Isolating the Causal Impact of Community College Enrollment on Educational Attainment and Labor Market Outcomes in Texas

By
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Isolating the Causal Impact of Community College Enrollment on Educational
Attainment and Labor Market Outcomes in Texas

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Abstract: In this paper, we attempt to isolate the causal impact of enrolling in a community college upon educational attainment and labor market outcomes in the state of Texas. Using administrative data on all public high school graduates from the state, we use both matching and IV methods to investigate the impact of community college enrollment on the probability of obtaining a bachelor’s degree. Both methods indicate that enrolling in a community college over a university decreases the probability of completing a bachelor’s degree by approximately 26%. Using data from the Texas Workforce Commission, we go on to look at the labor market return to initial college choice. Using IV to deal with the selection issue, we find that initiating one’s academic career in a community college instead of a university lowers one’s earnings by approximately $6800 per annum for young adults just completing college. After conditioning upon completion of a baccalaureate degree, this estimate falls substantially, and becomes statistically indistinguishable from zero for one of three favored specifications. Our results are quite sensitive to the exclusion of relevant information about the local labor market, which casts doubt upon the results of some past studies using distance IVs to look at labor market outcomes.

Much of the work presented in this paper was supported by the Shultz Graduate Student Fellowship in Economic Policy through a grant to the Stanford Institute for Economic Policy Research (SIEPR). The author would like to thank the Texas Higher Education Coordinating Board for its support of this project. Susan Brown, Donn Godin, Janet Beinke, Diane Eargle, Gloria Borcoman and Julie Eklund have been particularly helpful. Special thanks go to the author’s advisor, Dr. Eric Hanushek, whose contributions to this work are innumerable. The author would also like to thank Dr. Isaac McFarlin at the University of Texas at Dallas, both for providing distance data and for his many comments. Others whose helpful comments have been incorporated in this study include Doug Bernheim, Michael Kirst, Jesse Cunha, and Saar Golde of Stanford University, as well as numerous participants in the 2006 SIEPR Policy Forum on Education at Stanford University.
**Section I: Introduction**

The community college is an integral part of the American higher education system. Of the over 17 million students enrolled in higher education in the United States in Fall 2002, over 40 percent were enrolled in two-year institutions (U.S. Department of Education, 2004). In Texas, the emphasis on the community college system is particularly strong. Over 60 percent of the 1998 high school graduating class matriculating at Texas public colleges and universities in 1999 enrolled in a two-year institution. Moreover, with the recent passage of a statewide initiative entitled “Closing the Gaps by 2015” aimed at “closing educational gaps within Texas, as well as between Texas and other states,” Texas policymakers are proactively seeking to increase access to community colleges in the state. As such, the share of Texas college students enrolling in two-year institutions is likely to rise even further in the coming years.

Many policy makers, both in Texas and in the U.S. as a whole, have questioned the wisdom behind the push to expand the community college system. Indeed, very few community college students ever complete a bachelor’s degree. For example, less than 13 percent of the 1998 Texas public high school graduates matriculating at Texas public two-year colleges in 1999 completed a baccalaureate degree within six years. The corresponding statistic for Texas students matriculating at Texas public universities was 54 percent. Moreover, it is clear that students who choose to initiate their college careers in a community college have lower incomes than those who begin their schooling in a four year university. The mean total earnings in the fourth quarter of 2005 for 1994 Texas high school graduates enrolling in a two-year school in 1995 was $9903, while the corresponding statistic for those enrolling in a four-year school was $12,571.
While the above statistics may be cause for concern, it is not clear that they indicate a negative impact of community college attendance. It is clear that the choice to attend a community college over a university is non-random. Due in part to their lower cost and emphasis on teaching, community colleges tend to attract students who are less academically prepared and have fewer financial resources than students attending four-year universities.

To address these concerns, this paper attempts to isolate the causal impact of community college attendance upon educational attainment and labor market outcomes. Employing both IV and matching-type models our results indicate a substantial negative impact of initiating one’s college career at a two-year school upon the probability of obtaining a baccalaureate degree. Similarly, after dealing with the selection issue and adding relevant controls for local labor market conditions, we find a negative causal effect of initiating one’s academic career in a community college upon earnings of young adults. However, after conditioning upon completion of a baccalaureate degree, this effect diminishes substantially, becoming statistically indistinguishable from zero for one of three preferred specifications.

While earlier studies have dealt with these issues, they have suffered from data quality issues. Only fairly recently have major nationwide studies like the National Longitudinal Study and High School and Beyond begun to ask questions about type of college attended, and these tend to have relatively small sample sizes, on the order of 8,000 respondents. This has lead to imprecise point estimates, especially when IV methods have been used to deal with selection. In contrast, we have access to statewide administrative data that allows us to track all Texas public high school students into
Texas public colleges and universities and into the Texas labor force. As such, our
sample size is as large as 500,000 for some of the models we estimate. We are also able
to control explicitly for the set of courses taken during high school, and for later cohorts,
we have access to College Board and admissions data, allowing us to control explicitly
for the set of colleges to which the student applied and was accepted, as well as SAT
scores and a host of demographic variables on the SAT questionnaire. Finally, the
extensiveness of our data allows us to control explicitly for local labor market conditions
that might impact educational attainment and earnings. The result is very precise point
estimates and much more powerful tests than have been reported in past studies.
Moreover, we find convincing evidence that failure to control for local labor market
conditions could substantially bias estimates of the labor market impact of education that
employ a distance IV approach, and this casts some doubt on the results of several well-
cited studies.

The remainder of this paper is organized as follows. Section II gives some
background on the American community college system and goes on to discuss the
current state of community colleges in Texas. Section III surveys the existing literature
on community college outcomes. Section IV describes the data. Sections V and VI
discuss the statistical models and results for educational attainment and the labor market,
respectively. Section VII concludes.

