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How and Why Does Two-Year College Entry Influence Baccalaureate Aspirants' Academic and Labor Market Outcomes?

A CAPSEE Working Paper

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Abstract

Using detailed administrative data from Virginia, this paper examines how and why the community college pathway to a baccalaureate influences students' degree attainment and short-term labor market performance. We find that the community college pathway sharply reduces the likelihood of earning a bachelor's degree but does not have a significant impact on students' short-term labor market performance. We examine various mechanisms that may stand in the way of students' baccalaureate completion: the impacts of two-year attendance on early academic progress, the logistical challenges inherent in selecting and enrolling in a four-year transfer destination, the loss of credits at the point of transfer, and post-transfer academic "shock." Our results suggest that the primary culprit is that many otherwise successful community college students never enter a four-year transfer destination. Among students who do transfer, their probability of baccalaureate attainment and their short-term labor market performance are comparable to those of native four-year students. After taking into account the lower costs of community college attendance, our cost-benefit analysis finds that two-year entrants fare as well as or better than four-year entrants, at least in the short run (eight years after college entry).

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1. Introduction

Each year, community colleges provide a key point of access to postsecondary education for millions of low-income and ethnic minority students. Over half of low-income students, approximately half of Hispanic students, and about one third of African American students begin their college careers at a two-year institution (Berkner & Choy, 2008; National Center for Public Policy and Higher Education, 2011). In addition to the attractions of community colleges' open-admissions policies and flexible scheduling options, many students who aspire to a bachelor's degree may be drawn by the relative bargain of community college costs. In 2014–2015, public two-year colleges' tuition and fees averaged only $3,347, compared with an average in-state rate of $9,139 for public four-year colleges. In addition, most potential students live in close geographic proximity to at least one community college, allowing them to avoid an average of $9,804 per year in room and board charges (Baum & Ma, 2014). Thus, an aspiring bachelor's degree student who spends two years attending community college might reasonably expect to save over $30,000 on the total cost of a bachelor's degree.

Despite these up-front savings, however, it remains unclear whether community colleges represent the most cost-effective pathway to earning a bachelor's degree (and to reaping the labor market benefits conferred by that degree). While the vast majority of community college entrants—an estimated 81 percent—aspire to transfer to a four-year college and earn a bachelor's degree or higher, only 6 percent manage to do so within five years (Horn & Skomsvold, 2011). As a result, community college entrants may fare more poorly in the labor market in comparison to similar students who began in the four-year sector (Miller, 2007).

In this paper, we examine how and why the community college pathway to a baccalaureate influences students' degree attainment and short-term labor market performance, using detailed administrative data from Virginia. We use propensity score matching to compare the outcomes of aspiring baccalaureate students who enter the two-year and four-year sectors. Consistent with previous literature, we find that the community college pathway sharply reduces the likelihood of earning a bachelor's degree but does not have a significant impact on students' short-term labor market performance. We examine various mechanisms that may contribute to lower baccalaureate completion among these students, including the impacts of two-year attendance on early academic progress, the logistical challenges inherent in selecting and enrolling in a four-year transfer destination, the loss of credits at the point of transfer, and post-transfer academic "shock." Our results suggest that the reduced likelihood of baccalaureate completion is driven primarily by the fact that many otherwise successful community college students never enter a four-year transfer destination. Among students who do transfer, their probability of baccalaureate attainment and their short-term labor market performance are comparable to (or, in some model specifications, even better than) those of "native" four-year students. After taking into account the lower costs of community college attendance, our cost-benefit analysis finds that two-year entrants fare as well or better than four-year entrants, at least in the short run (eight years after college entry).

2. Literature Review

In our review of previous evidence on the community college pathway to the baccalaureate, we first discuss how baccalaureate-seeking community college students differ from native four-year college students. We then discuss studies on the academic and labor market impacts of initiating a baccalaureate in the two-year versus four-year sector. Finally, we discuss potential mechanisms that may contribute to these impacts.

The Differing Profiles of Baccalaureate Seekers Who Enter Two-Year Versus Four-Year Colleges

Data from the National Education Longitudinal Study (NELS) (Alfonso, 2006) suggest that baccalaureate aspirants who enter community college are more likely to be Hispanic, to be of lower socioeconomic status, to have lower high school math and reading performance, and to be married or have a child at first college enrollment, compared with those who enter directly into four-year colleges. The initial enrollment patterns of community college entrants are also quite different: They are more likely to delay their initial college enrollment, less likely to enroll full-time, and more likely to enroll in remedial education. Such differences are not necessarily unexpected, given that the four-year college sector includes highly selective elite universities, while the community college sector is composed entirely of nonselective institutions.

In order to create more comparability between the background characteristics of baccalaureate seekers entering two-year versus four-year colleges, two recent studies limited their focus to less selective institutions. Using administrative data from Ohio, Long and Kurlaender (2009) restricted their sample to students who indicated an intent to earn a bachelor's degree, first enrolled between the ages of 17–20, took the ACT, and initially attended either a public two-year college or a nonselective public four-year university. Within this more homogenous subset, community college students were only modestly different from university students in terms of high school grades and ACT test scores (for example, their ACT math scores were 19.2 and 20.5, respectively). However, community college students were still less likely to enroll full-time (56 percent versus 67 percent) and more likely to enroll in remediation, particularly in math (46 percent versus 27 percent).

Taking a similar approach, Monaghan and Attewell (2015) limited their Beginning Postsecondary Students (BPS) Longitudinal Study dataset to financially dependent students attending either community colleges or nonselective or minimally selective four-year institutions who enrolled full-time in their first semester, who were enrolled either in a bachelor's or associate degree program, and who aspired to a bachelor's degree or higher. Within this sample, the two- and four-year entrants were similar in terms of income and wealth; however, community college entrants had lower levels of parental education (e.g., 34 percent had a parent with a bachelor's degree, versus 48 percent of four-year entrants), lower levels of high school mathematics course-taking (28 percent, versus 43 percent of four-year entrants, took precalculus

or calculus in high school), and lower SAT scores (a larger proportion of community college entrants did not take the SAT, and among those who did, their average combined score was 922, versus 976 among four-year entrants).

The tactic of eliminating from the sample those students who entered selective four-year colleges may seem a reasonable one, as the modal student at a selective college is quite different from the modal community college student. However, this tactic also assumes little to no overlap between community college baccalaureate aspirants and selective college entrants. The studies discussed above did not examine this assumption, but if such overlap exists, it may be more appropriate for researchers to include selective college students and then apply methods such as propensity score matching to ensure strong comparability between two- and four-year college entrants on background characteristics.

Overall, while baccalaureate seekers who enter community college are much more similar to nonselective four-year college students than they are to selective university students, they may still have lower levels of academic preparation, and they may also be more likely to enroll part-time and to enroll in remedial coursework. The extent to which these enrollment patterns are a cause as opposed to a consequence of choosing the two-year sector is unclear—an issue which we discuss in more detail in Section 4.

The Academic and Labor Market Impacts of Initiating a Baccalaureate in the Two-Year Sector

Studies comparing two- and four-year entrants in terms of educational attainment have found that two-year entrants are much less likely to earn a bachelor's degree (Alba & Lavin, 1981; Alfonso, 2006; Anderson, 1981; Brand, Pfeffer, & Goldrick-Rab, 2012; Breneman & Nelson, 1981; Doyle, 2009; Leigh & Gill, 2003; Miller, 2007; Rouse, 1995; Stephan, Rosenbaum, & Person, 2009; Velez, 1985; Wang, 2012). However, most studies either do not control for educational aspirations (thus including many community college students who have no desire to transfer or earn a baccalaureate) or do not control for four-year college selectivity (thus including many four-year students who are highly dissimilar from community college entrants).

Using NELS data, Reynolds (2012) demonstrated that by restricting the analytic sample to baccalaureate seekers at less selective colleges, the estimated negative impact of two-year college entry was sharply reduced; however, even in the restricted sample and with the use of propensity score matching, the percentage of two-year entrants who earned bachelor's degrees within approximately eight years was nearly 25 points lower than that of four-year entrants. Using similar restrictions and a propensity score matching approach, Monaghan and Attewell (2015) found that two-year entrants' six-year bachelor's degree attainment rates were nearly 17 percentage points lower. Similarly, Long and Kurlaender (2009) found that two-year entrants' nine-year bachelor's attainment rates were 21 percentage points lower under propensity score matching, and 15 percentage points lower under an instrumental variable (IV) approach.

Among community college students who successfully transfer to a four-year college (known as "vertical transfer"), the probability of earning a bachelor's degree seems fairly comparable to that of native four-year students (Bowen, Chingos, & McPherson, 2009; Glass & Harrington, 2002; Jones & Lee, 1992; Lee, Mackie-Lewis, & Marks, 1993; Melguizo & Dowd, 2009; Melguizo, Kienzl, & Alfonso, 2011; Monaghan & Attewell, 2015). However, each study's definition of a successful vertical transfer student is somewhat idiosyncratic, For example, Melguizo and Dowd (2009) required that vertical transfer students earn more than 10 credits at their four-year transfer destination; Melguizo, Kienzl, and Alfonso (2011) required that they first earn at least 59 college-level credits at community college; and Monaghan and Attewell (2015) required that they first earn 48 credits. Such sample restrictions are likely to distort the representativeness of the transfer student population. For example, Monaghan and Attewell found that only 47 percent of students who transferred from a community college to a four-year college earned 60 or more credits prior to transfer. Similarly, another study that used college administrative data from the public higher education system in one state found that vertical transfers earned an average of 39 community college credits (Crosta & Kopko, 2014), and a study using Los Angeles data found that such students earned an average of 27 community college credits (Melguizo, Hagedorn, & Cypers, 2008). Accordingly, a restriction similar to Melguizo, Kienzl, and Alfonso's might remove half of the vertical transfer population from analysis. In addition, Monaghan and Attewell's analysis excluded the more than 80 percent of four-year entrants who attended selective four-year colleges. If a sizeable proportion of vertical transfer students attend a selective four-year institution, then such a sample restriction would not necessarily result in better matches.

Whether or not vertical transfer students perform similarly to native students after transfer, it is clear that many baccalaureate-seeking community college entrants never make the transition to a four-year college in the first place. Accordingly, it would be unsurprising if two-year entrants also fared more poorly in the labor market than four-year entrants. Evidence on this point, however, is mixed. Using the restricted sample and propensity score matching, Reynolds (2012) found no labor market penalty for two-year entrants at approximately age 25, which may indicate that some two-year entrants earned vocational associate degrees with high short-term labor market payoffs. In contrast, using an administrative dataset from Texas with an IV approach, Miller (2007) found a strong labor market penalty ($1,449 per quarter) for two-year entrants at approximately ages 27 to 29.

Other studies examining the labor market impacts of initially enrolling at a two-year college have limited their focus to students who ever transferred to, or graduated from, a four-year college. Among these more selective populations, two-year entrants seem to suffer little to no labor market penalty (Hilmer, 2000; Leigh & Gill, 2003; Light & Strayer, 2004; Miller, 2007). Indeed, one study suggests that baccalaureate students' labor market outcomes are driven almost entirely by the quality of institution from which they received their degree, and that first attending a two-year college may allow students to select higher quality universities than they could have otherwise, with the largest quality increases observed for students who came from

poor families or performed poorly in high school (Hilmer, 1997). On the other hand, two studies suggest that the longer eventual baccalaureate-earners stay at a two-year institution, the less likely they are to reap the full labor market rewards that would be typical for a graduate from their four-year university (Brown & Xia, 2014; Hilmer, 2000).

