College on the Cheap: Costs and Benefits of Community College

Jeffrey T. Denning*

University of Texas at Austin

Job Market Paper

November 19, 2014

Abstract

Community college students represent approximately 45 percent of all students enrolled in higher education in the United States. However, relatively little is known about the price sensitivity of community college attendance or the long-run impacts of community college enrollment on educational attainment. This paper examines the effects of community college tuition on college enrollment using a natural experiment in Texas where students experienced reduced community college tuition. For high school graduates, a $1,000 decrease in community college tuition increased immediate transition to community college by 5.1 percentage points which translates to an own price elasticity of -.29. Lower tuition also increased enrollment in community college every year for six years after high school graduation and transfer from community colleges to universities. Attending a community college also increased the probability of earning a bachelors degree.

*I would like to thank the Texas Education Research Center and the Texas Association of Community Colleges for providing the data. I would also like to thank Jason Abrevaya, Sandra Black, Carolyn Heinrich, Dayanand Manoli, Rich Patterson, Chet Polson, Jeffrey Smith, and several participants at seminars at the University of Texas of Austin for helpful comments on this project. The author acknowledges support for this research from the National Academy of Education and the National Academy of Education/Spencer Dissertation Fellowship Program. The conclusions of this research do not necessarily reflect the opinion or official position of the Texas Education Research Center, the Texas Education Agency, the Texas Higher Education Coordinating Board, the Texas Workforce Commission, or the State of Texas. All errors are my own.

1 Introduction

Understanding the decision to enroll in post-secondary education and its long-run consequences has long been a topic of interest to economists as well as policymakers. There is now much work focusing on student investment in four-year colleges; however, much less is known about investment in and consequences of community college. This is despite the fact that, in 2011, community college students represented 45 percent of all students enrolled in higher education and 42 percent of first time freshman.[1]

Community colleges are a large part of the United States higher education system, but very little is known about the price sensitivity of community college enrollment and long-term educational consequences of community college attendance.[2] This paper attempts to fill this void by exploring the effect of price on community college attendance using a novel identification strategy that exploits plausibly exogenous variation in community college tuition. It further explores the effects of community college attendance on educational attainment.

Community colleges differ from four-year universities in many ways. Unlike many universities, community colleges are open-enrollment which means they are open to any student who has a high school diploma or GED credential.[3] Community colleges students are more likely than four-year university students to be from backgrounds with historically lower educational attainment such as racial minorities and low-income families and are also more likely to be the first generation of college students in their family (Nunez and Carrol, 1998; Bailey et al., 2005). Consequently, understanding community colleges may lend new insights into understanding socioeconomic gaps in educational attainment and income.

Community colleges also stand in contrast to many other college options in that they are substantially less costly to attend. In 2010-2011, average annual community college tuition was $2,439 while average tuition at public four-year institutions was $7,136, with private four-year institutions being even more costly at $22,771. After adjusting for inflation, public four-year college tuition has risen 241 percent since 1981 while community college tuition has risen at a slower pace of 159 percent. (National Center for Education

[1] I will refer to two-year schools as community colleges throughout this paper, though in principle two-year colleges can include technical schools as well as community colleges. These statistics are calculated by the American Association of Community Colleges using the 2012 NPSAS.

[2] Kane and Rouse (1999) provide a nice summary of community colleges, their history and impacts.

[3] Community colleges often offer remedial courses that enable students without a high school diploma or GED to eventually enroll in community college

Statistics, 2014) Community colleges may become more attractive as four-year college costs continue to rise faster than community college costs. In fact, the net price of community college (accounting for financial aid) actually decreased from 2000 to 2009 while four-year net college price increased over the same period (Gillen et al., 2011).

There has been a recent move to reduce community college costs further. For example, Tennessee has made community college free to all high school graduates staring in 2015, and similar proposals have been considered in Texas, Oregon, Massachusetts, and Mississippi. However, increased access to community college is somewhat controversial because the effect of community college on students' educational attainment is not well known. This paper will explicitly consider the effects of reduced community college tuition on student enrollment and educational attainment.

Estimating the effect of community college price on enrollment has been difficult for at least three reasons. The first is measurement; in most settings, the cost of community college is not observed by the researcher because tuition is paid only by students who enrolled in college. For students who do not attend community college it is not clear which price was the relevant price for their decision. I overcome this challenge by using a feature of Texas community colleges where students receive a tuition discount if they attend the local community college. This feature makes the local community college's price the relevant tuition for most students.[4] The second is identification: even in settings where the relevant community college tuition is known for each each student, community college tuition may be set in ways that reflect unobserved characteristics about the community college's base of potential students. I overcome the challenge in identification by leveraging changes in students' eligibility for community college tuition discounts across time and geography. The third difficulty associated with estimation is the stringent data requirements–one needs data that links enrollment and tuition. I am able to use administrative records on all public high school graduates in Texas and their college enrollment.

I leverage the expansion of discounts for tuition in a differences in differences framework to examine the effect of reduced community college tuition on college enrollment. I find that a $1,000 decrease in community college tuition increases immediate enrollment in community colleges by 5.1 percentage points (pp) relative to a baseline of 26.5 pp, and also increases attendance at community college in the year after high school by 7.1 pp relative to a base of 38.4 pp.

[4]This feature also gives a rule for assigning community college price even for students who did not attend community college.

Moreover, estimating the effect of community college on long-run educational outcomes is difficult because different types of students choose to enroll in community college (versus no college or a four-year university), and simple OLS estimates will be biased. The long-run effects of community college can be studied by finding a situation where community college enrollment is altered by a factor unrelated to unobserved student characteristics. I examine exactly such a situation using the variation in community college enrollment induced by expansions of community college tuition discounts. I find that community college attendance increases both two-year and bachelor's degree receipt. The increase in educational attainment is apparent for students who switch enrollment from universities to community colleges as well as for students who are induced to attend community college who would not have attended any college otherwise.

The paper unfolds as follows. Section 2 discusses the conceptual framework for enrollment responses to community college costs and the long term effects of community college enrollment. Section 3 describes the institutional setting explored in this paper. Section 4 describes the data. Section 5 discusses the identification strategy and results for the effect of community college price on enrollment. Section 6 discusses the identification strategy used to examine the longer run effects of community college as well as the estimated effects of community college on longer run outcomes. Section 7 discusses how the effects estimated differ by race, gender, and income. Finally, Section 8 concludes

2 Conceptual Framework

2.1 Costs of College

Economic theory predicts that lowering the costs of college will increase college enrollment. This common sense prediction is verified in prior work that generally finds a $1,000 decrease in college costs leads to a 2-4 pp increase in enrollment. (Dynarski, 2000, 2003, 2004; Scott-Clayton, 2011; Castleman and Long, 2012; Seftor and Turner, 2002; Turner, 2011).[5] However, these studies do not generally distinguish between two-year and four-year college costs because they study grants that apply to both community colleges and universities. This paper expands the work on price sensitivity of college enrollment by specifically examining the effects of community college costs on community college and university enrollment.

[5] Deming and Dynarski (2009) summarize this literature.

One might expect larger effects for changes in community college tuition than for increases in financial aid primarily used at universities for several reasons.[6] On average, community colleges serve a lower-income population that may be more price sensitive. Also, a $1,000 reduction in tuition in costs represents a substantially higher fraction of total costs at community colleges than at universities so students may have a stronger response to the same dollar amount reduction in community college costs as compared to universities. Lastly, studies using cross-state variation have found larger effects for community college price sensitivity than for universities (Kane, 1995; Rouse, 1994).[7] However, these studies should be interpreted with caution as they may capture other factors like changing policy objectives of states rather than changes in community college enrollment caused by changes in community college costs. This work expands the large literature on the price sensitivity of college enrollment by providing compelling evidence on the effect of community college prices on enrollment.

In concurrent work, Martorell et al. (2014) examine the effect of community college prices on college enrollment in Texas by leveraging variation in community college tuition induced by taxing districts. They conclude that living in community college taxing districts increases college attendance. While they use similar institutional features for identification, the identifying assumptions are quite different than those used in this paper. They compare students who live on opposite sides of district boundaries who face different community college costs and argue that the students are otherwise equivalent. Martorell et al. (2014) builds on McFarlin (2007) which uses a similar strategy and administrative data in Texas. A key concern is whether students who live on opposite sides of the boundaries sort based on educational amenities. Kane et al. (2006) explores student sorting and finds that sorting across school district boundaries does occur. My paper uses variation induced by changes in these boundaries over time, thereby comparing individuals who live in the same K-12 school districts.

Moreover, the setting described in this paper allows me to identify both the own price enrollment elasticity of community college and the cross price elasticity for four-year enrollment due to precise measurement of community college tuition. Prior studies have largely focused on the effect of a $1,000 change in tuition. However, the interpretation of

[6]Other costs of college have been shown to be relevant for community college enrollment including distance (Jepsen and Montgomery, 2009; Miller, 2007) and weak labor markets Betts and McFarland (1995).

[7]However, Hilmer (1997) finds that the price elasticity for community colleges is lower than it is for universities. Nutting (2008) also examines the enrollment elasticity of community college enrollment using cross-campus, cross-year variation in community colleges in New York and finds that there is a negative relationship between community college enrollment and price. However, the estimates are not easily interpretable as rates of community college attendance.

this parameter across time and different college settings is difficult as the value of $1,000 changes and represents a different fraction of total price. Estimating an elasticity allows a comparison across time and different settings because it is unitless.

There is also a related literature that examines the changes in enrollment patterns that occur when the costs of one sector of post secondary education are decreased and the costs of other sectors are held constant. Prior work has focused on subsidies for in-state colleges, and the present study expands that literature by focusing on a different sector–community college. Cornwell et al. (2006); Goodman (2008); Cohodes and Goodman (2014) find that students were less likely to attend out of state colleges when scholarships that reduced the cost of attending in state were implemented. Cohodes and Goodman (2014) also document that the change in student enrollment patterns reduced graduation rates. Similarly, I examine the long term effects of a change in the relative price of community college on educational outcomes like graduation and credits attempted similar to Cohodes and Goodman (2014).

It is not clear which students will respond to decreases in the price of community college. Students who enroll in community college due to decreased costs could come from two groups: students who were planning on attending four-year universities or students who were not going to enroll in college. Knowing who responds to community college price changes is important for policymakers considering the effects of community college tuition. Existing work has not explicitly considered who is attracted to community colleges when community college price changes, and this study will be able to answer this question.

2.2 Educational Attainment

Increased access to community colleges has a theoretically ambiguous effect on ultimate educational attainment.[8] As articulated by Rouse (1995), there are two competing forces that affect educational attainment when there is increased access to community college: democratization and diversion. Democratization occurs when students switch from no college enrollment to enrollment in community college which would have positive effect on overall educational attainment. However, the diversion effect occurs when increasing access to community college diverts students from four-year universities to two-year col-

[8] In this paper, increased access to community college will be caused by decreased community college tuition.

leges. Diversion could reduce overall educational attainment if students who switch do not go on to get a bachelor's degree. This paper will provide quasi-experimental evidence of which effect dominates.

Separating the democratization effect from the diversion effect is difficult because selection into community college is nonrandom. This study overcomes this challenge and presents quasi-experimental evidence on the effect of community college attendance on educational attainment by using variation in community college attendance caused by expansions of community college discounts over time and geography. This variation over time and geography provides "as if random" variation in community college attendance. Goodman et al. (2014) is relevant to this study as they examine SAT cutoffs for admissions to four-year universities. Failure to meet these cutoffs make students more likely to attend community college or not enroll in college. They find that switching from non-enrollment or community college attendance to university attendance increases bachelor's degree receipt, suggesting that the diversion effect dominates.[9] Moreover, McFarlin (2007) finds that initially attending community colleges decreases bachelor's degree attainment in the first five years after high school by comparing students in community college taxing districts to students not in community college taxing districts.