**Section II: Background**

Following Kane and Rouse (1999), we will define a community college to be any
institution of higher learning offering a 2-year associates degree as its highest credential.
Such colleges first appeared in the United States around the turn of the century. In an
effort to increase access to higher education without swamping existing colleges and universities, American community colleges were originally designed primarily as a place where students could complete introductory coursework before transferring to a traditional four-year college or university to complete a baccalaureate degree. Consistent with the goal of increasing access to higher education, community colleges typically had lower tuition and focused more resources toward remedial education than did their four-year counterparts.

The American community college system experienced rapid expansion immediately following World War II, as returning soldiers took advantage of the GI Bill. This expansion has continued to this day, especially during and immediately following the Vietnam War (Kane and Rouse 1999). Today, 43% of all American undergraduates attend community colleges (NCES 2006).

While the transfer function remains the primary mission for most community colleges, many two-year schools have broadened their focus to include vocational and technical education programs, adult continuing education and job training programs (Kane and Rouse 1999). The extent of this shift varies considerably across the country so that there are now wide differences in the community college systems of different states. Some states, like California, operate large community college systems focused mainly towards the transfer function, whereas others, like Ohio, mainly focus their community colleges towards terminal vocational and certificate programs.

While there is widespread agreement amongst academics and policymakers that community colleges have helped to increase access to higher education in the United States, there is considerable skepticism regarding the quality of education provided by
community colleges. Indeed, only about 16% of 1984 high school graduates initially enrolling in a community college completed a baccalaureate degree by the year 1994. The corresponding statistic for those enrolling in four-year universities is 59% (Kane and Rouse 1999).

The history of community colleges in Texas closely mirrors that of the United States as a whole. Community college enrollment in the state has grown from 38,000 in 1964 to over 500,000 today, and community college students now represent more than half of all undergraduate students in the state of Texas (THECB 2006). Mirroring their counterparts in other parts of the country, Texas community colleges have broadened their focus in recent years. Indeed, according to the Texas Higher Education Coordinating Board (2003),

“Texas public community colleges are two-year institutions whose primary mission is to serve their local taxing districts and service areas in Texas in offering vocational, technical, and academic courses for certification or associates degrees. Continuing education, remedial and compensatory education consistent with open admissions policies, and programs of counseling and guidance also are provided.”

Consistent with the College Board’s mission statement, the Texas community college system lies somewhere between California and Ohio on the academic-technical spectrum. Sixty-three percent of Texas community college students enroll in academic programs, with the remainder enrolling in vocational and continuing education programs (THECB 2006). Broadly speaking, the state of Texas operates a fairly large and comprehensive community college system, which plays an increasingly important role in the state’s system of higher education.

Like their counterparts in the rest of the nation, Texas community college students are much less likely to complete a baccalaureate degree and have much lower incomes
later in life than do students who choose to enroll in a university. Less than 13 percent of the 1998 Texas public high school graduates matriculating at Texas public two-year colleges in 1999 completed a baccalaureate degree within six years. The corresponding statistic for Texas students matriculating at Texas public universities was 54 percent. Turning to the labor market, the mean total earnings in the fourth quarter of 2005 for 1994 Texas high school graduates enrolling in a two-year school in 1995 was $9903, while the corresponding statistic for those enrolling in a four-year school was $12,571.

Despite the large disparities in graduation rates and labor market outcomes of community college and university enrollees in the state, the Texas legislature recently enacted legislation that is expected to dramatically increase the share of high school graduates choosing to enroll in community colleges. The state’s new higher education plan, “Closing the Gaps,” seeks to increase the state’s higher education participation rate from 5.0% to 5.7% by the year 2015\(^1\), and it is widely believed that the majority of this increase will go through the state’s community college system (THECB 2003). In light of this goal, it is particularly important from a policy standpoint to gauge the impact of increasing access to community colleges in the state. What kind of impact do we expect to see from this policy on average educational attainment in the state, and how will it affect the state’s labor market? These are questions we hope to address with this study.

**Section III: Literature Review**

Many of the earliest studies of community college effectiveness, which relied on raw statistics and OLS estimates to make their case, were quite critical, finding large negative impacts of initiating one’s post-secondary career in a community college on the

\(^1\) The state defines the participation rate to be the percentage of all residents enrolled in higher education during a given year.
probability of obtaining a baccalaureate degree (Karabel, 1972; Anderson, 1981; Velez, 1985) and small or non-existent impacts of community college enrollment on occupational status and income later in life (Monk-Turner, 1983; Monk-Turner, 1990; Breneman and Nelson, 1981). However, like most studies relying on OLS estimation for identification, these studies were later called into question because they were unable to adequately control for all factors impacting both selection into community college and the dependent variable.

The first studies of the impact of community colleges upon educational attainment to address the selection issue were conducted by Rouse (Rouse, 1995; Rouse, 1998). Following work by Brint and Krabel (1989), Rouse (1995) emphasizes what she calls the “democratization” and “diversion” effects of community colleges. She uses a linear probability model with distance and tuition levels as instruments for college choice to investigate the impact of initiating one’s college career in a community college upon the probability of obtaining a bachelor’s degree. Here, the democracy effect is the coefficient on community college enrollment, and represents the probability of completing a baccalaureate degree for a potential student on the margin between choosing to enroll in community college and dropping out of the education pipeline. The diversion effect is the difference in the coefficient on community college enrollment and university enrollment, and represents the decreased probability of baccalaureate completion associated with enrolling in a community college for a student on the margin of choosing a university over a two-year school. Imprecise point estimates lead her to conclude that there is no significant diversion effect. Even so, her point estimate of -.09 is quite large, indicating that if a community college student had initiated his college
career in a university, his probability of graduating would increase by approximately 9 percent. For this reason, many subsequent authors have criticized this study on the grounds that, due to insufficient data, there is no real statistical power in the test of interest (Jargowsky, et al, 2004).

