

Chapter 5

Reassessing the Two-Year Sector's Role in the Amelioration of a Persistent Socioeconomic Gap: A Proposed Analytical Framework for the Study of Community College Effects in the Big and Geocoded Data and Quasi-Experimental Era



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5.1 Introduction

The public two-year or community college sector remains one of the most controversial segments of the U.S. higher education system (Brand, Pfeffer, & Goldrick-Rab, 2014; Dougherty, 1994). On the one hand, these institutions are often criticized for lower rates of degree and credential production despite the fact that they enroll close to 50% of all undergraduate students in the U.S. higher education system (AACC, 2016; González Canché, 2012) while having access to significantly fewer monetary and non-monetary resources (*e.g.*, fewer financial resources, fewer full-time faculty, and fewer students for whom the pursuit of a higher education credential is a full-time endeavor) than their public four-year higher education counterparts (AACC, 2016; Delta Cost, 2012). On the other hand, the community college sector is also viewed as potential mechanism toward closing the persistent socioeconomic gap in the United States by providing an entry point to higher education to a significant portion of all first-generation in college, low-income, ethnic minority and under prepared students (Brand et al. 2014).

Notably, despite its controversial status, federal (*e.g.*, Complete College America), state- (*e.g.*, Tennessee Promise¹), and city-level (*e.g.*, San Francisco tuition-free plan²) initiatives often call upon community colleges to meet market demands for college graduates. This continued emphasis on the community college sector as both

¹<http://tnpromise.gov/about.shtml>

²<http://money.cnn.com/2017/02/10/pf/college/san-francisco-free-community-college/index.html>

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the prominent entry point to higher education for underrepresented students and a source of economic growth by policy- and decision-makers, justifies the study of the effects of this sector on students' educational, occupational, and financial outcomes. Such an analysis is needed to better inform current and future policy decisions. Accordingly, this chapter assesses whether the community college sector can be conceptualized as a way of attaining U.S. economic goals, ameliorating persistent academic and socioeconomic gaps, or both.

5.2 Purpose

The purpose of this chapter is threefold. First, it provides a comprehensive and systematic review of extant research on the educational and occupational outcomes associated with community college attendance. This literature review prioritizes (but is not limited to) comparisons of outcomes attained by students who began college enrollment in the public two- and four-year sectors. The second purpose is to provide a critique of this line of research concerning its methodological rigor by highlighting the emergence of analytic applications that deal not only deal with systematic differences between two- and four-year entrants but also are capable of handling big-data issues (e.g., fitting on “noise” or overfitting³). As part of this purpose, an innovative analytic framework is provided for researchers and practitioners to utilize when dealing with comparisons of these student populations. Finally, the third purpose is to apply the proposed analytic framework to analyze a topic that, while timely and relevant, has remained virtually undiscussed in the study the two-year sector effects. Specifically, this section analyzes the effect of initial two-year sector enrollment on undergraduate loan debt accumulation comparing different enrollment pathways and levels of education attainment.

To address this comprehensive purpose, the chapter is comprised of three main sections. The first section provides a description of the origins and role of the community college sector in the United States. It then analyzes and critiques over 50 years of research on the sector effects of community colleges on students' outcomes. This section depicts observed differences between two- and four-year students and highlights the importance of accounting for these differences before estimating the effects of the two-year sector on students' outcomes. The second section proposes an analytic framework that researchers and practitioners may use to compare the effect of beginning college in the public two-year sector as opposed to other sectors of the U.S. higher education system. This section pays close attention to the availability of big and geocoded⁴ data at the institution, state, and geographic-

³Overfitting occurs when a model is excessively complex, such as having too many parameters (Harrel, 2015; Zhao et al., 2011).

⁴Geocoded data are the result of identifying the intersection between latitude and longitude coordinates on the earth's surface. The result of this identification process can take the form of a

level and the manners in which analyses of two-year sector effects should proceed in order to minimize issues of self-selection, confoundedness, and omitted variable bias that have permeated previous research. Sections one and two are mapped out in Fig. 5.1, which presents a visual summary of the effects of the community college sector on educational and occupational outcomes along with recommended policy and methodological plans of action. Specifically, Fig. 5.1 begins by showing the two comparison aspects that guided the literature review presented (effect of community college attendance on educational and occupational outcomes) along with the findings and conclusions reached in these two sections of the manuscript. In addition, the figure also contains the questions addressed in the discussion section and next steps and/or plans of action, which offer both methodological implications and practical recommendations that emerge from the literature review presented herein.

The third and final section, entitled “Community College Effects on Undergraduate Loan Cost of Attendance,” applies the proposed analytic framework presented in the second section. Specifically, this framework is exemplified in an investigation of the affordability of the community college sector, focusing on its effects on the accrual of student loan debt, a financial outcome that has remained understudied in the literature (González Canché, 2014a, 2014b). As such, this section emphasizes the timeliness and importance of analyzing the effect of initial two-year sector enrollment on undergraduate loan debt accumulation by comparing different enrollment pathways and levels of education attainment. The final section of the chapter discusses challenges and opportunities in the use of big and geocoded data in higher education policy along with future lines of research that involve the use of Geographical Network Analysis (González Canché, 2018) to assess the effects of place in the analysis of factors affecting community college students’ outcomes, a topic that remains understudied. Finally, the chapter reassesses the role of the community college sector in (re)producing socioeconomic mobility opportunities in the United States.

5.2.1 Section 1: Previous Research on the Community College Sector and Its Outcomes: A Brief History of the Origins and Role of the Community College Sector in the U.S.

Since their very inception in the early 1900s, public two-year institutions, junior or community colleges, were conceptualized as institutions serving their local communities (Clark, 1960b; Cohen, 1987; Vaughan, 1995). Indeed, these institutions were

point (e.g., an institution), a polygon (e.g., a county or state), or a line (e.g., a river). Once this information is stored, analysts can use geocoded data to generate maps using geographical information system procedures, and/or to conduct more inferential analysis using spatial statistics or spatial econometric analyses (see more at González Canché, 2014a, 2014b, 2017a, 2016, 2018).

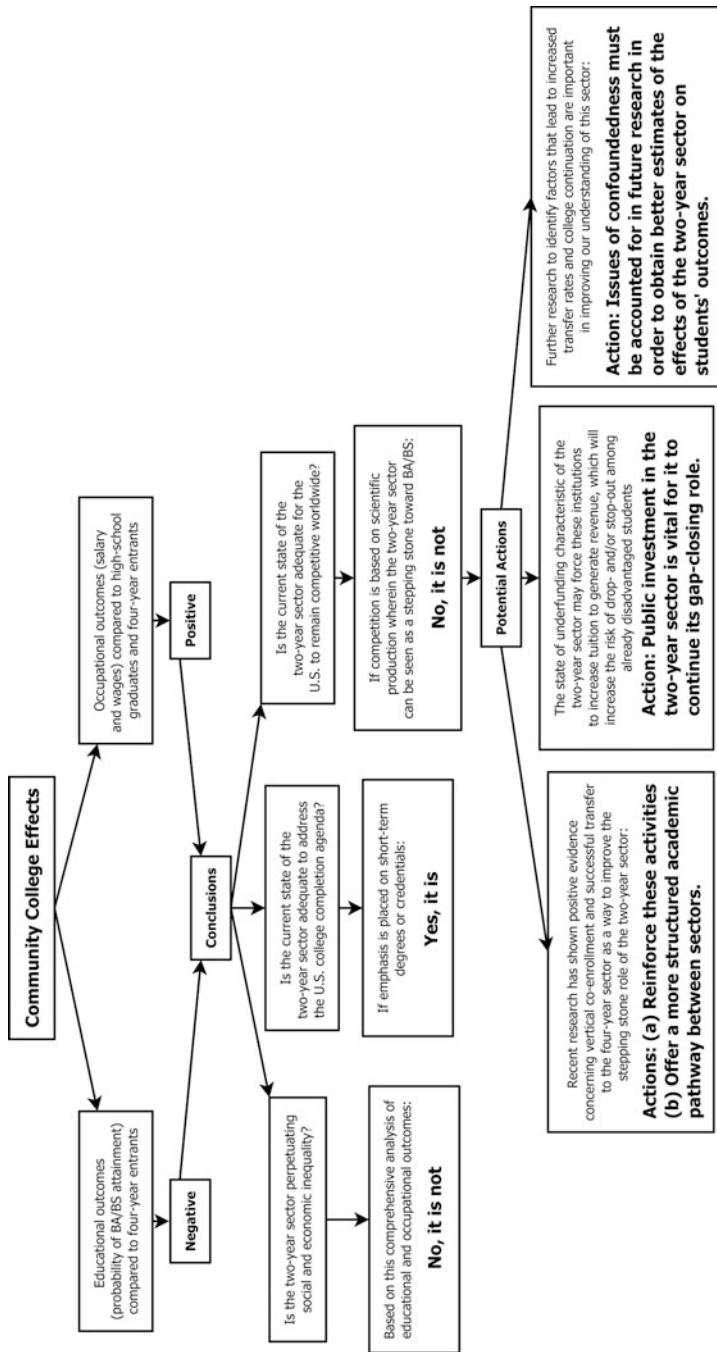


Fig. 5.1 Summary of the overall structure of the effects of community colleges on education and occupational outcomes and potential actions

initially designed to offer programs attached to high schools as 13th and 14th years of formal education (Garrison, 1975; Helland, 1987). Even though an official high-school-to-college connection is no longer observed among community colleges today, it is worth noting that their original association with high schools created some confusion about the role of community colleges in the U.S. higher education system. This situation led some authors like Clark (1960b) to state that “[t]he junior college is a school whose place in education is by no means clear and whose character has been problematic” (p. 2). Similarly, other authors pointed out that, given their purpose to serve local school districts, these institutions would be unlikely to contribute to an increase in the quality of the postsecondary education system or the meaningful formation of human capital (Hofstadter & Hardy, 1952; Riesman, 1956).

The role of the community college in U.S. higher education has clearly evolved over time. For example, before 1910, these colleges were charged with offering education beyond high school to students who did not want to attain a bachelor’s degree. By the turn of the 1920s, these institutions began to parallel the work of the first two years of coursework offered at four-year colleges. Because of this similarity in coursework, two-year institutions began to be conceptualized as colleges that educated students who could transfer out to the four-year sector in their “junior year,” or third year of college (Spindt, 1957).

The first and second World Wars (WWI and WWII, respectively) were two of the most important events to trigger the expansion of the community college sector in the U.S. (Vaughan, 1995). In 1915, there were only about 19 two-year institutions nationwide with a total enrollment that did not exceed 600 students. After WWI, not only did the number of institutions grow exponentially, reaching 178 colleges serving 45,000 students, but also and perhaps just as importantly and naturally, the role of these institutions began to diversify (Cohen & Brawer, 2003; Vaughan, 1995). Notably, a large portion of the enrollment increases at community colleges were composed of returning WWI veterans who enrolled in this sector part-time and often had no intent to transfer to the four-year sector (Radford, 2009). This socio-political context, then, meant that these institutions attracted students who only aspired to the 14th year of formal education. With respect to WWII, the Servicemen’s Readjustment Act of 1944, most commonly known as the G.I. Bill, provided a range of benefits for returning WWII veterans that included cash payments of tuition and living expenses to attend high school, two-year colleges, or four-year colleges and universities. At least two interrelated factors helped to shape the college choice of returning WWII veterans and drove them to select the two-year sector. The first was that four-year colleges and universities during the 1940s were primarily viewed as institutions reserved for the privileged and elite (Arendale, 2011; Turner & Bound, 2003), and the second was the emergence of admissions officers at four-year institutions who served as gatekeepers and “dissuad[ed] casual shoppers, and focus[ed] on the kinds of students that their universities wished to attract” (Palmer et al., 2004, p. 11). Given the open admission policy characteristic of two-year colleges, returning veterans who did not intend, aspire, or possess the academic preparation to attend a four-year institution before WWII considered the

two-year sector to be an attractive educational option, particularly given that they received payment while receiving a college-level education (Phillippe & González Sullivan, 2005; Turner & Bound, 2003).

The G.I. Bill not only represented a key factor in the further expansion of the two-year sector but it also contributed to the broadening of their “array of vocational programs [...] offered in order to accommodate returning soldiers to prepare for jobs and ease their reentry into a peacetime economy” (Phillippe & González Sullivan, 2005, p. 2). Based on this renewed demand, by 1947 the number of two-year institutions reached 328, and welcomed a total of 500,000 students (Vaughan, 1995; Celis, 1994). Another important event that shaped the mission and history of community colleges in the U.S. was the publication of the Truman Commission Report in 1947 (Zook, 1947), officially entitled “Higher Education for American Democracy,” which enabled the creation of a network of community-based colleges, thus strengthening these institutions’ missions to help their local communities. This report was so influential that it led many two-year colleges to include “community” in their names. It is clear that public two-year institutions were formed to serve their local communities and that this political and social context was instrumental in shaping the type of students that this sector has traditionally served.

5.2.1.1 The Contemporary Community College

More recently, the public two-year sector has become one of the most important engines of human capital formation and economic growth in the United States. More than half of all students attending college in the U.S. higher education system complete at least their first year of college at a public two-year institution (Horn & Skomsvold, 2011), and data from the Integrated Postsecondary Education Data System (IPEDS) reveal that at least 84% of all part-time, degree-seeking students attend the public two-year sector (IPEDS, 2013). It is clear that community colleges are unique institutions in terms of the student populations they enroll, which can be viewed as a reflection of their historical commitment to providing multiple pathways of access to higher education, especially among first-generation in college (*i.e.*, neither parents or guardians attended college), ethnic minority, low-income, and academically under-prepared prospective college students (Brand, Pfeffer, & Goldrick-Rab, 2014; Dietrich & Lichtenberger, 2015; Goldrick-Rab, 2010; Melguizo & Dowd, 2009; National Center for Education Statistics, U.S. Department of Education, 2013). The attraction of students with the characteristics just listed to the community college sector is not random. On the contrary, community college is an appealing option for many of these students, particularly during tough economic times, because it requires a smaller initial financial investment compared to other higher education options. In fact, according to the American Association of Community Colleges (AACC), tuition and fees in the community college sector have always been, on average, a third of the amounts charged by public four-year institutions (AACC, 2016), and only one tenth of the tuition and fees charged by private not-for-profit four-year colleges (IPEDS, 2014). Moreover,

given that a large proportion of community college students are already employed (AACC, 2016), the community college sector has an immediate impact on the U.S. labor force. As such, the skills and knowledge developed in this sector are likely to be an effective strategy for closing the socioeconomic gap between low- and high-income groups in the U.S. by providing low-income students with the means to increase their salary prospects through education at an affordable price.

Despite the set of characteristics just described, many of which community college advocates highlight when touting the role of this sector as an equalizing engine (Astin, 1985; Leigh & Gill, 2003; Melguizo & Dowd, 2009; Rouse, 1995), community colleges continue to be among the most controversial and criticized institutions of higher education (Brand et al., 2014; Dougherty, 1994; Goldrick-Rab, 2010). Researchers have long argued that community colleges consistently play an active role in the reproduction of inequality in American society by diverting students from the attainment of a four-year degree (Brint & Karabel, 1989; Clark, 1960a, 1960b; Dougherty, 1992; Karabel, 1986). In spite of these serious accusations, this sector has become a major player in college completion agendas, which aim to make the U.S. the country with the highest proportion of college graduates in the world (Cook & Hartle, 2011; Horn & Skomsvold, 2011; Shear, 2010; U.S. Department of Education, 2015). Notably, as competition for science, technology, and economic development tightens globally, the production of well-prepared college graduates is of increasing importance to any country aspiring to compete worldwide. Clearly then, an analysis of the empirical evidence of the effects of the community college sector on student educational and occupational outcomes has become increasingly necessary in order to assess whether community colleges can be conceptualized as a way of achieving the goals of the U.S. college completion agenda, the amelioration of a persistent socioeconomic gap, or both.

5.2.1.2 Previous Research on Community College Effects

This section analyzes research findings regarding the effect of community colleges on their students' educational and occupational outcomes.