Additionally, Brand et al. (2012) makes it clear that choosing the comparison group is critical when examining the long-term effects of community college. In this paper, I will separately examine the long term effects of community college for students who would have attended a university but were induced to switch to community college as well as students who would not have attended any college and were induced to switch to community college.

3 Texas Community College System

Community colleges typically provide both academic and vocational training whereas universities focus on academic subjects. Academic training at community colleges is designed to award associates degrees and help students transition to a four-year university.

[9]Other work has primarily used two approaches to address nonrandom selection into community college. The first is distance to college instruments (Rouse, 1995; Long and Kurlaender, 2009) where the validity of the assumption of the exclusion restriction has been shown to be tenuous (Card, 2001). The second is and propensity score matching that controls for desired schooling levels and assumes that sorting into community college is random after controlling carefully for schooling intentions and other observable characteristics (Reynolds, 2012; Doyle, 2009; Leigh and Gill, 2003; Brand et al., 2012). The results from these studies are mixed with some studies suggesting democratization and others diversion.

Technical training typically takes the form of a certificate program and offers vocational skills.

Texas provides an ideal laboratory to study community college enrollment; there are 50 public community colleges, each serving distinct geographical areas.[10] Specific municipalities pay ad-valorem property taxes to support each community college.[11] Students who live in municipalities that pay property taxes supporting a community college are eligible for reduced tuition at that college called "in-district" tuition; I will use this policy for identification.[12] The boundaries of community college taxing districts where students are eligible for in-district tuition is shown in Figure 1. For the 2014-2015 school year, community colleges in Texas will charge 63 percent more, on average, to out-of-district students relative to in-district students. This paper leverages over 20 expansions in taxing boundaries that have occurred since 1995 that induced large changes in tuition. The timing of these expansions is outlined in Table 1.

Importantly for my identification strategy five community colleges in Texas have expanded their taxing district through annexation of municipalities. The first annexation contained in the data occurred in 1995 and, in total, 22 municipalities joined a community college district. These expansions have increased the number of students eligible for reduced, "in-district" tuition.[13] The colleges that have expanded and are the focus of my study are Austin Community College, Lone Star College, Amarillo College, Houston Community College, and Hill College.[14] Table 1 lists the expansions and Figure 2 shows the districts annexed. These colleges represent a range of sizes and geographies with Hill College being in a rural setting and having just over 4,000 students enrolled in Fall 2013 and Lone Star College in Houston having over 61,000 students enrolled in the same year. It is the variation in community college price induced by annexations of municipalities that I will use for my identification.

[10] In addition to the 50 public community colleges the Texas State Technical College System and Lamar State University system also provide public, two-year college options.

[11] This in-district feature of community college tuition pricing is present in a few other states namely Arizona, Arkansas, Illinois, Maryland, Michigan, Missouri, Montana, New Jersey, New Mexico, Pennsylvania, and South Carolina. These states do not necessarily have this feature at all community colleges in the state but do at at least some community colleges. In the 2012-2013 school year nearly 70 percent of community college students in Texas were paying in-district tuition.

[12] The exception is El Paso Community which does not offer a discount to students who live in the taxing district.

[13] There has been one additional annexation at Brazosport College after the time covered by the data. Also there was an additional annexation for Austin Community College of the City of Austin in 2005, but this annexation does not map into a school district as it annexed only parts of school districts and is excluded for this reason.

[14] Lone Star College was known as North Harris Montgomery Community College District prior to 2007.

In order for a tax entity to be added to the taxing district for a community college, the residents must gather signatures for a petition to vote on annexation into the community college taxing district. After a petition has a sufficient number of signatures, a vote authorizing an increase in property taxes is taken. The increase in property taxes is on the order of $.10 per $100 of property value, although it varies by college. Community colleges use the property tax revenue from their taxing district as well as other sources of revenue including state appropriations, and tuition and fees to fund their operations. As soon as a municipality approves the property tax, students begin paying in-district tuition as opposed to out-of-district tuition. The assumptions required to use these annexations as variation in community college tuition will be discussed further in Section 5.

Many times the vote for annexation also includes plans for new facilities being built in the annexed area. Table 1 contains a list of relevant campus building projects and building open dates. Additional campuses reduce the costs of attending community college and may influence both non-monetary costs like convenience and monetary costs.[15] I will control for the presence of new campuses to isolate the change in tuition associated with annexation.

4 Data

The data for this project come from several sources. The primary student-level data come from the Texas Education Research Center (ERC) and cover the school years that start from 1994-2012 although the primary estimating sample will focus on 1994-2005.[16] These data contain demographic and academic performance information for all students in public K-12 schools in Texas provided by the Texas Education Agency. These records are linked to individual level enrollment, graduation, and financial aid data from all public institutions of higher education in the state of Texas as well as many private institutions using data provided by the Texas Higher Education Coordinating Board. Data on tuition comes from the Texas Association of Community Colleges and contains tuition information starting in 1992. Data on tuition is on the sticker price of attendance rather than on tuition actually paid by students. However, sticker price is particularly relevant in the community college setting and is very close to what is actually paid by students. Sticker versus actual price will be discussed further in Section 5. County level unemployment

[15] New campuses are often located relatively close to existing campuses and as such are unlikely to affect the decision to live at home if attending community college.

[16] For a description of these data see http://www.utaustinerc.org/

rates for August of each year from the Bureau of Labor Statistics are also used.

I assembled information on community college districts in Texas by visiting each community college's website and through conversations with administrators in cases of ambiguity.[17] Historical information for each school district's annexation history was obtained several ways. For a detailed description of determining annexation dates see Appendix A.1.

4.1 Measuring Tuition Status

Eligibility for in-district tuition depends on the taxing district of a student's residence. The ERC data do not contain precise address information or taxing district information, so in-district status for the purposes of this paper is inferred by the in-district status of a student's high school. In all instances in this study, the boundaries for community college taxing districts are defined by school districts which means eligibility is observed with smaller error than when using other geographic boundaries. However, there are several reasons for measurement error in taxing district residence including attending a high school for which the student does not live in the boundary and students who move the year after high school.

For students who attend community college, the data contain whether they paid in-district or out-of-district tuition. Panel B of Figure 3 shows that eligibility for in-district tuition increases sharply in the year of annexation. This figure is created using students who graduated from K-12 school districts that would experience annexation and plots the fraction who paid in-district tuition while attending community college. This figure should be interpreted with caution as annexation will be shown to cause students to enroll in community college, but it is useful for illustrating the discrete change in payment of in-district tuition. Ideally, the data would reveal the change in the fraction of students *eligible* for in-district tuition. However, only the change in students actually *paying* in-district tuition can be measured. In the period after annexation, some students will have their in-district status changed and other students will not. The new attendees are likely to be students who did experience a change in tuition status because those students face lower tuition costs. For this reason, the plotted or estimated change in in-district tuition payment is likely to increase more than the change in the eligibility for in-district tuition.

Prior to annexation around 15 percent of students are paying in-district tuition; after an-

[17] The information compiled from school websites for the district of each school is available upon request.

nexation the number is approximately 80 percent. In the first year of annexation there appears to be some slippage, with approximately 60 percent of annexed students paying in-district tuition. This could be explained by administrative issues in the implementation of annexation. In the data for individual K-12 districts, the first year of annexation often has a smaller fraction paying in-district tuition than subsequent years which suggests that the slippage is not due to measurement error in the annexation date. Figure 3 demonstrates that the annexations did affect the price paid by students for community college.

When interpreting the effects of a $1,000 change in tuition it is important to remember that tuition is assigned to change for *all* students who attended a K-12 district that was annexed. However, Table 4 show that among students who enrolled in community college, 55 percent of students changed from out-of-district to in-district. As previously discussed, the 55 percent estimate is likely to be an overestimate because students who are eligible for in-district tuition are more likely to attend community college and thus appear in the data than students who are not eligible for in-district tuition. To further reduce the measurement error in tuition, estimates that measure the effect of a $1,000 tuition change should be scaled up by dividing by .55 (or multiplying by 1.8). Because .55 is likely to be an overestimate of the true change in in-district eligibility, dividing by .55 will not scale up the results as much as if the coefficients were divided by the true, smaller estimate. As such, dividing by .55 is likely to be a lower bound on the effect of a $1,000 change in tuition. For this reason, results that are scaled by tuition will also be scaled by the change in in-district eligibility.

Another important consideration for interpretation is how annexation affects the net price of college. To this point, I have focused on changes in tuition but annexation could also affect grants and influence net price through changes in grant aid.[18] If decreases in tuition are offset by decreases in grant payments, then the magnitude of the change in tuition will overstate the actual change in the costs of college.

I investigate this by examining the patterns of grants received. Only students who enroll in community college are observed, and prior results show that annexation is related to additional students enrolling in community college. Because annexation affects enrollment, and thus the sample used in estimation, the result on grants should be viewed as

[18]Grants will be defined as the annual amount of Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, TEXAS Grants, and Texas Public Education Grants. All of these grants are need-based but are funded by different sources. TEXAS Grants are funded by the state and Texas Public Education Grants are funded by individual colleges.

descriptive rather than causal. Data on grants disbursed starts in 2001 and so results presented will be from 2001 to 2012. Column 3 of Table 4 examines the effect of annexation on grant aid received at community colleges and finds a statistically imprecise decrease in grant aid received of $173. When considering only students who received some grants at a community college in Column 4 of Table 4, the average amount of grants received went down after annexation by $286. Even after accounting for imperfect measurement of eligibility this represents roughly half of the change in tuition. However, the number of students receiving grants at community colleges during this time period is relatively small with 15-20 percent receiving non zero grants.[19] This suggests that there may be small countervailing effect of reduced grants, but this only affects a minority of high school graduates. The evidence on changes in grants suggests that the results may be biased downwards.

4.2 Constructing the Sample

The sample used for analysis consists of students who graduated from Texas public high schools when 17 or 18 years old between 1994 and 2005. I will first examine the immediate transition of these students to college. Studying on-time graduates of high school and their enrollment behavior in the fall after their graduation has the advantage that on-time high school graduates were unable to manipulate the timing of their entry into college as a result of changing tax jurisdictions. This is because the annexation vote takes place during their senior year. Students who were out of high school for some time may wait to enroll in college until after a vote is taken. However, examining recent high school graduates will only capture part of the total effect of annexation and lower tuition on community college enrollment. For instance, lower tuition is also likely to attract other students to "go back" to school.

Because the sample is selected from high school graduates the estimates may be biased if annexation changes the probability of graduation from high school. This might happen if students see the opportunity for less costly post secondary schooling and change their effort. This is tested in Panel B of Table 5 which shows that students do not change high school graduation behavior in response to less expensive community college tuition.

For the majority of the analysis, the sample is limited to students who graduated from

[19]This is likely due to issues explored in the literature on FAFSA take up and financial aid complexity (Bettinger et al., 2012; Dynarski and Wiederspan, 2012).

high school from 1994-2005. This allows an examination of graduation outcomes like bachelor's degree receipt eight years after high school. I also use students from 1994-2012 for enrollment outcomes to take advantage of additional annexations that occur from 2006-2012, and these results are discussed in Appendix A.2. The sample is limited to students from K-12 school districts that are part of a community college taxing district that experienced annexation from 1994 to 2005. As a result, all K-12 districts in the sample will be part of a community college taxing district by 2005. This restriction causes the sample to consist of approximately 15 percent of high school graduates in Texas during this time period.[20]

Table 2 contains summary statistics for the primary estimating sample which includes high school graduates from 1995 to 2006. K-12 districts that experienced annexation makes up 39 percent of the observations and post-annexation observations account for 25 percent of the observations. Over 26 percent of students attend community college immediately after high school graduation, and 24.7 percent attend public universities. Table 3 splits the data for the districts that experienced annexation before and after the annexation. After annexation there are increases in community college enrollment, in-district community college enrollment, payment of in-district tuition, graduation probability, and credit hours at community colleges and universities. Tuition drops from $1962 annually to $1160. These preview the results, but the patterns described here generally hold upon more precise statistical examination.