Rouse (1998) uses differences in state-level funding for community colleges across time to address the same issue. Using a differences in differences analysis with state-level average educational attainment as the dependent variable and measures of state-level support for community colleges as the independent variable, Rouse finds that two-year colleges increase overall educational attainment, primarily through the democratization path. However, this method is only able to capture a reduced form model in which access to community college is the independent variable. As such, Rouse is interested in the overall impact of community colleges, rather than the causal impact for an individual on the margin between enrolling in a community college and a university. Moreover, like many studies relying on state-level aggregate data, this study has subsequently been criticized on the grounds that using data aggregated at the state-level to investigate individual-level outcomes leads to over-rejection of hypotheses (Hanushek, Rivkin and Taylor, 1996).

Two more recent studies closely follow Rouse in estimating democratization and diversion effects (Leigh and Gill, 2003b; Sandy, Gonzalez and Hilmer, in Press). Leigh and Gill use the NLSY along with distance IV’s, controlling explicitly for desired educational level to find significant diversion effects of -.7 to -1.0 years of schooling. However, their estimated democratization effect dominates leading them to conclude that community college has a significant positive impact upon overall educational attainment.
Sandy, Gonzalez and Hilmer (in Press) take a somewhat different approach, running OLS models and subsequently performing an Oaxacan decomposition to learn something about selection into community college. They determine that community college students are less likely to obtain a baccalaureate degree than are university students, but that this is due primarily to pre-existing differences in the students rather than the quality of instruction.

Very few studies of the effect of community colleges upon labor market outcomes that deal satisfactorily with the selection issue also deal explicitly with community college attendance. Most study the impact of credentials and degrees earned at community college upon income measured sometime later in life (Grubb, 1992; Grubb, 1993; Kane and Rouse, 1995; Leigh and Gill, 1997; Leigh and Gill, 2003a; Light and Strayer, 2003). Each of these studies finds some positive impact of credentials.

In a study similar to our own, Card (1995) uses variation in geographic proximity to four-year colleges to look at the labor market impact of educational attainment. His results indicate that the causal impact of education upon earnings may be as much as 25-60% higher than what is typically obtained by simple OLS regression, and this is likely due to measurement error in the education variable. However, it could also be due to the group of students most affected by the instrument, namely low-income students on the margin of enrolling in college. In a follow-up study, Kling (2001) finds that the college proximity instrument employed by Card has its largest effect upon students on the margin of enrolling in college and entering the job market directly after high school.

One potential problem with the Card and Kling studies is the possibility that college proximity might be correlated with important aspects about the local labor market.
that might have a causal impact upon earnings. If this is the case, then absent adequate controls for local labor market conditions, the IV estimates could be biased due to violation of the exclusion restriction. While Card devises a test to look at the importance of this issue, data limitations lead to inconclusive findings. Kling acknowledges the problem, but simply cites Card’s non-finding.

The only study to specifically estimate models of the overall labor market return to initiating one’s college career in a community college is Leigh and Gill (2003a). Leigh and Gill find no significant impact of starting post-secondary schooling at a community college, but they restrict attention to actual college graduates, and use OLS methods, which are sensitive to missing variables that might be correlated with the choice to attend a two-year school.

Overall, the state of the literature on community college effectiveness is quite mixed, and there are no real definitive answers. While the literature on educational attainment is quite extensive, data limitations have lead to imprecise point estimates in the few studies that adequately deal with selection. We believe we have the data to alleviate this problem. Indeed, in contrast to past studies using IV, our estimates indicate a statistically significant negative impact of initiating one’s college career at a two-year college.

The literature dealing with labor market returns to community colleges has focused mostly on returns to credentials. Only one study of which we are aware looks specifically at the return to initiating one’s college career in a community college, and it restricts attention to college graduates. However, as we will show, enrolling in a community college over a university has a negative causal impact upon the probability of
obtaining a baccalaureate degree. Because our estimates capture this negative effect in the reduced form labor market return to initiating one’s college career in a community college, we believe our method represents a potential improvement over past studies.

Finally, our data allows us to address a major concern with using college proximity to instrument for education in studies of the labor market return to education more generally. Contrary to the findings of Card (1995) we find substantial evidence that the failure to control for relevant information about the local labor market can bias estimates of the labor market return to education using college proximity to instrument for educational attainment. This result casts some doubt on the findings of Card (1995) and Kling (2001), and should inform future studies of the labor market return to education.

Section IV: Data

In many ways, data is what makes this study particularly strong. We are able to get past many difficulties encountered in past studies simply due to the extensiveness of the data used in this study. The bulk of the data is Texas micro-level administrative data housed at the Texas Higher Education Coordinating Board (THECB) in Austin, TX. While most of this data is reported directly to THECB by Texas colleges and universities, some of it is reported first to other state agencies, and then shared with THECB. The Texas Education Agency (TEA) shares micro-data on all high school students in the Texas public school system, while the Texas Workforce Commission (TWC) shares micro-data on all workers employed in the state of Texas. THECB also houses micro-level SAT data reported directly to the Agency by the College Board (CB). We are able to link all of the above data sources to each other and across time using social security
numbers. As such, we are able to use the data at the THECB to construct an extensive longitudinal dataset following all 1994-1999 Texas public high school graduates into Texas public colleges and universities and into the Texas workforce from the time of high school graduation until the fourth quarter of 2005. Thus, with some 200,000 public high school graduates per year in the state of Texas, many of our models are estimated with as many as 600,000 observations, which is a considerable improvement over past studies using a maximum of 10,000 observations.

The following data is reported by Texas public colleges and universities directly to THECB for the years 1994-2005 and all Texas colleges and universities (public and private) for the years 2003-2005: the Student Report, the Graduation Report, and the TASP report. Along with several demographic variables, the Student Report has an indicator for all colleges and universities attended by a student during the fall, spring and summer semesters of the report year. It also includes fairly extensive information about the student’s college major during each semester. The Graduation Report has an indicator for all degrees earned by a student during the report year. The TASP Report has indicators for total credit hours attempted and total credit hours passed for each semester-school attended by a student during the report year.

The Application Report is reported directly to THECB by all public Texas colleges and universities for the years 1998-2003. It includes indicators for each public university to which a student 1) applied and 2) was accepted during the report year.