Method Followed to Identify the Literature Analyzed To address the first purpose of this chapter, an extensive literature review of research published primarily in the most influential American peer-reviewed journals focused on higher education issues, along with other publication outlets such as books, reports, and dissertations, encompassing comparisons of students' outcomes was conducted. The methodology employed was based on the approach proposed by What Works Clearinghouse (WWC) Procedures and Standards Handbook Version 3.0 (2014) and consisted of a comprehensive and systematic search of published literature examining the impact or effects of community colleges on educational and occupational outcomes. Based on the ample nature of the study, no specific time criterion was selected when conducting the literature search. Consequently, the resulting literature review spans more than 50 years. The leading journals in the field of higher education in

the U.S. (*The Journal of Higher Education*, *The Review of Higher Education*, and *Research in Higher Education*) along with journals with a high impact factor in education (*Educational Evaluation and Policy Analysis*, *Economics of Education Review*, *Teachers College Record*), and journals and outlets specialized in community college issues (*Community College Review* and *Community College Journal of Research and Practice*) were the primary peer-reviewed sources. A review of doctoral dissertations was conducted through ProQuest Dissertations and Theses Database. Policy briefs and reports were searched using the Community College Research Center, MDRC, Achieving the Dream, Center for Analysis of Postsecondary Education and Employment, and JBL Associates. In addition, the list of electronic databases consulted included the following: Academic Search Premier, SocINDEX with Full Text, Campbell Collaboration, Dissertation Abstracts, EconLit, SAGE Journals Online, Education Research Complete, Scopus, EJS E-Journals, WorldCat, and ERIC.

It is worth noting that the results obtained through specific journal websites overlapped to a great extent with those from the list of electronic datasets listed above. To avoid redundancy and due to space limitations, the first eight rows of Table 5.1 summarize the findings from the literature search conducted across academic journals. The first column of Table 5.1 contains the specific web address for each journal. The second column of this table indicates the key words used in the literature search. These key words rendered a given number of documents that were potentially relevant for this literature review. It is worth mentioning that some journals required the use of specific search criteria. For example, given that at the time of the search *The Journal of Higher Education* did not have a standalone website, its results were provided through JSTOR and required the inclusion of the journal's JSTOR ID to delimit the search. Given the comprehensive and systematic nature of this search process, the keywords used to search academic journals' websites did not include the words *effects*, *impact*, *outcomes*, *penalty*, or *gap*, but only accounted for the sector's name of interest as follows: "two-year colleges" OR "community colleges" OR "2-year colleges." This review approach successfully excluded sources that did not involve the study of community colleges. Each potential document was reviewed starting with the abstract, or the entire document if there was no abstract, to determine if the study met the inclusion criteria described below.

Another important source of documentation was identified by analyzing the reference lists of articles that met the inclusion criteria. This step led to the identification of studies that were published in journals and by think tanks different from those mentioned above. When a prolific researcher was identified, her or his name was used in the search criteria. Whenever possible, original sources of secondary data were utilized to depict the general scope of the community college sector in the U.S. national postsecondary education system. These sources included IPEDS, the U.S. Department of Education, and the *Digest of Education Statistics*.

Inclusion Criteria Documents that compared community college students' educational outcomes with four-year students' educational outcomes were included in the

Table 5.1 Search criteria and website information of main academic journals included

Source	Search criteria	Number of matches	Articles selected ^a
<i>The Journal of Higher Education</i> http://www.jstor.org/action/showPublication?journalCode=jhighereducation	("two-year colleges" OR "community colleges" OR "2-year colleges") AND jid:(j100225)	710	7
<i>The Review of Higher Education</i> http://muse.jhu.edu/journals/review_of_higher_education/	(two-year colleges OR community colleges OR 2-year colleges)	138	5
<i>Research in Higher Education</i> http://www.springer.com/gp/	("two-year colleges" OR "community colleges" OR "2-year colleges") AND (journal no. 11162) Then select "online content"	530	6
<i>Community College Journal of Research and Practice</i> ^b http://www.tandfonline.com/action/doSearch?pageSize=10&pubType=journal&AllField=two-year+colleges%2C+community+colleges%2C+2-year+colleges&join_AllField=AND&join_Title=AND&join_pubTitle=AND&join_Contrib=AND&join_PubIdSpan=AND&join_Abstract=AND&Keyword=effects&Ppub=&content=standard&target=default	(two-year colleges or community college or 2-year colleges, keywords = Effects)	533	2
<i>Community College Review</i> http://crw.sagepub.com/search/results	(two-year colleges or community college in abstract or 2-year colleges in abstract)	222	2
<i>Economics of Education Review</i> ^c http://www.sciencedirect.com/science/journal/02727757	("two-year colleges" OR "community colleges" OR "2-year colleges")	273	8
<i>Teachers College Record</i> ^c http://www.tcrecord.org/		270	5
<i>Educational Evaluation and Policy Analysis</i> ^c http://epa.sagepub.com/		16	6

(continued)

Table 5.1 (continued)

Source	Search criteria	Number of matches	Articles selected ^a
Google, Google Scholar, refseek	“Community college comparison” OR “two-year colleges comparison”, “community college effects” OR “two-year colleges effects”, “impact of community colleges” OR “impact of two-year colleges”, “baccalaureate gap”, “cooling-out function”, “community colleges and attainment gap” OR “two-year colleges and attainment gap”, “community college wage penalty” OR “two-year colleges wage penalty”, “community college occupational outcomes” OR “two-year colleges occupational outcomes”, “community colleges educational outcomes” OR “two-year colleges educational outcomes”		

^aSee selection criteria in the literature review methodology section

^bFor this journal, the search criteria, as implemented in all previous journals, rendered 200,098 results. As such, the search criteria were modified to include the term “effects.” This link accounts for more than one journal source

^cThese journals were searched using the same search criteria

current analysis. Regarding occupational outcomes, comparison groups were broadened to allow for the inclusion of high school graduates, community college graduates, students with community college credits, four-year graduates, and students with four-year credits. It is worth noting that the literature concerning two-year effects on educational outcomes has also compared the effects of different types of two-year institutions on students’ outcomes. The findings from these types of studies are included as a subsection of the section discussing community college effects on educational outcomes.

Exclusion Criteria Documents that analyzed factors associated with successful transfer and eventual attainment of a four-year degree were excluded from this literature review as this synthesis of the literature has already been conducted (Goldrick-Rab, 2010). No documents were excluded based on publication date. Additionally, in order to avoid dealing with an unmanageable number of documents and reports, the review of online search engines (*e.g.*, Google, Google Scholar) was more limited than the review of the journals as shown in Table 5.1. The last row of Table 5.1 contains the key words used in the decision tree for selecting articles and descriptors using these sources. The review of these documents and reports followed the same procedure employed in the inclusion/exclusion criteria described above.

Results from the Literature Review This section accounts for the main findings of the literature review and is organized into three main parts. The first subsection describes findings that document observed differences between two- and four-year students and the second and third subsections present findings on educational and occupational outcomes of community college students, respectively.

Two- and Four-Year Students' Attributes and Characteristics Considering their more affordable tuition and fee prices and their open-door admission policies, community colleges tend to attract students that, compared to four-year entrants, generally exhibit weaker academic preparation for college, tend to have access to fewer social and financial sources of support, and consequently have lower expectations about their realistic possibilities of attaining a baccalaureate college degree (Berkner, Choy, & Hunt-White, 2008; Doyle, 2009; González Canché, 2014a, 2014b; Long & Kurlaender, 2009; Stephan, Rosenbaum, & Person, 2009). For instance, Berkner et al., (2008) reported that, based on data taken from the Beginning Postsecondary Students Longitudinal Study (BPS), 81% of the total 2003–2004 students who first enrolled in a four-year institution expected to attain at least a four-year degree. For two-year students, this percentage was 9.8%. Similarly, using data from the National Educational Longitudinal Study (NELS), González Canché (2014a, 2014b) found that even when only considering full-time students, 95% of initial four-year entrants and only 68% of community college entrants expected to attain a four-year degree or more. The most recent dataset documenting student transitions into and out of college (Education Longitudinal Study [ELS]) shows similar results with 96% and 71% of first-time, full-time four- and two-year entrants expecting to attain a four-year degree or more, respectively. These differences in access to social capital, financial resources, and four-year degree expectations are an important source of bias if studies attempting to capture community college effects on four-year degree completion do not account for the ways in which these pre-college disparities influence students' outcomes regardless of sector of enrollment. For example, before making inferential claims, analyses should consider that for many community college students, a four-year degree is not part of their academic goals.

Notably, even when community college students aim to pursue a four-year degree, they very often exhibit characteristics that put them at risk of dropping out of the educational system altogether. In a comprehensive report about community college students participating in NELS:1988, Hoachlander, Sikora, and Horn (2003) found numerous characteristics that placed community college students at risk of dropping out of high school and college. These factors included single-parenthood, having a parent with no high school diploma, limited English proficiency, earning a combined family income less than \$15,000, having a sibling who dropped out of high school, delayed enrollment between high school graduation and postsecondary entry, part-time attendance at first institution, high school completion via a certificate or the GED, working full time when first enrolled, having children at a young age, being a single parent, or having been alone at home more than 3 hours a day while in high school (Hoachlander et al., 2003, pp. 52, 60).

With these general descriptions of two- and four-year college students in mind, it is worth asking whether studies comparing the educational and occupational outcomes of two- and four-year students have accounted for the fact that, on average, four-year students have had better opportunities in many aspects of their lives. More specifically, one may ask, assuming that four-year students indeed realize better

outcomes than their two-year counterparts, would these differences in outcomes hold even if four-year institutions suddenly started admitting the type of students that the two-year sector has traditionally served? In other words, are these outcome differences simply a reflection of unequal starting points in terms of the socioeconomic well-being characterizing students who begin college in the two- versus the four-year sectors? From this point of view, as Astin (1985) questioned, is it really fair to blame and/or criticize community colleges for inferior outcomes vis-à-vis their four-year counterparts given that these public two-year institutions are receptive to all kinds of students, regardless of their academic and financial backgrounds?

As the preceding discussion illustrates, the comparison of two- and four-year colleges' effects on any type of outcome without first accounting for the self-selection inherent in their student bodies (Leigh & Gill, 2003; Long & Kurlaender, 2009; Melguizo & Dowd, 2009; Stephan et al., 2009) may not render the best possible unbiased results. According to Heckman (1979) self-selection "bias results from using non-randomly selected samples to estimate behavioral relationships" (p. 153). He goes on to explain that when there are expected benefits from participating in a program or treatment (in this case, sector of initial college attendance), it is usually the case that these non-randomly selected samples are systematically different and that participants tend to not be given the same opportunities to participate in alternative preferable programs (Heckman, 1979). Consequently, any attempt at estimation merely accounts for past differences that drove self-selection in the first place rather than identifying unbiased estimations of the outcomes that resulted from participation in a particular educational program (or treatment condition). In the context of this chapter, this issue can be found in at least two scenarios. In the first, four-year students self-select into the four-year sector as a result of a rational choice process (G. S. Becker, 1962) based on the believed greater benefits, both professional and economic, that four-year colleges may bring when compared to two-year colleges (*i.e.*, better income and better quality of education). In the second, the structure of the higher education system motivates four-year institutions to purposefully filter applicants and select the most capable candidates in terms of their probabilities of success and their ability to pay the costs of tuition, fees, and living expenses (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). These two scenarios are not mutually exclusive; rather, they intermingle, resulting in a pool of four-year students that is systematically different from participants that were either denied admission to four-year institutions or decided not to enroll there. Accordingly, the self-selection issue implies that four-year students are more likely to come from upper-socioeconomic-class backgrounds with more types of support, including those that are social, monetary, and morale-boosting, than their two-year counterparts.

Given the likely presence of self-selection bias issues regarding the estimation of educational and occupational outcomes as a function of two-year enrollment, the following two subsections exploring literature related to the educational and occupational outcomes of the community college sector will pay special attention to the methodologies, analytic techniques, and samples of students that have been used to conduct these comparisons. Tables 5.2 and 5.3 summarize the literature on educational and occupational outcomes, respectively, as reported next.

Table 5.2 Summary of the impact of two-year enrollment on the likelihood of four-year degree attainment

Authors	Method	Data	Scope	Operationalization	Findings
Dougherty (1992)	Review of literature (1975–1990) based on Logit and Probit regressions	National Longitudinal Study (1972), and High School and Beyond (1980), other surveys whose scopes were not national	National and institutional level	One stage, native Logistic or Probit regression	Decreases in the 11.4% to 18.7% range across studies
Rouse (1995)	Instrumental variables	High School and Beyond (1980)	National	Instruments: College accessibility captured by average in-state tuition at public two- and four-year colleges and distance from those colleges	Decrease of around 11% and one less year of college enrollment Due to large standard errors these negative effects did not reach traditional levels of statistical significance.
Gonzalez and Hilmer (2006)	Instrumental variables	High School and Beyond (1980)	National	Same instruments proposed by Rouse (1995) but models were disaggregated by ethnicity (Hispanic, African American, and White)	Decrease of around 34% and 77% for Hispanics and African Americans, respectively similar to rouse, due to large standard errors, these negative effects did not reach statistical significance. White participants in the two-year sector had an increase of 1.8% compared to white participants first attending the four-year sector.

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Table 5.2 (continued)

Authors	Method	Data	Scope	Operationalization	Findings
Alfonso (2006)	Instrumental variables and an extension of the Heckman (1979) two-stage sample selection model	National Education Longitudinal Study (1988)	National	Same instruments proposed by Rouse (1995)	Compared to four-year students, two-year entrants experienced a decrease of 30.5% in likelihood of BA/BS degree attainment without accounting for final degree expectations, and a decrease of 21.4% when accounting for expectations of college degree.
Sandy et al. (2006)	Oaxaca decomposition	National Longitudinal Study (1972), Beginning Postsecondary Student (1994), High School and Beyond (1992)	National	The Oaxaca decomposition enabled authors to separate student and institutional components affecting the probability of graduating from a four-year college.	The probability that students with two-year characteristics completed a bachelor's degree if they attended four-year institutions is 0.735 in the National Longitudinal Study specification, 0.436 in the high school and beyond, and 0.373 in the beginning postsecondary student. These results suggest that not even four-year institutions may be able to help two-year entrants.