5 Community College Price Sensitivity

5.1 Identification

The first goal of this paper is to uncover the effect of community college tuition on enrollment patterns. This is difficult for a number of reasons. First, in many settings it is not clear which community college tuition is relevant for students making enrollment decisions. Second, even in settings where the relevant community college tuition is easy to assign, finding variation in costs of community college unrelated to underlying student characteristics is difficult. For instance, cross sectional differences in community college tuition are likely to represent unobserved differences in the areas that support the com-

[20]For analysis that includes years up to 2012 the sample is expanded to include a new community college taxing district that experienced annexation, Houston Community College.

munity colleges. Temporal variation in community college price may arise from business cycle fluctuations or secular trends in college costs.

To address these issues, I exploit previously described institutional features of the Texas community college system. For the assignment of community college tuition I leverage the fact that Texas students face differential tuition depending on their residence. The system of in-district tuition creates a rule that assigns the relevant community college tuition. Namely, prior to a K-12 district's annexation the price of community college is the out-of-district price and after annexation, it is the in-district price. I also overcome the challenge of tuition being set in response to student characteristics by exploiting sharp changes in tuition within K-12 school districts over time by using taxing district annexation (which represents a substantial shock to the cost of community college for students).

To identify the causal impacts of tuition on enrollment, I implement a differences in differences estimator by comparing enrollment of annexed districts to districts already in a taxing district before and after annexation takes place. The language of a quasi-experiment will be employed with annexed K-12 districts being referred to as the treatment group and districts already included in the community college taxing districts being referred to as the control group.[21] Because the variation in tuition occurs at the K-12 district/year level I cluster standard errors at the district level.[22] To examine the effect of annexation or treatment the following reduced form equation is estimated:

$$Y_{icdt} = \theta \cdot Annexation_{dt} + X_{idt}\alpha + W_{tc}\beta + \gamma_d + \eta_t + \tau_{tc} + \epsilon_{icdt} \tag{1}$$

Importantly, i indexes individuals, d indexes K-12 districts, t indexes school year, c indexes community college district, and ϵ_{icdt} represents an idiosyncratic error term. Y_{icdt} is a student enrollment outcome like attendance at community college and $Annexation_{dt}$ is an indicator for a K-12 district d that has been annexed in year t. As such, θ is parameter of interest and is the effect of annexation and the attendant reduced tuition on a student outcome. Variables that control for K-12 district characteristics that may be related to college-going are included in X_{idt} like race, gender, an indicator for economic disadvan-

[21] The control K-12 districts are already included in the taxing district of the college. These districts are likely to be most similar to annexed districts because they are in the same locality and they have access to community college services. Choosing K-12 districts that were never treated would be problematic because the students are further away from the community college and are less likely to attend the community college under consideration. The control districts were all annexed prior to 1992 or were included initially in the formation of the taxing district.

[22] Performing the analysis on data collapsed into K-12 school district/year cells that are weighted by the number of high school graduates in the cell yields very similar results.

tage, and limited English proficiency.[23] X_{idt} also includes an indicator for a new campus of the community college being open in the K-12 district. W_{ct} contains covariates that control for factors affecting college attendance at the community college district level like county unemployment rates and number of high school seniors in the graduating cohort; these are only included in specifications without college/year fixed effects.[24]

In addition to district characteristics, fixed effects for K-12 district, γ_d, and year, η_t, are included. These fixed effects control for fixed observed and unobserved characteristics of K-12 districts. They also control for fixed community college characteristics as K-12 districts comprise the community college taxing district. Year fixed effects account for trends in community college enrollment and for factors common to all community college districts that change with time. In addition to year fixed effects, in some specifications time is also accounted for using community college-specific linear time trends. However, in the preferred specification, community college district-by-time fixed effects, τ_{tc}, are included to account for common trends and shocks that occur to both the treatment and control group in a community college district.

The rich set of controls and fixed effects in Equation 1 enable a comparison of enrollment rates *within* K-12 districts *across* cohorts who experienced lower tuition. The K-12 districts who were already part of the taxing district serve as the comparison group. These controls are in place so that θ captures only the effect of taxing district annexation after controlling for K-12 district fixed characteristics, demographic characteristics, time effects, labor market conditions, trends common to all K-12 districts in the community college district, and new campuses.[25]

Equation 1 captures the effect of annexation and the resulting cheaper tuition on student outcomes. However, this does not scale the effects of annexation by the change in tuition. In order to do this an instrumental variables strategy is used where listed community

[23] Economic disadvantage is determined by free and reduced lunch receipt.

[24] Bound and Turner (2007) find that large cohort sizes within states lead to low educational attainment, so I control for cohort size explicitly.

[25] As an illustrative example of the spirit of the estimator, consider the annexation of Del Valle Independent School District (ISD). Dell Valle ISD was annexed into the Austin Community College taxing district in 2004 and will serve as the "treatment group". After 2004, high school graduates from Del Valle ISD experienced reduced tuition as a result of annexation into the taxing district. Austin ISD was part of the Austin Community College taxing district many years prior to the data and will serve as the "control group" because students in Austin ISD did not experience substantial changes in tuition. I compare the change in enrollment rates for Del Valle ISD before and after 2004 to changes in enrollment rates for Austin ISD before and after 2004. The difference in these differences is interpreted as the effect of the reduced tuition resulting from annexation on community college enrollment. The actual estimation performs this type of exercise for many treatment and control districts simultaneously while also controlling for many other factors.

college tuition is instrumented for using $Annexation_{dt}$ as in the following first stage equation:

$$Tuition_{cdt} = \varsigma \cdot Annexation_{dt} + X_{dt}\phi + W_{ct}\chi + \vartheta_d + \delta_t + \omega_{ct} + \mu_{cdt} \tag{2}$$

The second stage equation becomes:

$$Y_{cdt} = \sigma \cdot \widehat{Tuition}_{dt} + X_{dt}\kappa + W_{ct}\rho + \pi_d + \zeta_t + \lambda_{ct} + \upsilon_{cdt} \tag{3}$$

$Tuition_{dt}$ is the sticker price of community college tuition and fees for two semesters of 12 credit hours measured in 1,000s of 2012 dollars. Prior to a K-12 district's annexation $Tuition_{dt}$ is the out-of-district price and after annexation, it is the in-district price. The parameter of interest is σ which is the coefficient on in-district tuition and represents the effect of a $1,000 increase in sticker tuition on enrollment outcomes. Several outcomes will be considered as Y_i including indicators for community college enrollment, enrollment in the in-district community college, four-year university enrollment, and no enrollment. This will allow an investigation of not only the own price sensitivity of community college enrollment, but also the cross price sensitivity for four-year college enrollment.

Assumptions for Identification

For the identification strategy used to examine the effect of annexation on enrollment to be valid, I must assume that treatment and control K-12 districts have the same trends in college enrollment prior to treatment.[26] While this seems reasonable given that students in these K-12 districts share many common characteristics like geography, labor markets, etc., I will test this in more detail later in the paper by providing visual evidence.[27]

Another assumption is that there are no other shocks occurring at the same time as annexation that would also affect the decision to enroll. To address this issue I control for potential confounders like demographic characteristics, indicators for new community college campuses in the K-12 district, and use year-by-college fixed effects to capture shocks common to treatment and control groups. While there could still be unaccounted for shocks

[26]Formally the assumption for identification is that $E(\epsilon_{icdt}|Annexation_{dt}, X_{idt}, W_{tc}, \gamma_d, \eta_t, \tau_{tc}) = 0$.

[27]In addition to visual tests presented later in the paper, I test for parallel trends explicitly in each case of annexation. In all but two of the annexation events, the trend for the treatment and control districts are not statistically distinguishable. When excluding these two annexations, the results do not change substantively.

that occur, the shocks would have to be systematically correlated to annexation across different colleges and districts. It is worth noting that a shock to the entire community college taxing district would be experienced by both the treatment and control groups and would not be an issue except if treatment and control districts reacted to the shock differently.[28]

As previously discussed, annexation is always associated with a vote approving the annexation. The assumption is that timing of a vote authorizing annexation is exogenous or unrelated to factors that may affect community college enrollment. The timing of votes cannot be related to the underlying characteristics of students or taxing district which will be tested in Table 5.

One way to test that annexation is unrelated to other factors is to examine whether observable characteristics of a district are related to annexation. If student observable characteristics are related to annexation, student unobservable characteristics are likely to be related as well. Table 5 presents these results and finds that annexation is unrelated to gender, race, economic disadvantage status, and limited English proficiency indicators. I also consider whether annexation is related to high school graduation by selecting a sample of 10th graders and find no relationship between annexation and the probability of graduating from high school in column 9 of Table 5.[29] Lastly, student plans for college are measured and are found to be negatively related to annexation though this result is marginally statistically significant. The implications of no change (or possibly a small negative change) in college plans will be discussed further in the results section. Overall, Table 5 presents evidence that student characteristics were not observably different by annexation status. This evidence lends credibility to the assumption that there were no simultaneous changes at the time of annexation.

In order for the estimates of σ in Equation 3 to reveal the effect of community college tuition on enrollment several assumptions for instrumental variable estimation need to

[28]One potential confounder would be a change in the admissions policies of community colleges that coincided with annexation. This is a potential problem in a selective college setting, but because community colleges are open-enrollment this is not an issue. If community colleges changed in quality after annexation this increased quality would affect both the treatment and control districts.

[29]I define the annexation variable for these students as cohorts who will experience an annexation in their senior year rather than in their tenth grade year. A special consideration is that students may change their graduation plans in response to annexation. Graduation plans would be difficult for students to change as annexation is announced during a student's senior year, but I can test for this directly. The probability of graduation does not change for cohorts that will be annexed. This means that using the sample of high school graduates does not suffer from the sample selection related to annexation. Interestingly, students are asked whether they plan to attend college and this variable does not change. The implications of this finding will be discussed in the Section 5.2.

hold. The first is that annexation is strongly related to tuition. Annexation is a policy that intentionally changes the tuition and so this should be true. Table 4 examines the impact of annexation on the sticker price of tuition and finds that annexation reduces tuition by $1124. This reduction is verified visually in Panel A of Figure 3 where annexation results in a substantial drop in tuition by approximately 50 percent.

I must also assume that annexation is correlated with community college tuition but is not related to any other factors that would influence enrollment behavior. Ultimately this exclusion restriction is untestable, but controlling for the factors that are most likely to vary at the county/K-12 district level as previously outlined helps alleviate potential problems. One change of particular interest may be the changing of services offered by community colleges which I attempt to capture using indicators for new campuses being built.

The last required assumption for a Local Average Treatment Effect (LATE) interpretation of the instrumental variable estimation is a monotonicity assumption. The LATE interpretation implies that the parameter estimated applies to the group of students who were induced to attend community college by the instrument. The monotonicity assumption means that annexation cannot induce some students to enroll in community college and discourage some students who would have enrolled in community college from enrolling. In this context this assumption seems very reasonable as a story where less costly community college leads to decreased community college enrollment is counter-intuitive.

5.2 Enrollment Results

Panel A of Table 6 contains the reduced form estimates of the effect of annexation on immediate community college enrollment. Only the preferred specification is presented which includes year, K-12 district fixed effects, demographic characteristics, and college by year fixed effects. Results for other specifications are quantitatively and qualitatively similar and are available upon request.[30] Column 1 shows that annexation is associated with a 3.2 pp increase in community college attendance, which is a 12 percent increase over the sample average. Column 2 in Panel A of Table 6 examines the effect of annexation on enrollment at four-year universities. In the preferred specification there is a very small point estimate of -.05 pp that is not statistically significant suggesting no impact of

[30]Other specifications that do not include demographics or college/year fixed effects tend to measure effects that are slightly larger in absolute value than the results presented.

annexation on public, four-year enrollment.