The TEA data is reported directly to the TEA by all Texas public high schools for the years 1991-2005. The TEA provides this data to the THECB, and we use the cohorts of 1994-1996 and 1998-1999 high school graduates. Along with several demographic
variables, it includes indicators for the high school from which the student graduated, and all classes taken by the student during grades 9-12.

The TWC data is reported directly to the TWC by businesses in the state of Texas. The TWC shares data with the THECB for the third quarter of 1997 through the fourth quarter of 2005. It includes, total quarterly earnings for each job reported to TWC during the report quarter.

The College Board data, is purchased annually from the College Board by THECB. THECB currently has CB data for years 1998-2003. In addition to math and verbal SAT scores for each SAT-taker in the state, it includes self-reported demographic data on the SAT questionnaire administered by the College Board on the day of the exam. The students report their household income, the educational attainment of each of their parents, their planned major, and their planned educational attainment.

All of the above data is linked by means of the student’s Social Security Number (SSN). In the end, we create the cohorts of Texas public high school graduates for the years 1994-1996 and 1998-1999. We use SSN to merge the data sources and track individual students into Texas public colleges and universities and into the Texas workforce. It is important to note that any given student can be enrolled in more than one college or university during a given year. To deal with this, each year we use the data on credits attempted to assign each student to the college or university at which he or she attempted the most credit hours during that year. Similarly, since any given individual can have more than one job during a quarter, we sum the earnings from all jobs worked by each individual in the data during each quarter to obtain total quarterly earnings from
all jobs in the state. In the end we create 5 cohorts of high school graduates ranging in size from 164,767 for 1994 to 203,306 for 1999.

The IV estimates in our study rely on measures of the distance between each student’s high school and the nearest two- and four-year colleges. Computed using the geographical software, GIS, in conjunction with geographic data from the Texas Schools Micro Panel housed at the University of Texas at Dallas, this data was merged to the cohorts above using the high school indicators.

Finally, to address the concern that geographic proximity to college might be correlated with local labor market outcomes, we use the U.S. Census’s County and City Data Book to collect median household earnings in 1990 by county for all counties in the state of Texas. This is merged with the above data using county indicators for each high school in the state.

For our purposes, the main weakness of the THECB data is the inability to track students into private colleges and universities within the state of Texas until the year 2003. While it is possible to observe degrees attained from private colleges for later cohorts, it is impossible to observe which students initiated their college careers at a private college. As such, we restrict attention to public colleges and universities in this study. We are not extremely concerned by this because very few community college students transfer to private colleges. Indeed, only 4% of the cohort of 1999 high school graduates matriculating at Texas public community colleges graduated from a private university in the state of Texas during the years 2003-2005.

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2 Many thanks to Dr. Isaac McFarlin at the University of Texas at Dallas for providing the distance data.

3 This data is obtained online from the Geospatial and Statistical Data Center at the University of Virginia Library (http://fisher.lib.virginia.edu/).
Section V: Community College and Educational Attainment

We are interested in isolating the causal impact of initiating one’s college career in a community college instead of a four-year university. We begin by following Rouse (1995) and estimating models of the following form:

\[ \text{Prob}(\text{Bach}_i = 1) = a_1 + a_2 \text{Univ}_i + a_3 \text{JC}_i + e_a \]

\[ \text{Prob}(\text{Univ}_i = 1) = b_1 + b_2 \text{DUniv}_i + b_3 \text{DJC}_i + e_b \]

\[ \text{Prob}(\text{JC}_i = 1) = c_1 + c_2 \text{DUniv}_i + c_3 \text{DJC}_i + e_c, \]

where \( \text{Bach}_i \) is an indicator for whether or not student \( i \) completed a baccalaureate degree within seven years of high school graduation, \( \text{Univ}_i \) is an indicator for whether or not student \( i \) enrolled in a university within one year of high school graduation, \( \text{JC}_i \) is an indicator for whether or not student \( i \) enrolled in a community college within one year of high school graduation, and \( \text{DUniv}_i \) and \( \text{DJC}_i \) represent the distances between student \( i \)’s high school and the nearest four- and two-year schools, respectively. Like Rouse, all of our models are run as Linear Probability Models using either OLS or IV.

Running her models on all students in the data, Rouse interprets her IV coefficient \( a_3 \) as the “democratization effect,” or the increased probability of obtaining a baccalaureate degree for a student on the margin of entering a community college or dropping out of school. Using similar logic, Rouse interprets the difference in the IV coefficients \((a_3 - a_2)\) as the “diversion effect,” or the difference in probability of obtaining a baccalaureate degree for a student on the margin between entering a community college and a four-year school, who chooses to enter a community college. The democratization
effect is unambiguously positive since it is impossible for a student failing to enroll in any college to graduate. However, the sign of the diversion effect is not known a priori. Students may benefit from the remedial classes and emphasis on personalized instruction provided at the two-year school, thereby increasing the probability of graduation, or they may suffer from negative peer effects, lower expectations, and the easier courses at two year schools, thereby decreasing the probability of graduation.

Table I below presents the results from several models run using the Rouse methodology, and Table II presents the first step equations for the IV estimates that use distance IV’s:

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
<th>Model V</th>
<th>Model VI</th>
<th>Model VII</th>
<th>Model VIII</th>
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Table I: Rouse (1995) Models for Various Cohorts
Model II partially corrects for the pre-existing differences between community college and university students by controlling explicitly for race, gender, and the courses taken during the senior year of high school. As one would expect, this reduces the

Model I indicates that only about 12 percent of community college matriculants complete a bachelor’s degree within six years. In comparison, nearly 50 percent of matriculants at Texas public four-year universities complete a baccalaureate degree within six years. Thus, the typical community college matriculant is 38 percentage points less likely than the typical university matriculant to complete a bachelor’s degree. This “estimate” of the effect of community colleges is spurious because it fails to take into account pre-existing differences between community college and university students. One would think that the typical community college student would be less likely than the typical university student to complete a bachelor’s degree, even if he had initially enrolled in a four-year school, and this would cause Model I to overestimate any true effect of community college enrollment.
estimated community college effect. Model II indicates that the typical community college student is about 33 percentage points less likely to graduate than a university student of the same race and gender who took similar courses during the senior year of high school.