Stephan et al. (2009)	Propensity Score Matching	National Education Longitudinal Study (1988)	National	Controlled for propensity to enroll in the four-year sector and used this propensity to reduce baseline differences	Two-year entrants experienced an average decrease of 23% in their likelihood of BA/BS degree attainment compared to similar four-year entrants.
Doyle (2009)	Propensity Score Matching and Cox proportional hazards model	Beginning Postsecondary Study (1996)	National	Two stage approach: First Propensity Score Matching to control for baseline indicators and then a Cox proportional hazards model in order to accurately model the inherently time-dependent process of degree attainment	Enrollment in a community college lowers the hazard rate to 0.68 of its baseline value, indicating that community college students have a hazard rate of 0.32. This hazard rate translates into probabilities of surviving that are 15% lower after 6 years of enrollment compared to initial enrollment in the four-year sector ($15\% = 1 - [(1 - EXP(-0.32 * 6))]$).
Long and Kurlaender (2009)	Propensity Score Matching and Instrumental variables	Administrative dataset of students in the Ohio public higher education system	State level	Instruments: Distance from student's home to the closest two-year college and the distance to the closest non-selective four-year university	Decrease of 15% using the instrumental variables approach, and 21% using the PSM approach

(continued)

Table 5.2 (continued)

Authors	Method	Data	Scope	Operationalization	Findings
Reynolds (2012)	Propensity Score Matching	National Education Longitudinal Study (1988)	National	Models were disaggregated by gender and, in a subset of analyses, students enrolled in selective four-year institutions and students without expectations to attain a four-year degree were removed.	Results of restricted sample indicate a reduction of 23% for males and 25% for females
Wang (2014)	Propensity Score Matching and Path Analysis model	Beginning Postsecondary Students (2004)	National	Emphasis on STEM The author relied on propensity score matching to balance the data on observed characteristics and then used this balanced data to estimate a path analysis model.	Decrease of 35.6% in the probability of a typical student completing a bachelor's degree or persisting in four-year STEM fields after 6 years
Brand, Pfeffer, and Goldrick-Rab (2014)	Propensity Score Matching	High school graduates of Chicago Public Schools	State level	Tested for effect heterogeneity by conducting propensity score matching analyses where the comparison groups were separated into the following categories: not attending college within one year of high school graduation, attending a non-selective four-year college, attending a selective four-year college, and attending a highly selective four-year college	Decreases of 5.4%, 9.43%, and 35.5% when comparing two-year students versus enrolling at: non-selective, selective, and very selective four-year colleges, respectively

Table 5.3 Summary of the Influence of two-year enrollment on students' occupational outcomes

Authors	Comparison	Sample	Scope	Method	Outcome	Findings
Smart and Ethington (1985)	Four-year students	National Longitudinal Study (1972)	National	2×3 multivariate analysis of covariance (manova)	Job status, stability, and satisfaction	No differences in the outcomes of two- and four-year students
Whitaker and Pascarella (1994)	Four-year students	National Longitudinal Study (1972)	National	Ordinary least squares	Income and job status	Students initially enrolling in community colleges had levels of occupational prestige and earnings that differed in only trivial and non-significant ways from their counterparts who initially enrolled in four-year institutions.
Kane and Rouse (1995)	Four-year students	National Longitudinal Study (1972) & National Longitudinal Survey of Youth (1972)	National	Ordinary least squares	Wages and annual earnings	Similar returns to earned credits at two- and four-year colleges regardless of graduation
	High school graduates					Students who attended a two-year college earned about 10% more than individuals without any college education.
Lin and Vogt (1996)	High school graduates	National Longitudinal Study (1972)	National	Ordinary least squares	Income and job status	Compared to no college, attending a two-year institution was associated with higher income and job status. For African American students, community college

(continued)

Table 5.3 (continued)

Authors	Comparison	Sample	Scope	Method	Outcome	Findings
Sánchez, Laanan, and Wiseley (1999)	Community college students at different levels of credit attainment	California Community Colleges and the Employment Development Department's Unemployment Insurance	State level	Descriptive statistics about median annual earnings	Earnings	attendance rendered no statistically significant differences. There is a positive relationship between formal education and earnings. As students complete more education, they increase the likelihood of experiencing greater gains in their post-college earnings. Greatest payoffs are related to completing a vocational certificate or associate's degree compared to attainment of a few credits.
Grubb (2002)	High school graduates	Not applicable	National	Review of the literature	Earnings	Most estimates show that individuals who complete associate degrees earn about 20% to 30% more, with estimates for men being somewhat lower than those for women compared to high school graduates. One-year of coursework (without completing a degree) at either a two- or a four-year college increased

Gill and Leigh (2003)	Four-year entrants	National Longitudinal Study of Youth (1972)	National	Two-equation framework to account for selectivity bias	Salaries	an individual's earnings by about 5% to 10%. Four-year graduates who began college in the two-year sector attained similar wages to their counterparts who began college in the four-year sector.
Marcotte, Bailey, Borkoski, and Kienzl (2005)	High school graduates	National Education Longitudinal Study (1988)	National	Ordinary least squares	Earnings	Compared to high school education, community college education has positive effects on earnings among young workers. This effect was indeed larger for annual earnings than for hourly wages. Earnings benefits accrued both to those who failed to earn a credential and to those who earned an associate degree.
Jacobson and Mokher (2009)	High school graduates	Administrative records in Florida	State level	Descriptive statistics	Earnings	Provided evidence of the benefits of attending community colleges compared to completely dropping out of the postsecondary education system after high school in terms of salary. These benefits remained across different types and levels of schooling.

(continued)

Table 5.3 (continued)

Authors	Comparison	Sample	Scope	Method	Outcome	Findings
Marcotte (2010)	No college enrollment, two-year enrollment (certificate, associate's degree, bachelor's degree)	National Education Longitudinal Study (1988)	National	Ordinary least squares	Wage and yearly salary	Compared to no college education, credits and degrees at both two- and four-year colleges rendered significant results, especially for women.
	Academic and vocational credits attained at two-year schools, credits attained at four-year schools					Among two-year students, there were no differences in terms academic and vocational credits attained.
Belfield and Bailey (2011)	High school students	Not applicable	State level	Literature review	Earnings, health, crime, and welfare reliance	Strong evidence of significant gains from attending a community college versus high school education
						Literature on health, crime, and welfare reliance is very limited and potentially offers an important area for further research.
Jepsen et al. (2012)	Community college students at different levels of attainment: Associate's degree, diploma, or certificate	Administrative data from Kentucky	State level	Panel-data models	Earnings	Among two-year entrants, students with associate's degrees and diplomas have higher returns compared to those with certificates even after controlling for differences among students in pre-college earnings and educational aspirations.

González Canché (2012)	Four-year entrants	National Education Longitudinal Study (1998)	National	Propensity score matching, Heckman 2-stage control function	Annual salaries	No significant differences in annual salaries after accounting for observed and unobserved differences in the analytic samples given two-year enrollment status
Daglar and Trimble (2014)	Two-year entrants at different levels of education attainment	Washington state: Longitudinal college transcripts and unemployment insurance records for students who entered a Washington state community college in 2001–2002	State level	Individual fixed effects model	Wages	Earning an associate's degree leads to positive increases in wages in practically any field, compared to earning some credits but not attaining a credential.
González Canché (2017a)	Two- and four-year entrants who attained a Ph.D. in STEM fields	Survey of Doctorate Recipients (1995–2008)	National	Propensity score weighting, instrumental variables with dynamic panel data models	Annual salaries	Scientists who began college in the two-year sector had lower salaries and less salary growth over the 10-year period observed.

Community College Effects on Educational Outcomes The empirical question guiding the studies summarized in Fig. 5.2 and Table 5.2 is: “What is the effect of beginning tertiary education in the two-year public sector on the attainment of a four-year degree compared to the effect of having started college in the four-year sector?” Note that Table 5.2 summarizes the type of analysis employed, the scope of the analytic sample (*e.g.*, state, national), the main operationalization procedures (*e.g.*, sample disaggregation, two-state approaches, instruments used), and magnitude of the main findings reported. Another common characteristic of the studies shown in Fig. 5.2 is that their authors presented the results in terms of probability changes, with the exception of Doyle (2009) who estimated changes in hazard rates. These hazard rates were translated into survival probabilities for the purposes of this literature review.

As noted in Table 5.2, researchers have used different types of data to explore the effect of community colleges on educational attainment. Some relied on longitudinal data gathered by the U.S. National Center for Education Statistics, while others used state-level data, and others relied on administrative records and/or institutional data. The analysis of community college effects can be separated into two main periods, the pre-quasi-experimental and quasi-experimental design eras. The pre-quasi-experimental design era, which ignores issues of self-selection, took place between 1992 and 2005 whereas the quasi-experimental design period, which began correcting for self-selection issues, started in 2006.

It is worth noting that all the estimates presented in Table 5.2 and Fig. 5.2 consistently rendered negative effects of two-year enrollment on the attainment of a four-year degree, and that these effects remained despite the introduction of sophisticated quasi-experimental approaches, such as the use of instrumental variables (Alfonso, 2006; González & Hilmer, 2006; Long & Kurlaender, 2009; Rouse, 1995), propensity score matching (Brand et al., 2014; Doyle, 2009; Long & Kurlaender, 2009; Reynolds, 2012; Stephan et al., 2009; Wang, 2014), and other non-quasi-experimental but still sophisticated analytic techniques such as Oaxaca Decomposition (Sandy, González, & Hilmer, 2006). Indeed, the combined estimated average reduction in the probabilities of attaining a four-year degree for community college entrants was 28.4% (s.d. = 19.2%) across studies. This finding indicates that across samples, decades, and scopes of the inferences reached, researchers have consistently found that students who began college in the two-year sector were less likely to attain a bachelor’s degree than their counterparts who began college in the four-year sector, even after controlling for self-selection issues among participants across sectors.

Figure 5.2 is restricted to reporting the main magnitudes presented in the studies reviewed in Table 5.2. For example, Alfonso (2006) reported likelihood of bachelor’s degree attainment with and without accounting for students’ expectations to attain a four-year degree. Accordingly, the corresponding section in Fig. 5.2 contains two bars for Alfonso’s findings. In some cases, there is only one main finding reported (see Doyle, 2009; Rouse, 1995; Wang, 2014). In this view, a more meaningful understanding of Fig. 5.2 is achieved through a closer examination of Table 5.2.

Average Decrease In Probabilities of Four-year Degree Attainment Due to Initial Community College Enrollment
 (mean decrease across studies=28.4%, sd=19.7%)

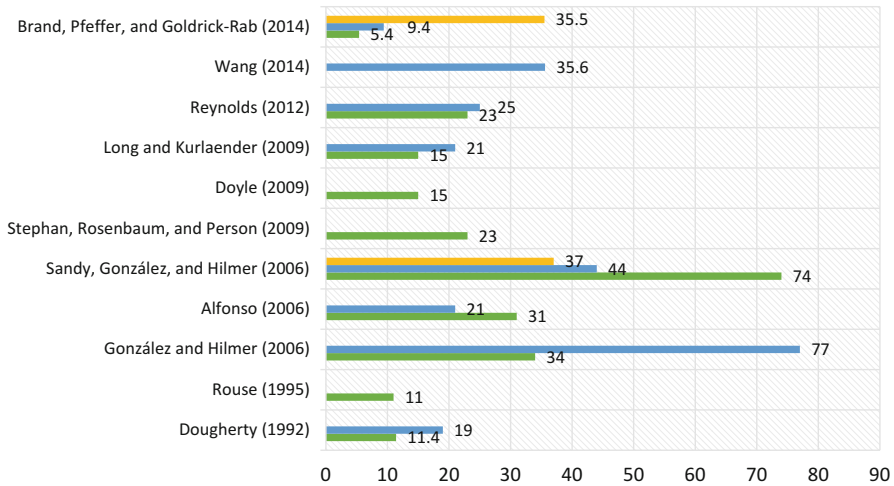


Fig. 5.2 Summary of the two-year sector effects on BA/BS degree attainment, where the higher the bars, the lower the chance of four-year degree attainment given initial two-year enrollment. The number of bars, indicates number of main models estimated in each study

Diverging Approaches to Measuring Community College Effects Before moving to findings related to community college enrollment and occupational outcomes, it is worth noting that there is a subset of studies of two-year sector effects on educational outcomes that can be classified in two types. The first type consists of studies that compare the academic outcomes of community college students who transferred to the four-year sector (termed “rising juniors”) with outcomes of rising juniors who began college in the four-year sector (Dietrich & Lichtenberger, 2015; Melguizo, 2009; Melguizo & Dowd, 2009; Melguizo, Kienzl, and Alfonso, 2011; Monaghan & Attewell, 2014). In most of these studies, the authors relied on propensity score methods to account for self-selection bias (except in the cases of Melguizo and Dowd (2009) who manually matched participants in their analytic sample and Melguizo (2009) who restricted the sample to Hispanics and used OLS models) and found that rising juniors who started college in the two-year sector were as likely as rising juniors who began college in the four-year sector to attain a four-year degree. These findings suggest that, at least since the 1990s, two-year students who were able to successfully transfer to the four-year sector were not negatively affected by their community college educational experiences.

The second type of recent research corresponds to studies that have moved away from the comparison of two- and four-year entrants on educational attainment. This line of research, instead, has focused on (a) comparing community college students

with different levels of educational expectations (Leigh & Gill, 2003) or (b) analyzing the effects of attending different types of community colleges on educational attainment (Crisp, 2013; Roksa, 2006; Wang & Wickersham, 2014). In the former case, Leigh and Gill (2003) found that community college students who aspired to attain at least a bachelor's degree actually attained anywhere from 0.4 to 1 extra year of schooling compared to similar students with no bachelor's degree aspirations.

Regarding the second line of research, Roksa (2006) utilized the National Education Longitudinal Study (1988–2000) and IPEDS data to create a measure of community colleges' emphasis on short-term certificates or vocational associate degrees. The author captured this emphasis by measuring the proportion of all credentials offered by a given institution that were classified as certificates or associate's degrees. Roksa (2006) then relied on logistic regression to estimate the influence of these two indicators on the likelihood of (a) attaining an associate's degree, (b) transferring to a four-year institution, and (c) attaining a four-year degree. Results indicated that a vocational focus of the two-year institution was not related to decreases in educational attainment. Also within this second line of research, Wang and Wickersham (2014) identified students who exhibited what the authors termed "vertical-co-enrollment." This type of enrollment was classified as initially enrolling at a community college and at some point co-enrolling in the four-year sector. They also identified community college students who co-enrolled at other two-year institutions and called it "lateral co-enrollment." Wang and Wickersham (2014) relied on Beginning Postsecondary Students ([BPS] 2004–2009) and used multinomial probit analysis to estimate the effect of these two types of co-enrollment versus non-co-enrollment while in community college on four-year degree attainment within four, five, and six years of initial college enrollment. The authors found that vertical co-enrollment had a positive and significant effect on bachelor's degree attainment compared to non-co-enrollment. Finally, Crisp (2013) also used BPS:2004–2009, but relied on propensity score modeling, to test for the effect of co-enrollment among community college students on transfer to, and graduation from, a four-year institution. Her findings also showed positive effects of co-enrollment, but, different from Wang and Wickersham (2014), Crisp (2013) did not differentiate between vertical and lateral co-enrollment.

It is worth noting that the studies by Crisp (2013) and Wang and Wickersham (2014) on the effects of co-enrollment on education attainment and the research on rising juniors or two-year transfers (Dietrich & Lichtenberger, 2015; Melguizo & Dowd, 2009; Melguizo et al., 2011; Monaghan & Attewell, 2014) provide positive evidence regarding some of the ways in which the two-year sector's stepping stone role toward the attainment of a four-year degree may be strengthened. Given these positive findings, future research should focus on increasing our understanding of factors that promote the production of rising juniors by the two-year sector. Notably, these factors not only consist of experiences in the two-year sector, but also the improvement of articulation agreements between two- and four-year institutions. The latter is an important point given that two- and four-year institution articulation agreements have consistently been shown to be ill-implemented and lead to loss of

credits that jeopardize student persistence in and graduation from higher education (Anderson, Alfonso, & Sun, 2006; Dougherty, 1992, 1994; Knoell & Medsker, 1965; Monaghan & Attewell, 2014).

The following section offers a similar overview of research in terms of the effects of community colleges on labor market outcomes while emphasizing the types of comparisons conducted in this line of research.

Community Colleges and Labor Market Outcomes Research on the effects of community college enrollment on labor market outcomes has gone beyond the analysis of initial two- versus four-year enrollment. Indeed, this line of research has focused on comparing labor market results in the form of annual salaries and/or wages realized by high school graduates versus those earned by community college enrollees who attained associate degrees or simply accumulated some credits without attaining any credential (Grubb, 2002; Jacobson & Mokher, 2009; Kane & Rouse, 1995; Lin & Vogt, 1996; Marcotte, Bailey, Borkoski, & Kienzl, 2005). All these studies have found that, compared to high school education, enrollment at a two-year institution, regardless of degree or credential attainment, is associated with increased salaries and/or wages. Other researchers have compared salaries and wages attained by initial two- and four-year entrants (Gill & Leigh, 2003; González Canché, 2012; Kane & Rouse, 1995; Smart & Ethington, 1985; Whitaker & Pascarella, 1994) and have consistently found that students initially enrolling in community colleges had similar levels of occupational prestige and earnings compared to their counterparts who initially enrolled in four-year institutions. Finally, researchers have compared community college students based on their level of attainment including no diploma or credential, associate's degree, diploma, or certificate (Dagdar & Trimble, 2014, Jepsen, Troske, & Coomes, 2012; Sánchez, Laanan, & Wiseley, 1999). The results from this line of research indicate that there is a positive relationship between community college education and earnings wherein community college students who complete more education tend to receive greater monetary payoffs.