To test whether the local community college's price is the relevant price for community college for most students, I compare the estimated effects of enrollment in any community college in Panel A, column 1 of Table 6 to the effects of in-district enrollment found in Panel A, column 3 of Table 6.[31] If students could easily switch enrollment between community colleges, annexation might have zero effect on enrollment in community college but a large increase in enrollment in-district. The estimated annexation effect is larger for enrolling in-district at 4.4 pp than for enrolling in any community college which is 3.2 pp. The discrepancy in magnitudes indicates annexation induced some students to switch enrollment in community college from out-of-district to the community college that was closest to home. Ultimately this switching should only bias the estimates of tuition's effect on community college enrollment downward as it is an indication that the local community college's tuition may not be the relevant tuition for a subset of students.

Column 4 in Panel A of Table 6 examines the effect of annexation on the decision to not enroll in any public college in the data.[32] High school graduates are 3.1 pp less likely to not attend college as a result of annexation–that is, students were 3.1 pp more likely to attend college with all of the increase occurring at community colleges.

Another important result for interpretation is the combination of the estimated enrollment effects and the lack of effects found on stated college intentions in Column 9 of Table 5. This suggests that several students had planned on going to college who would not have enrolled except for changes in community college costs. Lowering tuition costs did not affect college plans but allowed students who had a stated interest in college attendance to enroll. This result builds on a growing body of work that suggests interventions in a student's high school career can affect student enrollment behavior (Castleman and Page, 2013).

Taken together, these results indicate that annexation and the reduced tuition associated

[31] For cohorts that were not in district at the time of high school graduation this is defined as the community college into which their K-12 district would eventually be annexed.

[32] Students may be switching enrollment from private two-year colleges to public community colleges. Notably, Cellini (2009) finds that additional funding for public community colleges induces students to switch from proprietary schools to public community colleges. Unfortunately, data on for private two-year colleges has only recently been collected by the THECB. However, the THECB estimated that students at private two-year colleges represented just 3 percent of state college enrollment in 1999 as compared to public community colleges which represented 44 percent (Texas Higher Education Coordinating Board, 2001). In fact, if *all* students switched from private two-year colleges to community colleges that would only account for approximately 60 percent of the measured effect. For this reason, switching from private two-year colleges is likely to be at most a small part of the story.

with annexation resulted in students attending community college at higher rates. It also appears that lower tuition induces students who would not have attended any college to attend community college and that cheaper tuition did not induce students to switch from public four-year colleges to community colleges.

To scale the results by the changes in sticker tuition, Equation 3 is estimated and results are presented in Panel B of Table 6, where the effect of community college tuition is in $1,000s of dollars. A $1,000 increase in the annual *sticker price* of tuition decreases community college attendance by 2.8 pp. It also decreases enrollment in-district by 3.8 pp and increases the fraction of students enrolling in no college by 2.8 pp. As there are not large changes in financial aid, the change in sticker price is likely to reflect the true tuition bill for students who experienced annexation. However, sticker price is measured with error which needs to be corrected.

As previously discussed, the results should be scaled by the change in the fraction of students eligible for in-district tuition which was measured as .55. Using this information a decrease of $1,000 in tuition per semester would lead to an increase in immediate community college enrollment for high school graduates of 5.1 pp. This is slightly higher than estimates of the effect of financial aid on college attendance. There are at least two possible reasons for a slightly higher estimate. The first is that the actual change in the costs of college is observed relatively well in this study, so appropriate adjustments can be made for measurement error. The second reason is that students on the margin of attending community college may be more price sensitive than the entire population of potential college goers.

The estimates thus far have been in terms of the enrollment rate to aid comparability with prior estimates in the literature. An alternate approach is to estimate equation 3 but to use the natural logarithm of Y_{cdt} and $Tuition_{dt}$.[33] This specification yields estimates of the elasticity of enrollment with respect to community college tuition. An elasticity has the benefit of being unitless and allows comparisons across time and context. Panel C of Table 6 contains these elasticity estimates. Column 1 indicates that a 10 percent increase in community college tuition would lead to a 1.6 percent decrease in community college enrollment, or 2.9 percent if scaled by the change in in-district tuition payment. Column 2 confirms that an increase in tuition does not affect enrollment at public four-year universities. Column 3 indicates that the elasticity is higher for in-district enrollment as previously discussed. Finally, Column 4 indicates that a 10 percent increase in commu-

[33] When using collapsed data, the cells are weighted by the number of high school graduates.

nity college tuition increases the probability that a student is not attending any college by .98 percent, or 1.8 percent when accounting for payment of in-district tuition.

Overall, these results indicate that students respond to a $1,000 decrease in community college tuition by increasing immediate community college attendance by 5.1 pp, or a 20 percent increase over the baseline. Students do not appear to switch their enrollment from universities to enroll in community college but instead switch from not enrolling in college to enrolling in community college. This finding provides evidence that access to community college in the form of cheaper tuition has a democratizing effect but no diversion effect.

Effects by Cohort Relative to Annexation

To examine the timing of these effects a model is estimated with indicator variables for cohorts relative to annexation instead of a single annexation indicator in an event study framework.[34] This gives a sense of when enrollment patterns changed and if pre-existing trends are driving the results. The coefficients are plotted in Figure 4 along with 95 percent confidence intervals; the omitted category is for the cohort one year prior to annexation. Prior to annexation, treatment and control groups appear to have similar trends in community college enrollment as can be seen by a flat difference in years prior to annexation. Also, in four of the five years prior to annexation, the 95 percent confidence interval contains zero which means that in those years, the difference between treatment and control groups cannot be distinguished from what it was in the year before annexation. If there were differential trends the levels of the plotted coefficients would exhibit a trend. Five years before annexation there appears to be a one time deviation from a flat trend, but in the four years leading up to annexation there does not appear to be any trend.

There is a jump in the probability of attending community college in the year of annexation, and by the second cohort after annexation treated districts are statistically significantly more likely to attend community college attendance relative to the control districts. The effects are largest after three years and seem to stabilize in years 3-5 after annexation.[35] A similar exercise for enrollment in university is performed in Panel B of Figure 4 for enrollment in university though there does not appear to be any change in university

[34]Cohorts beyond five years after annexation are combined into one indicator for five years or greater. Cohorts six years or greater before annexation are similarly combined.

[35]The gradual increase in the estimated effects of annexation could happen for a few reasons, but one potential explanation that is consistent is a salience story where students may not be entirely aware of the change in community college price but as time passes information is diffused.

enrollment.

Placebo

To provide an alternate measure of the probability of these estimates arising from chance, I conduct a placebo exercise. Using data from community college enrollments in 1996 I predicted whether a college ever expanded its taxing district using the fraction of male students, fraction of Hispanic students, fraction of students in technical programs, and the log number of students. The four colleges that had the highest likelihood of annexation and as such make up the "placebo data" were Dallas Community College, Tarrant County College, Tyler Junior College, and Collin County Community College. These four colleges were mapped to the four colleges that did experience annexations prior to 2006.[36] Within matched colleges, each K-12 district in the placebo data was randomly assigned to a K-12 district in the actual data and was given the annexation dates (if any) of the district in the actual data. This assignment rule ensures the same number of treated K-12 districts and timing of simulated annexations as were contained in the original data.[37] Then the reduced form regression of the effect of annexation on community college enrollment was performed and the results were stored. This process was repeated 500 times and the results are visually summarized in Figure 5. The vertical line shows the coefficient estimated in the actual data and the distribution of the estimates.

In the case of enrollment in community college, there were no placebo regressions in which a larger effect was estimated. This presents strong evidence that annexation and the attendant decreases in tuition did increase community college enrollment. In contrast, the estimated effect of annexation on enrollment in a four-year college was in the 46th percentile of estimates of the placebo exercise. The estimate of the effect of annexation on enrollment at a four-year college from Table 6 was statistically insignificant, and the placebo exercise confirms that the enrollment in universities was not affected.

[36] This was done to make sure that the matched college had a greater or equal number of school districts that were in the taxing district as the college that actually experienced the expansion. Inherently this matched schools of roughly similar sizes. Dallas was matched with Lone Star College, Tarrant County College with Austin Community College, Tyler Junior College with Amarillo College, and Collin County Community College with Hill College.

[37] There are more control K-12 districts in the placebo data than in the original data because the four placebo community college districts had more K-12 districts than their actually-treated counterparts.

Longer Term Enrollment

To this point immediate enrollment in the fall after high school has been the focus of the estimation. However, enrollment patterns beyond the fall following high school graduation are interesting as well. When examining year two after high school, some students who did not experience reduced community college tuition directly after high school graduation had exposure to lower community college tuition two years after high school graduation. The more years pass after high school, the greater the portion of the control group that has some level of treatment increases so effects in the later years should be attenuated.

Panel A of Table 7 examines community college enrollment in the years after high school. The dependent variable is a binary indicator with unity if the student enrolled in community college in the 1st, 2nd, etc. calendar year after their high school graduation. In all years students are more likely to be enrolled in community college with the largest estimates being in the years directly after high school. High school graduates are more likely to respond to annexation in the entire first year as compared to just fall enrollment immediately following graduation. The estimated effect of annexation on enrollment in the calendar year after highs school is 4.5 pp as opposed to 3.2 pp when considering fall only. This translates into a 7.1 pp increase for a $1,000 decrease in community college tuition when dividing by .55. The magnitude gets smaller over time but is fairly constant at around a 10 percent increase over the baseline attendance rate in that year. Taken together these results indicate that reduced tuition induces high school graduates to attend community college immediately and continues to affect enrollment for several years after high school. The effects past the first year can come through either increased persistence in college or increased first time enrollment at older ages. Further consideration of longer term attendance is considered in A.3 which examines credit hours attempted.

Panel B of Table 7 performs a similar exercise considering enrollment at a public university in each year since high school. In the first three years after high school graduation, students do not appear to be more likely to attend a four-year university if they experience an annexation. However, starting in year four after high school, the coefficients increase in magnitude and in year six after high school the increase is statistically significant. Table 8 further explores this result by examining transfer from community colleges to universities. For each year after high school graduation I define transfer as if a student is enrolled in a university in the current year and had been enrolled in a community college in a prior year. In years three to six after high school, students are more likely to be

at universities with prior attendance at community colleges. These results suggest that reduced tuition for community colleges induces students to initially enroll in community colleges and eventually attend four-year universities after attending community colleges.

The evidence on enrollment suggests that reduced community college tuition has a democratization effect and no diversion effect. Reduced community college tuition induced students who would not have attended college of any type to enroll in community colleges. This is compelling, quasi-experimental evidence on the effect of community college access on enrollment, and the results suggest that reduced community college tuition increases college attendance but does not reduce university enrollment.

6 Educational Effects of Community College

6.1 Identification

Knowing the relationship between community college access and long term educational outcomes is difficult because students who attend community college are likely to be unobservably different from students who do not. In order to overcome this challenge, a source of variation is needed that influences community college attendance but does not directly influence long term outcomes. For the second part of my analysis, I use community college taxing district annexations as an instrument for community college attendance to identify the effects of community college attendance on educational attainment. Annexation has been shown to strongly influence community college attendance and induces students to attend community college who would not have attended college otherwise.

For this analysis, I am estimating the following first stage equation using high school graduates from 1994-2005. The familiar indicator for annexation, $Annexation_{dt}$ is an instrument for attendance at a community college in the first year after high school $AttendCC_{dt}$:

$$AttendCC_{dt} = \varsigma \cdot Annexation_{dt} + X_{dt}\phi + W_{ct}\chi + \vartheta_d + \delta_t + \omega_{ct} + \mu_{cdt} \tag{4}$$

The second stage equation becomes:

$$Y_{cdt} = \aleph \cdot \widehat{AttendCC}_{dt} + X_{dt}\kappa + W_{ct}\rho + \pi_d + \zeta_t + \lambda_{ct} + \upsilon_{cdt} \tag{5}$$

Y_{cdt} is an education outcome like graduation from a four-year college. The indices are the same as prior estimating equations with c indexing community college taxing district, d indexing K-12 school district, and t indexing time. As before, these specifications include year fixed effects, K-12 district fixed effects, and community college district by time fixed effects as well as controls for demographic characteristics.