In one exception to the general pattern of minimal labor market penalties for vertical transfers, Brown and Xia (2014) analyzed NELS data using both OLS and IV approaches based on distance to the nearest four-year college, and found nonsignificant or small negative estimates using OLS but large and significant labor market penalties using IV (with point estimates implying a 27–29 percent reduction in hourly wages). However, Miller (2007) suggests that the use of an IV strategy based on distance may be inappropriate in this context, as high-quality job opportunities may be thicker in geographic areas close to four-year colleges and universities. In particular, when including county-level median household earnings in a distance-based IV model, Miller found no significant labor market penalty for baccalaureate earners from the two-year sector; however, when excluding the county-level earnings measure, the model yielded "nonsensical" estimates. Excluding the Brown and Xia study, then, the previous literature suggests that successful vertical transfer students, particularly those who transfer to a four-year college quickly, have labor market outcomes that are fairly similar to those of native four-year students.

Only one study has performed a cost-benefit analysis combining data regarding the likelihood of transfer, eventual graduation, and resulting labor market outcomes with information regarding the costs of college attendance in the two- and four-year sectors. In his NELS study, Reynolds (2012) estimated college costs based on the average published costs (for community colleges and public four-year colleges separately) for the state in which each student resided during his or her senior year of high school, and estimated lifetime earnings based on census data (using the averages for male and female bachelor's degree earners versus individuals with some college but no degree). He concluded that the lower costs of community college attendance are offset by the decreased likelihood of earning a bachelor's degree and the accompanying reduction in lifetime earnings.

Potential Mechanisms

In the literature, four mechanisms have been cited as potential reasons why baccalaureate aspirants may fare more poorly if they choose to enter a two-year rather than four-year college: (1) two-year colleges may have a negative impact on students' early academic progress; (2) students may have difficulty navigating the challenges inherent in selecting and enrolling in a four-year transfer destination, (3) students may lose credits at the point of transfer, and (4) vertical transfers may suffer from post-transfer academic shock. We discuss each of these mechanisms in more detail below.

First, of the studies concluding that two-year entrants are less likely to earn a bachelor's degree, most assume that the underlying mechanism is a "diversionary" impact of community

college attendance (e.g., Brand et al., 2012; Leigh & Gill, 2003; Rouse, 1995). Popularized by Brint and Karabel (1989), the diversion hypothesis suggests that community colleges draw potential four-year college attendees into the two-year sector, where those students' educational outcomes are negatively impacted. For example, community colleges have fewer resources for academic and nonacademic student supports than do four-year public institutions (Desrochers & Hurlburt, 2014), which could lead to poorer grades and term-to-term persistence for their students. Similarly, few community colleges offer the option of on-campus residence, making it more difficult for community college students to engage in extracurricular activities and otherwise socially integrate into campus life, which is thought to have a negative impact on persistence (Choy & Gifford, 1990; Pascarella & Chapman, 1983; Pascarella & Terenzini, 1991; Tinto, 1975, 1987).

In addition, aspiring baccalaureate students who choose to enter the two-year sector seem to encounter different requirements and supports in terms of remediation, given that the high rate of math remediation for community college students is out of proportion to the small difference in academic preparation between matched community college and four-year students (Long & Kurlaender, 2009; Monaghan & Attewell, 2015). Recent studies suggest that remediation is unnecessary for many students who receive it, and that it tends to divert students from college-level coursework, resulting in fewer college-level credits earned (Scott-Clayton, Crosta, & Belfield, 2014; Scott-Clayton & Rodriguez, 2012). Accordingly, students with marginal levels of math preparedness may accrue more college-level credits if they enter a four-year rather than a two-year college, simply by virtue of skipping math remediation. Similarly, two- and four-year entrants could encounter different policies or incentives in terms of carrying a full credit load (30 credits per year), such as the college's financial aid packaging, advising practices, or general cultural expectation of full-time attendance (cf. Klempin, 2014; Long & Kurlaender, 2009). If indeed four-year colleges' cultural or policy environment tends to encourage a heavier credit load, then community college students could quickly begin to lag behind their four-year peers in terms of college credit accrual.

If, in the early stages of their college career, two-year students are less likely than similar four-year students to persist and accrue college-level credits, then their loss of "academic momentum" will reduce their likelihood of eventual degree attainment (Adelman, 2006; Attewell, Heil, & Reisel, 2012; Calcagno, Crosta, Bailey, & Jenkins, 2007). In addition, students may recalibrate their expectations for themselves and begin to aim for sub-baccalaureate credentials and degrees, rather than transferring to a four-year institution and continuing the pursuit of a bachelor's degree (Clark, 1960, p. 574).

Despite the underlying assumption of a diversionary mechanism, few studies comparing two- and four-year students' eventual outcomes have explicitly examined the hypothesis that community colleges have a negative impact on early academic outcomes. An early study using data from the National Longitudinal Study of the High School Class of 1972 (NLS-72) (Anderson, 1981) indicated that two-year college students had a 5 percentage point higher dropout rate at the end of their first year, and a 14 percentage point higher dropout rate by the

end of their second year, compared with four-year college students. Although the study was well controlled in terms of student background characteristics, it included selective four-year colleges in the comparison. It also included all students who entered academic programs in the analysis, and classified those who switched from an academic to a vocational track as dropouts. More recently, Monaghan and Attewell's (2015) BPS study found that community college entrants and their similar four-year peers had similar outcomes across their first two years in terms of term-to-term persistence, credits attempted, percentage of attempted credits completed, and overall cumulative credits, before those outcomes started to diverge in their third year.

A second potential mechanism has been surfaced by a variety of qualitative studies, which document that community college students find the logistical operation of selecting and transferring to a four-year school to be frustrating and bewildering (Jaggars & Fletcher, 2014; Kadlec & Gupta, 2014; Kadlec & Martinez, 2013; Public Agenda, 2012). For example, at one large comprehensive community college, students had difficulty finding useful and accurate information about transfer options for a given field of study, in part because of breakdowns in communication between area four-year schools and the community college. As one student recounted,

> [The college's advising staff] have helped me out a lot. But they still confuse me when I go down there sometimes, because they all tell me different things. Like one time, someone told me that [transfer school] had a dental hygiene program. And then I went there a couple weeks ago, and she was like, "I've never actually heard of that," and she tried pulling it up, and it wasn't there. So I don't know—I don't know what happened there. But that was just confusing and just—I don't know. (Jaggars & Fletcher, 2014, p. 16)

In contrast, for students at four-year colleges, persisting into the junior year is a relatively straightforward process, requiring no new research about options, no new cost-benefit calculations, no new college and financial aid applications, and no geographic relocations (Dougherty, 1994). Given the logistical work required to navigate the vertical transfer process, it is unsurprising that many academically successful community college students opt not to transfer (Monaghan & Attewell, 2015).

Third, among students who do eventually enroll at a four-year school, one key barrier to success may be a loss of credits at the time of transfer. In their BPS study, Monaghan and Attewell (2015) found that, for 14 percent of vertical transfer students, the four-year institution accepted almost none of their community college credits, while for only 58 percent of students did the four-year college accept almost all of their credits. Moreover, credit loss impacted students' likelihood of graduation. Those who transferred most or all of their credits had 2.5 times greater odds of graduating within six years than those who transferred less than half of their credits (Monaghan & Attewell, 2015). In addition to credit loss, many students may also suffer from excess credit requirements; although many states have policies requiring public four-

year colleges to accept an agreed-upon set of credits from the state's community colleges, most agreements do not guarantee that these credits will apply to the student's intended major. For example, a student's math course may transfer only as a general education or elective credit, requiring the student to take another similar math course to fulfill major requirements (Bailey, Jaggars, & Jenkins, 2015). Due to either credit loss or excess credit requirements, vertical transfer students may need more time to complete their bachelor's degree than native four-year students. For example, using an administrative dataset from Texas that controlled for a rich set of individual and college-level characteristics, Cullinane and Lincove (2014) examined four-year college enrollees and found that those who began in the two-year sector were much less likely to graduate on time, but only slightly less likely to graduate within six or seven years.

Fourth, Hills (1965) advanced the hypothesis that vertical transfer students can suffer from transfer shock—that is, because the cultural or academic expectations of their new environment are quite different from those of the community college, vertical transfer students may perform poorly or drop out. And indeed, some community college students' grade point averages (GPAs) decline upon entry into a four-year college, although the dip appears to be temporary and confined to certain areas of study (Bahr, Toth, Thirolf, & Masse, 2013). More consequential are concerns surrounding whether community colleges appropriately prepare students for the rigors of four-year college—that is, after transferring to their new destination, do vertical transfer students perform comparably to similar native four-year students in terms of GPA, credit accumulation, and term-to-term persistence? Early work on this topic suggested that vertical transfer students have higher dropout rates than native four-year students, but it did not control for student characteristics or college selectivity (Dougherty, 1994). Recent work has not examined course success or term-to-term persistence per se, and has instead focused on more distal outcomes, such as overall years of education completed and likelihood of completing a bachelor's degree. As noted in the previous section of our literature review, this aspect of transfer shock has been studied (and discredited) primarily among the "successful" transfer population, which may exclude up to half of vertical transfers from analysis. Accordingly, the relevance of these results to the remaining proportion of the transfer population remains unclear.

Unique Contributions of the Current Study

As calls to improve higher education efficiency continue to grow louder, it becomes increasingly urgent to understand how the community college pathway may influence baccalaureate-seeking students' academic and labor market outcomes. Our study adds to the current literature on this topic in four major ways.

First, the majority of existing studies have used national datasets to estimate an average effect of community college attendance. Yet states vary substantially in their transfer policies and in the quality of the relationship that exists between their two- and four-year sectors, resulting in large variation in state-level transfer outcomes (Jenkins & Fink, 2015). A state-level

perspective can provide a more detailed understanding of the mechanisms at play, and our study adds one more state to the slowly growing literature of state-specific studies on this topic.

Second, previous analyses comparing vertical transfer students and native four-year students have typically limited their sample based on somewhat arbitrary definitions of successful transfer in order to make vertical transfers more comparable to native four-year students. In addition, due to the relatively small sample sizes available in national datasets, nearly all existing studies match vertical transfer students and native four-year students across institutions, and therefore cannot take into account the possibility that transfer students choose to attend different types of institutions than native four-year students. We compare these matching strategies to one where we match vertical transfer and native four-year students based on prior credits earned and on the destination four-year institution, and find substantial differences in estimates based on different matching strategies.

Third, among the studies discussed in our review, only Reynolds (2012) performed a cost-benefit analysis, which was based on state-level college costs and census data on average labor market outcomes. We extend Reynolds' cost-benefit analysis by including data on individual colleges' costs matched to individual students' patterns of enrollment, and individual earnings drawn from Unemployment Insurance (UI) data. We also include an analysis of the cost-benefit for vertical transfer students.

Finally, we explore four potential mechanisms through which the effects may unfold: diversion, logistic challenges of transfer, credit loss, and transfer shock. We explore the diversion hypothesis through two different propensity score matching analyses, with one representing the upper bound and one representing the lower bound of the potential impact. We are not able to directly observe the logistic challenges of transfer, but we present descriptive data on this point and discuss how our larger results (together with the previous literature) suggest that such challenges may be the key barrier for many aspiring transfer students. Although we are not able to directly observe credit loss, we can observe excess credit requirements, and we explore how they may contribute to an extended time to degree and accompanying short-term labor market losses. Finally, we explore the transfer shock hypothesis by examining term-by-term fluctuations in students' academic performance.