Compared to research on community college effects on bachelor's degree attainment, research on labor market outcomes among community college students is not characterized by a clear starting point with respect to the utilization of quasi-experimental techniques for model estimation. Indeed, of the studies presented in Table 5.3, only Gill and Leigh (2003), González Canché (2012), and González Canché (2014a, 2017a) have offered quasi-experimental estimations. Of these studies, only González Canché (2017a) has gone beyond the analysis of the effect of the two-year sector on salary given the eventual attainment of a bachelor's degree by comparing monetary compensation realized by Ph.D. holders in STEM fields whose only observable difference was having begun college in the two-year sector. That is, in González Canché's study, whereas a subset of the sample started college in the community college sector, other students began college in the four-year sector. Results indicated that participants who began college in the two-year sector realized about 10% less salary than their counterparts who began college in the four-year sector, and realized less salary growth over a 10-year period. One of the main

contributions of this study is that the author accounted for both observable and unobservable differences in the analytic sample by relying on propensity score weighting and instrumental variable techniques with longitudinal panel data, which allowed him to control for observed and unobserved heterogeneity before making inferential claims. In addition, this is the only study to date that has compared the long-term effects of initial two-year enrollment on students' salary outcomes, finding a negative association between salary and initial enrollment in the two-year sector. Nonetheless, González Canché (2017a) concluded that the two-year sector cannot be blamed for the salary-based differences found in this study. On the contrary, he remarked that the community college sector was instrumental in the early formation of the scientists included in the analytic samples and that the main driver of salary differences corresponded to structural socioeconomic inequality permeating U.S. society.

5.2.2 Section 2: An Analytic Framework for the Study of Community College Sector Effects

From the literature on educational outcomes reviewed, it is clear that decades of research have consistently identified a baccalaureate gap (Table 5.2) wherein the comparison of two- and four-year college students has shown that the former are significantly less likely to obtain a bachelor's degree. These gaps have remained even when authors relied on quasi-experimental techniques aimed at creating groups with baseline equivalences (using propensity score modeling techniques) or when controlling for unobservables (relying on instrumental variables or the Heckman two-stage control function, for example). Nonetheless, despite these methodological advances there still exists the possibility that even the findings based on quasi-experimental methods exaggerate the negative effect of the two-year sector on their students' educational attainment failing to account for availability of big and geocoded data that can be retrieved at the state, county, and institution-level to further adjust for during college enrollment indicators. More specifically, even though quasi-experimental methods have addressed issues of self-selection and systematic differences in the student bodies attending the two- and four-year sectors, to date this line of research has not yet accounted for issues of confoundedness and geographically based (or georeferenced) omitted variable bias that can be addressed with the availability of big and geocoded data sources such as the US census and other federal agencies such as the National Center for Education Statistics.

5.2.2.1 Confoundedness and Georeferenced Omitted Variable Bias

All the studies discussed in this review comparing two- and four-year entrants' likelihood of attaining a four-year degree (see Table 5.2) faced an issue of

confoundedness, wherein the effect of the treatment of interest (community college attendance) was also influenced by the control condition (initial attendance in the four-year sector). Consequently, the outcome of treated participants is subjected to the effect of both conditions, rather than just one. More specifically, if starting higher education in community college is conceptualized as the treatment condition, then students who transferred to the four-year sector were by default exposed to the control condition (*i.e.*, the four-year sector) as well. This means that a student's likelihood of earning a four-year degree was the result of both the two- and four-year sectors' effects, and not solely those of the two-year sector. This issue of confoundedness goes above and beyond issues of self-selection and non-random assignment discussed in this review. Indeed, in cases of confoundedness "it is not possible to tell whether the intervention or the confounding factor is responsible for the difference in outcomes" (WWC, 2014, p. 19). Only studies reviewed in this document that analyze the outcomes of two-year entrants who did not interact with the four-year sector are exempt from confoundedness issues. Nonetheless, all studies that have not incorporated big and geocoded data at different levels are still subject to georeferenced omitted variable bias issue that may confound the estimates provided by the authors.

Raising issues of confoundedness and georeferenced omitted variable bias in this line of research is important because researchers and policymakers alike should acknowledge that four-year institutions must also be held accountable for failing to help community college transfer students successfully complete a bachelor's degree. From this perspective, the baccalaureate gap documented in the literature may not only be a function of the four-year sector's effects but also should overlook access to local factors, such as unemployment, poverty, income-levels that surround these types of institutions. This is an important issue in the production of four-year graduates that has remained under-discussed in over 50 years of research on two- and four-year sector effects on student educational outcomes and less notably, but still present in the comparisons on two and four-year entrants salary outcomes conducted by Gill & Leigh (2003), González Canché (2012), Kane & Rouse (1995), Smart and Ethington (1985), and Whitaker and Pascarella (1994).

This section presents an analytic framework that relies on the notion of big and geocoded data, counterfactual causality, and doubly robust estimations as a means toward the minimization of the bias associated with the confoundedness and georeferenced omitted variable bias issues. This strategy is depicted in Figs. 5.3 and 5.4, both of which enable continued assessment of a student's initial sector of enrollment after accounting for baseline indicators influencing likelihood of beginning college in the two- or four-year sectors. In addition, this framework enables continued assessment of institution, state, and county-level localized factors and characteristics that may affect students' outcomes during college enrollment, which allows researchers to capture the effect of the four-year sector even among two-year entrants once these students become rising juniors. Figure 5.3 depicts comparisons that aim to capture the effect of the two-year sector on educational outcomes. Figure 5.4 offers an analytic framework to estimate the effect of these institutions on student financial outcomes, such as annual salary or wages discussed

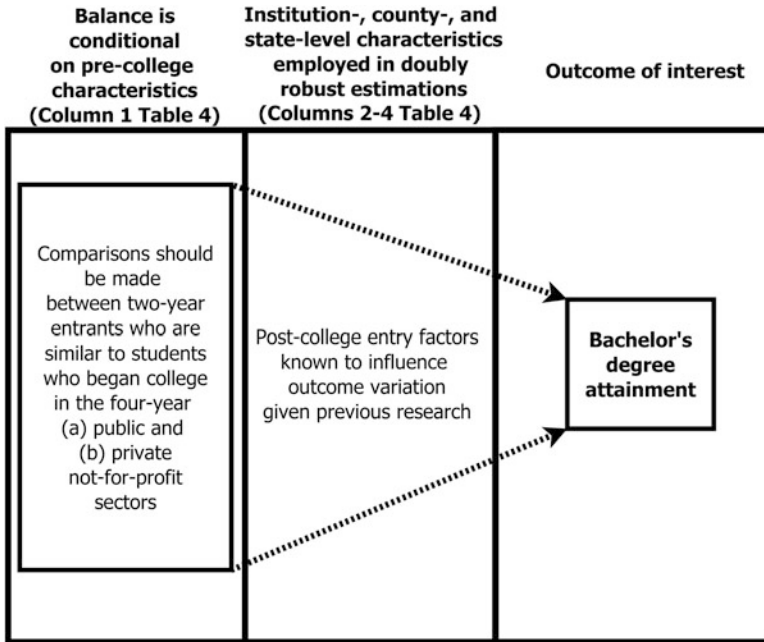


Fig. 5.3 Proposed analytic approach to study the effect of two-year colleges on the attainment of a four-year degree

above. Although further described below, the main difference between these two models is that Fig. 5.4 allows estimation of coefficient magnitudes that vary across different levels of education and therefore implies a more complex set of comparison groups, whereas in Fig. 5.3, the main outcome of interest remains bachelor’s degree attainment with initial college entry points as the main comparison of interest.

5.2.2.2 Methodological Conceptualization: Counterfactual Causality

Despite the ‘simplicity’ of asking whether starting college in the public two-year sector rather than in either the public or private not-for-profit four-year sectors is associated with lower likelihood of bachelor’s degree attainment or similar salaries, answering this question requires complex procedures. As the literature review for this chapter indicates, not only do two- and four-year students come from systematically different socioeconomic and academic backgrounds, they also attend sectors that present important differences in terms of access to resources and cost of attendance that will likely affect students’ outcomes. This issue makes necessary the implementation of big and geocoded data and analytic techniques that deal with systematic individual differences at college entry and throughout college enrollment, as shown in Figs. 5.3 and 5.4.

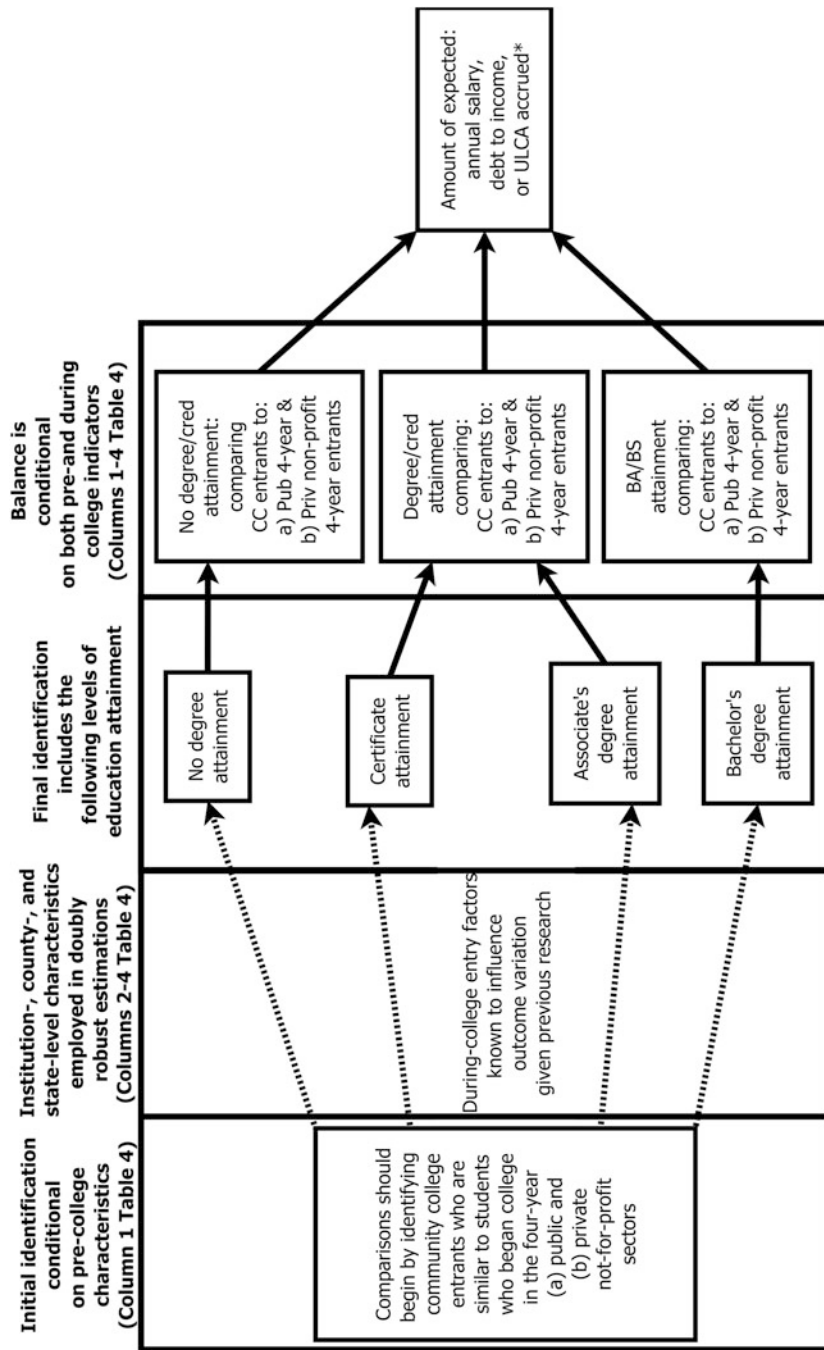


Fig. 5.4 Proposed analytic approach to study the effect of two-year colleges on labor market outcomes (*Last outcome is tested in the last section of this chapter)

The methodological framework discussed in the following lines is guided by the counterfactual or potential outcomes framework and may be used to address problems of confoundedness and georeferenced omitted variable bias in research on outcomes related to community college enrollment. This framework indicates that if researchers could observe (a) the outcomes of the same student i following two different enrollment trajectories (*i.e.*, started college in the two-year sector while also started college in the four-year sector either simultaneously or at different points in time) and (b) the outcome of each trajectory independently from the other academic trajectory, then researchers would simply need to observe the outcomes difference resulting from each enrollment trajectory in order to evaluate which decision rendered better results (Caliendo & Kopeinig, 2008; Holland, 1986; Lewis, 1973; Rubin, 2005). This estimation, which is called individual causal effect (Rubin, 2005), is impossible to obtain (Holland, 1986; Rubin, 2005) and researchers are constrained to the comparison of the outcomes of students who attended a two-year college with the outcomes of students who enrolled at a four-year institution. Given the persistent effects of socioeconomic inequality and reproduction of disparities, college enrollment decisions do not happen on a level playing field (Bourdieu, 1986) and the lower access to resources characteristic of two-year entrants may be the actual driver of the outcome of interest (in direction and magnitude) rather than the sector itself. The counterfactual or potential outcomes framework enables statistical correction for systematic differences before estimating the effects of different enrollment trajectories on students' outcomes.

The analytic framework presented in Figs. 5.3 and 5.4 highlights the need to control for indicators that account for baseline differences that influence the probability of a student (a) initially enrolling in either a two- or a four-year institution (Fig. 5.3) or (b) enrolling in a given sector and attaining a given level of education (Fig. 5.4). According to this perspective, analytic techniques that correct for this issue (*e.g.*, propensity score weighting (PSW), Heckman control function, instrumental variables) should be employed in any study that aims to minimize the risk that variation in outcomes of interest is driven by students' greater initial observable sources of support and/or self-selection issues based on unobservables, rather than by initial sector of enrollment and/or level of education attained. Nonetheless, assuming that accounting for baseline differences is enough to capture sector effects on students' outcome variation is shortsighted. As such, statistical models should also rely on doubly-robust procedures (Ridgeway, McCaffrey, Morral, Burgette, & Griffin, 2014) to further adjust for initial and transfer institutions-, county-, and state-level variables affecting participants' behaviors during college enrollment (*e.g.*, big and geocoded data). Notably, doubly-robust adjustment is more important when analyzing sector effects on educational attainment as shown in Fig. 5.3 than when analyzing financial outcomes measured post-college enrollment (as shown in Fig. 5.4). Specifically, comparison groups require identification of factors that predicted enrollment in different sectors before actual enrollment was observed. In the case of the analytic model contained in Fig. 5.4, economic/financial outcomes are measured after students leave college and such outcomes are a direct function not only of initial sector of enrollment, but also, and as importantly, a function of the

level of education attained. For this reason, Fig. 5.4, in addition, includes a set of comparison groups incorporating initial enrollment and levels of tertiary education attained. From this perspective, then, the initial balance needs to consider both pre-college and during college enrollment indicators for the initial re-creation of comparison groups across this complex set of status definitions (e.g., community college entrants with no degree attainment compared to initial public four-year entrants with no degree attainment and initial private non-profit four-year entrants with no degree attainment). When researchers have information about post-college enrollment indicators measured before final outcome assessment, such indicators should be used in doubly-robust procedures as depicted in Fig. 5.3. More specifically, in cases when there is a time-lag between college enrollment and salary variation, analysts may access data sources that incorporate individual and geographic (state, county, census tract, or block) indicators that may affect the variation of salary. Once such indicators, typically available from the American Community Survey, for example, are retrieved analysts could then adjust for these potential sources of georeferenced omitted variable bias before making inferential claims.

Table 5.4 contains a list of variables and indicators obtained from big and geocoded data sources (see footnote on Table 5.4) that may be used in model operationalization of analyses employing quasi-experimental procedures to capture pre-college and during-college enrollment variables and indicators that are likely to affect students' outcomes. Regarding *during-college enrollment factors*, for example, the persistence behaviors of participants who enrolled at an institution that offered them several forms of financial aid (such as grants, waivers, or work-study) or that charged greater amounts of tuition and fees, should arguably differ from the persistence behaviors of participants whose only aid disbursements were loans. Similarly, at the state level, *ceteris paribus*, participants attending college in states that favor merit or grant aid over loan aid would be expected to have less burden in terms of tuition and fee costs. County-level indicators (e.g., educational attainment, median income, crime rates, unemployment, and cost of living) should also be included in the models to control for geographic socioeconomic conditions surrounding students' college options. With respect to the last point, zip code tabulated area indicators can also be incorporated at the institution- or even student-level during model specification if their corresponding zip-codes are available.

