

Table 2. Descriptive Statistics, 2009–16 High School Graduates

	All Students			Analysis Sample		
Variable	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 (HS) in Michigan between 2009 and 2016, take the Michigan Merit Exam, 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 (CC) district boundary. Students who attend alternative education high schools or juvenile detention centers are not included in either sample. FRPL = free or reduced-price lunch.

who live within two miles of their nearest boundary segment.[18] I also present separate means for the 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 ELLs. This is not surprising because community college districts tend to be located in more urban and diverse areas of the state. Panel B 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,

18. 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.

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 percent 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 percent enroll in vocational colleges, with fewer in-district students doing so than out-of-district students. In the sample of all students, about 41 percent of graduates enroll in a four-year college, while about 38 percent 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 percent of all Michigan public high school graduates enroll in college within one year, while about 67 percent 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:

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

where Y_{ibt} is an outcome of interest for student i who resides along boundary segment b and graduates from high school in year t. $District_i$ is a dummy variable equal to 1 if student i resides in a community college district and equal to 0 otherwise. $\boldsymbol{X}_i$ 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. ν_{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}.

To estimate how community college tuition itself affects students' choices and outcomes, I also use a two-stage least squares (2SLS) 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:

$$Tuition_{ibt} = \zeta + \lambda District_i + \boldsymbol{X}_i\Phi + \mu_{bt} + \upsilon_{ibt} \tag{2}$$

and the second stage equation is:

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

where $\widehat{Tuition}_{ibt}$ is predicted from the first stage, and the remainder of the variables are defined as in previous equations.[19]

19. One could also estimate this relationship via ordinary least squares, but this would impose that the relationship between the tuition differential (in dollars) and the effect of residing in-district is linear, that is, the largest in-district effects occur when there are the largest raw tuition differentials. This may be reasonable, considering I do not see much correlation between tuition differentials and observable characteristics but it is also possible that boundaries with high tuition differentials are unobservably different than boundaries with low differentials. Thus, to remain agnostic about this relationship, I prefer the 2SLS approach.

In order for β to represent the causal effect of local community college tuition on student outcomes, it must be the case that (1) $Cov(District_i, Tuition_{ibt}|\boldsymbol{X}_i, \mu_{bt}) = 0$ and that (2) $Cov(District_i, \varepsilon_{ibt}\boldsymbol{X}_i, \mu_{bt}) = 0$. 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. Given that all community colleges in Michigan set different tuition rates for in-district and out-of-district students, this assumption should hold. However, it is also directly testable in the data. Table A.5 in the online appendix presents the estimated first stage value of λ in three specifications of equation 2: including no control variables, including only distance-related control variables, and including a full set of distance and student control variables.[20] 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. All three estimates also have partial F-statistics greater than 40, limiting the probability that the 2SLS estimates suffer from weak instrument bias.

The second 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 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 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. 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.[21]

Second, very few students move into community college districts between ninth and twelfth grades. 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 percent of all students move census blocks during high school, less than 1 percent move from an out-of-district census block to an in-district census block.[22] Moreover, conditional on beginning high school in a community college district, a student has a 99 percent probability of finishing high school in a

20. The distance-related variables are the distance between a student's census block of residence and the nearest campus of 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.

21. 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.

22. My 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.

Table 3. Balance Tests of Student Characteristics

Outcome	White (1)	Male (2)	FRPL (3)	SPED (4)	FRPL (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)**	**Predicted 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 (CC) district boundary segment and graduated from high school between 2009 and 2016. Each coefficient is estimated from a single regression that regresses the student characteristic of interest on a dummy variable for in-district status and the full set of boundary segment by year fixed effects. 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. FRPL = free or reduced-price lunch; SPED = special education.

*$p < 0.10$; ***$p < 0.01$.

community college district. In contrast, conditional on beginning high school outside of a community college district, a student has a 4 percent probability of finishing high school in a community college district. 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. Table 3 reports balance tests of observable student characteristics and predicted community college enrollment along the boundary segments.[23] 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 FRPL eligible, and to be ELLs. They also score similarly on standardized tests, graduate on-time from high school at similar rates, and have similar 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.[24] Tables A.6 and A.7 in the

23. 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.

24. 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 districts.

online appendix provide additional evidence of balance across neighborhood characteristics and distance to local colleges.