3. Background

Data and Setting

Data for our analysis were provided by the State Council of Higher Education for Virginia (SCHEV), which also provided matched data from the National Student Clearinghouse (NSC) and from Virginia's UI records. The SCHEV dataset encompasses data from the Virginia Community College System (VCCS, which comprises 23 public community colleges on 40

campuses), one transfer-oriented public junior college, 15 public four-year institutions, and 31 private nonprofit four-year institutions within the state of Virginia. Collectively, these colleges enrolled approximately 70,000 students during the fall term of 2004, with approximately half enrolled in a two-year institution.

The SCHEV dataset included demographic data, transcript records, and degree attainment information for first-time-in-college, credit-seeking students who initially enrolled in any of the included Virginia colleges in the fall of 2004. The NSC dataset provided student enrollment and award data for non-SCHEV colleges, and the Virginia UI database provided quarterly wage records from the first quarter of 2004 to the last quarter of 2012, eight years after college entry. We drew upon the UI data to assess students' precollege employment status (the number of quarters in which the student had nonzero earnings across the first three quarters of 2004, before entering college in the fall of 2004), during-college quarterly employment and earnings (which we account for in our labor market and cost-benefit analyses), and short-term labor market outcomes (each student's quarterly earnings in 2012, averaged across the number of quarters with employment in 2012). Missing quarterly earnings (which could be due to nonemployment, employment in a nonreporting industry, or employment out of state) were treated as missing rather than converted to zeroes (which would assume nonemployment).[1]

Table 1 describes the characteristics of students enrolled in any of the dataset's colleges in 2004. Compared with a national sample,[2] Virginia students are more likely to be Black and less likely to be Hispanic; among four-year entrants, Virginia students are more likely to be female and under 20 years of age.

Overall, the state includes a mix of large and small schools, and institutions located in rural, suburban, and urban settings within a diverse geographic region. Similar to community colleges nationwide, Virginia's public two-year colleges serve multiple functions—with offerings including basic skills training, vocational and technical programs, adult continuing education, and various job training programs through partnerships with employers—but transfer to a four-year institution is one of their key missions. Among the community college entrants in our dataset, approximately 56 percent initially expressed the intent to earn a bachelor's degree. Each of VCCS's 23 schools develops its own mechanisms to support its transfer mission, including increasing awareness of transfer requirements, improving articulation of programs with four-year partners, and monitoring student success post-transfer. State legislation also proactively encourages formal articulation agreements (Va. Code Ann., 2006). In response, more than 25 public and private four-year colleges in Virginia guarantee admission to students from

[1] The analysis of labor market outcomes was conducted on students who were matched with at least some UI records in 2012. In a separate robustness check, we included students without any earnings records in 2012 to the analysis and averaged individual annual earnings in 2012 across four quarters (instead of the number of quarters with actual employment records), and the results were fairly similar to those presented in Table 6 and Table 8.

[2] Our data are drawn from the 2009 Beginning Postsecondary Students Longitudinal Study (BPS) (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2011). BPS contains student-level data on a national representative sample of students who enrolled in college for the first time in 2003–2004 and were tracked to 2009.

VCCS who meet established academic thresholds. Additionally, more than 500 formalized program transfer agreements are in place between VCCS schools and four-year institutions in Virginia.

Table 1: Characteristics of Students in the SCHEV Database Compared to a Nationally Representative Sample of Students in Higher Education

	National Sample[a]		SCHEV	
Characteristic	2-Year Entrants	4-Year Entrants	2-Year Entrants	4-Year Entrants
Portion of sample	52%	39%	45%	55%
College entry term	Fall 2003	Fall 2003	Fall 2004	Fall 2004
Demographic characteristics				
Gender				
Female	59%	45%	57%	55%
Male	41%	55%	43%	45%
Race/ethnicity				
Black	18%	10%	24%	17%
Hispanic	18%	10%	6%	3%
White	56%	69%	63%	68%
Other	8%	11%	7%	12%
Age upon entry				
Average age	—	—	23.4	18.1
19 or younger	52%	90%	53%	97%
20–23	18%	5%	17%	2%
24–29	12%	2%	12%	< 1%
30 or older	19%	3%	18%	< 1%
Academic attributes and outcomes				
Took any developmental education	25%	17%	57%	5%
Baccalaureate-seeking upon enrollment	37%	100%	56%	100%
Highest award attained in 6 years				
Bachelor's	9%	63%	9%	70%
Associate	15%	3%	12%	1%
Certificate or diploma	16%	1%	4%	< 1%
No award	61%	33%	75%	29%
Institutional characteristics				
% starting in open-admission or minimally selective colleges	—	—	98%	12%
Average total price of attendance (2012)[b]	—	—	$9,343	$33,218
Observations	8,451	6,284	31,418	38,259

Note. Precise average age is not available for the national sample; the dataset reports ages in categories.

[a]Author derived data from BPS: 2009 using the National Center for Education Statistics (NCES) QuickStats tool. BPS: 2009 contains student-level data on a nationally representative sample of students who enrolled in college for the first time in 2003–04, tracked to 2009.

[b]Derived from Integrated Postsecondary Education Data System (IPEDS) data; see Section 6 of this manuscript for more information.

Sample

Our first set of analyses estimates the overall impacts of the community college pathway on the probability of attaining a bachelor's degree and on labor market earnings in 2012 among two distinct subpopulations: (1) baccalaureate aspirants who are first entering college, and (2) students who eventually transfer to a four-year college.

For the first subpopulation, we restricted the sample to students who expressed the intent to earn a bachelor's degree at college entry and had any GPA in their first semester, resulting in $n = 43{,}735$ students, approximately one quarter of whom began at a two-year college (hereafter termed the "baccalaureate-seeking sample").[3] Table 2 contrasts the full dataset with the baccalaureate-seeking sample. While the sample restriction creates a stronger balance between two- and four-year entrants in terms of demographic characteristics and precollege employment status, two-year entrants are still older (21 vs. 18 on average), much more likely to attend part-time during their initial term (35 percent vs. 1 percent), and much more likely to attend an open-admission or less selective college (97 percent vs. 8 percent); they also tend to have lower first-semester GPAs. To create stronger balance between the two groups, our analyses take advantage of propensity score matching, as discussed below.

For the second subpopulation, we restricted the two-year college entrant sample to vertical transfers: those who transferred to a four-year institution included in the SCHEV dataset.[4] We released the restriction on students who expressed the intent to achieve a bachelor's degree upon initial enrollment, as it is less relevant to this analysis. In order to identify a comparison group for vertical transfers among native four-year students, previous studies have imposed rather arbitrary sample restrictions; for example, the most recent, comprehensive, and rigorous analysis imposed the restriction that students earn at least 48 credits (Monaghan & Attewell, 2015). We instead matched native four-year students with vertical transfer students based on prior credits earned. Because the resulting sample is based on a matching algorithm, we postpone further discussion of the sample until later in the paper.

[3] Two-year and four-year entrants are directly defined in the SCHEV administrative dataset, where two-year entrants were students whose first long semester of college enrollment (fall or spring, but not summer) was at a two-year college, and who were not concurrently enrolled at a four-year college.

[4] For two-year entrants, vertical transfer was defined as enrolling at any four-year college at any point in the eight-year tracking window. For this analysis, however, we excluded students who transferred to non-SCHEV colleges (14 percent of the transfer student sample), due to the unavailability of transcript data.

Table 2: Sample Characteristics (Baccalaureate-Seeking Students Starting in Either Two-Year or Four-Year Colleges)

	All Baccalaureate-Seeking Students		Analytic Sample (Students with 1st Term GPA)	
Characteristic	Initiating in 2-Year	Initiating in 4-Year	Initiating in 2-Year	Initiating in 4-Year
Demographic characteristics				
Age upon initial enrollment	23	18	21	18
Gender				
Female	57%	55%	57%	56%
Male	43%	45%	43%	44%
Race/ethnicity				
Black	24%	17%	19%	17%
Asian	6%	6%	6%	7%
Hispanic	6%	3%	5%	3%
White	63%	68%	69%	67%
Other	1%	6%	1%	6%
Academic attributes				
Full-time	58%	98%	65%	99%
Applied and eligible for financial aid	35%	49%	35%	47%
Ever took English as a second language (ESL) course	5%	0%	2%	0%
Ever took remedial course	57%	5%	59%	4%
Started in open-admission or minimally selective college	98%	12%	97%	8%
GPA in first term	1.72	2.65	1.72	2.65
Education and labor market outcomes				
Baccalaureate intent	56%	99.6%	100%	100%
Transferred to 4-year	18%		29%	
Highest award attained				
Bachelor's degree or higher	9%	70%	17%	73%
Associate degree	12%	1%	14%	1%
Long-term certificate	2%	0%	1%	0%
Short-term certificate	2%	0%	1%	0%
Labor market information				
Quarters employed upon entry (2004)	1.8	1.1	1.1	1.2
Quarterly earnings in 2012	$6,915	$8,766	$6,538	$8,665
Observations	31,418	38,259	10,811	32,924

It is worth noting that most recent studies of the community college pathway to the baccalaureate (e.g., Long & Kurlaender, 2009; Monaghan & Attewell, 2015) have further restricted their four-year entrant sample to those who attended nonselective or minimally selective four-year institutions, on the assumption that there is little to no overlap between two-year entrants and selective college attendees. Yet as shown in Table 3, 90 percent of the vertical transfer students in our sample transferred to a four-year institution categorized as either "selective" or "more selective" in the federal IPEDS database. As might be expected, native four-year students are more likely than vertical transfers to attend more selective institutions, smaller colleges, and those with higher levels of per-student resources. However, given the high proportion of vertical transfers who enrolled in a selective four-year college, we were reluctant to drop selective attendees from either our two-year or four-year entrant samples. We return to this topic in more detail in our discussion of propensity score matching.

In addition to our two primary subpopulations, we also applied sample restrictions (e.g., restricting the analysis to students who earned a baccalaureate) to explore supplemental questions in terms of the four potential mechanisms and the cost-benefit analysis. These sample restrictions are discussed in later sections of the paper in the context of the relevant analyses.

Table 3: Institutional Characteristics of Four-Year Colleges Attended by Vertical Transfer Students Versus Native Four-Year Students

Institutional Characteristic	Transfer Students	Native Four-Year Students
Selectivity		
Inclusive	10%	9%
Selective	73%	47%
More selective	17%	43%
SAT Critical Reading—25th percentile	486	509
SAT Critical Reading—75th percentile	586	609
SAT Math—25th percentile	485	509
SAT Math—75th percentile	583	608
Size		
Total headcount	15,605	14,146
Full-time equivalent (FTE) enrollment	21,062	17,594
Total expenses per FTE student	$19,836	$23,021

Note. Information on institutional characteristics was retrieved from IPEDS.

4. Method

Comparing Community College Entrants and Four-Year College Entrants

Our first set of analyses estimates the overall impacts of the community college pathway on the probability of attaining a bachelor's degree and on labor market earnings in 2012. For bachelor's degree attainment, a naïve comparison would follow Equation 1:

$$\text{Probit}\,(BAattainment_i) = \alpha + \beta Twoyear_i + X_i + \mu_i \quad (1)$$

The outcome measure is whether a student received a bachelor's degree from any college within eight years of college entry. The key explanatory variable β is equal to 1 if a student started in a two-year college, and X_i represents a vector of controls, shown in Table 4.[5]

For labor market earnings, a parallel equation would follow the classic Mincerian model shown in Equation 2:

$$Y_i = \alpha + \beta Twoyear_i + Exp_i + Exp_i^2 + X_i + \mu_i \quad (2)$$

where Y_i represents average quarterly earnings in 2012 for individual *i*. The effect of initiating in two-year colleges is captured by β, X_i represents the same vector of controls used in Equation 1, and Exp_i represents the student's labor market experience in 2012. Our estimate of labor market experience includes two components. First, using UI data, we calculated each individual's number of quarters of employment between 2004 and 2012 and divided it by 4 to obtain years of employment. Second, to estimate the number of years of employment prior to 2004, we followed the approach used by Liu, Belfield, and Trimble (2015) by subtracting 18 years and the number of quarters enrolled in college (converted to years first by dividing the total number of quarters by 4) from a student's age at the beginning of 2004. We also added a quadratic term of work experience to accommodate the possibility of nonlinear relationships between work experience and earnings (e.g., diminishing returns to work experience), as noted by Mincer (1958, 1974).