Based on the doubly-robust modeling rationale and a quasi-experimental approach that requires complex comparison groups, variables and indicators should be separated into two categories: those to be used to account for pre-college entry differences—all of which should be measured before students entered college—and those measured during college enrollment to be used in the second stage of the doubly-robust implementation (in the case of doubly-robust procedures shown in Fig. 5.3) or in the baselines of quasi-experimental procedures that require complex comparison groups (as shown in Fig. 5.4). Additionally, model estimation should focus on capturing all available individual, institutional, and geographic factors (shown in Table 5.4) that previous research has found to influence educational and occupational attainment. The results obtained from the analytic models shown in

Table 5.4 Individual-, institution-, county-, and state-level characteristics identified in the literature to predict college enrollment and adjust for factors potentially affecting variation in the outcomes of interest

Predictors of college entry	Factors taking place during college enrollment		
Student-level	Institution-level	Geographic	State-level
Gender & ethnicity	Tot. cum. tuition cost	City	Merit aid millions
SES family 12th grade	Tot. cum. fee charges	Suburb	Need aid millions
Public K-12 education	Total cum. grant aid	Town	Loan aid millions
Expect BA degree	Total cum. loan aid	Rural	Prop 18–24 college
Acad. award 10–12 grades	Total cum. work-study aid	New England	Tuition agreements
Place study at home importance of financial aid	Tuition waiver selectivity level	Mid East Great Lakes	WICHE ^a SREB ^b
Importance college selectivity	Open admission policy	Plains	Midwest stdt exch
Importance placed on grades	SAT math 25 & 75	Southeast	New England
Married at admission	ACT comp 25 & 75	Southwest	No tuition agreemt
Children at admission	SAT verb 25 & 75	Rocky Mountains	No. IHEs agreemt
Mother college support	Changed major	Far West	
Father college support	Major of degree		County-level
Relatives college support	Number of majors		Cost of living
Teacher/counselor college sup	IHE offered grant		Median income
AP classes	IHE offered loan		Crime rate
Took SAT/ACT	IHE offered work-study		Unemployment rate
Took PSAT	IHE offered waiver		Educ. attainment
Extra HS class preparation	Highest degree offered		
Took private class preparation	Institutional size		
Used book preparation SAT	Carnegie classification		
GPA 9th to 12th grades	Time to degree		
Strdrz math & reading scores	Transfer (2 to 4)		
Number siblings	Transfer (4 to 2)		
Worked 8–12	No. institutions attended		
Never worked 8–12	Distance from home		
Ever dropped 8–12	Residency status		

Data sources: IPEDS, The U.S. Census Bureau, The Bureau of Labor Statistics, The Bureau of Economic Analysis, U.S. Department of Commerce, U.S. Census Bureau, Geography Division, U.S. Department of Housing and Human Development, ACS, CPS

^aWestern Interstate Commission for Higher Education, ^bSouthern Regional Education Board

Figs. 5.3 and 5.4, and operationalized in Table 5.4, are expected to be less biased and more robust to georeferenced omitted variable bias compared to the results of studies subject to issues of confoundedness.

5.2.3 Section 3: Community College Effects on Undergraduate Loan Cost of Attendance

This section further explores the role of the two-year sector as a financial gap-closing mechanism. As mentioned above, despite the fact that about 50% of students begin college in the two-year sector, likely because of its lower sticker price, sufficient evidence that this sector results in less reliance on student loan debt is lacking, particularly when considering different levels of educational attainment. From this perspective, this section implements the analytical framework presented in Fig. 5.4 to capture the effect of community college attendance on debt accumulation, a topic that remains understudied in the higher education literature.

The main premise of this section is straightforward. Given that current college-goers are the most indebted students in the country's history (Baum, 2015), students—particularly those from low-income backgrounds—and their families need to have a clear and comprehensive understanding of the expected cost of loan debt that a typical traditional-age undergraduate college student will accrue as a result of postsecondary enrollment and level of degree attainment. This knowledge is relevant given that student loan debt has reached levels so critical that it has become a crisis that may place the new U.S. workforce generation's economy at risk, especially among students who default on their loans (Cunningham & Keinzel, 2011; Dynarski & Kreisman, 2013; Gladieux & Perna, 2005; Pinto & Mansfield, 2006). Despite being a vital part of the college-choice process (even more so when considering the loan debt crisis), information on the expected loan cost that students will need to bear post-college enrollment⁵ is virtually absent from the student aid and finance literatures. Specifically, researchers, counselors, and students and their families tend to evaluate *overt costs of college attendance* that consist of tuition and fees, books, and room and board expenses with little attention paid to the average total amount of loan debt that a typical recent high school graduate is expected to accrue during undergraduate college education.

The measure of debt cost used in this study is *undergraduate loan cost of attendance* (ULCA) and is operationalized as capturing the total loan debt accrued by students conditional on (1) sector of first college enrollment (public two-year or community college, public four-year college, and private not-for-profit 4-year college) and (2) level of education attainment (no associates' degree or credential, certificate and/or associate's degree, or bachelor's degree). The construction of a

⁵In the case of students borrowing from private lenders and/or unsubsidized loans, interest begins to accrue during college enrollment.

dataset containing pieces of information that come from big and geocoded data sources at the state, county, and institution-level, enables an assessment of expected ULCA as a function of diverging enrollment trajectories during undergraduate education that is robust to omitted variable bias and confoundedness. In this way, the question of how loan debt costs change for differing levels of educational attainment conditional on different initial enrollment decisions can be answered. The selection of public two-year, public four-year, and private non-profit four-year institutions as points of entry to higher education are a function of big and geocoded data availability presented in two nationally representative samples of college-goers during the 1990s and the 2000s. It is worth noting that the estimates presented in this last section of the chapter apply to typical college-age students. While this sub-sample is a potential limitation with respect to generalizability of the findings, it is important to recall that about 50% of all undergraduate students interact with the community college system in the U.S. (AACC, 2016; González Canché, 2012), accordingly the sub-samples employed are relevant across the contiguous United States. In sum, the estimates found in this section are most applicable to recent high school graduates who may be considering initial enrollment in the two-year sector as an immediate cost-saving alternative.

ULCA represents an important piece of information that should be an essential component of students' college-going decisions. Policy- and decision-makers, and students and their families, should be clearly informed about expected ULCA so that they can make better and more informed decisions regarding their college choices, which would ideally prevent students from falling into delinquency status or defaulting on their loan debt altogether. The importance of this information is arguably more relevant for low-income students who tend to face tighter budget constraints and, all else equal, face greater challenges to repay loan debt than their more affluent counterparts. The informational campaigns that may result from the findings presented herein will enable students to select the most cost-effective higher education options and may prove to be an effective mechanism toward financial literacy and self-sufficiency.

The logic used to measure variations in ULCA is an implementation of the proposed analytic approach shown in Fig. 5.4 to study the effect of two-year colleges on student financial outcomes. In this case, the outcome of interest is variation in ULCA. As discussed in the previous section, this analytic framework accounts for theoretically and empirically sound indicators utilized in rigorous research conducted on factors affecting the variation of student loan debt burden (Belfield, 2013; Chen & Wiederspan, 2014; Deming, Goldin, & Katz, 2011) and sector effects on educational attainment (Brand, Pfeffer, & Goldrick-Rab, 2014; Dietrich & Lichtenberger, 2015; Doyle, 2009; Melguizo et al., 2011; Rouse, 1995; Stephan et al., 2009). In this sense, model estimation will pay special attention to capturing all available individual and institutional factors that previous research has found to influence debt accumulation (González Canché, 2014a, 2014b) while in addition incorporating geographic level indicators obtained from big data sources (shown in Table 5.4) such the US census to further adjust for potential omitted variable bias. The logic model shown in Fig. 5.4, and operationalized in Table 5.4, was designed

with the purpose of obtaining estimates that reflect the least biased expected ULCA across institutional sectors, levels of educational attainment, and enrollment trajectories.

5.2.3.1 Research Question

The overarching question guiding this section is the following: What is the expected cost of loan debt resulting from initial enrollment in the public two-year sector compared to initial enrollment in either the public four-year or private not-for-profit four-year sectors conditional on different levels of educational attainment?

The logic model employed herein takes into consideration that ULCA amount varies conditional on different levels of degree attainment (*e.g.*, students who persist until bachelor's degree attainment remain enrolled for longer and therefore require more financial resources than students who drop out of college after one year of attendance or those who attain a certificate, for example). Accordingly, sector effects on ULCA will be measured while estimating models disaggregated based on different levels of degree attainment. In this sense, the overarching question can be decomposed into the following more specific research questions, all of which will be addressed after accounting for key factors that may influence students' need to rely on loan debt (*e.g.*, tuition, fees, grants, time of enrollment, local cost of living) shown in Table 5.4:

1. Do two-year entrants who obtained a bachelor's degree complete their studies with similar ULCA as their counterparts who also attained a four-year degree but started in either the public four-year sector or private not-for-profit four-year sector?
2. How do these estimates change across non-degree/certificate, and associate's degree recipients?
3. Have the answers to these two questions remained constant across decades?

This last research question is addressed using model specifications that rely on over 20 years of official non-self-reported loan data retrieved from the National Student Loan Data System (NSLDS). This system captured all loan disbursements and repayments made by college students from two nationally representative samples of recent high school graduates—The National Educational Longitudinal Study ([NELS], 1988–2000) and the Educational Longitudinal Study ([ELS], 2002–12)—who started college between the ages of 16 and 19 and who were followed up to nine years after initial college enrollment. From this view, the logic model and the longitudinal panel nature of the data analyzed will enable assessment of the effect of enrollment trajectories and educational attainment on ULCA variation across generations. This framework also serves to demonstrate that big data availability was a reality since the 1990s.

5.2.3.2 Methods and Statistical Procedures

The method implemented for this study follows the counterfactual or potential outcomes framework described above, which accounts for the fact that college enrollment decisions do not happen on a level playing field (Bourdieu, 1986), wherein lower access to resources characteristic of two-year entrants may drive students' level of education attainment, which in turn affects loan debt variation (in direction and magnitude). As such, variations in loan debt may not be the result of initial sector of enrollment, but rather result from other confounding factors. Accordingly, model identification was conducted to create comparison groups that identified both initial sector of enrollment and levels of educational attainment before correcting for systematic differences across comparison groups. Specifically, following Fig. 5.4, the models considered both pre-college entry indicators that identified college-choice status and during-college indicators that may have affected likelihood of educational attainment (using information from all four columns shown in Table 5.4). Pre-college indicators included information on diverging sources of academic, social, and financial support to which students had access during high school. During-college indicators were comprised of institution-, county-, and state-level variables affecting participants' comparison group status before measuring the effect of initial community college attendance on ULCA variations. These procedures, although time-consuming in terms of collecting big data information from different sources, are important given that the borrowing behaviors of participants who enrolled at an institution that offered them other forms of financial aid (such as grants, waivers, or work-study) or that charged greater amounts of tuition and fees, were arguably different from the borrowing behaviors of participants whose only aid disbursements were loans. As described in the second section, at the state level, *holding everything else constant*, state-level policies that favored merit or grant aid over loan aid would be expected to students' reliance on loans (e.g., the Georgia effect with the HOPE scholarship). County-level indicators are also included in the models to control for geographic SES conditions surrounding students' college options.

Propensity Score Weighting The quasi-experimental procedures implemented in this study rely on propensity score modeling approaches, specifically focused on weights obtained from participants' probabilities to be classified in one of the three boxes contained in Fig. 5.4 and listed next:

1. Comparisons among non-degree holders who (a) began college enrollment in the two-year sector, (b) began college enrollment in the public four-year sector, or (c) began college in the private non-profit four-year sector.
2. Comparisons among associate/certificate-degree holders who (a) began college enrollment in the two-year sector, (b) began college enrollment in the public four-year sector, or (c) began college in the private non-profit four-year sector.

3. Comparisons among bachelor's degree holders who (a) began college enrollment in the two-year sector, (b) began college enrollment in the public four-year sector, or (c) began college in the private non-profit four-year sector.

In all these cases the main group of interest consists of students who began college in the public two-year sector. From this viewpoint, all comparisons made in this chapter are of the type (a) versus (b) or (a) versus (c). Other studies may compare differences in (b) and (c).

PSM assumes that treatment assignment (in this case, beginning college in the two-year sector) and selection are fundamentally based on observables (Reynolds & DesJardins, 2009; Rosenbaum & Rubin, 1983). These observables are conceptualized as the factors and covariates that are influential in determining participants' probabilities of receiving treatment. The standard procedure to obtain this probability consists of naïve logit estimators, as follows in (1):

$$\log \frac{P(t = 1|x)}{1 - P(t = 1|x)} = \beta'x \quad (5.1)$$

where β is selected to maximize the logistic log-likelihood. Considering that the inclusion of big data increases the likelihood of fitting on noise or overfitting (Harrell, 2015; Zhao et al., 2011), analysts should impose a penalty based on multicollinearity issues and overinfluence of indicators on the prediction of interest. One way to overcome this issue consists of applying a penalty term for coefficients that are large in absolute value and may lead to inflated propensities (Ridgeway et al., 2014), as follows in (2):

$$\ell\beta = \frac{1}{n} \sum_{i=1}^n t_i \beta' x_i^s - \log(1 + \exp(\beta' x_i^s)) - \lambda \sum_{j=1}^J |\beta_j| \quad (5.2)$$

where the term $\lambda \sum_{j=1}^J |\beta_j|$ is the penalty term as it decreases the overall value of $\ell\beta$.

In practice, and in the approach implemented in this chapter, propensity scores are often computed using predictors of treatment status that are highly correlated with each other across different potential outcomes. In this case, “the lasso [least absolute subset selection and shrinkage operator, captured in the second term of the right hand section of Eq. (5.2)] tends to include all of them [predictors] in the model, shrink their coefficients toward 0, and produce a predictive model that utilizes all of the information in the covariates, producing a model with greater out-of-sample predictive performance than models using variable subset selection methods” (Ridgeway et al., 2014, p. 29).

The estimate of $\ell\beta$ obtained is typically referred to as $e(x)$ in the propensity score modeling literature (Reynolds & DesJardins 2009; Rosenbaum & Rubin, 1983). This estimator allows for the computation of the balancing score [$b(x)$], which ensures that the comparison between treated ($t = 1$) and control ($t = 0$) units are

made considering similar pretreatment or baseline characteristics (x_i^s) given $b(x)$. Note that $b(x)$ is a theoretical construct that is only approximated by $e(x)$ if the researcher has access to truly influential covariates that explain treatment assignment and allow for the identification of counter-factual cases (Rosenbaum & Rubin, 1983). When all observable predictors x_i^s are balanced across treated and control units, this approach is assumed to have statistically recreated natural treatment and control groups whose counter-factual outcomes can be compared.

Given that $b(x)$ can take an infinite value, one method to create balance across treatment and control statuses is to rely on matching mechanisms (Rosenbaum & Rubin, 1983), where, conditional on $b(x)$ values, the covariates x_i^s become balanced (see S. Becker & Ichino, 2002 for a survey of the most frequently used balancing mechanisms). Another use of $b(x)$ consists of using it as a weight to create a balanced sample. The main advantage of this weighting method is that propensity weights can be used like survey sampling weights, thus allowing researchers to use them in different statistical approaches, including doubly robust procedures, to adjust for covariates that were not balanced or that were captured after the treatment assignment took place (Ridgeway et al., 2014). For example, if treatment is defined as two-versus four-year enrollment and the outcome is probability of four-year degree attainment, one can balance on precollege indicators to estimate the propensity to two-year enrollment, and then use college-enrollment indicators (institutional size, financial aid, major, etc.) in the outcome equation to account for indicators that may have further affected a given student's likelihood of four-year graduation above and beyond the initial propensity toward two-year enrollment. The treatment effect of interest in this chapter is the ATT, or average treatment effect for the treated, which captures the effect of initial community college enrollment and educational attainment on ULCA, and is mathematically expressed as $E[Y(1) - Y(0)|t = 1]$, where $Y(1)$ is the ULCA realized by students who initially attended a community college (across the three levels of education attainment identified in Fig. 5.4), $Y(0)$ is that of students initially attending either the four-year public or private not-for-profit sectors (also across the different levels of education attainment identified in Fig. 5.4), and $t = 1$ is treatment status. The propensity score weights (PSWs) for the ATT are defined as follows: $w(x) = K \frac{f(t=1|x)}{f(t=0|x)} = K \frac{b(x)}{1-b(x)}$, where $b(x)$ is the propensity (or assumed balancing) score described above and K is a normalization constant, used to reduce any probability function to a probability density function with total probability of one, that will cancel out in the outcomes analysis (Ridgeway et al., 2014).