Despite these mitigating factors, the largest threat to identification is the fact that community college district boundaries are often congruent with school district boundaries.[25] This overlap is a potential threat to the identifying assumption for two reasons. First, high schools may provide different college information and guidance to students depending on whether the school is located in a community college district. Second, families often select where to live based on school district attributes and their preferences for public education (Caetano and Macartney 2014), which may be correlated with their preferences for community college access. 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. However, 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 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, I repeat the analysis using a subset of students who live in school districts that are bisected by a community college district. Students in this sample come from families who choose to live within the school district's boundaries (and therefore likely have similar preferences for education), and overwhelmingly attend the same high school (and 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 is likely driving my main results.

5. RESULTS

College Enrollment

Table 4 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 types of college choices: (1) the local community college (at which in-district students receive reduced tuition), (2) non-local community colleges (both in Michigan and in other states), (3) private vocational colleges, and (4) four-year colleges. Students may enroll in more than one type of college within their first year following high school graduation, so the sum of these estimates need not equal the overall college enrollment effect presented in column 5. Panel A presents estimates for all cohorts of students, and panel B presents estimates only using the 2009–11 cohorts who will be used for analyses of college completion.

25. The overlap of counties and community college districts is less concerning as the vast majority of college advising and implementation of college access policies occur 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.

Table 4. 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: 2009–11 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 (CC) 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 $\beta \times 1000$, 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 regressions include controls for a student's race/ethnicity, gender, free or reduced-price lunch status, special education participation, English language learner 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. All standard errors are clustered at the boundary segment level.

$^{**}p < 0.05$; $^{***}p < 0.01$.

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 6.4 percentage points (31 percent), while decreasing enrollment in non-local community colleges by 2.8 percentage points (31 percent) and in private vocational colleges by 0.7 percentage point (20 points). All three of these estimates are statistically significant at the 99 percent confidence level and imply that students shift enrollment away from other two-year colleges and toward their local community colleges 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 small: −1 percentage point, or 2.7 percent of the mean enrollment rate. On net, these enrollment effects increase overall college enrollment within one year of high school graduation by 1.3 percentage points, or approximately 1.9 percent of the mean enrollment rate of 67.3 percent. The community college and vocational college enrollment effects are qualitatively similar for the 2009–11 cohorts, but the overall college enrollment effect for this subsample is much smaller (0.6 percentage points)

Table 5. 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's 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 $\beta \times 1000$, 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 regressions include controls for a student's race/ethnicity, gender, free or reduced-price lunch status, special education participation, English language learner 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. All standard errors are clustered at the boundary segment level.

$^{**}p < 0.05$; $^{***}p < 0.01$.

and not statistically different from zero.[26] The increase in local community college enrollment for these cohorts comes primarily from a reduction in enrollment in 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 local community college by $1,000. Across all students, this reduction in tuition increases enrollment at the local community college by 3.5 percentage points (18 percent) and is primarily driven by a 1.5 percentage point (17 percent) decrease in enrollment in non-local community colleges and a 0.4 percentage point decrease in enrollment in private vocational colleges (11 percent). Taken together, these enrollment effects increase overall college enrollment in the year following high school graduation by a statistically significant amount of 0.7 percentage point, or approximately 1 percent of the mean enrollment rate of 67.3 percent. Again, the community college and vocational college enrollment effects are qualitatively similar using the 2009–11 subsample, but the overall enrollment effect is smaller (0.4 percentage point) and statistically insignificant.

College Completion

Table 5 estimates how residing in a community college district affects longer-run educational outcomes for the 2009–11 cohorts. All outcomes are measured in 2017, at the end of the timeframe of the dataset. The first row of the table presents reduced form effects. In-district status significantly increases the total number of college semesters students complete by 0.34 (4.2 percent) and the total number of credits students complete by

26. In table A.8 in the online appendix, I estimate the main specification including an interaction term between the in-district dummy variable and a dummy variable for being in the 2009–11 cohorts. I find the effects for local community colleges, vocational colleges, and four-year colleges are statistically no different for the 2009–11 cohorts compared to the 2012–16 cohorts. However, the effects for non-local community colleges and overall college enrollment are statistically different between the two groups.