[5] First-term full-time enrollment, first-term GPA, and remedial course-taking are included in the vector of controls in order to create as much comparability as possible between two- and four-year entrants in terms of their baseline characteristics and academic capabilities. If, as the diversionary hypothesis suggests, students' early academic performance is adversely impacted by choosing the community college route (by, for example, being required to take developmental courses that are not strictly necessary), then controlling for these early academic factors may underestimate any negative impacts of the community college pathway on students' longer term outcomes. We further explore the validity of the diversionary hypothesis in a subsequent analysis.

Table 4: Sample Characteristics (Baccalaureate-Seeking Students Starting at Two-Year or Four-Year Colleges)

		Unmatched				Matched			
Variable	Sample	Mean	Std. Dev.	Std. Diff.	S-Ratio	Mean	Std. Dev.	Std. Diff.	S-Ratio
Age	2-year	20.82	6.1	0.59	4.07	20.24	5.4	0.09	1.15
	4-year	18.20	1.5			20.77	6.2		
Age-squared term	2-year	470.18	371.2	0.50	3.93	438.76	334.9	0.09	1.08
	4-year	333.42	94.5			469.60	362.2		
Female	2-year	0.57	0.5	0.03	1.00	0.56	0.5	0.16	1.00
	4-year	0.56	0.5			0.49	0.5		
Black	2-year	0.19	0.4	0.05	1.00	0.19	0.4	0.03	1.00
	4-year	0.17	0.4			0.20	0.4		
Asian	2-year	0.06	0.2	0.05	1.50	0.06	0.2	0.05	1.00
	4-year	0.07	0.3			0.05	0.2		
Hispanic	2-year	0.05	0.2	0.11	1.00	0.05	0.2	0.07	1.00
	4-year	0.03	0.2			0.04	0.2		
Other race	2-year	0.01	0.1	0.35	2.00	0.01	0.1	0.06	1.00
	4-year	0.06	0.2			0.01	0.1		
Ever took ESL course	2-year	0.02	0.1	0.30	71.43	0.01	0.1	0.09	1.00
	4-year	0.00	0.0			0.01	0.1		
Applied and eligible for financial aid	2-year	0.35	0.5	0.24	1.00	0.36	0.5	0.09	1.00
	4-year	0.47	0.5			0.40	0.5		
Ever took remedial course	2-year	0.59	0.5	1.45	2.50	0.55	0.5	0.11	1.00
	4-year	0.04	0.2			0.50	0.5		
Full-time in first term	2-year	0.65	0.5	0.95	5.00	0.72	0.5	0.07	1.00
	4-year	0.99	0.1			0.68	0.5		
GPA in first term	2-year	1.72	1.2	0.88	1.33	1.76	1.2	0.04	1.00
	4-year	2.65	0.9			1.72	1.2		
Quarters employed pre-entry	2-year	1.81	0.5	1.84	5.00	1.76	0.5	0.10	1.00
	4-year	1.15	0.1			1.81	0.5		

Note. Std. Diff. = standardized difference in group means, calculated following the formula by Austin (2008. The S-ratio is the ratio of the standard deviation between the two-year and four-year samples, calculated by dividing the higher standard deviation by the standard deviation of the other group.

Given the distinct differences in background characteristics between our samples of two- and four-year entrants, we followed the lead of other recent studies (Long & Kurlaender, 2009; Monaghan & Attewell, 2015; Reynolds, 2012) and applied Equations 1 and 2 after constructing a more balanced sample using propensity score matching (Rosenbaum & Rubin, 1985). We used a probit model for propensity score estimation:

$$\text{Probit}\,(Twoyear_i) = \alpha + X_i + \mu_i \quad (3)$$

where $Twoyear_i$ is the treatment assignment for student *i*, and is equal to 1 if the student started in a two-year college.

Our propensity score matching estimation was performed in three steps. First, we estimated each student's propensity to start in a two-year college given their observable characteristics, following Equation 3. Second, we used the estimated propensity scores to find the nearest matching native four-year student for each two-year entrant, using the nearest-neighbor method with a caliper of 0.1 (Dehejia & Wahba, 2002). Two-year entrants who had no near match (within 0.1 standard deviation of the propensity score) among native four-year college students were dropped from analysis. Accordingly, the post-match sample represents the type of baccalaureate aspirant who is at least somewhat likely to consider both two- and four-year entry. We then checked the balance on both covariate means and higher-order sample moments, such as standard deviations, and added a higher-order term (i.e., a squared term) to the model in cases where unsatisfactory balance was observed (Hill, 2008). Third, Equations 1 and 2 were estimated on the matched sample (Abadie & Imbens, 2002; Hill, 2008; Rosenbaum & Rubin, 1985; Rubin & Thomas, 2000).

Table 5 presents the marginal effects for the X_i coefficients from Equation 3, indicating that two-year colleges were more likely to be selected by older students, female students, White students, ESL students, students who were ineligible for (or did not apply for) need-based financial aid, students who enrolled part-time in their initial term, students who took remedial coursework, students who were employed for more pre-entry quarters, and students who earned lower GPAs in their first semester. The pseudo R^2 of the model is 0.55, indicating that these variables, taken together, explain more than half of the variability in the probability of starting in a two-year college.

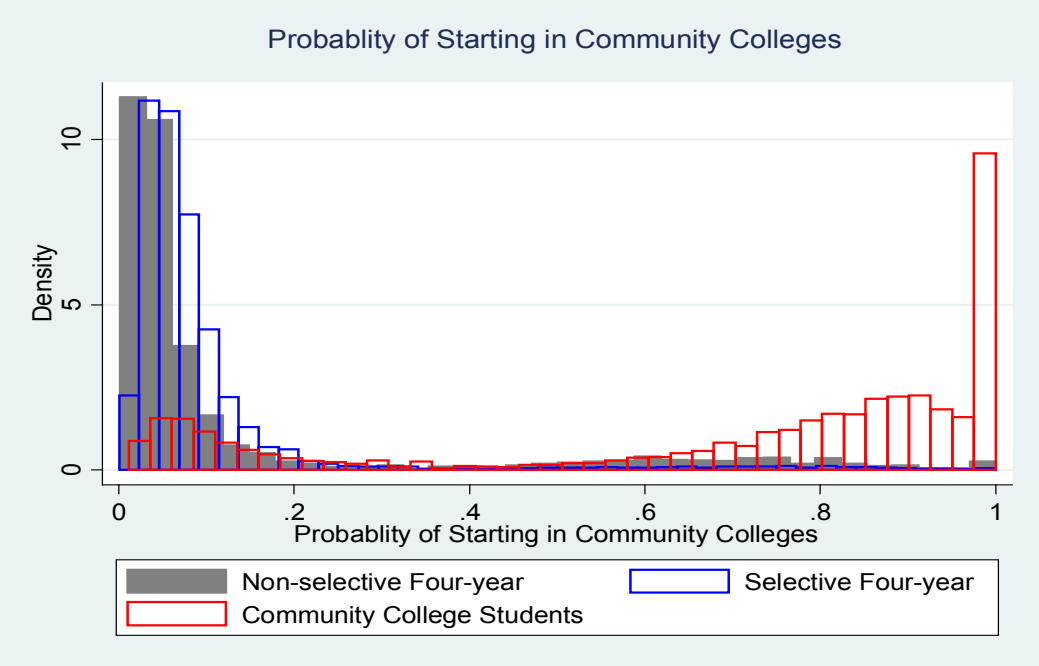
Figure 1 presents the distributions of the probability of starting in a two-year college for two-year versus four-year entrants, with the latter group further subdivided into nonselective and selective four-year college entrants. The majority of two-year college entrants had a high probability of choosing the community college pathway (with approximately 76 percent having a probability of greater than .5, and less than 10 percent having a probability of less than .1), while the majority of four-year entrants had an extremely low probability. Contrary to the prevailing assumption in the literature, the probability distribution of nonselective four-year entrants was not markedly more similar to that of two-year entrants than was the probability distribution of selective four-year entrants; both were sharply skewed to the left. As a result, we kept both types of four-year entrants in the sample to serve as a potential match for community college entrants.

Table 5: Probability of Initiating in a Two-Year College Among Baccalaureate-Seeking Students (Probit Model With Marginal Effects Reported)

Variable	Coefficient (Marginal Effects)	Standard Error
Age at initial enrollment	0.094***	0.0040
Age-squared term	-0.001***	0.0001
Female	0.013***	0.0049
Black	-0.075***	0.0057
Asian	-0.027***	0.0092
Hispanic	0.013	0.0126
Other race	-0.177***	0.0044
Applied and eligible for financial aid	-0.101***	0.0049
Ever took ESL course	0.480***	0.0070
Ever took remedial course	0.631***	0.1085
Full-time in first term	-0.712***	0.0092
GPA in first term	-0.071***	0.0024
Quarters employed pre-entry	0.0472***	0.0018
R-squared	0.546	
Observations	43,735	

*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

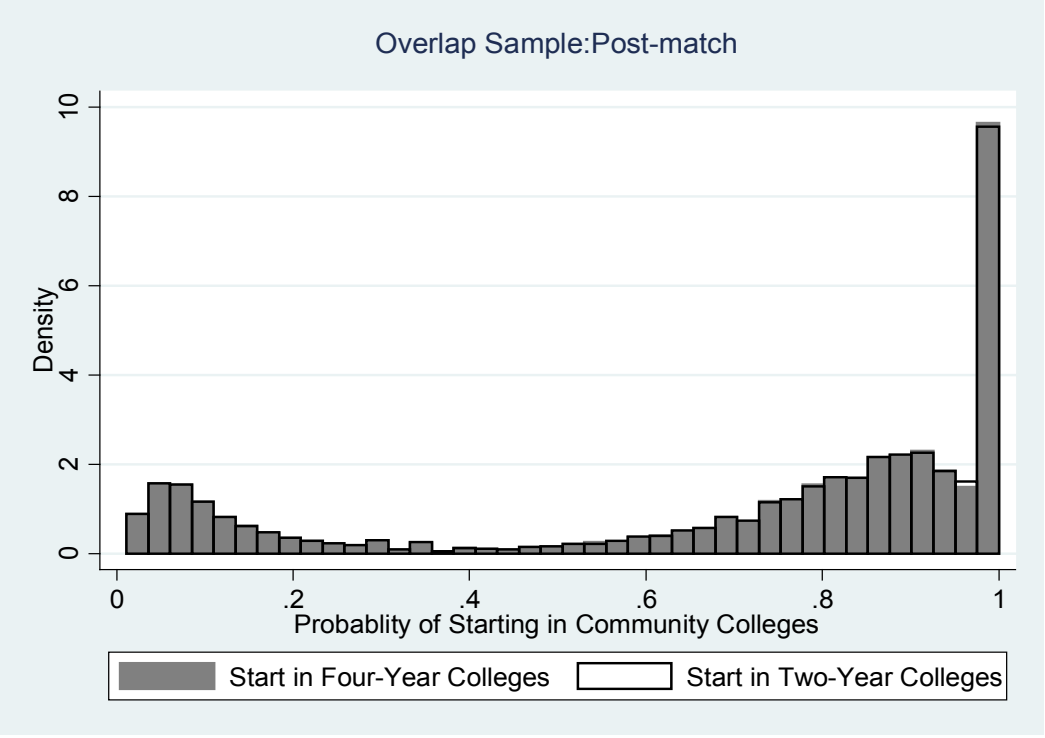
Figure 1: Distribution of Probability of Starting in Community Colleges for Different Groups of Students



During the matching process, we discarded many four-year college students with low probabilities of selecting two-year college entry, but because the four-year college entrant population was much larger than the two-year college entrant population, approximately 90 percent of two-year college entrants were successfully matched within 0.05 standard deviations of the propensity score. Thus, approximately 10 percent of two-year entrants (N = 1,083) were discarded from the sample due to lack of support.