Outcome Variable The loan data contained in NSLDS was obtained from an administrative linkage system using sample members' dates of birth and Social Security Numbers. All loan information came directly from external institutions and includes specific dates of all non-self-reported amounts of disbursements and repayments made by all survey participants who borrowed and enrolled in any Title IV institution. In the case of NELS, the debt data account for students who attended college between 1991 and 2000. For ELS, the NSLDS contains loan disbursements and repayments from 2001 to 2012. The loan outcomes analyzed in

this chapter are restricted to undergraduate loan disbursements. This restriction is possible given that the three NSLDS datasets have a variable called “Academic level” (ACADLVL) that registered the undergraduate year in which a given amount was disbursed—including amount, date, and type of loan (*e.g.*, subsidized or unsubsidized). The detailed information contained in the NSLDS allowed for the creation of an indicator measuring the proportion of ULCA accrued that was subsidized as opposed to unsubsidized. If this indicator has a value of 1, this would indicate that all loan amounts were obtained from federally subsidized sources. If this indicator is 0.5, then half of the debt accrued came from subsidized support. This indicator is important considering that debt burden is expected to change given students’ reliance on subsidized or unsubsidized debt. In the former, borrowers are not required to pay interest while still attending college. Borrowers with unsubsidized loans, on the other hand, are required to pay interest while still enrolled as a student. This indicator was included in the doubly robust procedures described above.

Variables and Indicators Used to Predict College Choice In line with the conceptual framework outlined in Section 2 of this chapter, variables employed to predict students’ initial sector of attendance considered their various resources in the form of (a) social capital, such as support from parents, relatives, and high school teachers and counselors to pursue a college education; (b) economic capital, including socioeconomic status, access to private tutors and private classes, the need to work to support their education in high school, importance placed on availability of financial aid in college-going decisions, and public elementary school attendance; and (c) proxies of cultural capital, accounted for by participation in advanced placement classes, importance placed on good grades, academic recognition, and having taken the SAT/ACT, all of which can reflect a college-going culture typically associated with students coming from families who can afford greater monetary investments in education. Previous research (Alfonso, 2006; Dougherty, 1992; Doyle, 2009; González Canché, 2014, 2017a; Long & Kurlaender, 2009; Melguizo, 2009; Melguizo & Dowd, 2009; Reynolds, 2012; Stephan et al., 2009) has shown that these indicators are systematically different for two- and four-year students, thus empirically justifying the need to control for observed differences.

During-College Factors Baseline indicators used before model estimation also accounted for factors that were measured during college enrollment to account for institution-, county-, and state-level variables assumed to affect students’ borrowing behaviors. Institution-level variables were selected to account for variations in college major and other forms of financial aid offered by the institutions where students attended. Forms of aid consider grants, loans, work-study, and waivers. This aid information is stored in the student-institution files contained in both NELS and ELS studies. In addition, an estimate of the total tuition and fees that students paid during undergraduate college enrollment was computed for each student. This estimation considered time of enrollment (in years) and tuition and fee charges at each institution. These charges were retrieved directly from IPEDS records. Institutional selectivity is also included in the NELS and ELS samples. Additionally,

modeling included Carnegie classification as provided by IPEDS along with a binary indicator of whether a given institution had an active open-door admission policy during a student's college attendance. The models also included institution size and locale to capture whether institutions were located in cities, suburbs, towns, or rural areas. Land grant status of the students' college were also considered as these institutions are assumed to serve local or in-state students and enrollment in this type of institution may capture other forms of aid or support not captured by the ELS survey. Time of enrollment was another important indicator calculated from NELS and ELS surveys using information about date of initial college enrollment and date of last college attendance.

State-level indicators at this second stage of model estimation included a measure of per capita disposable personal income (dollars), defined as total personal income minus personal current taxes, a measure retrieved from The Bureau of Economic Analysis during each year of enrollment, as well as a measure of college access in the state where students first enrolled in college, which is defined as the proportion of inhabitants aged 18–24 years who are enrolled in college (United States Census Bureau Population Estimates, 2014). In addition, given that some authors have discussed the influence of state and regional tuition reduction agreements in mobility flows across neighboring states, which in turn affects tuition and fees variation (Cooke & Boyle, 2011; Zhang & Ness, 2010), the models incorporated this information provided by the following organizations: MSEP (2014); NEBHED (2014); SREB (2014); WICHE (2014). The models also included states' total amount in merit, loan, and need-based financial aid spent during the year students were enrolled in college, information retrieved from several reports available from the National Association of State Student Grant & Aid Programs (1992–1993, 2004–2005). County-level characteristics captured socio-economic geographic attributes such as educational attainment, median income, crime rates, unemployment, and cost of living as mechanisms potentially affecting ULCA variation above and beyond state-, institution-, and individual-level indicators.

Given that model estimation relied on two different datasets and multiple comparison groups, results of balance tests are available upon request. This chapter will now focus on the estimates outlined in Figs. 5.5, 5.6, and 5.7.

5.2.3.3 Findings

Figures 5.5, 5.6 and 5.7 summarize the results of the model specifications just discussed. Figure 5.5 shows the effects of initial enrollment in the two-year sector among participants who did not attain any credential or degree. Of these four quasi-causal estimates, the only result that did not show significant differences was the comparison between public two- and four-year entrants during the 1990s (NELS data). Specifically, although the models show a reduction of about \$2000 in debt for community college entrants compared to public four-year entrants, this difference is not significant. A decade later (ELS), this gap increased to a significant \$8000,

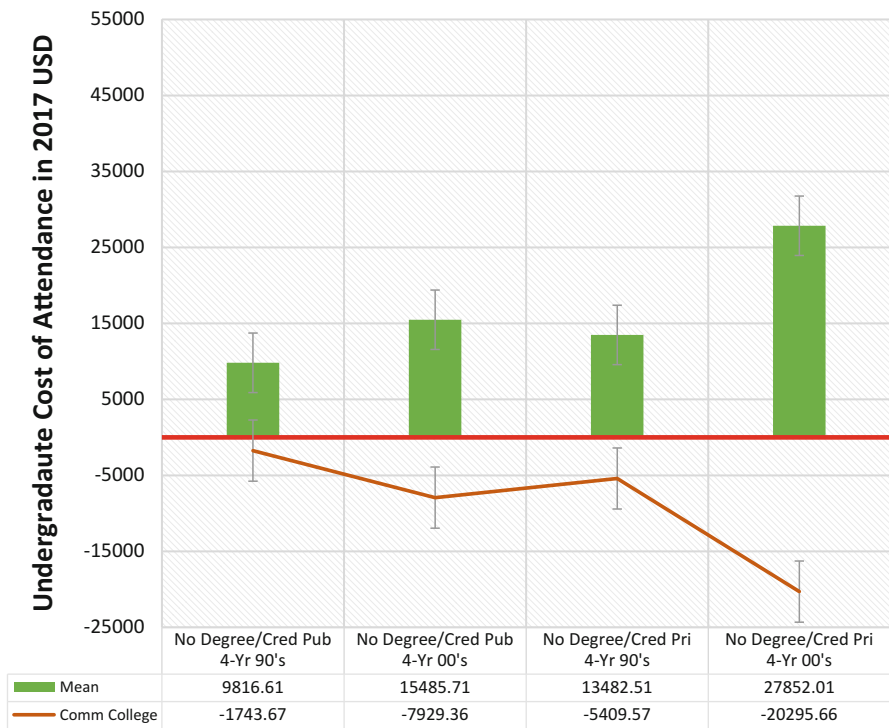


Fig. 5.5 Comparisons among non-degree holders

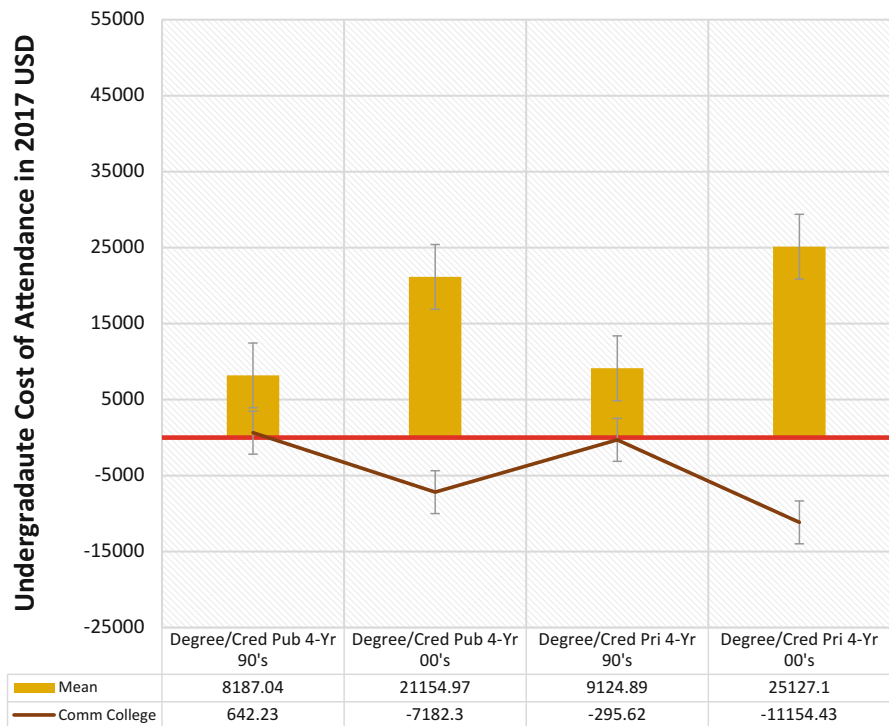


Fig. 5.6 Comparisons among less than four-year degree holders

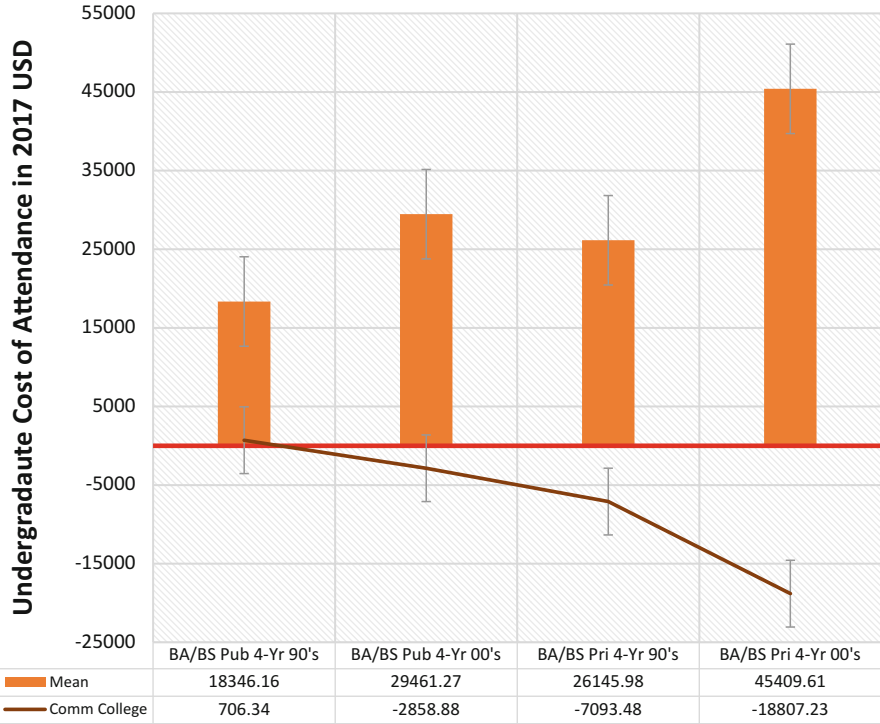


Fig. 5.7 Comparisons among Bachelor’s degree holders

indicating that had two-year entrants who did not attain any degree begun college enrollment in the public four-year sector, their debt accrument would have been approximately \$8000 higher. The most alarming finding for non-degree holders was found in the 2000s, wherein the estimated gap reached over \$20,000 in the comparison of two-year and four-year not-for-profit entrants. In this case, two-year entrants who did not attain any degree would have ended up with extra \$20,000 in debt had they begun their studies in the private non-profit four-year sector. Another way to interpret this result is that had students who initially enrolled in the four-year private non-profit sector begun college instead in the community college, their debt accumulation would have been about \$8000 instead of an estimated \$27,852.

Figure 5.6 compares participants who attained an associate’s degree. In this case, the 1990s data show that among these students, beginning college in the public two-year sector did not translate into significant decreases in debt accumulation. This result holds true for comparisons of both four-year public and private non-profit institutions. For example, when compared to students who initially enrolled in the four-year public sector, community college participants accrued on average about \$600 more in debt. In the following decade, however, community college students who attained a less-than-four-year degree had an overall debt accumulation that was \$7000 and \$11,000 lower than if they had instead initially enrolled in the four-year

public and private non-profit sectors, respectively. That is, these contemporaneous results indicate a lower ULCA for initial two-year entrants who attained an associate's or comparable degree (e.g., a certificate).

Finally, results for students who attained a four-year degree were mixed across decades, but consistent between sectors, as shown in Fig. 5.7. More specifically, for participants who attained a four-year degree, initial enrollment in the community college sector versus the four-year public sector resulted in insignificant differences in ULCA variation across decades. In the 2000s, the average ULCA accumulated by four-year degree holders was about \$30,000 in 2017 dollars. Two-year entrants had an ULCA that was about \$3000 (10%) lower than their public four-year counterparts. Notably, four-year degree holders who initially enrolled in the two-year sector consistently accrued significantly less ULCA than their four-year private non-profit counterparts. This disparity was about \$7000 in the 1990s and almost \$19,000 during the 2000s. The results in Fig. 5.7 additionally indicate that for initial attendees of the four-year non-profit sector, ULCA was over \$45,000 in the 2000s on average.

In sum, the most consistent finding in this study is that after controlling for baseline indicators that not only considered pre-, but also during-college, enrollment indicators, beginning college in the two-year sector during the 2000s resulted in a considerably lower ULCA.

5.3 Discussion

The findings presented in the literature comparing the effect of two-year institutions on students' likelihood of bachelor's degree attainment consistently suggest that, compared to four-year entrants, students beginning their studies in the two-year sector have lower probabilities of bachelor's degree attainment (Table 5.2). Conversely, when analyzing the effect of two-year enrollment against no college enrollment and four-year attendance, results indicate that two-year students have better or similar salary benefits compared to high school graduates and four-year students, respectively (Table 5.3). From this perspective, any study attempting to comprehensively evaluate the role of the two-year sector on students' propensity to upward mobility must at least consider these two sets of outcomes before drawing conclusions about this sector's role in the reproduction of inequality of opportunities. While academic outcomes can be interpreted as the two-year sector playing an important role in the reproduction of inequality in educational attainment, salary-based findings suggest that the two-year sector may indeed have a gap-closing effect on socioeconomic inequality in the United States. Nonetheless, future studies should also incorporate other comparison sectors and explore additional outcomes using the analytic framework presented in this chapter, as exemplified in the third section. Concerning the analysis presented in this chapter in particular, initial enrollment in the two-year sector was consistently found to render a much more affordable path than beginning college in the private non-profit four-year sector. These results illustrate another way in which community colleges may have a gap-closing effect

on socioeconomic inequality. Accordingly, students should be made aware of the ULCA they are expected to incur as a function of initial enrollment in any of the three sectors studied. Likewise, it is important for future students to know that the worst-case scenario found in this study is found among initial four-year entrants who did not attain any degree or credential, as these students ended up with no degree or credential but with almost \$30,000 in debt.