In an attempt to fully control for selection into community college, Model III uses distance to the nearest two- and four-year colleges to instrument for initial college choice. Under the assumption that distance 1) influences a student’s decision to enroll in a two- or a four-year school and 2) does not independently influence the student’s college success, the results of Model III can be used to recover the true causal impact of community college enrollment upon educational attainment. As emphasized by Rouse, the IV estimates have an interesting interpretation. The estimate \(a_3\) indicates that a community college student on the margin of entering a two-year college and dropping out of the educational pipeline has approximately a 20 percent probability of completing a bachelor’s degree. In contrast, the estimate \(a_2 - a_3\) indicates that a university student on the margin of entering a community college and university increases his probability of graduating by approximately 22.5 percentage points by choosing to enroll in a university. While still quite large, this estimate is considerably less than the naïve estimate obtained in Model I.

One potential problem with Model III is the fact that it fails to control for local labor market conditions that might be correlated with our distance instrument. If students living in areas with strong local economies either 1) have enhanced outside opportunities causing them to be less likely to enter college or 2) perceive greater returns to higher

\[4\] The results presented here are for models where distance enters the equation linearly. We have replicated the analysis in models where distance enters as a polynomial or a series of dummy variables, and the key results remain unchanged.
education causing them to be more likely to pursue a college degree, and if colleges and
universities are located in areas with strong local economies, then distance is capturing
some of the true effect of the local labor market upon educational attainment, and hence
violates the exclusion restriction. To investigate this concern, we run Model IV, which
controls explicitly for region, metro status, and median household income in the county
where the student’s high school is located. The results indicate that the above concern is
a valid one. The democratization effect increases substantially to .262, implying that a
student on the margin of matriculating at a community college and entering the labor
market would increase his probability of completing a baccalaureate degree by 26
percentage points by choosing to enter community college. Even so, the diversion effect
holds relatively constant when adding the regional and labor market controls. The
estimated diversion effect in Model IV is .245, which implies that a student on the margin
of entering a community college and a university would increase his probability of
college completion by approximately 25 percentage points if he were to choose to enter
the university. This is only marginally larger than the estimate of .222, which we derived
in Model III.

Models V-X repeat the analysis in Models I-IV for later cohorts. The results
remain relatively unchanged over time. The preferred estimates for the 98 and 99
cohorts, which includes controls for local labor market conditions, are .263 and .278,
respectively, which is quite similar to the estimate of .262 obtained for the 94-96 cohorts.

Table II shows the first stage estimates for the IV models reported in Table I. The
results indicate that distance is a fairly powerful instrument for college choice. The R^2
for the models predicting community college and university enrollment are
approximately .04 and .13, respectively for all cohorts. Moreover, the distance variables are statistically significant in all first-stage models.

While many of our models follow Rouse’s methodology closely enough to take on the democratization/diversion interpretation, we are ultimately more concerned with isolating the diversion effect. As such, we also estimate some models whereby only this effect may be recovered. These matching-type models use all of the data available at THECB in attempt to purge the estimates of any remaining selection\textsuperscript{5}. We call these models matching-type models rather than matching models per se because we run them using OLS rather than an explicit matching procedure. Even so, the identification strategy is similar to that used in explicit matching models in that it requires all selection to go through the extensive set of observable control variables. In particular, we limit the sample to those students who took the SAT, and control explicitly for the set of schools to which each student applied and was accepted, all of the College Board data including SAT math and verbal scores, parental education, household income, and planned educational attainment, and the high school course taking data for several courses that might indicate tracking in high school\textsuperscript{6}. Thus, for these estimates to isolate the causal effect of community college enrollment on the probability of baccalaureate attainment, we need selection into community college to be completely determined by these variables.

Because the matching-type models are only estimated using students who actually took the SAT, the democratization/diversion interpretation is inappropriate. However,

\textsuperscript{5} Since we only have College Board and Application data for 1998 onwards, we must restrict attention to the cohorts of 1998-1999 high school graduates when running these models.

\textsuperscript{6} These include calculus, pre-calculus, English IV, Debate/Public Speaking, and several courses in the Fine Arts. We also control for the number of AP and IB courses taken during the senior year.
Berg and Krueger (2002) offer a theoretical interpretation of these models for a similar context. Berg and Krueger attempt to isolate the causal impact of college quality on labor market outcomes, and are concerned about unobservable traits that might be correlated with the quality of the college attended by a given student and also impact that student’s labor market success. Berg and Krueger show that under the assumption that students apply to schools that 1) are likely to accept them and 2) are a good fit for their academic ability and interests, students partially reveal these unobservables through their application decisions. Moreover, admissions committees reinforce this information through their decisions. The authors give several cases under which including indicators for the schools to which students apply and are accepted fully accounts for selection into college quality\(^7\). We adopt a similar interpretation here. By explicitly controlling for each student’s application decisions and acceptances, along with a host of other measures available in the THECB data, we hope to fully account for selection into two-year schools and recover the causal impact of choosing to enroll in a junior college.