Table 4 shows the post-match balance of covariates. Following Austin (2008), we used the standardized difference (or SD, the absolute difference in sample means divided by an estimate of the pooled standard deviation of the variable, where zero indicates perfect balance) to check balance in group means. Some researchers (e.g., Hill, 2008) also recommend examining higher-order sample balance; therefore, we also checked the ratio of standard deviations between the two-year entrants and the four-year entrants (the S-ratio, where 1 indicates perfect balance). Overall, the matching process resulted in satisfactory balance, reducing most SD values to below 0.10, with S-ratios hovering near 1. Figure 2 shows the probability densities for two-year versus four-year entrants after matching, and demonstrates that the matching operations achieved satisfactory overlap between the two groups of students. The sufficient overlap, together with satisfactory balance on all covariates, justifies subsequent analyses based on the matching sample (n = 12,485).

Figure 2: Distribution of Probability of Starting in Community Colleges After Propensity Score Matching



Comparing Vertical Transfers and Native Four-Year Students

To estimate the impact of beginning postsecondary education at a community college among those students who eventually transfer, we applied Equations 1 and 2 on the subpopulation of vertical transfers and similar native four-year students. We used four different strategies to identify similar native four-year students, and compared the results across strategies.

Our first two strategies mimic typical approaches in the literature. We first present results when restricting the sample of vertical transfers and native students to those who earn at least 48 credits; we then maintain the 48-credit restriction and use Equation 3 to identify native students who are similar to each vertical transfer in terms of the background characteristics listed in Table 3. This represents a cross-institution matching strategy; a native student at any four-year college in the SCHEV dataset would be eligible to match with a vertical transfer student at any other four-year college in the dataset.

Third, we released the 48-credit restriction and used cross-institution propensity score matching based on the characteristics listed in Table 3, as well as accumulated college-level credits at the time of transfer. For example, if a community college student transferred in fall 2006 with 40 credits, he or she was matched with a four-year entrant who had earned a similar number of credits at the beginning of fall 2006. And fourth, to take into account the fact that vertical transfers were less likely to enroll in more selective institutions, we used within-institution propensity score matching based on the characteristics in Table 3 and accumulated college-level credits at the time of transfer, such that a native student at a given four-year college would be eligible to match only with a vertical transfer student at the same receiving college.

5. Results

Community College Entrants Versus Four-Year College Entrants

To estimate the impact of two-year college entry on students' academic and labor market outcomes, we focus on three outcome measures: bachelor's degree attainment within eight years of initial college enrollment (using Equation 1), quarterly earnings in 2012 (using Equation 2), and quarterly earnings in 2012 conditional on bachelor's degree attainment (using Equation 2 and restricting the sample to bachelor's degree earners). Table 6 shows the estimated impact of two-year entry across six different analyses: one analysis for each combination of three outcomes and two samples (the full baccalaureate-seeking sample, and the post-match sample constructed using Equation 3).

Table 6: Impacts of Initiating in a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes

Outcome	Estimate	Standard Error	R^2	*N*
Without matching				
Baccalaureate attainment	-0.379***	0.008	0.30	43,735
Average quarterly earnings, 2012	-$1,553***	128	0.10	22,727
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$1,606***	253	0.05	13,444
Propensity score matching				
Baccalaureate attainment	-0.218***	0.020	0.21	12,315
Average quarterly earnings, 2012	-$256	225	0.13	7,448
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$535	360	0.10	1,922

*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

Overall, two-year entrants were significantly less likely to attain a bachelor's degree and had lower average quarterly earnings in 2012 (though the latter result was not statistically significant for post-match sample). Interestingly, the negative estimates persisted even among students who received a bachelor's degree (although again, the labor market estimate was not statistically significant for the post-match sample), suggesting that two-year college entry may influence students' labor market performance through mechanisms other than its influence on the probability of bachelor's degree attainment.

Despite being consistently negative, the estimates were substantially smaller in the post-match sample than in the full baccalaureate-seeking sample. In particular, the descriptive 56 percentage point difference between two- and four-year entrants in bachelor's degree attainment narrowed to 38 points after controlling for student characteristics, and to 22 points after propensity score matching. Similarly, the gap between two- and four-year entrants in 2012 quarterly earnings was -$2,127 in the descriptive tables, -$1,553 after controlling for student characteristics, and a nonsignificant -$256 in the post-match sample.

One potential explanation for the nonsignificant differences between two-year and four-year students in the post-match sample is that four-year students may be more likely to leave the state after graduation, and may have stronger labor market earnings than those who choose to remain in the state. Although we could not observe whether a student worked in another state, the NSC data indicates whether a student ever transferred to an out-of-state college, which may help shed some light on this issue. Descriptive analyses indicate that based on the matched sample, the two-year and four-year groups were fairly similar in the proportion of students who transferred to a college outside of Virginia at any time (4 percent for the community college sample and 5 percent for the four-year sample). Students who are missing earnings records in 2012 are also less likely to have attained a baccalaureate degree and have a slightly lower first-

term GPA on average, which suggests that out-of-state workers with potentially higher earnings are unlikely to comprise the majority of students with missing earnings records.

That being said, we still conducted a robustness check in which we imputed higher earnings (in the 75th percentile of earnings) for students who were missing earnings records in 2012 but had attained their baccalaureate degree. The magnitude of the negative impact on earnings became stronger than the magnitude of the impacts presented in Table 6, but it remained statistically nonsignificant at the .05 level (-$369, $p = 0.07$ on the matched sample; -$370, $p = 0.16$ on the matched sample and further conditional on bachelor's degree attainment).

Vertical Transfers Versus Native Four-Year Students

After students transfer to the four-year sector, are their outcomes still affected by their initial choice to enter community college? To answer this question, we again used Equations 1 and 2 to examine the same three outcomes, but we used the four separate sample-construction strategies discussed in Section 4: (1) a 48-credit restriction and no matching, (2) a 48-credit restriction with across-institution matching, (3) matching on accumulated credits, and (4) our preferred strategy, matching on accumulated credits and transfer destination. Table 7 shows the estimated impact of vertical transfer across each combination of the three outcomes and four sample-construction strategies.

In terms of bachelor's degree attainment, only the no-matching strategy resulted in a statistically significant negative estimate. The credit-restricted across-institution post-match sample resulted in a near-zero positive estimate, while the two samples matched on accumulated credits resulted in statistically significant positive estimates, with a fairly large positive effect (a 14 percentage point higher probability of baccalaureate attainment) for the within-institution match. The sharp difference in results across sample-construction strategies highlights the importance of taking into account the comparability of four-year institutions between vertical transfers and native four-year students.

In terms of labor market outcomes, estimates were consistently negative across all analyses, although they were no longer statistically significant after controlling for accumulated credits. Focusing on our preferred strategy of matching on accumulated credits and transfer destination, the estimates suggest that vertical transfer students are much more likely than their similar native peers to graduate within eight years of college entry, and suffer few or no negative labor market impacts at that time.[6]

[6] We also conducted a robustness check by imputing higher salaries (75th percentile of earnings) for students who were missing earnings records in 2012 but had attained their baccalaureate degree. The estimates on earnings remained insignificant under the preferred matching strategy (matched within institution).

Table 7: Baccalaureate Attainment and Labor Market Outcomes of Transfer Students Versus Native Four-Year College Students

Outcome	Estimate	Standard Error	R^2	N
Without matching (48-credit restriction)				
Baccalaureate attainment	-0.06***	0.01	0.11	31,526
Average quarterly earnings, 2012	-$1,413***	184	0.06	16,717
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$1,608***	234	0.05	13,693
Propensity score matching across destination colleges (48-credit restriction)				
Baccalaureate attainment	0.03	0.02	0.12	4,830
Average quarterly earnings, 2012	-$278	261	0.08	3,228
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$641*	349	0.08	2,140
Propensity score matching across destination colleges (matched on credits prior to transfer)				
Baccalaureate attainment	0.09***	0.01	0.12	5,188
Average quarterly earnings, 2012	-$36	162	0.08	3,507
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$118	214	0.09	2,199
Propensity score matching by destination college (matched on credits prior to transfer)				
Baccalaureate attainment	0.14***	0.01	0.16	4,378
Average quarterly earnings, 2012	-$124	174	0.11	2,974
Average quarterly earnings, 2012 (conditional on bachelor's attainment)	-$234	229	0.14	1,863

*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

Exploring the Four Potential Mechanisms

The diversionary impact of community college attendance. Following Monaghan and Attewell (2015), we examined this first potential mechanism by comparing students' academic progress during the first two years of college enrollment. Given that students' enrollment and completion of introductory courses in the early stage of their college career is critical to their academic momentum and degree attainment, we considered six sets of indicators—the number of credits attempted (college-level or remedial), the number of college-level credits attempted, the number of credits earned, the number of college-level credits earned, the percentage of attempted credits completed, and persistence in college—and compared two-year entrants and four-year entrants based on the post-match baccalaureate-seeking sample.

If the two-year college experience dampened students' early academic success (e.g., by influencing students to attempt fewer credits, or by diverting students into remedial coursework,

where any credits they earn are not at the college-level), we would expect to find a negative influence on credit accumulation in the early years of students' college career, when comparing them with similar four-year college entrants matched on baseline characteristics. Our matching strategy included (among other variables) baseline characteristics of first-term full-time enrollment, first-term GPA, and whether the student took any remedial course. Inclusion of these variables helps to ensure that community college and four-year entrants are academically similar during their first semester. Yet if community college attendance influenced student enrollment and academic performance as early as students' initial term, then our matching strategy would produce downwardly biased results. On the other hand, excluding those variables may introduce strong selection effects, upwardly biasing the results. Accordingly, we present two strategies: a lower-bound estimate in which students are matched on first-semester attributes, and an upper-bound estimate in which first-semester attributes are discarded from the match.

As Table 8 shows, while the negative estimates in the lower-bound model are substantially smaller, the results are consistently negative regardless of the matching equation. Focusing on the lower-bound estimates (i.e., the model controlling for first-term academic attributes), the two groups started with equivalent credit loads during the first year, but community college students dropped to lower credit loads in the second year, implying that the community college culture or policy environment may encourage students to take lower credit loads, which may gradually influence students' course enrollment behaviors. Similarly, the results show a gradual divergence in terms of course completion: While the two groups were equally likely to complete each course in which they enrolled during the first year (as expected, given that the two groups were matched on first-semester GPA), community college students were 4 percentage points less likely to complete the courses in which they were enrolled by the end of the second year. The combination of these influences resulted in community college students completing approximately three fewer credits by the end of the second year.