The conceptualization of the two-year sector as an entity capable closing gaps in socioeconomic inequality in the United States must incorporate a discussion of the current situation in the U.S. with respect to inequality and stratification of opportunities based on socioeconomic status. The purpose of presenting this information is to depict more comprehensively the rather difficult circumstances that low-income students continue to face in U.S. society. Following this illustration, the main findings and conclusions regarding the role of the two-year sector in closing socioeconomic gaps are revisited while emphasizing the mission of the two-year sector and the types of students it has historically served.

5.3.1 Pre-college Entrance Inequality, Educational Stratification, and College Choice

Although the present study focuses on tertiary education, considering that income inequality is a social issue of marked prevalence in the U.S., it is important to contemplate the ways in which this problem continues to shape the lives of at least 46 million Americans (DeNavas-Walt & Proctor, 2015). Accordingly, this section provides a synthesis of the systematic barriers experienced by low-income students long before college entry takes place and the ways in which this persistent socioeconomic inequality more often than not obstructs their probabilities for upward socioeconomic mobility into adulthood.

5.3.2 Pre-college Socioeconomic Inequality

Low-income children attending school in the United States (who overwhelmingly tend to be of African American, Hispanic or Latino, and American Indian in origin) have been systematically exposed to structural disadvantages that have permeated all aspects of their lives and—when compared to their more affluent counterparts— have made their prospects for attaining social and economic mobility less feasible (Jiang, Ekono, & Skinner, 2015; Laub, 2014). For example, low-income students are more likely to live in single-parent households, which are usually composed of families supported by single-mothers (Hill, 2010), and tend to grow up in homes characterized by poorly functioning family environments. Both of these home life situations constitute widely documented serious risk factors associated with an increase in the

probability of clashes with the juvenile justice system (Gottesman & Schwarz, 2011; Laub, 2014). It is worth noting that even in cases where both parents are present in low-income households, these parents are more likely to be unemployed or to hold underemployed positions that pay minimum wages that, conditional on the number of dependents in the family, may not be enough to cover living expenses between paychecks (Jiang et al., 2015). With respect to education attainment and substance consumption, parents in low-income families are less likely to hold a high school degree (Jiang et al., 2015; Ludwig et al., 2013) and are more prone to alcohol, tobacco, and/or substance dependence (Coley, Kull, Leventhal, & Lynch, 2014; Foster, 2000; Maring & Braun, 2006), both of which are factors typically associated with violence and crime (Ludwig et al., 2013).

Moving beyond their households, low-income students tend to grow up in neighborhoods or communities plagued with high poverty and crime rates, lower education attainment indices, higher health care issues and unemployment rates, and low overall housing quality (Ludwig et al., 2013; Rosenblatt & DeLuca, 2012; Sampson, 2012). Structurally, low-income children growing up in low-income neighborhoods are surrounded by other at-risk peers (Ludwig et al., 2013) and attend K-12 schools that reflect these structural barriers. This vicious cycle translates into access to low performing schools (Rosenblatt & DeLuca, 2012) that suffer from high teacher turnover resulting from a scarcity of resources at the district and school levels and overall poor working conditions (Ingersoll, Merrill, & Stuckey, 2014; Simon & Johnson, 2015). These high turnover rates in low-income schools imply that low-income students are typically taught by new teachers who do not necessarily have the work experience needed to develop effective teaching strategies, particularly those necessary for working in a low-income setting (Borman & Dowling, 2008; Simon & Johnson, 2015). Additionally, low-income schools present higher indices of crime that not only affect these students' odds of continuation but also make them more likely to be victims of crime and/or be the offenders themselves (Bowen & Bowen, 1999; Ludwig et al., 2013).

From a postsecondary access perspective, an important barrier to higher education faced by low-income students is that they rarely have access to quality guidance—or guidance at all—in the college preparation and selection process. Indeed, the student-to-counselor ratio usually reaches nearly 1000:1 in financially segregated zones with access to fewer resources and higher risk factors (Gandara, Alvarado, Driscoll, & Orfield, 2012; Haskins, Holzer, Lerman, & Trusts, 2009; McDonough, 2005; McDonough, Korn, & Yamasaki, 1997). In this view, it is clear that the structural inequalities experienced by low-income students systematically permeate all aspects of their young lives long before they have had any formal contact with the U.S. postsecondary system. Taking into consideration the systematic barriers just described, it is not surprising that even when considering only high-achieving students, low-income youth are eight times less likely to attend college than their higher income counterparts and more than twice as likely to attend a community college (Giancola & Kahlenberg, 2016).

It is worth noting that the disparities between community college students and four-year entrants, as described previously, are not merely a reflection of

socioeconomic inequality that translates into differing levels of access to quality K-12 schools that then mediate opportunities to attend college and academic performance during college (Gandara et al. 2012; Hauser, 1970; Martinez-Wenzl & Marquez, 2012). On the contrary, these discrepancies in two- and four-year students are also a reflection of the community college mission that is captured in its open-door policy, which indicates that “students neither need to compete for admission at a set time of the year nor demonstrate a level of academic proficiency to enroll” (Provasnik & Planty, 2008, p. 10). It is worth noting that 97% of all community colleges in 2013–2014 had such a policy. The corresponding proportion of public and private not-for-profit four-year colleges with open door admission policies in the same year were 17% and 12%, respectively (IPEDS, 2013). Unsurprisingly, this level of openness attracts students who either have no interest in pursuing a four-year degree (Berkner et al., 2008; González Canché, 2014a, 2014b) or have been excluded from the four-year sector (Kasper, 2003; Rendón, Novack, & Dowell, 2005) due to academic and financial challenges that may jeopardize eventual degree completion (Dietrich & Lichtenberger, 2015; Melguizo & Dowd, 2009; Goldrick-Rab, 2010; Provasnik & Planty, 2008). In this sense, one can conclude that four-year institutions prefer to exclude at risk students whereas community colleges take pride in including as many of them as possible (Kasper, 2003; Townsend, 1999). As such, community colleges more frequently expose themselves to an increased risk of ‘failure’ in helping students persist, yet are criticized for not helping these same students attain a bachelor’s degree at levels comparable to those of students who, for a variety of reasons (*e.g.*, monetary, academic, or both), begin college in the four-year sector.

From this perspective, the results summarized in Table 5.2 that have led many to conclude that community colleges decrease students’ opportunities for educational advancement overtly ignore the positive economic payoffs of community college attendance resulting from credits, degrees, and certificates attained in this sector. In this regard, it seems that claiming that two-year institutions are perpetuating stratification of opportunities for upward mobility may be wrong or, at the very least, incomplete. The fact that community college students attain similar monetary payoffs from their education even when compared to four-year entrants is remarkable and is a finding that has been ignored by critics of the two-year sector who depict this sector as an engine of inequality. Given the difficulties faced by low-income students, any social entity that is capable of providing students with the opportunity to escape the vicious cycle of poverty perpetuated by socioeconomic inequality should hold a valued and respected role in society. Unfortunately, this is not the case for community colleges. To the contrary, public two-year institutions continue to be underfunded and have historically received less state support than their public four-year counterparts while still enrolling higher numbers of students across states (Delta-Cost-Project, 2012; IPEDS, 2013). This considerably limited access to resources has translated into a constant decrease in full-time faculty (Delta-Cost-Project, 2012; González Canché, 2012) that reached all time low proportions in 2012 (34.25%). Consequently, students attending the two-year sector, who additionally tend to be academically vulnerable, are less likely to have access to full-time

faculty to help them develop the knowledge and skills necessary to continue education beyond the two-year sector or face the job-market (Fain, 2014; McClenney & Arnsperger, 2014).

Despite the barriers just described, the open-door admissions policy typical of the two-year sector continues to be perhaps the best approach to ameliorating socioeconomic inequality in U.S. society. Research has consistently shown that community college entrants, when compared to high school graduates, are in better socioeconomic standing and are in similar standing compared to four-year students. Decision-makers, then, should focus on both these democratizing- and socioeconomic-leveling functions of community colleges when making funding decisions that may lead to tuition increases in the two-year sector. This notion is noteworthy given that two-year institutions, despite receiving less state support, are constrained in terms of their ability to raise revenue from increases in tuition charges. A rather small increase in tuition amounts can render college attendance almost unaffordable to low-income students (Dynarski, 2002), whose most realistic option for attending college is through the community college sector. Thus, if these institutions raise tuition, the most affected students and citizens would be those in most need, on average, of financial aid. Lower levels of state and federal support combined with the inability to raise tuition prices may result in the need to cut admissions and as a consequence, the socioeconomic gap-closing effect of the two-year sector will also diminish. Support for the two-year sector, then, implies a commitment to those with the most financial need, an idea supported by the literature reviewed in this chapter. Any reduction in the socioeconomic gap will have positive externalities in the larger economy of any country, not just in the personal lives of low-income students benefiting from access to college.

5.3.3 Community Colleges' Role in (Inter)National Competitiveness

As mentioned before, federal-, state-, and city-level initiatives often intend to increase the community college sector's role as the starting point of post-secondary education. If the emphasis of such initiatives is placed on producing short-term credentials and vocational careers, then this increased presence of the community college sector is not problematic, as research has, to a great extent, indicated a positive effect for this sector on employment outcomes, wages, and lower ULCA accumulated, overall. However, if emphasis is placed on using the two-year sector as the 'gateway' to a baccalaureate degree, research suggests that this approach may be misguided in the absence of more structural changes. Indeed, in its current state, the negative effect of starting college in the community college sector has remained even after accounting for self-selection bias by incorporating sophisticated techniques into modeling specifications –with the caveats highlighted earlier in this chapter.

The analysis of the role of the community college sector in the economic well-being of the U.S. is not a trivial endeavor. Community colleges may not be systematically and purposefully demotivating or cooling-out students, but these institutions do nevertheless face barriers when it comes to helping students navigate undergraduate education. In addition to welcoming academically challenged students who usually must work to finance their education while enrolled, these institutions have more restricted access to resources compared to their four-year counterparts. For the community college to become a feasible gateway to a bachelor's degree, structural changes need to co-occur that extend beyond policies designed to make community college attendance free. Asking for more resources to be directed to the community college sector is rooted in strong evidence about the effective use of these funds in improving students' outcomes. For example, the City University of New York system has implemented a program called Accelerated Study in Associate Programs (ASAP) that focuses on providing intensive advising, tutoring, tuition waivers, money for books, and transportation for students. A study of its effects, conducted by Scrivener et al. (2015), followed almost 900 students, half of which participated in ASAP. These authors found that ASAP students doubled their likelihood of receiving an associate's degree (40% versus 22%) within three years of initial enrollment and were 8% more likely to have transferred to the four-year sector (25% versus 17%). This finding is similar to that reported by Barrow, Richburg-Hayes, Rouse, and Brock (2014), who conducted a random experiment where initial scholarship eligibility criteria (before randomization occurred) included being low-income and having children. This experiment took place on three campuses, and Barrow et al. (2014) consistently found that over a 2-year period, randomly selected treatment students completed nearly 40% more credits than their non-selected counterparts. Finally, Scott-Clayton (2011) also found that a merit scholarship combined with performance incentives conditional on grades and credits earned increased two-year students' likelihood of attaining a 4-year degree. Despite these encouraging reports, important setbacks continue to occur. Arizona, for example, completely cut funding for two of its largest community college districts (Smith, 2015). Although these institutions (one of which serves 265,000 students) have stated that no tuition increases will take place in the short run, the question remains whether, or how long, they can continue to survive.

Community colleges with limited resources have helped millions of students to improve their socioeconomic well-being, but for the U.S. to maintain its international competitiveness, short-term degrees may not be enough. Four-year degrees may indeed be essential for the U.S. to remain a relevant economic competitor internationally. Recent research on students who successfully became rising juniors (*i.e.*, successfully transferred from the two- to the four-year sector) and on vertical co-enrollment has highlighted factors facilitating the academic success of these students. In this view, a better articulated transfer path or immersion of two-year students in the four-year sector may be valid options that increase these students' odds of academic success.

5.3.4 *A More Structured Pathway*

Past research (Rosenbaum, Deil-Amen, & Person, 2007) has indicated that low-income students in the community college sector usually feel overwhelmed by the variety of choices they face when it comes to selecting classes. This feeling is not only the result of the actual multiplicity of choices available at most community colleges but is also likely due to structural issues that began during high school where the student to counselor ratio usually reaches nearly 1000:1 in low-income areas (McDonough, 2005). Among students attending these high schools, those who are able to enroll in the local community college tend to be first generation college students. Consequently, their parents are usually not prepared to offer academic guidance. Given that state appropriations are in constant decline and that community colleges benefit the least from these resources, expanding the number of community college counselors on which students can rely to make informed decisions may not be a feasible option. A more cost-effective approach would be to offer community college students access to more structured plans of study to navigate the first two-years of college with a clear route to attaining an associate's degree and/or transferring to a four-year degree.

With a structured route, curricula may be designed to guide students to academic pathways that will be beneficial to the U.S.'s prospects of remaining a competitive force in knowledge and scientific production. For example, given the importance of STEM fields, plans of study that lead students to pursue a STEM degree may be a more affordable option (compared to hiring more counselors to communicate these paths to students individually) that may result in shorter times to degree and in greater likelihood of scientific production and economic growth for the country.

5.3.5 *Looking at the Role of Place in Community College Student Outcomes*

A common omission across all the studies reviewed in this chapter entails the effect of location on the assessment of community college effects. Although the estimates obtained in the assessment of ULCA variation included state- and county-level indicators, model specification did not control for other space-based effects given community colleges' proximity to four-year institutions. More specifically, considering that researchers have demonstrated that local availability of college options positively influences students' likelihood to apply to and enroll in college, future studies should begin exploration of whether the *local availability* of four-year institutions is associated with higher likelihood of four-year degree attainment by initial two-year/community college entrants.

More specifically, studies of community college effects should prioritize examination of factors that may serve as mechanisms that would bolster the "stepping stone" function of community colleges toward the attainment of a four-year degree, better

employment outcomes, and lower ULCA. One such factor comes from the notion of universities as “engines of growth” or “regional boosters” taken from the urban economics and public policy literatures (Florax, 1992; Florax & Folmer, 1992; Gilbert, McDougall, & Audretsch, 2008; Henderson, 2007; Lucas, 1988; Wallsten, 2001). Following this notion, it may be hypothesized that that *local availability* of four-year institutions may be associated with higher likelihood of four-year degree attainment by initial two-year/community college entrants. This hypothesis formalizes assessment of whether students attending community colleges situated within commuting distance from four-year institutions realize higher levels of educational attainment than comparable two-year entrants without nearby four-year options. While this notion is straightforward, more than forty years of research on community college students’ outcomes have not yet tested its validity. Future research that accounts for the geographic locations of institutions of higher education is needed to assess the feasibility of innovative ways in which academic (and eventually socioeconomic) gaps due to initial college sector of attendance in the United States may be reduced.

Once again, the set of covariates identified and used in this chapter contained in Table 5.4 can be used for model specification. The only methodological challenge involved in the testing of this hypothesis is the successful identification of community colleges that have four-year neighbors within *commuting distance* and community colleges without such neighbors. This is challenging given that no previous framework exists to guide the operationalization of *commuting distance* between two- and four-year institutions. However, previous literature provides two operational and conceptual definitions of *commuting distance* for sensitivity and robustness checks that may be applied in future research. The first definition of commuting distance is taken from Rapino and Fields (2013), who estimated that commuters in the U.S. typically travel 18.8 miles to work each way (margin of error = $(+/-)$ 0.01). While this definition is straightforward, it is important to consider that commuting distances differ in rural and non-rural areas given the longer distances usually traveled in the former. In this regard, Turley (2009) estimated that students who lived in rural areas typically commuted twice the distance traveled by students living in non-rural areas. This finding was based on the median commuting distance of students living at home during college, taken from a nationally representative sample. In this study, Turley (2009) found that students commuted a median distance of 12 and 24 miles to school in non-rural and rural locations, respectively. Accordingly, a first definition of commuting distance, following Rapino and Fields (2013), that may be used in future research allows for a maximum distance of 20 miles in non-rural and 40 miles in rural locations to identify community colleges with and without four-year neighbors. Following Turley (2009), a second possible, more conservative, definition of commuting distance accounts for a maximum travelling distance of 12 and 24 miles in non-rural and rural areas, respectively. A visual representation of both definitions of commuting distance is shown in Fig. 5.8.