For this instrumental variables strategy to be valid there are several assumptions that need to be made. First, the instrument must be strongly correlated with attending community college. Section 5 established that annexation is strongly correlated with community college attendance. Second, the instrument must not be correlated with longer term outcomes like bachelor's degree receipt except through community college attendance.[38]

6.2 Educational Attainment Results

Panel A of Table 9 explores the effect of annexation on graduation probabilities from community college as well as universities. Column 1 of Panel A considers graduation from a community college with a degree or certificate and does not find any effect of annexation on degree or certificate receipt. Column 2 of Panel A considers graduation with a community college credential or degree after 4 years and finds no effect. Likewise, annexation is not associated with increases of bachelors' degree receipt in 4 or 6 years after high school graduation. However, for 8 years after high school graduation, there is an increase of 1.1 pp with a p-value of .11 providing marginally statistically significant evidence that annexation increased bachelor's degree receipt after eight years.

Panels C and D of Figure 4 consider graduation outcomes by cohort relative to annexation. In both instances graduation appears to have increased slightly in the years after annexation but not dramatically so. This confirms the results in Panel A of Table 9 which measured statistically imprecise increases in graduation as a result of annexation. The previously described placebo exercise is also performed and summarized in Panel C and D of Figure 5. The estimate for graduation from community college in 4 years is in the 10th percentile of estimates from the placebo exercise, and the estimate for bachelor's degree

[38] A potential violation of this assumption is if cheaper community college tuition affects students who would have attended community college anyway by giving them access to reduced tuition. In order to test this an indicator for the cohort prior to annexation is included. These students would have access to cheaper community college tuition in all but the first year of attendance. This indicator is statistically insignificant and very small suggesting that access to cheaper community college for students who would have attended community college in the presence of higher tuition did not affect graduation probabilities. This result supports the assumption of the exclusion restriction. The full results from this exercise are available upon request.

receipt in 8 years is in the 13th percentile. This mirrors the prior finding that attending community college appears to increase educational attainment.

To consider the effect of attending a community college on ultimate degree receipt Equation 5 is estimated. The results are very similar to what has been discussed previously but scales the results by the fraction of students who attended a community college in the first year after high school graduation. The results from this instrumental variables estimation are in Panel B of Table 9 which indicates that attending community college increases the probability of graduation with a four-year degree eight years after high school by 23 pp. This result is marginally statistically significant at the 10 percent level. This suggests that students induced to attend community college as a result of annexation are more likely to graduate with a four-year degree. These students would not have attended college otherwise, and so the decreased tuition provided a viable pathway toward bachelor's degree receipt.

7 Heterogeneity

This section examines the heterogeneous effects of reduced community college tuition on enrollment in addition to the heterogeneous effects of community college attendance on educational attainment by race, gender, and economic disadvantage status. Table 10 contains estimates for the enrollment effects as well as the reduced-form effects for educational attainment. In these analyses, I employ a fully interacted model where indicators for race, gender, or economic disadvantage status are interacted with every variable in Equation 1.

I will only discuss the results that have statistically different results by gender, economic disadvantage, or race while all others are statistically indistinguishable. For immediate enrollment in community college, African American students respond more strongly to annexation than white students. African American students also respond to annexation by diverting enrollment from universities to community college.

The measured diversion effect for African American students stands in contrast to the results for the whole sample where there was no switching from universities to community colleges. Interestingly, white students are more likely to receive a bachelor's degree in eight years and African American students are are not statistically any different in their bachelor's degree receipt despite being initially diverted from universities–in fact,

the point estimate is positive. This suggests that for these racial groups that community colleges have a democratization effect, even for students induced to attend community college who would have attended universities.

Exploring the heterogeneous effects suggests that minority students are particularly price sensitive in their community college enrollment decision. Additionally, the results present another piece of evidence that community colleges increase overall educational attainment because students induced to attend community college at higher rates due to lowered tuition have higher probability of bachelor's degree receipt. These results also suggest that reduced community college tuition is likely to affect minority students to a greater degree and that the long term effects for minority students do not differ from white students.

The evidence in this paper finds support for a democratization effect but no support for a diversion effect of attending community colleges. This may be because the groups induced to attend community college persist at higher rates due to lower costs or a better match of an the student's needs and institutional structures. The results suggesting that bachelor's degree receipt increases even for groups of students initially diverted to community college run counter to the findings of Goodman et al. (2014). There are several reasons that these findings may be different–the first is considering the local average treatment effect in both cases. In the present study the affected population are students who respond to price as compared to students who are constrained by low SAT scores. These groups of students need not be the same or share the same response to community college attendance. Also, students who elect to attend community college instead of a four-year university when community college tuition is decreased may respond differently to community college attendance than students who are excluded from university enrollment on academic grounds.[39] Additionally, the results in this paper find evidence in support of a democratization effect of community college for racial minorities.

8 Conclusion

This paper presents evidence on the price sensitivity of community college enrollment as well as the long term consequences of community college enrollment. Using variation in the price of tuition at community colleges in Texas caused by the expansion of community college taxing districts and administrative data, I find that students respond to changes

[39]The differing educational contexts in Georgia versus Texas may also matter.

in community college tuition at a higher rate than the rate at which prior studies have measured responses to grant aid. Overall, students do not switch from four-year college to community college as a result of price decreases but rather switch to attending from not enrolling in college. However, there is important heterogeneity by race in the response to reduced community college tuition with racial minorities initially diverting attendance from universities to community colleges.

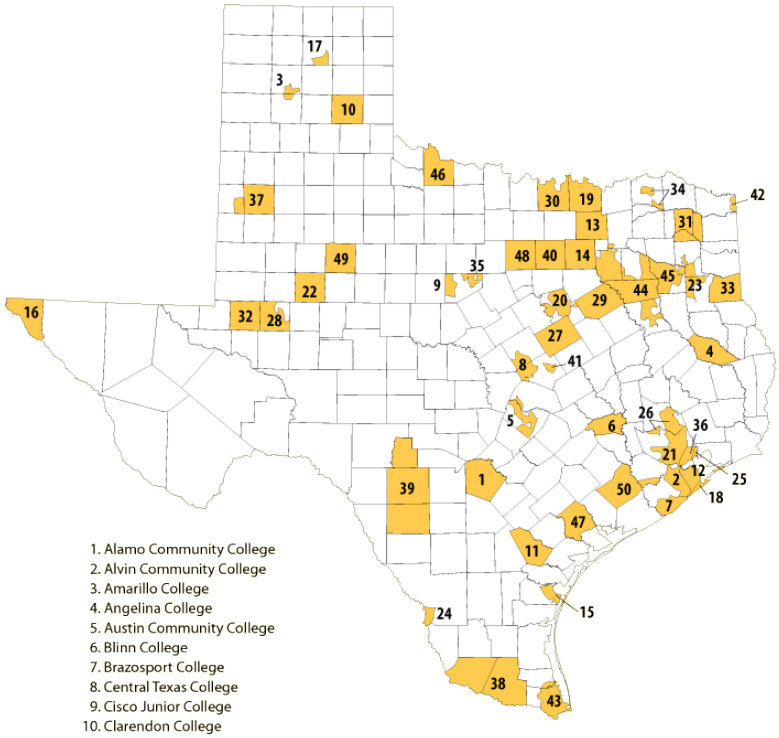
For students induced to attend community college, educational attainment is increased as measured by bachelor's degree receipt and credits attempted. Increased educational attainment occurs for students who switch to community college attendance from both not enrolling in college as well as from attending a university. This paper provides quasi-experimental evidence on the democratization versus diversion effect of community college and finds evidence supporting a democratization effect for community college.

Overall, lowering community college costs provides a pathway for more students to attend college. It also has positive, longer term benefits of bachelor's degree receipt. The benefits of community college attendance makes lowering community college tuition an attractive option for policymakers seeking to increase educational attainment.

9 Tables and Figures

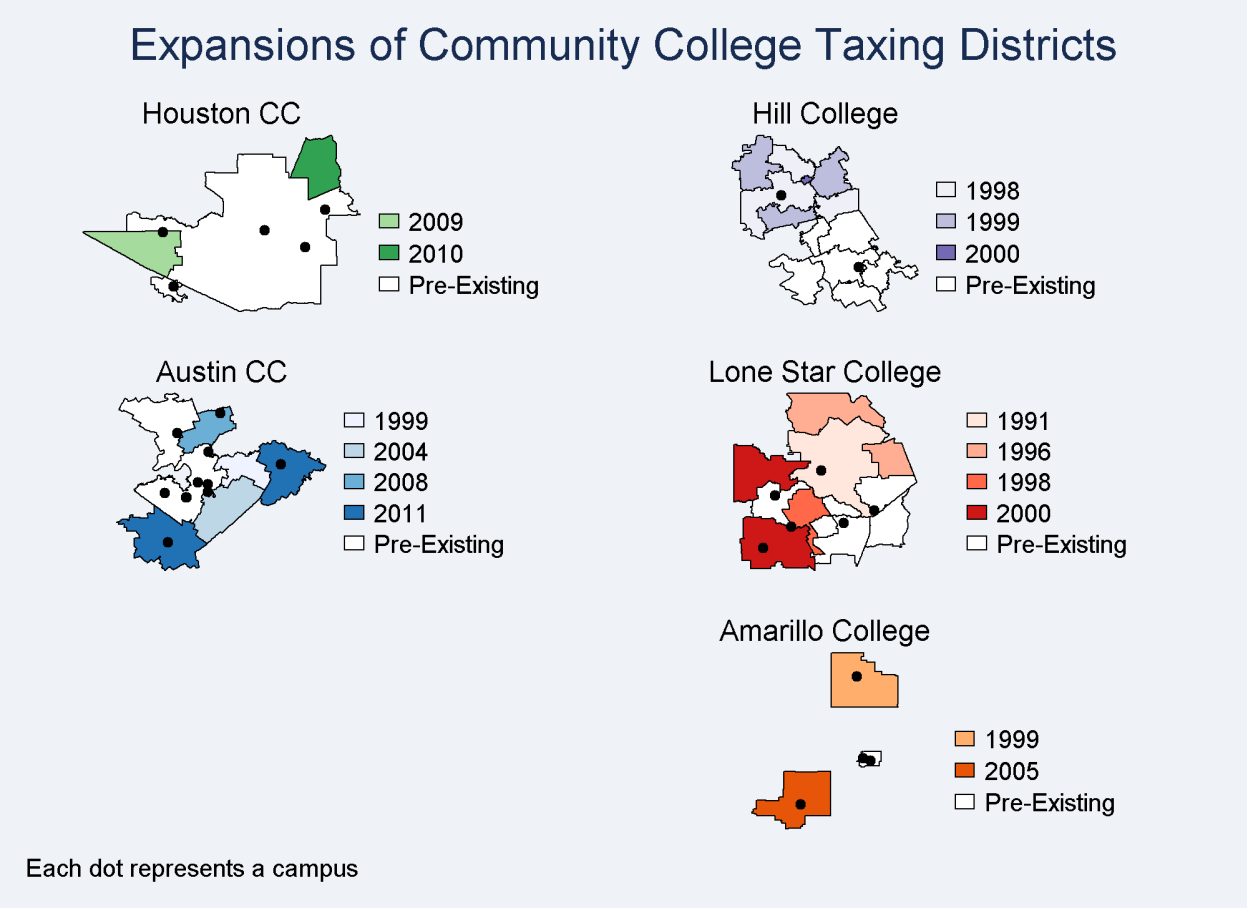
9.1 Figures

Figure 1: Texas Community College Taxing Districts



Source: Texas Association of Community Colleges, 2008. This figure highlights the areas in Texas included in a community college taxing district in 2008.