Table 8: Disparity in Early Academic Progress Between Matched Two-Year and Four-Year Entrants

	Not Matched on First-Term Attributes		Matched on First-Term Attributes		Effect Size Based on Post-Match Regression Analysis	
Outcome	2-Year Entrants	4-Year Entrants	2-Year Entrants	4-Year Entrants	Not Matched on First-Term Attributes	Matched on First-Term Attributes
Any credits attempted						
First semester	8.4	12.1	12.0	11.5	-3.9 (0.3)***	-0.3 (0.2)
First year	16.6	24.0	21.0	21.1	-7.8 (0.7)***	-0.6 (0.5)
First two years	29.4	45.6	35.3	37.5	-16.9 (2.1)***	-2.4 (1.0)**
College-level credits attempted						
First semester	5.9	11.8	9.1	10.8	-5.9 (0.4)***	-1.8 (0.2)***
First year	12.4	23.5	17.0	20.0	-11.2 (0.7)***	-3.3 (0.4)***
First two years	24.0	44.9	31.4	35.8	-21.4 (2.1***)	-5.3 (0.9)***
Any credits earned						
First semester	6.6	11.5	9.9	9.3	-5.0 (0.3)***	0.4 (0.2)*
First year	13.0	22.5	17.0	17.2	-9.9 (0.7)***	-0.5 (0.5)
First two years	22.8	43.1	28.7	30.9	-21.0 (2.2)***	-3.2 (0.9)***
College-level credits earned						
First semester	4.8	11.1	7.7	8.8	-6.4 (0.4)***	-1.2 (0.2)***
First year	10.0	22.1	14.0	16.3	-12.2 (0.7)***	-2.4 (0.4)***
First two years	19.1	42.5	25.2	29.6	-23.4 (2.1)***	-5.1 (0.8)***
Percentage of credits completed						
First semester	79%	94%	83%	83%	-0.16 (0.01)***	0.01 (0.01)
First year	77%	92%	80%	82%	-0.16 (0.01)***	-0.02 (0.01)
First two years	74%	91%	77%	82%	-0.18 (0.01)***	-0.04 (0.01)***
Early college persistence						
Fall-to-spring persistence	78%	85%	78%	74%	-0.08 (0.04)**	0.03 (0.03)
Fall-to-fall persistence	54%	70%	62%	62%	-0.22 (0.04)***	-0.02 (0.02)
Enrolled at least one year	72%	83%	77%	79%	-0.16 (0.02)***	-0.04 (0.02)**

Note. The first four columns present descriptive information on key early academic indicators for two-year and four-year entrants, who were matched based on slightly different strategies: The first two columns matched students only on demographic and preenrollment characteristics; the next two columns also included first-semester attributes (first-term full-time enrollment, first-term GPA, and whether the student took any remedial course). The last two columns present the model-adjusted estimates of the difference between two-year and four-year entrants with a regression model that controls for baseline covariates.

*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

In addition, a divergence in attempted college-level credits began as early as the first term of enrollment, suggesting that community college students were also referred to more remedial credits than their similar four-year peers (even though the two groups were matched on whether they ever took remedial courses). As a result, although the two groups were equally likely to complete courses during the first year, community college students completed approximately one fewer college-level credit in their first semester, which increased to 2.4 credits by the end of the first year, and to more than five credits by the end of the second year.

Finally, community college students were equally likely to persist into the next term as well as to return in the following fall, but they were 4 percentage points less likely to enroll in college for at least one academic year. This suggests that among students who failed to enroll during the following fall, a large percentage of community college students never returned to school afterward while many four-year college students returned to school later.

The logistical challenges of the transfer process. Next, we explored transfer patterns among baccalaureate-seeking community college entrants. Table 9 suggests that even among very successful community college students who initially aspired to the baccalaureate, transfer rates are not high: Only 68 percent of associate degree earners and only 57 percent of students who earned more than 60 college-level credits ever transferred to a four-year institution. The results in Table 9 also show striking variation in students' transfer pathways. Traditionally, students are thought to transfer at the beginning of their third academic year, after earning approximately 60 credits at the community college, yet few students followed that pattern. For example, over 15 percent transferred in their first or second year, and another 15 percent transferred seven or eight years after entry. Similarly, vertical transfer students varied widely in their number of college-level credits accrued at the time transfer, ranging from zero to 184 college-level credits, with a mean of 54 credits, a median of 59 credits, and a large standard deviation of 25 credits. These patterns seem to suggest that there is no well-trodden, highly structured pathway for transfer students to follow. Instead, students seem to be left to discover their own idiosyncratic path to a four-year institution.

Table 9: Transfer Patterns Among Community College Baccalaureate-Seeking Students

Outcome	%	*n*
Transfer rate		
All baccalaureate-seeking two-year entrants	23	17,650
Associate earners	68	3,425
Diploma or certificate earners (no associate degree)	17	343
No community college award	12	13,882
College-level credits earned from community colleges		
< 20	5	8,166
20–39	18	3,310
40–59	36	2,329
≥ 60	57	3,845
Timing of transfer (among vertical transfers, *n* = 4,053)		
1st academic year	2	67
2nd academic year	14	585
3rd academic year	27	1,078
4th academic year	22	894
5th academic year	13	518
6th academic year	9	362
7th academic year	6	260
8th academic year or beyond	7	289
College-level credits earned upon transfer (among vertical transfers)		
< 20	12	486
20–39	17	674
40–59	21	868
60–79	39	1,575
≥ 80	11	450

Post-transfer academic shock. To explore whether vertical transfer students experience transfer shock after arriving at the receiving institution, we matched transfer students and native four-year college students within each receiving institution based on available baseline characteristics and the number of college-level credits accumulated by the time of transfer (i.e., strategy 4 in Table 7). Based on the matched sample (*n* = 4,378), we examined term-by-term fluctuations in number of credits attempted (Figure 3) and GPA (Figure 4).[7] Figures 3 and 4 show the term-by-term fluctuations in credits attempted and GPA, with the regular downward spikes in attempted credits indicating summer terms. Our data span 25 terms of potential enrollment; in each figure, the left-hand panels center time at initial college enrollment, while the

[7] Each time point in Figure 3 includes only students enrolled in the given semester. Vertical transfer students and their matched four-year peers were very similar in their persistence in the first few semesters after transfer (results not shown).

right-hand panels center time at the semester of transfer. Thus, in the right-hand panels, the data representing students who transferred later (and their matched four-year peers) heavily influence the patterns apparent in the -20 to -10 range, while the data representing students who transferred earlier (and their matched four-year peers) heavily influence the patterns in the +10 to +20 range. The majority of students in the matched sample influence the patterns across the -10 to +10 range, and all influence the patterns near the zero marker. The figures reveal four interesting patterns.

First, matched native students attempted slightly more credits across their first four years of enrollment; yet the fact that the two groups were matched on cumulative college-level credits (and terms since entry) at the time of transfer implies that the matched native students were less likely to complete those early courses. This pattern is echoed Figure 4: While the two groups began with similar first-term GPAs due to our matching strategy, four-year entrants' term GPAs quickly began to lag behind those of community college students.

Figure 3: Term-by-Term Fluctuations in Credit Load Among Vertical Transfers and Matched Native Students

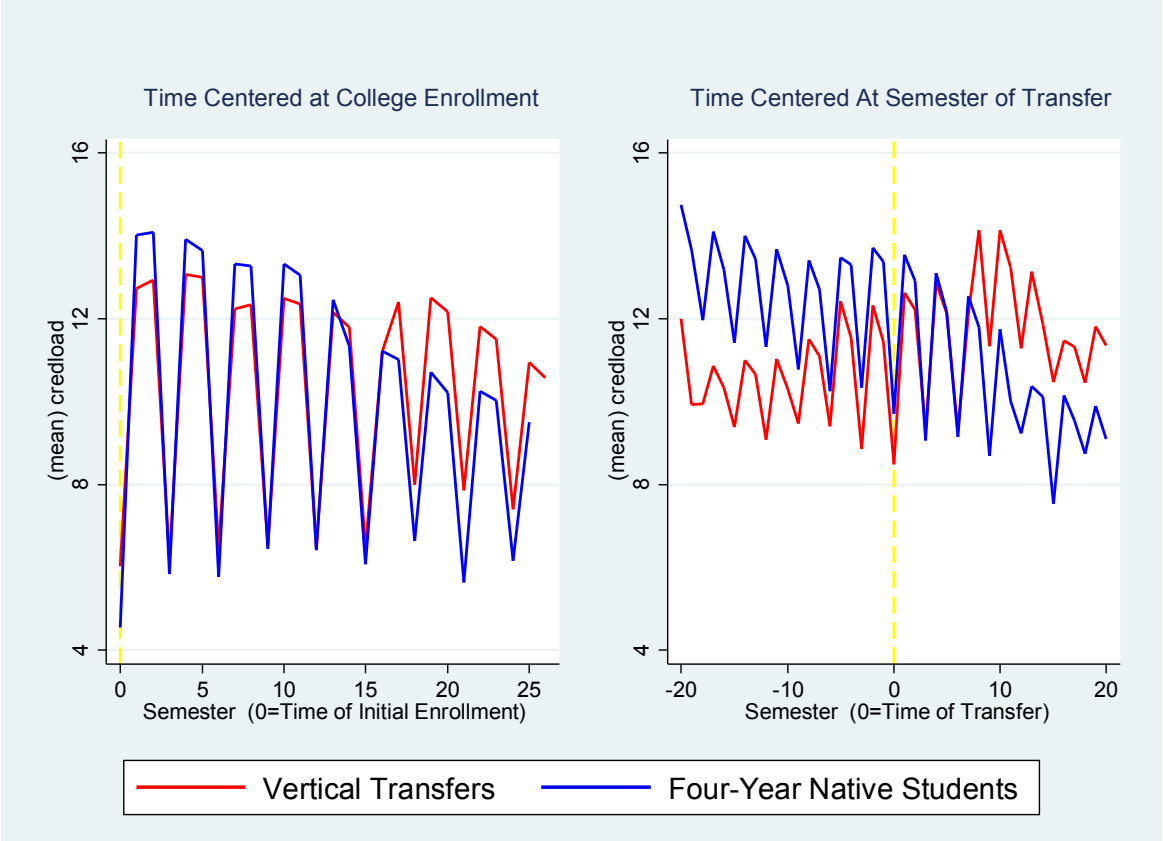
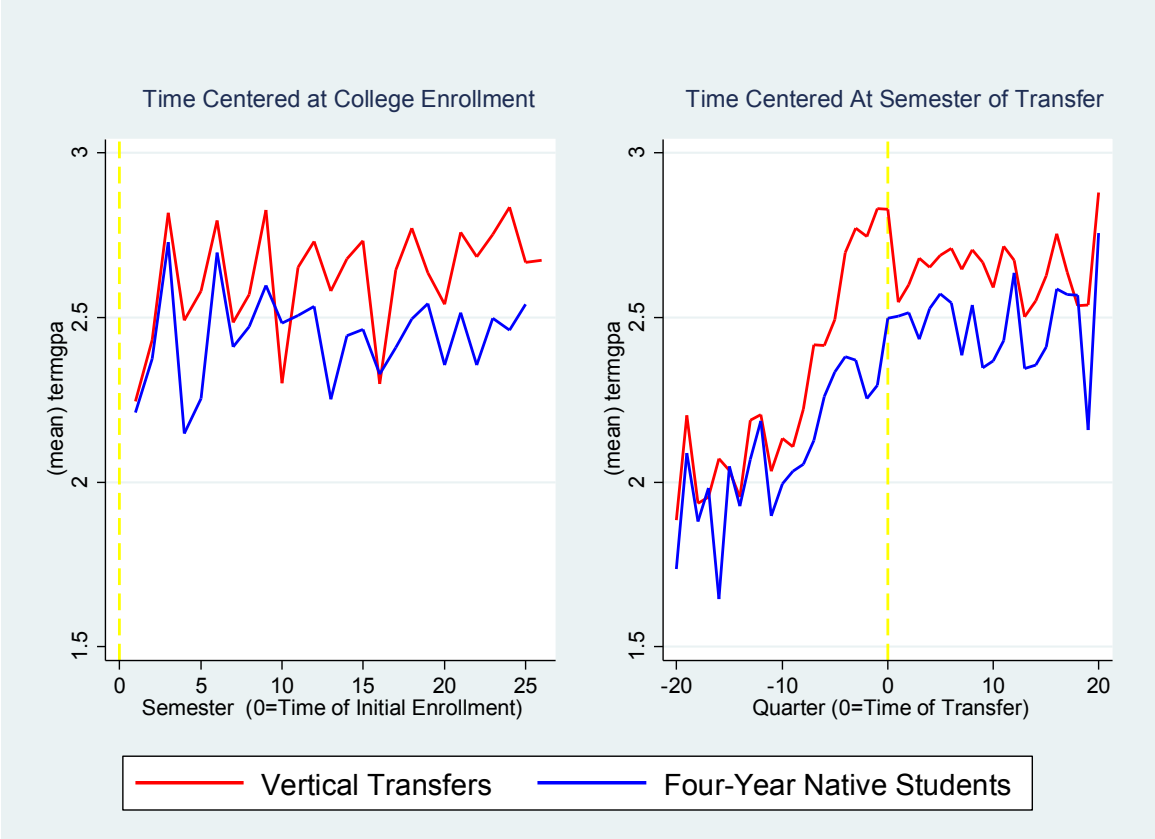