3.46 (4.5 percent), 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 1.1 percentage points (9.6 percent), where transfer is defined as a student beginning college at a community or vocational college but later enrolling in a four-year college. 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 0.21 (2.5 percent), the number of credits she completes by 2.07 (2.7 percent), and her probability of transferring from to a four-year college by 0.7 percentage point (6.5 percent).

Columns 4 and 5 show that residing in a community college district does not significantly affect students' completion of certificates nor associate's degrees, although the coefficient for associate's degree completion is positive. This lack of a degree completion effect could be driven by the fact that community colleges have lower completion rates than their vocational counterparts. On average, only 13.5 percent of students at Michigan's community colleges complete programs within 150 percent of their intended length, whereas 19.6 percent of students at vocational colleges do so. However, column 6 indicates that in-district status increases bachelor's degree completion by a statistically significant amount of 1.8 percentage points (5.7 percent). The 2SLS estimate shows that reducing a student's local community college tuition rate by $1,000 increases her probability of completing a bachelor's degree by 1.1 percentage points (3.5 percent).

To better understand these degree completion outcomes, table 6 reports the distribution of associate's and bachelor's degree increases across seven categories of majors: (1) general studies (which primarily consist 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 consist of degrees awarded without a major recorded in the data).[27] For each estimate, the outcome of interest is whether a student completes a given degree in a given field.

Panel A reports the reduced form and 2SLS results for associate's 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's degree by 0.6 percentage point (17.1 percent) and an associate's degree in other or unspecified fields by 0.2 percentage point (12.5 percent). These estimates indicate that, while reduced local community college tuition does not statistically significantly increase overall associate's degree completion, it shifts the fields in which students earn associate's degrees. Specifically, students are more likely to earn degrees that enable transfer to four-year colleges than degrees that lead to labor market entry. Panel B reports the effects of in-district status and reduced tuition on bachelor's degree completion by field and shows that the

27. For all students who enroll in a postsecondary institution covered by the NSC, the MDE/CEPI dataset records the six-digit federal 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. Table A.9 in the online appendix lists the set of two-digit CIP codes included in each category. If a student earns more than one degree of the same type (e.g., multiple associate's degrees), only the field of study for her first degree is considered in this analysis.

Table 6. Distribution of Degree Completion Increases across Majors

Outcome	General Studies (1)	Liberal Arts (2)	Health (3)	Business (4)	Technical (5)	Professional (6)	Other (7)
Panel A: Associate's 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 $\beta \times 1000$, 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 regressions include controls for a student's race/ethnicity, gender, free or reduced-price lunch status, special education participation, English language learner 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. All standard errors are clustered at the boundary segment level.

$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

increase in bachelor's degree completion is primarily driven by increases in bachelor's degree completion in business and professional fields of study. Given that business majors experience substantial earnings gains in the labor market (Andrews, Imberman, and Lovenheim 2017), this increase is likely to have longer-term payoffs for students.[28]

Taken together, these completion results indicate that having access to in-district tuition induces students to complete associate's degrees that enable transfer to four-year colleges, and to ultimately complete bachelor's degrees. These improved outcomes are likely the result of differences in institutional resources and objectives between Michigan's community and vocational colleges. For example, 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

28. To further explore the increase in professional fields, table A.10 in the online appendix 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.

Table 7. Heterogeneity by Student Characteristics

	One Year Enrollment					Completion	
	Local	Non-Local	Vocational	Four-Year	Any	Associate's Degree	Bachelor's Degree
Outcome	(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: Free or Reduced-Price Lunch 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
Observations	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. All standard errors are clustered at the boundary segment level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

colleges: 36 percent compared with 11 percent. Table A.11 in the online appendix provides additional summary statistics on the differences between these institutions that further explain why attending a community college, rather than a vocational college, could improve students' educational attainment.

Heterogeneity

Table 7 reports heterogeneous treatment effects by a student's FRPL eligibility, gender, and academic achievement for select college enrollment and completion outcomes.[29] Panel A shows that FRPL-eligible and ineligible students respond similarly to residing

29. For the binary FRPL status and gender variables, I extend equation 1 to include an interaction term between the in-district dummy variable 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 the in-district dummy variable.