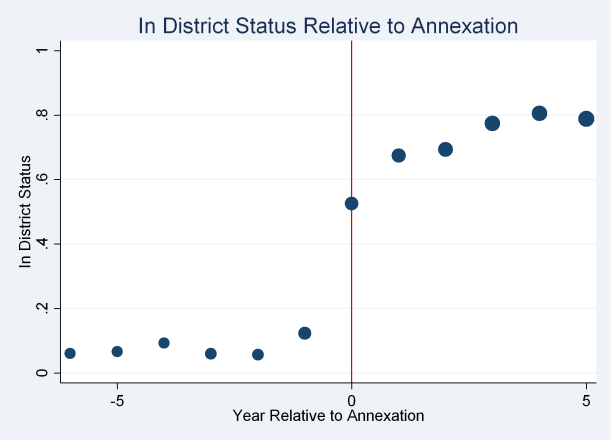
Figure 2: Texas Community College Expansions



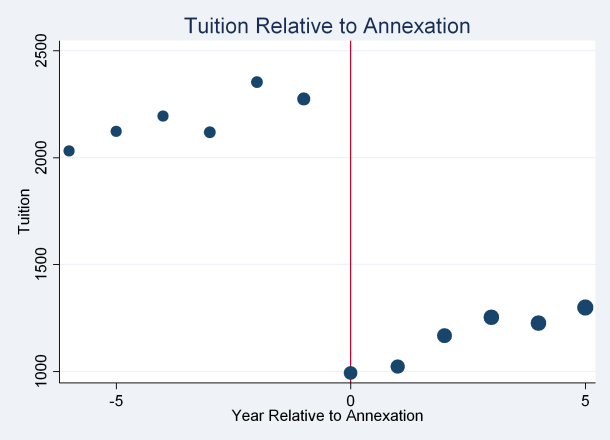
Each panel represents the taxing district of a distinct community college in Texas. The boundaries in the figures represent K-12 school district boundaries and the colors indicate when the K-12 district was annexed. K-12 districts that have no color were included in the community college taxing district prior to the start of the data.

Figure 3: Change In Cost

(a) In-District Status



(b) Tuition

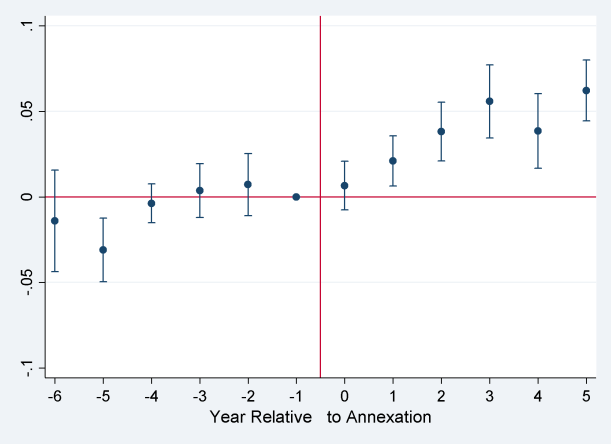


Panel A plots the fraction of students in a K-12 cohort paying in-district tuition at the local community college among students who attended community college. Each dot represents a cohort re-centered by its annexation date. The size of the dot is proportional to the number of students attending community college in that re-centered year. Only K-12 districts that experience an annexation are included in this figure.

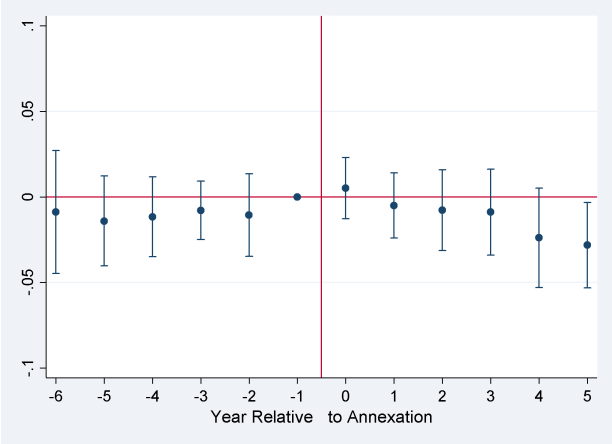
Panel B is a plot of the tuition and fees for two semesters of 12 credits paid by student at the local community college relative to annexation. For comparability, only schools that had five years prior to annexation and five years after were included.

Figure 4: Event Studies for Annexation

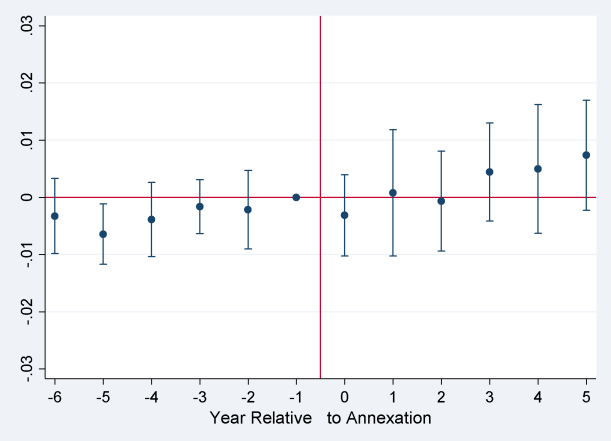
(a) CC Enrollment



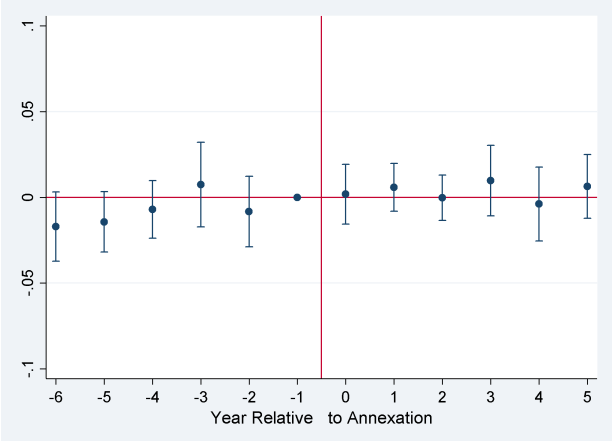
(b) 4yr Enrollment



(c) Grad CC, 4 yrs



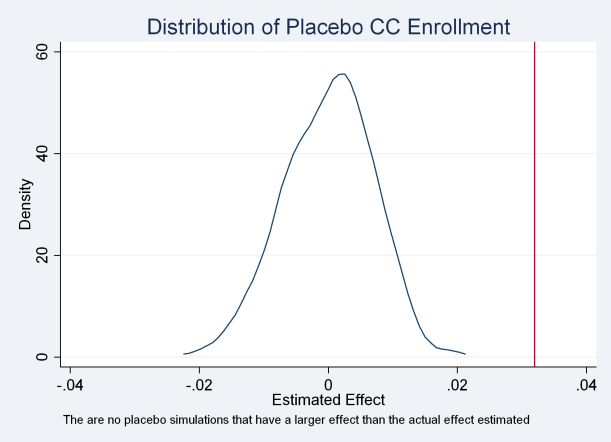
(d) Grad 4yr, 8 yrs



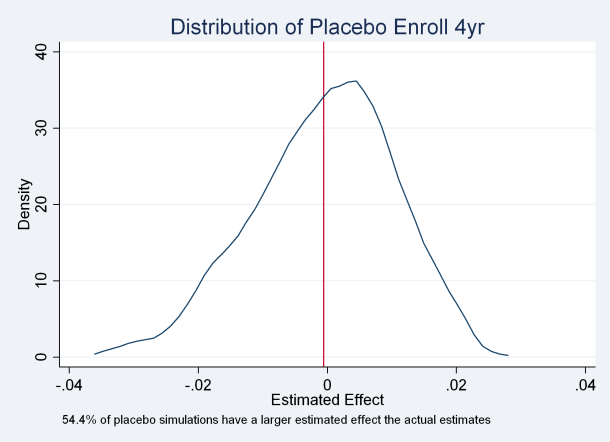
These figure plots the coefficients of a regression that compares yearly differences in student outcomes between annexed districts and districts already part of the taxing district. Panel A considers immediate enrollment in community college, Panel B considers immediate enrollment at a university, Panel C examines receiving a degree or certificate from a community college in 4 years, and Panel D examines receiving a bachelor's degree within 4 years. The regression that produces these differences also controls for demographic characteristics, year fixed effects, K-12 district fixed effects, college-by-year fixed effects, as well as the building of a new campus.

Figure 5: Placebo Regressions

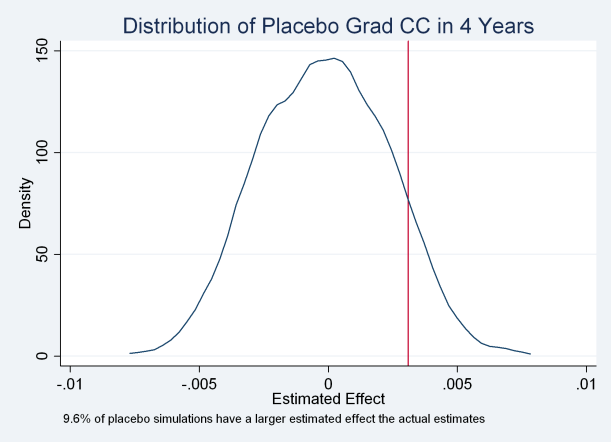
(a) CC Enrollment



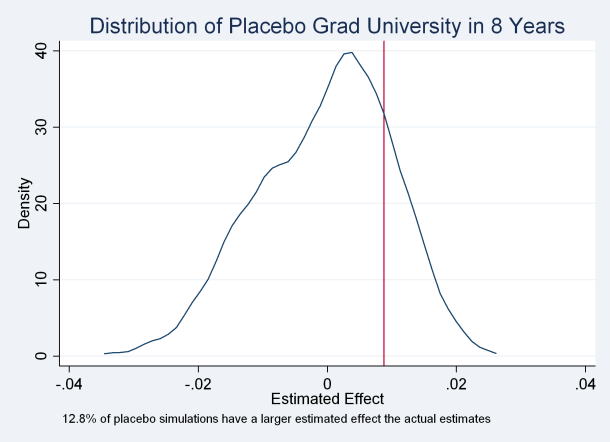
(b) 4yr Enrollment



(c) Grad CC, 4 yrs



(d) Grad 4yr, 8 yrs



The above figures represent the results of a placebo test describe in Section 5.2 for various student outcomes. Panel A examines enrollment in community college, panel B examines enrollment in universities, panel C examines graduation from community college within 4 years, and panel D examines bachelor's degree receipt within 8 years. The plots display the distribution of estimated treatment effects using data from other community college districts that did not experience annexation. The vertical line represents the treatment effect measured in the actual data.

9.2 Tables

Table 1: Expansions of Community College Taxing Districts

Austin Community College		
District	*Expansion of Taxing District*	*New Building*
Manor ISD	1999	1999
Del Valle ISD	2004	
Round Rock ISD	2008	2010
Elgin ISD	2011	2013
Hays ISD	2011	2014
Lone Star College		
District	*Expansion of Taxing District*	*New Building*
Conroe	1991	1995
Willis	1996	
Splendora	1996	
Klein	1998	2011
Cypress-Fairbanks	2000	2003
Magnolia	2000	
Amarillo College		
District	*Expansion of Taxing District*	*New Building*
Hereford	2005	2005
Dumas	1999	2001
Hill College		
District	*Expansion of Taxing District*	*New Building*
Rio Vista	1999	2000
Keene	2000	2000
Joshua	1998	2000
Grandview	1998	2000
Godley	1999	2000
Cleburn	1998	2000
Alvarado	1999	2000
Houston Community College		
District	*Expansion of Taxing District*	*New Building*
Alief	2009	2008
North Forest	2010	

This table outlines the expansions to the five community colleges that experience annexations of municipalities into taxing districts during the time contained in the data. Each row containts a K-12 District, the year of annexation and the year of building a new campus (if any). See Appendix A.1 for details on the collection of these dates.