Figure 4: Term-by-Term Fluctuations in GPA Among Vertical Transfers and Matched Native Students



Second, the typical transfer student experienced a decline in GPA at the time of transfer, by approximately 0.3 points on the 4.0 scale (e.g., from B- to C+) in the first term following transfer. Together with the first finding, this pattern might imply that community college students' GPAs are slightly inflated. However, the average vertical transfer student's GPA partially rebounded and remained consistently higher than that of matched four-year students, suggesting that community colleges appropriately prepared students for the academic rigor of the four-year context. Accordingly, the GPA dip may be partially due to transfer students' social and logistical adjustment to the new college environment.

Third, despite carrying a lighter credit load than native students, the average transfer student attended college full-time (taking at least 12 credits in a given semester) across the first four years of enrollment. However, students who transferred later (i.e., after 10–20 terms) attempted far fewer credits in their early terms of enrollment. These late-transferring students and their matched peers also had lower GPAs in their early terms (hovering near 2.0, while the overall sample's GPAs fluctuated across the 2.2–2.8 range). That is, late-transferring students tended to be lower performers, and were matched with four-year students who had struggled in their first few terms.

Fourth, native students' credit loads appear to decline over time. In the left-hand panel of Figure 3, this pattern is in part due to full-time native students completing college, leaving behind part-time students who carried lower credit loads; in contrast, their matched vertical transfer student peers maintained a similar credit load across time. In the right-hand panel, the clear crossover pattern is also partially due to the change in mix of students over time, as late-transferring students carried lower credit loads in early semesters than did their four-year matched peers, while early-transferring students carried higher credit loads in later semesters than did their four-year matched peers. Most interesting, however, is that in the second year after transfer, native and transfer students' credit loads reached equilibrium, and after that point, vertical transfer students carried a consistently heavier load. This pattern may suggest that vertical transfer students were working to overcome credit loss at the time of transfer or excess crediting requirements, a hypothesis that we further explore in the next section.

Loss of credits and delayed graduation. The results in Table 7 (based on our preferred within-institution matching strategy) suggest that while vertical transfers were more likely than matched four-year students to earn a bachelor's degree, they did not have higher earnings in 2012. One potential explanation for these findings is that vertical transfer students took longer to graduate, perhaps due to a loss of credits at time of transfer or excess crediting requirements. In turn, this longer time to graduation would have negatively influenced their short-term labor market performance, given that the bulk of positive returns to bachelor's degrees are due not to immediate increases in earnings levels but to increases in earnings growth across several years after graduation (Jaggars & Xu, 2016).

While we cannot directly observe loss of credits in the transcript data (as the dataset did not indicate which community college credits were accepted by each four-year college), Table 10 compares matched transfer and native four-year college students within the same destination college (i.e., using strategy 4 from Table 7) in terms of the number of college-level credits they earned. Vertical transfer students earned 20 more credits than their matched four-year peers. Among students who attained a bachelor's degree, vertical transfers earned 10 more credits than their four-year peers (and 16 more credits than should be necessary for a traditional four-year degree), suggesting either that they lost at least 10 credits at the point of transfer or that they were required to earn additional major-specific credits. It is not surprising, then, that two-year entrants spent more semesters in college than their native four-year counterparts, and were more likely to be still enrolled at the beginning of 2012 (more than seven years after their initial college enrollment).

Table 10: Enrollment Outcomes for Vertical Transfers Versus Native Four-Year College Students

Outcome	2-Year Entrants	4-Year Entrants	Effect Size
All matched students			
Number of credits (any type)	123	101	23.12 (1.89)***
Number of college-level credits	119	99	21.24 (1.90)***
Number of semesters enrolled	14	11	2.74 (0.21) ***
Still enrolled at beginning of 2012	40%	29%	0.10 (0.02) ***
Number of post-exit quarters	4	7	3.10 (0.02)***
Baccalaureate earners			
Number of credits (any type)	136	126	9.07 (1.33)***
Number of college-level credits	133	125	7.41 (1.36)***
Number of semesters enrolled	15	13	2.21 (0.20)***
Number of semesters until exit	4	5	1.10 (0.02)***

Note. The sample was constructed using our preferred matching strategy, a within-institution match including credits earned at the time of transfer.

6. Cost-Benefit Analysis

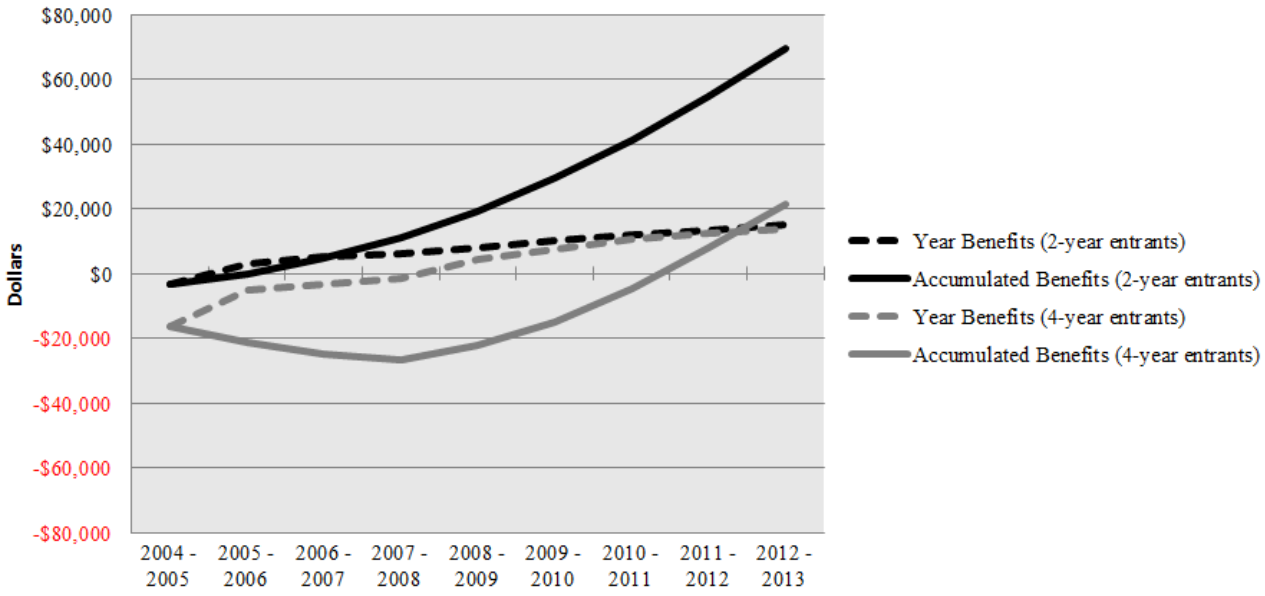
The results presented so far suggest that the community college pathway to the baccalaureate results in equal short-term earnings once we use propensity score matching to form comparable groups of students, whether or not students manage to transfer and earn a bachelor's degree. Students may also benefit from community colleges' lower tuition and fees, and the flexibility of the community college pathway may encourage them to remain more connected with the labor market, resulting in fewer opportunity costs of enrollment. To understand the overall implications of the community college pathway to the baccalaureate in terms of costs versus earnings, we conducted a simple cost-benefit analysis. Our data include earnings records through the eighth year after initial enrollment, allowing us to track the actual earnings for each student during this period. We focused on academic-year earnings (i.e., quarter four earnings added to the following year's earnings in quarters one to three) rather than calendar-year earnings, in order to appropriately match the earnings timeframe with published academic-year cost data. To estimate costs, we drew on the IPEDS total price variable for each institution (which includes in-state tuition and fees, books and supplies, room and board, and related off-campus expenses) for each year from 2004 to 2012.[8] For semesters in which students attended community college, we assumed they lived in the state but off-campus with their family; for semesters in which students attended a four-year college, we assumed that they lived in the state, off-campus, and independently from their family. The IPEDS total price variable is based on

[8] A number of colleges, in particular private four-year institutions, did not annually report total cost of attendance in IPEDS. In such cases, we used straight-line imputation to estimate annual costs. In rare cases, when only one or two years of cost data were available, we used the average percentage change in costs for similar institution types to estimate annual costs.

full-time attendance for a complete academic year; accordingly, we divided annual costs by 30 to estimate the cost per credit for each institution during each academic year, and then estimated the cost for each student based on the actual institution they attended and the number of credits they attempted that year. We converted all costs and earnings into 2012 dollars and estimated the net cost-benefit for each academic year by subtracting each student's academic-year costs from his or her academic-year earnings.[9]

As in our primary analyses in this paper, we performed the cost-benefit analysis using propensity score matching on two types of matched samples: (1) baccalaureate aspirants entering two-year versus four-year colleges, and (2) vertical transfer students matched with native four-year students within the same destination institution who had earned a similar number of credits at the time of transfer. For each matched sample, we also ran an analysis contingent on bachelor's degree completion. Table 11 reports the yearly and accumulated costs, earnings, and net cost-benefits for matched two-year and four-year entrants, and Figures 5 and 6 represent the data graphically for the full sample and bachelor's degree earners, respectively. Table 12 and Figures 7 and 8 report similar calculations for vertical transfers and matched native four-year students.

Figure 5: Yearly and Accumulated Cost-Benefits: Matched 2-Year and 4-Year Entrants



[9] Future discounting was set as zero, because our cost-benefit analysis looked at earnings and costs on a year-by-year basis. We did not attempt to estimate individual level nonpecuniary benefits, such as improved happiness or health, nor did we attempt to estimate the societal benefits and costs of education, including direct costs (e.g., public subsidies) and indirect benefits (e.g., lower crime rates). See Rouse (1998) and Romano and Djajalaksana (2011) for an analysis of the public costs of higher education. The aforementioned authors estimate the public expenditures to educate students at two-year and four-year colleges, taking into consideration, for example, that four-year universities incur higher costs associated with teaching upper division courses.