The concept of spillover effects with respect to four-year institutions argues that colleges and universities generate human capital spillovers (Henderson, 2007; Lucas, 1988), thus implying that students attending community colleges in close proximity to four-year institutions may be systematically different in their

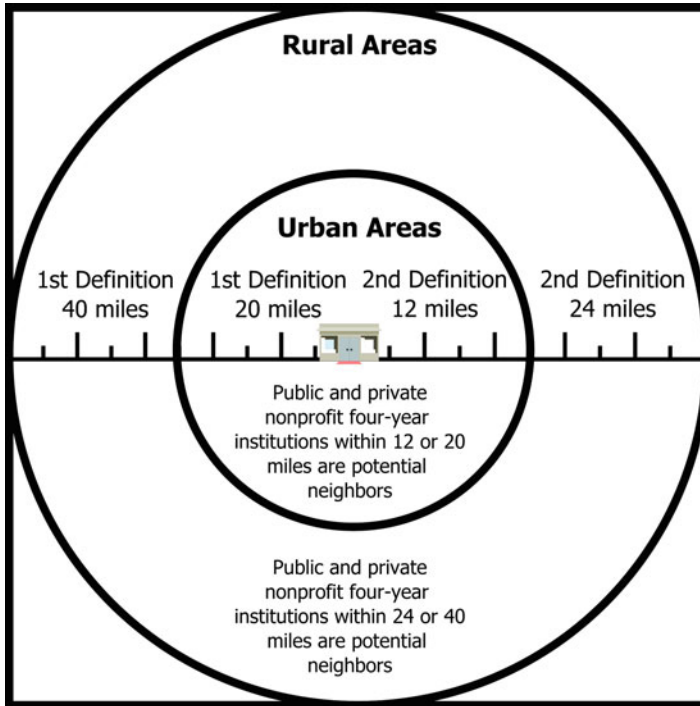


Fig. 5.8 Logic model followed to identify the presence of neighboring four-year institutions across rural—24 (Turley, 2009) or 40 mile (Rapino & Fields, 2013) radii—and non-rural areas—12 (Turley, 2009) or 20 mile (Rapino & Fields, 2013) radii. In all specifications, the definition of rural area was taken from the U.S. Department of Agriculture Economic Research Service under the 1993 and 2003 Rural-Urban Continuum Codes forms, classification schema. The criterion to define rural area was having a population of 2500 to 19,999, not adjacent to a metro area (U.S. Department of Agriculture Economic Research Service, 2013). The use of the 1993 and 2003 classifications schemes mentioned above may be used to approximate time of enrollment captured in NELS, BPS, and ELS surveys, for example. The implementation of the logic models relied on geographical information systems techniques. To test for potential effect heterogeneity given sector of four-year neighbors, models can or should examine public and private non-profit four-year neighbors separately. Subsequently, the two sectors may be considered together in a single model that incorporates sector as a predictor variable. Institutional characteristics of the neighboring institutions should also be incorporated in modeling estimations. For more information about this process and preliminary findings see González Canché, M. S. (2017b).

individual- and local-economy attributes when compared to students attending community colleges without four-year neighbors. Geographical stratification (Liu, 2015) suggests that these differences are based on greater resources given students' location. Although the literature on community colleges indicates that students tend not to choose one particular community college over another but rather attend

whichever community college is closest to their location, there remains a non-zero probability that some community college students with expectations of attaining a four-year degree select an institution for additional reasons. Consequently, while some community college students enroll in institutions with four-year neighbors by “default,” other students may enroll in community colleges with four-year neighbors strategically. From either perspective, it may be that students attending two-year institutions within commuting distance from four-year colleges differ systematically in their access to resources and sources of support compared to students attending community colleges without four-year neighbors. Consequently, models should test for systematic differences across participants using empirically and theoretically relevant variables taken from studies of sector effects on student outcomes that capture individual, geographic, socioeconomic, and academic resources during high school (as indicated in this chapter) before inferential claims are made.

While model identification and estimation is beyond the scope of this chapter, the operationalization of the logic model presented in Fig. 5.8 has been completed while relying on Geographical Network Analysis principles (González Canché, 2018) across the two datasets included in this chapter (NELS and ELS). Table 5.5 shows the empirical distribution of institutions identified following the logic model by urbanity and neighboring statuses. It also reflects the representation of this universe

Table 5.5 Distribution of institutions identified following the logic model by urbanity and neighboring statuses

	Rural area		Non-rural area		Total.		Π with respect to total ^a	
	24	40	12	20	12 & 24	20 & 40	12 & 24	20 & 40
IPEDS universe								
CC neighbor	5	17	371	472	376	489	–	–
CC no neighbor	86	74	442	341	528	415	–	–
Four-year neighbor	4	12	317	379	321	391	–	–
Four-year no neighbor	37	29	259	197	296	226	–	–
Total	132	132	1389	1389	1521	1521	–	–
ELS sample								
CC neighbor	2	5	296	368	298	373	.793	.763
CC no neighbor	34	31	265	193	299	224	.566	.540
Four-year neighbor	3	9	293	344	296	353	.922	.903
Four-year no neighbor	24	18	210	159	234	177	.791	.783
Total	63	63	1064	1064	1127	1127	.741	.741
NELS sample								
CC neighbor	2	6	233	293	235	299	.625	.611
CC no neighbor	35	31	234	174	269	205	.509	.494
Four-year neighbor	4	9	260	315	264	324	.905	.829
Four-year no neighbor	27	22	225	170	252	192	.850	.850
Total	68	68	952	952	1020	1020	.671	.671

^aΠ with respect to total refers to the ratio of the total of ELS and NELS samples and the corresponding IPEDS universe

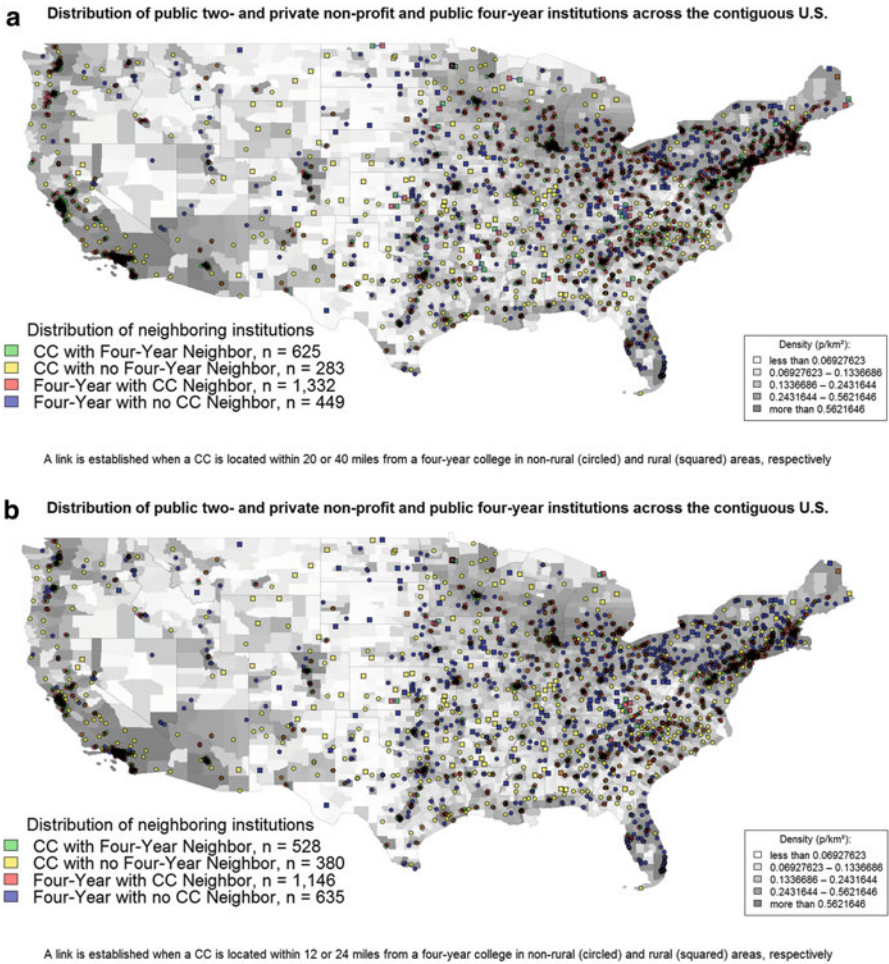


Fig. 5.9 Empirical representation of the logic model across the contiguous U.S.A., public and private non-profit four-year institutions (a) Empirical representation of 1st definition (20/40 miles), (b) Empirical representation of 2nd definition (12/24 miles) (Source IPEDS, 2013)

in the ELS and NELS samples. Overall, note that ELS captured 74% of the total universe across the contiguous US, whereas NELS captured 67%. The geographical identification of these institutions is presented in Fig. 5.9.

The incorporation of location in the analysis of community college effects is relevant for several reasons. First, although community colleges are certainly not at liberty to select the distance from their closest four-year neighbors, if the hypothesis of this new line of study presented here is corroborated, then recent high school graduates who are considering beginning college in a public two-year institution should be informed about the positive relationship between four-year proximity and better student outcomes. For students who expect to use the two-year sector as the

pathway toward a four-year degree, this information should translate into a stronger likelihood of improving their transfer and eventual four-year graduation prospects. If this hypothesis is not confirmed, then transfer agreements between neighboring two- and four-year institutions may need to be assessed or reassessed as empirical evidence would point to ill-functioning implementation or even absence of these agreements based on geographic proximity. In addition, students who may consider attending two-year institutions with four-year neighbors under the assumption of positive externalities, should be made aware of the lack of relationship between four-year neighbor presence and improvement in educational outcomes.

This line of research is also relevant given the population studied. As community colleges clearly play a central role in the early formation of college students in the U. S., particularly among low-income and minority students, the study of additional factors that may positively affect these students' odds of academic success should be a national priority. For the U.S. to remain economically competitive, the role of the community college as a stepping stone toward a four-year degree will need to be strengthened as well. Knowledge is power, and people could be empowered by the findings of the research proposed here.

5.3.6 Challenges and Opportunities in the Use of Big Data in Higher Education Policy

The availability of large amounts of information along with increases in computing power have prompted the need to develop innovative ways to collect, prepare, analyze, and visualize data whose level of dimensionality (in terms of number of units or participants [rows] and number of variables or indicators [columns] in a data frame) is traditionally referred to as “big data.” The present chapter highlighted opportunities related to the use of big and geocoded data in higher education analysis with clear policy implications. Notably, the mere analysis of big data does not warrant that results have relevant and/or timely implications from policy- and/or decision-making perspectives. In this view, analysts should consider the following challenges and opportunities when dealing with big data that may threaten the policy relevance resulting from analysis conducted in higher education research. These challenges, which the analytic framework employed in this chapter aimed to address, are the following: (a) big data and sophisticated methods *without relevant research questions* constitute a wasted opportunity, (b) when possible researchers should incorporate more than one analytic sample as validity and robustness checks, (c) researchers should prioritize testing for effect heterogeneity, and (d) researchers should rely on critical lenses that aim at reducing inequality of opportunities and the dismantlement of reproduction of vicious circles. Each of these challenges guided the analytic framework implemented herein.

Another important challenge consists of training [higher] education researchers in the critical analysis of big data that prioritize policy relevance and disruption

inequalities. In this view, the message is clear: given the availability of large amounts of data, graduate programs in education should continue investment in the development of researchers' critical-analytic skills. This training will not only make them more marketable, but will also benefit the field in general.

5.4 Conclusions Related to the Educational, Occupational, and ULCA Outcomes of Community Colleges

Based on the comprehensive analysis of the literature surrounding two-year students' outcomes in terms of salary and wage gains presented herein, it was concluded that the two-year sector does indeed have a democratizing function in U.S. society by improving students' prospects of becoming socioeconomically independent and self-sufficient. In this view, it is worth noting that while higher education is a worthwhile investment for all, this investment is perhaps even more important for the type of students historically served by the two-year sector. Nonetheless, despite this democratizing function in terms of economic gains, the community college has yet to become a likely gateway to a bachelor's degree. Considering that competition for science and technology development continues to tighten across the world, short-term degrees will not be enough for the U.S. to remain competitive in science, technology, and knowledge production worldwide. Accordingly, structural changes and strategies need to co-occur that extend well beyond making community college attendance free.

The role of the community college has clearly been, and will remain, an important component in the reduction of socioeconomic inequality in the United States. Similarly, this sector has great potential to advance U.S. college completion rates in that, with additional funding and better-structured pathways from the two- to four-year sectors, it may play a pivotal role in the production of four-year degree holders in economically important fields such as science and technology in the future. However, the reality is that the two-year sector continues to be underfunded and undervalued. Therefore, in its current state, this sector is unable to live up to its full potential due to lack of financial resources and lack of effective mechanisms to facilitate the transfer of students from the two- to the four-year sector. It is worth noting that the reinforcement of the democratizing function of the public two-year sector requires at least three actions: (a) the provision of additional funding at both the federal and state levels, (b) more research to examine how both two- and four-year institutions may improve successful transfer from the two- to the four-year sector, thus promoting eventual attainment of a four-year degree, and (c) a renewed recognition of this sector's socioeconomic gap-closing role among underserved communities in the United States. The results of the study presented in this chapter overwhelmingly show that when the outcomes of students with similar levels of academic attainment and divergent academic trajectories are analyzed, community college students accrued less debt than their private non-profit counterparts. This

lower cost of community colleges in terms of ULCA provide yet another piece of evidence of the democratizing function of this sector.

The two-year sector additionally seems to be a better option for students who are less likely to obtain a bachelor's degree. Accordingly, if four-year "eligible" students with lower probabilities of four-year degree attainment are recommended to start in the two-year sector, such suggestions should not be understood as a cooling-out function (Clark, 1960a). Ideally two- and four-year sector articulation agreements should be strengthened along with transfer support services. Indeed, if students' economic and social well-being is prioritized, transfer out initiatives should emphasize that the attainment of an Associate's degree (or at least certificate/diploma) is mandatory before being eligible to transfer to the four-year sector. If students who transferred find that the four-year sector is not for them and decide to leave, they would at least have a credential (and the knowledge and skills associated with it) to facilitate employment opportunity.

Although structural changes need to take place for the community college to serve as an effective stepping stone toward the attainment of a four-year degree, studies indicate that this sector continues to serve as a socioeconomic gap-closing mechanism. Future studies need to incorporate geographic data and network analysis as means to detect structural mechanisms that would enable two-year entrants to navigate college with greater likelihood of success. In addition, predictive analytics and probabilistic matching procedures should be implemented to detect students' expected outcomes before such outcomes take place. These procedures should not be considered as "cooling out functions" in the big and geocoded data era when indicating that some students would be better served by beginning college in the two-year rather than the four-year sector. To the contrary, recommendations based on unbiased analyses should serve as mechanisms designed to prevent academic failure with an increased debt burden (e.g., failing to attain any degree or credential and accumulating debt burden). Notably, even in cases in which students attained less-than-a-four-year credential, enrollment in the two-year sector was associated with significant reductions in debt burden. Indeed, evidence indicates that for students with no degree or an associate's degree (or equivalent), reduction in debt burden would have been maximized by beginning college in the two-year sector. Analyses that highlight the democratizing role of the two-year sector should not only consider educational attainment but also students' prospects of financial well-being and sustainability. The two-year sector has been thriving in the latter, but more work is required to succeed in the former.

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