Table 2: Summary Statistics

	Mean	SD	N
Enrolled in CC, Fall	0.265	0.441	206375
Enrolled in 4yr, Fall	0.247	0.431	206375
Enrolled In-District, Fall	0.211	0.408	206375
Enrolled in CC, 1 Year after HS	0.384	0.486	206375
Enrolled in 4yr, 1 Year after HS	0.232	0.422	206375
Pays In District Tuition	0.715	0.452	54658
Ever Annexed	0.391	0.488	206375
Post Annexation	0.250	0.433	206375
Building	0.180	0.384	206375
Did not Enroll	0.491	0.500	206375
Grad with 4yr Degree in 4 Years	0.077	0.266	206375
Grad with 4yr Degree in 6 Years	0.212	0.409	206375
Grad with 2yr Degree in 2 Years	0.011	0.106	206375
Grad with 2yr Degree in 4 Years	0.041	0.199	206375
Asian	0.043	0.203	206375
Black	0.112	0.315	206375
Hispanic	0.192	0.394	206375
White	0.651	0.477	206375
Male	0.512	0.500	206375
Economically Disadvantaged	0.152	0.359	206375
Limited English Proficiency	0.013	0.112	206375
Sticker Tuition	1266.2	390.7	206375
Grants	213.9	939.7	120580

This table is constructed using ERC and Texas Association of Community College data and includes students from 1994-2005 who live K-12 Districts that are part of community college taxing districts that experience any annexation from 1994-2005. This includes Austin Community College, Amarillo Community College, Hill Community College, and Lone Star Community College.

Table 3: Summary Statistics, Before and After Annexation

	Pre		Post	
	Mean	N	Mean	N
Enrolled in CC	0.230	29032	0.278	51680
Enrolled in 4yr	0.279	29032	0.279	51680
Enrolled In-District	0.143	29032	0.206	51680
Did not Enroll	0.493	29032	0.448	51680
Theoretical Tuition	1.962	29032	1.160	51680
Pays In District Tuition	0.109	6664	0.724	14390
Building	0.000	29032	0.359	51680
Grad with 4yr Degree in 4 Years	0.075	29032	0.095	51680
Grad with 4yr Degree in 6 Years	0.227	29032	0.245	51680
Grad with 2yr Degree in 2 Years	0.007	29032	0.013	51680
Grad with 2yr Degree in 4 Years	0.024	29032	0.050	51680

This table is constructed using ERC and Texas Association of Community College data and includes students from 1994-2005 living in K-12 districts that experienced annexation. The data are split before and after annexation. This includes Austin Community College, Amarillo Community College, Hill Community College, and Lone Star Community College.

Table 4: Changes in Cost

	(1) CC Tuition	(2) In District	(3) Grants	(4) Grants, No Zero
Annexation	-1.124***	0.55***	-173.1	-286.8***
	(0.0627)	(0.021)	(125.0)	(80.2)
Mean of Dep Var	1.266	0.71	322.3	3593.5
N, Students	206,375	206,375	274,739	24,639
Year and District FE	X	X	X	X
Demographics	X	X	X	X
College/Year FE	X	X	X	X

This table considers the changes in cost associated with annexation. CC tuition is the amount paid in tuition for two, 12 credit hour semesters in $1000s of 2012 dollars. In District is an indicator for whether a student pays in district tuition among community college attendees. For both tuition and in-district status, high school graduates from 1994-2005 are considered. Grants consider the amount of grants received at community colleges for high school graduates from 2001-2012. The rows at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, and college by year fixed effects. Standard errors are clustered at the K-12 district level and are in parentheses with
$^{*}p < .1, ^{**}p < .05, ^{***}p < .01$.

Table 5: Student Characteristics

	(1) Asian	(2) Black	(3) Hispanic	(4) White	(5) Male	(6) Econ. Disadv.	(7) Limited Engl.	(8) College Plans	(9) Grad HS
Annexation	0.0029	-0.0057	-0.010	0.013	-0.0022	-0.036	-0.0031	-0.041*	-0.00844
	(0.0032)	(0.012)	(0.015)	(0.020)	(0.0043)	(0.027)	(0.0023)	(0.022)	(0.0141)
Year and District FE	X	X	X	X	X	X	X	X	X
College/Year FE	X	X	X	X	X	X	X	X	X
New Campuses	X	X	X	X	X	X	X	X	X
Mean of Dep Var	0.043	0.11	0.19	0.65	0.51	0.15	0.013	0.77	0.705
N	206370	206370	206370	206370	206370	206370	206370	206370	232689

This table considers how student characteristics vary with annexation. Results in columns 1 to 8 use high school graduates from 1994-2005. Column 9 examines graduation behavior for cohorts that will be annexed in the future by examining 10th graders from the 1996-2005 graduating classes. The columns at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, college by year fixed effects, and an indicators for new campuses. Standard errors are clustered at the K-12 district level are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.

Table 6: Immediate Enrollment Effects

A. Reduced Form				
Immediate Enrollment	CC	4yr	In. Dist	Nowhere
Annexation	0.032***	-0.00057	0.044***	-0.031***
	(0.0059)	(0.0095)	(0.0096)	(0.0086)
Mean of Dep Var	0.26	0.25	0.21	0.49
N	206370	206370	206370	206370
B. Per $1000 Dollars				
Immediate Enrollment	CC	4yr	In. Dist	Nowhere
Annexation	-0.028***	0.00050	-0.039***	0.028***
	(0.0042)	(0.0040)	(0.0038)	(0.0046)
Mean of Dep Var	0.26	0.25	0.49	0.21
N	206370	206370	206370	206370
C. Elasticity	Log	Log	Log	Log
Immediate Enrollment	CC	4yr	In Dist.	None
Log Tuition	-0.16***	0.0016	-0.36***	0.097***
	(0.035)	(0.033)	(0.066)	(0.021)
N	372	372	372	372
Year and District FE	X	X	X	X
Demographics	X	X	X	X
College/Year FE	X	X	X	X
New Campuses	X	X	X	X

This table considers enrollment in the fall immediately after high school graduation. Panel A considers the reduced form effect of annexation on enrollment and Panel B instruments for changes in tuition with annexation. The CC column examines enrollment in a community college, 4yr considers enrollment in public universities, In Dist. considers enrollment at the in-district community college, and Nowhere is an indicator for not enrolling in any public colleges or universities. Standard errors are clustered at the K-12 district level are in parentheses with $^{*}p < .1,^{**}p < .05,^{***}p < .01$. Panel C collapses the data into K-12 District/Year cells and considers log outcomes and log tuition with tuition instrumented for using annexation. Robust standard errors are in parentheses. All results use high school graduates from 1994-2005. The rows at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, college by year fixed effects, and an indicators for new campuses.

Table 7: Enrollment in CC by Years after HS Graduation

A. Enrollment in CC	(1)	(2)	(3)	(4)	(5)	(6)
	1 year	2 years	3 years	4 years	5 years	6 years
Annexation	0.045***	0.035***	0.020***	0.012***	0.0095***	0.0087**
	(0.0084)	(0.0043)	(0.0051)	(0.0036)	(0.0025)	(0.0035)
Mean of Dep Var	0.38	0.25	0.18	0.14	0.11	0.089
N	206370	206370	206370	206370	206370	206370
A. Enrollment in 4yr	1 year	2 years	3 years	4 years	5 years	6 years
Annexation	-0.00036	0.00038	0.0038	0.0089	0.0044	0.0070***
	(0.011)	(0.012)	(0.012)	(0.0096)	(0.0037)	(0.0025)
Mean of Dep Var	0.23	0.25	0.25	0.20	0.12	0.089
N	206370	206370	206370	206370	206370	206370
Year and District FE	X	X	X	X	X	X
Demographics	X	X	X	X	X	X
College/Year FE	X	X	X	X	X	X
New Campuses	X	X	X	X	X	X

This table considers longer term enrollment patterns of annexation. Each column is a separate regression containing an indicator for if a student enrolled in the Xth year after high school graduation. For year 1, this would be if a student enrolls in the Fall, Spring, or Summer semester immediate after their high school graduation. The rows at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, college by year fixed effects, and indicators for new campuses. All results use high school graduates from 1994-2005. Standard errors are clustered at the K-12 district level and are in parentheses with
$^{*}p < .1,^{**} p < .05,^{***} p < .01$.

Table 8: Transfer

Transfer	(1) Year 2	(2) Year 3	(3) Year 4	(4) Year 5	(5) Year 6
Annexation	0.011	0.014*	0.015**	0.0070***	0.0083***
	(0.0067)	(0.0073)	(0.0056)	(0.0021)	(0.0018)
Year and District FE	X	X	X	X	X
Demographics	X	X	X	X	X
College/Year FE	X	X	X	X	X
New Campuses	X	X	X	X	X
Mean of Dep Var	0.13	0.17	0.14	0.097	0.071
N	206370	206370	206370	206370	206370

This table considers student transfer behavior. Transfer is defined as attending a university in the Xth year when having attended a community college in a prior year. The rows at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, college by year fixed effects, and indicators for new campuses. All results use high school graduates from 1994-2005. Standard errors are clustered at the K-12 district level and are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.

Table 9: Community College Effect on Educational Attainment

A. Reduced Form	(1) Grad CC in 2 yrs	(2) Grad CC in 4 yrs	(3) Grad 4yr in 4yrs	(4) Grad 4yr in 6yrs	(5) Grad 4yr in 8yrs
Annexation	-0.0023	0.00331	0.0015	0.0061	0.011
	(0.0015)	(0.00287)	(0.0040)	(0.0075)	(0.0070)
B. Instrumental Variables	Grad CC in 2 yrs	Grad CC in 4 yrs	Grad 4yr in 4yrs	Grad 4yr in 6yrs	Grad 4yr in 8yrs
Attend CC	-0.048	0.070	0.032	0.13	0.23*
	(0.029)	(0.061)	(0.079)	(0.14)	(0.12)
Year and District FE	X	X	X	X	X
Demographics	X	X	X	X	X
College/Year FE	X	X	X	X	X
New Campuses	X	X	X	X	X
Mean of Dep Var	0.011	0.041	0.077	0.21	0.25
N	206370	206370	206370	206370	206370

This table considers the effect of community college attendance on educational attainment from 1994-2005. Panel A considers the reduced form effect of annexation on graduation outcomes and Panel B instruments for community college attendance within the first year after high school graduation using an indicator for annexation. The rows at the bottom indicate inclusion of controls for year and district fixed effects, new campuses, demographic characteristics including race and gender, and college by year fixed effects. Standard errors are clustered at the K-12 district level and are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.

Table 10: Heterogeneous effects

	(1) Enr. CC	(2) Enr. 4yr	(3) Enr. Nowhere	(4) Grad CC, 4 years	(5) Grad 4yr, 8 years
A. Econ. Dis.					
Annexation	0.031***	0.0072	-0.037***	0.0027	0.012
	(0.0079)	(0.010)	(0.011)	(0.0029)	(0.0094)
Annexation*Econ Dis.	0.019	-0.035	0.016	0.00013	-0.0096
	(0.027)	(0.022)	(0.023)	(0.010)	(0.014)
B. Race					
Annexation	0.027***	0.014**	-0.040***	0.00051	0.014**
	(0.0071)	(0.0061)	(0.0084)	(0.0025)	(0.0060)
Annexation*Black	0.024**	-0.044***	0.020	0.0084*	0.0080
	(0.011)	(0.016)	(0.018)	(0.0049)	(0.011)
Annexation*Hispanic	0.015	-0.018**	0.00063	0.0051	-0.0093
	(0.012)	(0.0085)	(0.013)	(0.0060)	(0.0086)
C. Gender					
Annexation	0.029***	0.0087	-0.037***	-0.00045	0.014**
	(0.0078)	(0.0065)	(0.0087)	(0.0025)	(0.0067)
Annexation*Male	0.010	-0.0081	-0.0014	0.0078**	0.000074
	(0.0090)	(0.0085)	(0.010)	(0.0033)	(0.0074)
Year and District FE	X	X	X	X	X
College/Year FE	X	X	X	X	X
New Campuses	X	X	X	X	X
Mean of Dep Var	0.26	0.25	0.49	0.041	0.25
N	206370	206370	206370	206370	206370

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

This table considers the effect of annexation separately by different student characteristics. Each column represents a new outcome. Panel A contains results that fully interact the model with indicators fully for economic disadvantage. Panel B contains results that fully interact the model with indicators fully for race. Panel C contains results that fully interact the model with indicators for gender. The rows at the bottom indicate inclusion of controls for year and district fixed effects, an indicator for new campuses, and college by year fixed effects. All results use high school graduates from 1994-2005. Standard errors are clustered at the K-12 district level and are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.