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 3.3 percentage points less likely to enroll in a non-local community college and 6.7 percentage points 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 1.5 percentage points. These students also decrease enrollment in vocational colleges by 0.8 percentage point and increase overall college enrollment by 1.8 percentage points, indicating that access to a low-tuition local community college option is particularly important for overall college enrollment for lower income students. However, FRPL-eligible and ineligible students earn associate's 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 7.2 percentage points more likely to attend the local community college than their out-of-district peers, whereas female students are 5.6 percentage points 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 stem from the fact that vocational colleges tend to offer degrees in female-dominated fields, such as health care. Nevertheless, as in the case of FRPL-eligible and ineligible students, these differences do not persist when looking at completion outcomes. That is, even male students who forgo initially attending four-year colleges to attend their local community college do not forgo ultimately earning 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 7.4–7.5 percentage points. In contrast, students from the top quartile respond to in-district status by increasing their enrollment in the local community college by only 2.9 percentage points. There are also differences among these groups when considering substitution effects. Students from the 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.

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.[30] To test whether the results hold across comparisons of students who reside farther from or closer to one another, I repeat the reduced form analysis for local community college enrollment using varying bandwidths from 0.1 to 4 miles. Figure A.3 in the online appendix presents the estimates from these specifications, which range from 2.5 percentage points to 8.0 percentage points and are all statistically significant at the 90 percent level or greater. Moreover, the 90 percent confidence intervals of all of the point estimates contain the 6.4 percentage points estimate from the main specification, indicating the two-mile bandwidth selection is not the main driver of the results.

A greater threat to the identifying assumption is the fact that community college district boundaries are often congruent with school district boundaries, and families may 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 college district boundary. This situation 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. Figure A.4 in the online appendix identifies the twenty-five school districts in the state in which at least 10 percent of the high school residents reside within the community college district and at least 10 percent reside outside. 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, this approach 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 percent 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, replacing the boundary segment by year fixed effect with a school district of residence by year fixed effect. Table 8 presents results from this analysis for enrollment in the local community college for the 2009–16 cohorts and bachelor's degree completion for the 2009–11 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 5.0 percentage points, and reducing the tuition rate by $1,000, increases enrollment by 3.2 percentage points. Neither of these estimates is statistically different from the analogous estimates produced by the main specification.[31] The third and fourth columns show the estimated degree completion effect is also similar when using the within school district

30. Observed differences in student characteristics do not necessarily decrease as the bandwidth is narrowed, and in some cases, actually increase. Table A.12 in the online appendix documents this fact by providing the balance tests from table 3 for varying bandwidths.

31. Table A.13 in the online appendix 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.

Table 8. 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 (CC) 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 two-stage least squares estimates on the sample of school districts that overlap community college districts (see section 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.

$^{**}p < 0.05$; $^{***}p < 0.01$.

specification, indicating that the results are unlikely to be driven by selection into particular 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 or outcomes along borders where tuition rates do not differ and no related policies are 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.

Table 9 presents the results from these approaches. 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 (0.7 percentage point) is quite small compared with the estimate of 6.4 percentage points along the true community college district boundaries and is only marginally significant. The third column indicates that students who

Table 9. Placebo Tests

	Local CC Enrollment		Bachelor's Degree	
	Farther In	Farther Out	Farther In	Farther 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 (CC) districts. Columns 1 and 3 contract all community college districts by two miles; columns 2 and 4 expand all community college districts by two 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.

*$p < 0.10$.

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 true 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 or 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 increases the probability of enrollment at the college by 3.5 percentage points, or about 18 percent. This increase in local community college enrollment is predominantly driven by a decrease in enrollment at non-local community colleges and at

private vocationally focused colleges that 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, credit completion, transfer to four-year colleges, and bachelor's degree completion. These improved outcomes may be attributed to the substitution toward local community colleges and away from nonlocal 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 2019): namely, students who would have attended 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.[32] Given 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.[33] 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 percent. Other policies that induce students to attend community 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 2018), 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 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 policy studied in this paper

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

33. About 5,267 (22.9 percent) out-of-district students attend community colleges each year. Increasing this percent to 24.9 percent 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.

does not include changes in marketing, mentoring, or college campuses. Policies that include such factors (e.g., broad free-tuition programs or the expansion of community college districts) may influence students in different ways and should continue to be evaluated as they are implemented.

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