The results from these models are included in Table III below:

---

\(^7\) In more recent work, Avery and Hoxby (2004) present some strong evidence that the assumptions underlying the Berg and Krueger model may be invalid. First, contrary to the Berg and Krueger assumption that students make applications in a way that maximizes their utility, Avery and Hoxby show that when facing a menu of admissions/aid offers, applicants do not always act in a way that is consistent with rational choice. Second, they show that, contrary to the assumption underlying Berg and Krueger (2002), students do not randomly choose a college from the set of schools to which they are admitted; rather, they systematically respond to admissions/aid offers in a way that is easy to quantify.
Table III: Berg and Krueger (2002)
Models for 1998 and 1999 Cohorts

<table>
<thead>
<tr>
<th></th>
<th>Model I</th>
<th>Model II</th>
</tr>
</thead>
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<tr>
<td>$a_2$</td>
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</tr>
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<td>$a_3$</td>
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</tr>
<tr>
<td></td>
<td>0.008362</td>
<td>0.008154</td>
</tr>
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<td>-0.2687</td>
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<tr>
<td></td>
<td>0.006098</td>
<td>0.006038</td>
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<table>
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<tr>
<th>Cohorts</th>
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<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
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<td>OLS</td>
</tr>
<tr>
<td>N</td>
<td>40587</td>
<td>41967</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.2607</td>
<td>0.2691</td>
</tr>
</tbody>
</table>

Model I indicates that a community college student on the margin of choosing a four year school would increase his or her probability of graduation by approximately 26.1 percentage points by enrolling instead in a university. Model II finds similar results for the 1999 cohort.

The matching estimates for the causal impact of community college enrollment on the probability of baccalaureate degree attainment reported in Table III are remarkably similar to the preferred IV estimates reported in Table II. The preferred IV estimate for the 1998 cohort, which included controls for local labor market conditions, was 26.2%, while the corresponding preferred matching estimate is 26.1%. Overall, our results for educational attainment indicate that choosing to initiate one’s college career in a community college instead of a four-year university decreases the probability of completing a baccalaureate degree by 26-28 percentage points, depending on both the cohort of interest and the model one prefers. The results are remarkably consistent across causal models and across time. Finally, we find convincing evidence that our distance IVs are quite sensitive to the exclusion of relevant information about the local labor market, and that the case for exogeneity can only be made conditional on these variables.
Section VI: Labor Market Outcomes

Here we are interested in isolating the causal impact of initiating one’s college career in a community college upon earnings later in life. Following the standard Mincer (1974) framework, we estimate models of the following form:

\[ Y_i = a_1 + a_2 \text{Univ}_i + a_3 \text{JC}_i + a_4 \text{Exp}_i + a_5 \text{Exp}_i^2 + e_i, \]

where \( Y_i \) is earnings of individual \( i \) in the fourth quarter of 2005, \( \text{Exp}_i \) is the number of quarters of labor market experience for individual \( i \) since the third quarter of 1997, and \( \text{Univ}_i \) and \( \text{JC}_i \) are defined as before. In practice, we found that for any given cohort, \( \text{Exp}_i \), \( \text{Univ}_i \) and \( \text{JC}_i \) were highly collinear, which lead to very imprecise estimates when running the above model on a single cohort. To correct this problem, we ran the model simultaneously for the 1994, 1995 and 1996 high school graduating cohorts under the assumption that there is no independent cohort effect on earnings in 2005. Moreover, we distinguished explicitly between work experience during school and labor market experience after the completion of schooling. In the end, we ran models of the following form:

\[ Y_i = a_1 + a_2 \text{Univ}_i + a_3 \text{JC}_i + a_4 \text{Exp}_{\text{inschool}}_i + a_5 \text{Exp}_{\text{inschool}}_i^2 + a_6 \text{Exp}_{\text{post}}_i + a_7 \text{Exp}_{\text{post}}_i^2 + e_i, \]

Where \( Y_i \), \( \text{Univ}_i \) and \( \text{JC}_i \) are defined as before, \( \text{Exp}_{\text{inschool}}_i \) represents the number of quarters of labor market experience for individual \( i \) before he or she had completed schooling, and \( \text{Exp}_{\text{post}}_i \) represents the number of quarters of work experience post schooling completion for individual \( i \).

To correct for selection into community college, we controlled explicitly for race, gender, and courses taken during high school. We also ran IV models with distance to
the nearest two- and four-year schools as the excluded instruments. Under the assumption that 1) distance impacts an individual’s choice to enter a two- or four-year school, and 2) conditional on race, gender, courses taken during high school and labor market experience, distance does not have a direct impact on the student’s actual labor market outcomes, these IV models isolate the causal impact of initiating one’s college career in a community college over a four-year university. The structural form of these models is very similar to the Rouse (1995) model presented in Section IV, but with fourth quarter 2005 earnings as the dependent variable in the equation of interest:

\[
Y_i = a_1 + a_2\text{Univ}_i + a_3\text{JC}_i + a_4\text{Expinschool}_i + a_5\text{Expinschool}_i^2 + a_6\text{Exppost}_i + a_7\text{Exppost}_i^2 + e_i,
\]

\[
\text{Prob(Univ}_i = 1) = b_1 + b_2\text{DUniv}_i + b_3\text{DJC}_i + e_b
\]

\[
\text{Prob(JC}_i = 1) = c_1 + c_2\text{DUniv}_i + c_3\text{DJC}_i + e_c.
\]

Looking at the earnings equation above, it should be clear that Univ\(_i\) and JC\(_i\) have at least three independent effects upon earnings later in life. As we have seen, initiating one’s college career in a four-year university instead of a four-year community college substantially increases one’s probability of completing a bachelor’s degree. However, it also all but precludes the individual from ever completing an associate’s degree\(^8\). Moreover, the hands-on and practical instruction provided at two-year colleges may be more valuable than the more academic teaching provided at four-year universities in the job market. As such, we consider it best to think of the above model as a reduced form.

\(^8\)Technically, it is possible for a university student to transfer to a two-year school and earn a terminal associate’s degree, but this rarely occurs in practice.
for a more complex model taking all of these aspects of higher education, and possibly more, explicitly into account. Nonetheless, we believe the above model can provide important insight on the labor market returns to initial college choice, especially to those interested in the effect of extending access to community college education to a greater share of the population. By focusing attention on the overall effect of initiating one’s college career in a two-year institution, we are able to provide policy relevant insight without formally specifying the path through which the process operates.