References

Bailey, T., Jenkins, D., and Leinbach, T. (2005). What we know about community college low-income and minority student outcomes: Descriptive statistics from national surveys. *Community College Research Center*.

Bettinger, E. P., Long, B. T., Oreopoulos, P., and Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the h&r block fafsa experiment*. *The Quarterly Journal of Economics*, 127(3):1205–1242.

Betts, J. R. and McFarland, L. L. (1995). Safe port in a storm: The impact of labor market conditions on community college enrollments. *Journal of Human Resources*, pages 741–765.

Bound, J. and Turner, S. (2007). Cohort crowding: How resources affect collegiate attainment. *Journal of Public Economics*, 91(5):877–899.

Brand, J. E., Pfeffer, F. T., and Goldrick-Rab, S. (2012). Interpreting community college effects in the presence of heterogeneity and complex counterfactuals. *Unpublished Working Paper. WISCAPE*.

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

Castleman, B. L. and Long, B. T. (2012). Looking beyond enrollment: The causal effect of need-based grants on college access, persistence, and graduation.

Castleman, B. L. and Page, L. C. (2013). The not-so-lazy days of summer: Experimental interventions to increase college entry among low-income high school graduates. *New directions for youth development*, 2013(140):77–97.

Cellini, S. R. (2009). Crowded colleges and college crowd-out: The impact of public subsidies on the two-year college market. *American Economic Journal: Economic Policy*, 1(2):pp. 1–30.

Cohodes, S. and Goodman, J. (2014). Merit aid, college quality and college completion: Massachusetts adams scholarship as an in-kind subsidy. *American Economic Journal: Applied Economics*, Forthcoming.

Cornwell, C., Mustard, D. B., and Sridhar, D. J. (2006). The enrollment effects of merit-based financial aid: Evidence from georgias hope program. *Journal of Labor Economics*, 24(4):761–786.

Deming, D. and Dynarski, S. (2009). Into college, out of poverty? policies to increase the postsecondary attainment of the poor. Technical report, National Bureau of Economic Research.

Doyle, W. R. (2009). The effect of community college enrollment on bachelor's degree completion. *Economics of Education Review*, 28(2):199–206.

Dynarski, S. (2000). Hope for whom? financial aid for the middle class and its impact on college attendance. *National Tax Journal*, 53(3):2–61.

Dynarski, S. (2004). The new merit aid. *College Choices: The Economics of Where to Go, When to Go, and How to Pay for It*, page 63.

Dynarski, S. and Wiederspan, M. (2012). Student aid simplification: Looking back and looking ahead. Technical report, National Bureau of Economic Research.

Dynarski, S. M. (2003). Does aid matter? measuring the effect of student aid on college attendance and completion. *The American Economic Review*, 93(1):279–288.

Gillen, A., Robe, J., and Garrett, D. (2011). Net tuition and net price trends in the united states. *Center for College Affordability and Productivity*.

Goodman, J. (2008). Who merits financial aid?: Massachusetts' adams scholarship. *Journal of Public Economics*, 92(10):2121–2131.

Goodman, J., Hurwitz, M., and Smith, J. (2014). College access, initial college choice and degree completion.

Hilmer, M. J. (1997). Does community college attendance provide a strategic path to a higher quality education? *Economics of Education Review*, 16(1):59–68.

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

Kane, T. J. (1995). Rising public college tuition and college entry: How well do public subsidies promote access to college? Technical report, National Bureau of Economic Research.

Kane, T. J., Riegg, S. K., and Staiger, D. O. (2006). School quality, neighborhoods, and housing prices. *American Law and Economics Review*, 8(2):183–212.

Kane, T. J. and Rouse, C. E. (1999). The community college: Educating students at the margin between college and work. *The Journal of Economic Perspectives*, 13(1):63–84.

Leigh, D. E. and Gill, A. M. (2003). Do community colleges really divert students from earning bachelor's degrees? *Economics of Education Review*, 22(1):23–30.

Long, B. T. and Kurlaender, M. (2009). Do community colleges provide a viable pathway to a baccalaureate degree? *Educational Evaluation and Policy Analysis*, 31(1):30–53.

Martorell, P., McCall, B., and McFarlin, I. (2014). Do public tuition subsidies promote college enrollment? evidence from community college taxing districts in texas.

McFarlin, I. (2007). Do public subsidies promote college access and completion? evidence from community college districts.

Miller, D. W. (2007). Isolating the causal impact of community college enrollment on educationalm attainment and labor market outcomes in texas. *Stanford Insittute for Economic Policy Research Discussion Paper 06-33*.

National Center for Education Statistics (2014). Digest of education statistics: 2013.

Nunez, A.-M. and Carrol, C. D. (1998). First-generation students: Undergraduates whose parents never enrolled in postsecondary education. *National Center for Education Statistics*.

Nutting, A. W. (2008). Costs of attendance and the educational programs of first-time community college students. *Economics of Education Review*, 27(4):450–459.

Reynolds, C. (2012). Where to attend? estimating the effects of beginning college at a two-year institution. *Economics of Education Review*, 31(4):345–362.

Rouse, C. E. (1994). What to do after high school: The two-year versus four-year college enrollment decision. *Choices and consequences: Contemporary policy issues in education*, pages 59–88.

Rouse, C. E. (1995). Democratization or diversion? the effect of community colleges on educational attainment. *Journal of Business & Economic Statistics*, 13(2):217–224.

Scott-Clayton, J. (2011). On money and motivation a quasi-experimental analysis of financial incentives for college achievement. *Journal of Human Resources*, 46(3):614–646.

Seftor, N. S. and Turner, S. E. (2002). Back to school: Federal student aid policy and adult college enrollment. *Journal of Human Resources*, pages 336–352.

Texas Higher Education Coordinating Board (2001). Closing the gaps: The texas higher education plan. Technical report.

Turner, N. (2011). The effect of tax-based federal student aid on college enrollment. *National Tax Journal*, 64(3):839–862.

Appendix A

A.1 Annexation/Campus Data Collection

Data on the dates of annexation was obtained in three ways. The first is through information posted online on community college websites that detailed historical annexations. The second is by using archives of newspapers covering the votes on annexation. The third is by examining patterns of students payment of in-district tuition. For each annexation. The ERC data provides information on whether enrolled students paid in-district tuition. From this data I identified years in which the fraction of students paying in-district tuition jumped substantially in a K-12 district. These changes were then verified using news reports when possible. For additional information on the source for each annexation and campus building date see this online spreadsheet: http://goo.gl/6sjDvz.

In order to assign opening dates for new campuses, I collected information on existing campuses at the five community college taxing districts studied and determined when they were opened using information from the community college websites. I then used latitude and longitude data on campuses and school districts to map campuses to K-12 school districts.

A.2 Additional years of data

To take advantage of additional variation in community college tuition caused by annexation, I estimate the effect of annexation on enrollment for 1995 to 2012. These results are in Table A1 and include college/year fixed effects. In Column 1, annexation is associated with a slightly smaller increase in sticker price of tuition. The effect of annexation on community college enrollment is slightly larger with the estimate being 3.7 pp as opposed to 3.2 pp. The effects for enrolling in district and enrolling in no college are also larger than previous estimates but are still highly statistically significant. However, there is still no measured effect of annexation on enrollment at four-year colleges. The results for building a new campus are similar when using all data but slightly attenuated. These results suggest that the findings on enrollment are robust to using additional variation.[40]

[40]Specifically, there was one additional community college that had any annexations and five additional annexations from 2006-2012.

A.3 Hours attempted

Another measure of educational attainment is the number of college credit hours accumulated. The data contain information on the number of credit hours attempted, which I will use as another measure of attainment. Unfortunately the data do not contain information on credit hours passed during the relevant time frame but credit hours attempted serves as a good intermediate indicator of credits accumulated.

Panel A of Table A2 shows that reduced tuition resulting from annexation increased hours attempted at community colleges. After four years, annexation had increased average credits attempted by 2 credit hours. There point estimates on the increases in university credits are positive but are not statistically significant. Unfortunately, the data on credits attempted does not extend far enough to consider credits attempted at universities after 8 years which would give students more time to transfer to community colleges.

Panel B of Table A2 uses annexation as an instrument for attending a community college. The results have a similar pattern to Panel B of Table A2 but scale the coefficients by the number of students induced to attend community college. Students induced to attend community college as a result of annexation increased the number of credits attempted at community colleges after 6 years by 47.6 and the overall number of credits by 58.9. These results suggest that reduced community college tuition increased community college attendance and the students who attended were engaged nearly enough credit hours for an associate's degree.

Table A1: Enrollment, All Years

	(1) Tuition	(2) Enr. CC	(3) Enr. In. Dist	(4) Enr. 4yr	(5) Enr None
Annexation	-1.13***	0.037***	0.050***	-0.0019	-0.035***
	(0.073)	(0.0067)	(0.0081)	(0.013)	(0.011)
Year and District FE	X	X	X	X	X
Demographics	X	X	X	X	X
College/Year FE	X	X	X	X	X
New Campuses	X	X	X	X	X
Mean of Dep Var	1.33	0.27	0.22	0.24	0.49
N	390237	390237	390237	390237	390237

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

This table considers the effect of annexation on immediate college enrollment patterns using data from 1994-2012. The CC column examines enrollment in a community college, 4yr considers enrollment in public universities, In Dist. considers enrollment at the in-district community college, and Nowhere is an indicator for not enrolling in any public colleges or universities. The rows at the bottom indicate inclusion of controls for year and district fixed effects, demographic characteristics including race and gender, and college by year fixed effects. Standard errors are clustered at the K-12 District level and are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.

Table A2: Hours Attempted

A. Reduced Form	(1) Univ. Credits after 4 yrs	(2) Univ. Credits after 6 yrs	(3) CC Credits after 4 yrs	(4) CC Credits after 6 yrs	(5) All Credits after 6 yrs
Annexation	0.25	0.51	2.00***	2.15***	2.66*
	(1.25)	(1.34)	(0.24)	(0.25)	(1.40)
B. Instrumental Variables	Univ. Credits after 4 yrs	Univ. Credits after 6 yrs	CC Credits after 4 yrs	CC Credits after 6 yrs	All Credits after 6 yrs
Attend CC	5.56	11.3	44.3***	47.6***	58.9**
	(26.7)	(28.0)	(5.66)	(6.32)	(24.6)
Year and District FE	X	X	X	X	X
Demographics	X	X	X	X	X
College/Year FE	X	X	X	X	X
New Campuses	X	X	X	X	X
Mean of Dep Var	24.4	28.8	14.1	16.5	45.3
N	206370	206370	206370	206370	206370

This table considers the sum of hours attempted at community colleges and universities after four and six years. Panel A presents the reduced form effect of annexation on credits attempted and Panel B instruments for community college attendance using annexation. Each column is a separate regression considering the effect in the Xth year after high school. The rows at the bottom indicate inclusion of controls for year and district fixed effects, the building of new campuses, demographic characteristics including race and gender, and college by year fixed effects. Standard errors are clustered at the K-12 district level and are in parentheses with $^{*}p < .1,^{**} p < .05,^{***} p < .01$.