Table IV below shows the results from models of the type described above, while Table V presents the first-stage estimates for the IV models presented in Table IV:

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<td><strong>Model</strong></td>
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<td><strong>a₂</strong></td>
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<td></td>
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<td><strong>a₃</strong></td>
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<td><strong>a₃⁻a₂</strong></td>
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<td><strong>d</strong></td>
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<td></td>
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<tr>
<td><strong>Experience</strong></td>
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<td><strong>Demographic Data</strong></td>
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<td><strong>Courses</strong></td>
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<tr>
<td><strong>Labor Mkt</strong></td>
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<tr>
<td><strong>Completion</strong></td>
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<tr>
<td><strong>Method</strong></td>
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<tr>
<td><strong>N</strong></td>
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<tr>
<td><strong>R^2</strong></td>
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<td>----------------</td>
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<tr>
<td>( b_2 )</td>
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<tr>
<td>( b_3 )</td>
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<td></td>
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<tr>
<td>( c_2 )</td>
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<tr>
<td></td>
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<tr>
<td>( c_3 )</td>
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<td></td>
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<tr>
<td>( N )</td>
</tr>
<tr>
<td>( R^2 ) (Univ)</td>
</tr>
<tr>
<td>( R^2 ) (JC)</td>
</tr>
</tbody>
</table>

Model I indicates that a community college matriculant earned an average of $1246 more during the fourth quarter of 2005 than a high school graduate who enters the labor force directly out of high school, even after controlling for labor market experience. A university matriculant earned an additional $2393 during the fourth quarter of 2005. However, this difference fails to take into account any preexisting differences between community college and university matriculants. Since one would expect community college students to be less academically prepared and motivated than their university peers, we expect the estimated impact of community college enrollment to diminish after controlling for selection.

Model II partially controls for preexisting differences between community college and university students by factoring out the variance due explicitly to race, gender and courses taken during the senior year of high school. As expected, the estimated impact of community college enrollment drops to $1464.
In an attempt to fully control for selection into community college, Model IV uses the distance to the nearest two- and four-year colleges to instrument for initial college choice\textsuperscript{9}. To address concerns that our distance instrument might be correlated with local labor market conditions that have a causal impact upon earnings, we include controls for region, metro status and median earnings at the county level. Under the assumption that distance 1) enters the individual’s decision to enroll in a two- or a four-year school and 2) does not impact the individual’s earnings later in life independent of race, gender, local labor market conditions, and courses taken during high school, Model IV isolates the causal impact of initiating one’s college career in a community college upon fourth quarter wages in 2005. Our estimate for the coefficient $a3$ in Model IV indicates that a potential student on the margin of entering a community college and starting work directly after high school can increase his earnings net of experience by approximately $1048$ per quarter by choosing to matriculate at a community college. The estimate of $-1449$ for $(a3-a2)$ is our preferred estimate for the causal impact of matriculating at a community college over a four-year university, and it can be interpreted as the difference in fourth quarter 2005 income for students on the margin of going to a two-and four-year school who choose to enter community college. As seen in Table IV, the standard error for this estimate is 449, so we reject the null hypothesis of no causal impact of community college attendance upon earnings.

Model III is included to gauge the importance of including information about local labor market conditions in Model IV. If local labor market conditions influence

\textsuperscript{9} The results presented are for models where distance enters the equation linearly. We have run models where distance enters as a third order polynomial and as a series of dummies, and the key results remain unchanged. The main exception is that the diversion effect becomes statistically significant in Model V with both polynomial and dummy instruments.
earnings, and college proximity impacts local labor market conditions, then Model III violates the exclusion restriction, giving us biased results of the causal impact of community college enrollment upon earnings. The nonsensical estimates for Model III provide overwhelming evidence that this concern is a valid one. For example, our estimate of 9748 for $a_3$ in Model III would indicate a labor market return to community college matriculation of $9748 per quarter to a student on the margin of entering a community college and going straight to the labor force after high school. This seems highly unlikely considering that mean quarterly earnings for the cohort of 1994 high school graduates matriculating at a community college in 1995 is just $9908. The key point to take from Model III is that the case for exogeneity of our college proximity instrument can only be made conditional upon local labor market conditions, and this result casts some doubt on the results of several past studies such as Card (1995) and Kling (2001).

Model VI repeats the analysis of Model IV, but conditions upon completion of a baccalaureate degree. That is, we run models of the following form:

$$Y_i = a_1 + a_2 Univ_i + a_3 JC_i + dBA_i + a_4 ExpInschool_i + a_5 ExpInschool_i^2 + a_6 ExpPost_i + a_7 ExpPost_i^2 + e_a,$$

$$\text{Prob}(Univ_i = 1) = b_1 + b_2 DUniv_i + b_3 DJC_i + e_b$$

$$\text{Prob}(JC_i = 1) = c_1 + c_2 DUniv_i + c_3 DJC_i + e_c,$$

where $BA_i$ indicates whether or not individual $i$ completed a baccalaureate degree, and the other variables are defined as before.
The results for Model VI indicate that most of the causal labor market impact of matriculating at a community college rather than a university is a result of the differential probability of completing a baccalaureate degree. The estimate of -621 for \(a3-a2\) can be interpreted as the portion of the difference in fourth quarter 2005 income for students on the margin of going to a two-and four-year school who choose to enter community college that would remain if students matriculating at two- and four-year colleges were equally likely to complete a baccalaureate degree. The standard error for our estimate is 547, so we are unable to reject the null hypothesis that conditional upon completion, matriculating at a community college instead of a four-year university has no impact upon post-education earnings.

Model VI also indicates that most of the labor market return to college enrollment comes at the time of completion. The estimates for \(a3\) and \(a2\) are both small and statistically insignificant, while the estimate for \(d\), the return to completion of the baccalaureate degree is $3199 per quarter, and is highly statistically significant.

The nonsensical results for Model V, which repeats the analysis in Model VI but omits controls for local labor market conditions, are included simply to bolster our conclusion that the case for exogeneity of our college proximity instrument can only be made conditional upon such controls. Similar to the result for Model III, the estimate of $9840 for \(a3\) would indicate that a student on the margin of matriculating at a community college and entering the labor force just after high school could increase his earnings by nearly $10,000 per quarter by choosing to go to community college, and this is entirely too high to be believable. Perhaps even more striking, the estimate of -823 for \(d\) in
Model V would indicate a negative and marginally statistically significant labor market return to completing a baccalaureate degree, which seems highly unreasonable.

Table V shows the first stage estimates for the IV models reported in Table IV. The results indicate that distance is a fairly powerful instrument for college choice. The $R^2$ for the models predicting community college and university enrollment are approximately .05 and .15, and the distance measures are highly statistically significant with the expected sign.

One might be concerned that the wage models reported in Table IV require the return to labor market experience to be identical for community college and university students. Although we don’t know their exact age, we do know that the workers in our sample graduated from high school between 1994 and 1996. Thus, if we assume that these students were on a traditional academic track, then they would have been approximately 27 to 29 years of age in the fourth quarter of 2005, when we collected wage data. This is a very young cohort of workers with very little work experience, and there is reason to believe that community college and university students might have different returns to labor market experience. If the return to experience increases at a faster rate for community college students than it does for university students, then we may be underestimating the true labor market return to community college enrollment, thereby rendering bogus our finding that initiating one’s college career in a community college has no discernable effect on earnings.

To address the above concern, we run models of the following form:
\[ Y_i = a_1 + a_2 \text{Univ}_i + a_3 \text{JC}_i + a_4 \text{Exp}_i + a_5 \text{Exp}_i^2 + a_6 \text{Exp}_i \text{JC}_i + a_7 \text{Exp}_i^2 \text{JC}_i + a_8 \text{Exp}_i \text{Univ}_i + a_9 \text{Exp}_i^2 \text{Univ}_i + \epsilon_i. \]

This model is identical to the one reported in Table IV, except we require the return to labor market experience to be identical before and after educational completion, and we include interactions between labor market experience and initial college type in order to capture the possibility that the return to labor market experience might differ for community college and university students. However, because this model has six endogenous variables, and we only have two instruments, we can only estimate it using OLS.

Table VI below reports the results when we run models of the type described above. All estimates are calculated at the mean value of labor market experience:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
</tr>
<tr>
<td>dY/dUniv</td>
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<td></td>
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<td></td>
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<td>78.42784</td>
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<tr>
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<td>-1719.4</td>
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<tr>
<td>dY/dJCdexp – dY/dUnivdexp</td>
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<td>65.337</td>
</tr>
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<td></td>
<td>*</td>
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</tr>
<tr>
<td>R^2</td>
<td>0.0399</td>
<td>0.0402</td>
</tr>
</tbody>
</table>
Model I essentially replicates Model II of Table IV, but it restricts the return to experience to be the same both before and after the completion of education. The results are similar to those reported before. Model II allows the return to experience to vary according to initial college placement. The F-statistic for the joint hypothesis that all of the added experience-college type interactions are insignificant is 13.37. With 4 numerator and 256,340 denominator degrees of freedom, the test is rejected at any reasonable significance level. Calculated at the mean level of labor market experience in the data, the estimated impact of initiating one’s college career at a community college over a four-year university is $1719, and is somewhat larger than in Model I. Moreover, we calculate that on the margin, this impact is decreasing by $65 for each year of labor market experience. This result is consistent with a substantial body of literature finding decreasing returns to educational credentials over time (Belman and Heywood, 1997).

While we are unable to verify the above analysis using IV, we can conclude that the concern that the trajectory of earnings with respect to labor market experience might differ for community college and university students is well founded. There is reason to believe that, at least for the next few marginal years, the return to initiating one’s college career in a community college instead of a university would diminish as the students get older. However, this would tend to strengthen our conclusion that there is no discernable impact of initiating one’s college career at a junior college upon earnings. Since younger workers experience the greatest impact of community college enrollment on earnings, and these are precisely the workers that are used in our study, we would expect to overestimate the overall causal effect of community college enrollment on earnings. However, we already find no statistically significant effect, so we would expect
to come to the same conclusion if we were able to include a broader array of workers in our calculations.

**Section VII: Conclusion**

In this paper, we have attempted to isolate the causal impact of initiating one’s college career in a community college instead of a four-year school upon outcomes later in life. Using IV and matching-type methods, we find convincing evidence that matriculating at a community college reduces one’s probability of attaining a baccalaureate degree by 26-27 percentage points. This result is robust to the causal model used, and remains quite stable overtime. Turning to the labor market, we find that matriculating at a community college instead of a four-year school reduces earnings by approximately $6800 per annum, net of experience. However, the bulk of this difference is due to the differing completion patterns of community college and university students. Conditional upon completion, the labor market return to choosing a community college over a university decreases substantially and becomes statistically indistinguishable from zero for one of three of our favored specifications.

While our results on educational attainment are statistically significant, we believe that they are consistent with the existing literature. Rouse (1995) finds no evidence of a negative diversion effect on the probability of baccalaureate degree attainment. However, her point estimate of -.09 is substantial, indicating that her best estimate is that initiating one’s college career in a community college reduces one’s probability of obtaining a bachelor’s degree by 9 percentage points. Our result would be consistent with the interpretation that Rouse’s non-finding was due to data limitations that we were able to overcome with our study. Moreover, as far as we are aware, our
estimates of the reduced form model for the labor market return to initiating one’s college career in a community college are the first of their kind to be reported in the literature. As such, we believe that this study is a valuable contribution to the literature.

Our study also sheds some light upon the appropriateness of college proximity as an instrument for college choice, and educational attainment more generally. Like Rouse (1995), we find strong evidence that the case for exogeneity of college proximity with respect to college choice can only be made conditional upon local labor market conditions. This finding holds for both of our outcome variables, and thus casts some doubt on the results of several past studies of the labor market return to educational attainment like Card (1995) and Kling (2001) that fail to include controls for local labor market conditions when using geographic proximity to college to instrument for educational attainment.

References