Figure 6: Yearly and Accumulated Cost-Benefits: Matched 2-Year and 4-Year Entrants (Bachelor's Degree Completers Only)

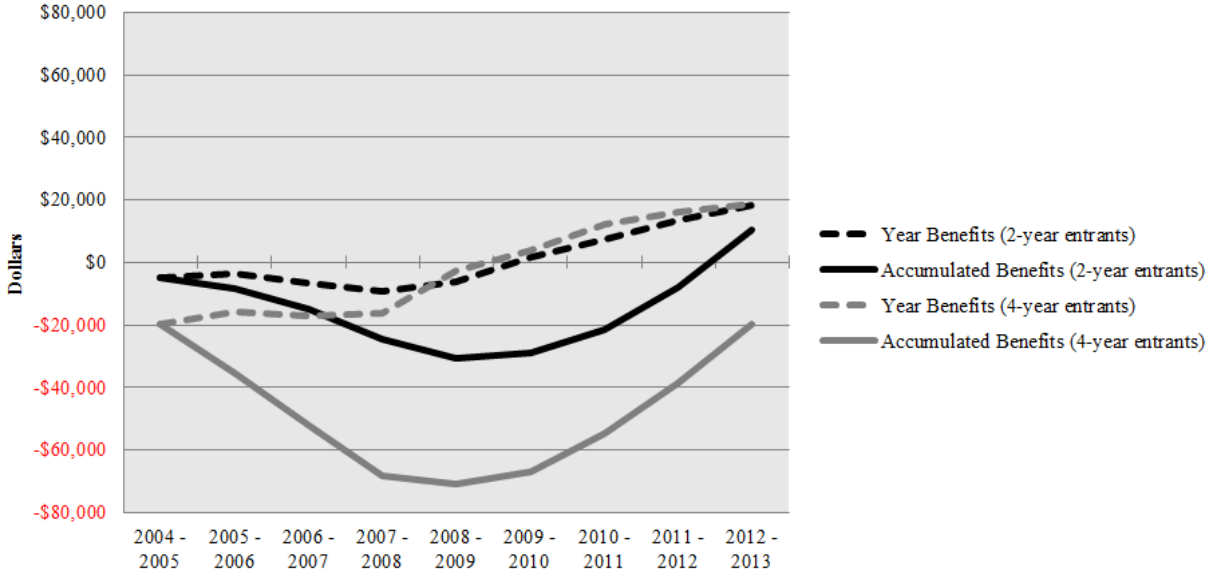


Figure 7: Yearly and Accumulated Cost-Benefits: Matched Transfer and Native 4-Year Students

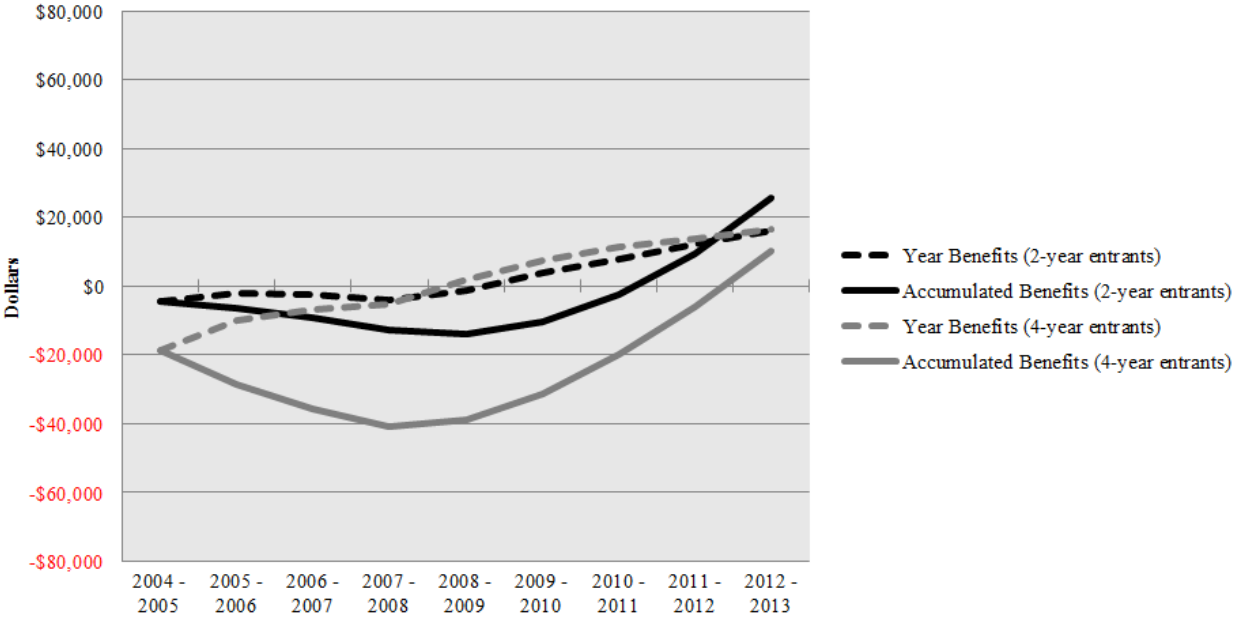


Figure 8: Yearly and Accumulated Cost-Benefits: Matched Transfer and Native 4-Year Students (Bachelor's Degree Completers Only)

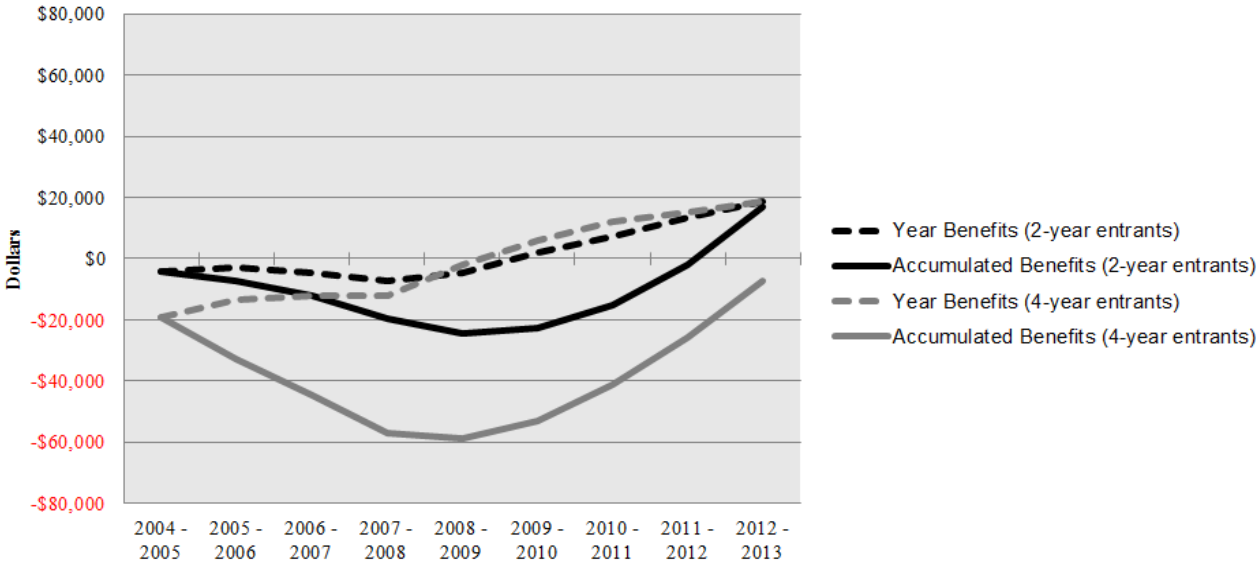


Table 11 indicates that two-year attendees faced lower costs and initially had higher earnings; for example, during their first academic year, two-year entrants suffered a net loss of only -$3,138, compared with -$16,350 among four-year entrants. Eight years later, all students' earnings had increased, but four-year entrants' salaries had still not surpassed those of two-year entrants. Moreover, the much higher accumulated costs ($65,609) of four-year attendance compared with two-year attendance ($29,599) resulted in much stronger net benefits for two-year students by 2012 ($69,605 − $21,527, or a more than $48,000 difference). While many community college entrants did not transfer or earn a bachelor's degree, it seems they accrued other valuable benefits from their community college experience—which may include credits earned, sub-baccalaureate degrees awarded, or the ability to stay connected to the labor market during their community college enrollment—that resulted in strong net benefits within the short-term timeframe that we examine here.

Table 11: Accumulated and Academic Year Cost-Benefits: Matched 2-Year and 4-Year Entrants

2-Yr Entrants

Matched 2-Yr and 4-Yr Entrants

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	5,207	5,207	2,069	2,069	-$3,138	-$3,138
2005 - 2006	4,391	9,598	7,263	9,332	$2,872	-$266
2006 - 2007	4,654	14,252	9,782	19,114	$5,128	$4,862
2007 - 2008	4,814	19,066	11,031	30,146	$6,217	$11,080
2008 - 2009	3,951	23,017	11,989	42,135	$8,038	$19,118
2009 - 2010	2,588	25,605	12,832	54,967	$10,244	$29,362
2010 - 2011	1,873	27,478	13,784	68,751	$11,911	$41,273
2011 - 2012	1,316	28,794	14,637	83,388	$13,321	$54,594
2012 - 2013	805	29,599	15,815	99,203	$15,011	$69,605

4-Yr Entrants

Matched 2-Yr and 4-Yr Entrants

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	17,826	17,826	1,477	1,477	-$16,350	-$16,350
2005 - 2006	12,443	30,270	7,278	8,755	-$5,165	-$21,515
2006 - 2007	11,214	41,483	7,737	16,492	-$3,477	-$24,991
2007 - 2008	10,870	52,354	9,214	25,706	-$1,656	-$26,647
2008 - 2009	5,858	58,212	10,260	35,966	$4,402	-$22,245
2009 - 2010	3,638	61,850	10,888	46,854	$7,250	-$14,995
2010 - 2011	1,978	63,828	12,389	59,244	$10,411	-$4,584
2011 - 2012	1,100	64,927	13,548	72,792	$12,449	$7,865
2012 - 2013	682	65,609	14,344	87,136	$13,663	$21,527

Matched 2-Yr and 4-Yr Entrants, Conditional on Bachelor's Completion

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	6,583	6,583	1,718	1,718	-$4,865	-$4,865
2005 - 2006	9,329	15,912	5,685	7,402	-$3,645	-$8,510
2006 - 2007	14,363	30,275	7,780	15,182	-$6,583	-$15,093
2007 - 2008	17,882	48,157	8,509	23,690	-$9,374	-$24,467
2008 - 2009	15,241	63,398	9,107	32,797	-$6,134	-$30,601
2009 - 2010	9,045	72,444	10,811	43,608	$1,766	-$28,835
2010 - 2011	5,788	78,231	13,203	56,811	$7,415	-$21,420
2011 - 2012	3,142	81,373	16,665	73,476	$13,523	-$7,897
2012 - 2013	1,097	82,470	19,210	92,686	$18,113	$10,216

Matched 2-Yr and 4-Tr Entrants, Conditional on Bachelor's Completion

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	20,815	20,815	1,219	1,219	-$19,595	-$19,595
2005 - 2006	21,113	41,928	5,469	6,688	-$15,644	-$35,240
2006 - 2007	22,978	64,906	6,053	12,741	-$16,925	-$52,165
2007 - 2008	23,301	88,207	7,285	20,025	-$16,017	-$68,181
2008 - 2009	11,814	100,021	9,186	29,212	-$2,628	-$70,810
2009 - 2010	7,205	107,227	11,019	40,231	$3,814	-$66,996
2010 - 2011	3,059	110,285	15,419	55,650	$12,360	-$54,636
2011 - 2012	1,177	111,463	17,315	72,964	$16,138	-$38,498
2012 - 2013	420	111,883	19,296	92,260	$18,876	-$19,622

Table 12: Accumulated and Academic Year Cost-Benefits: Matched Transfer and Native 4-Year Students

2-Yr Entrants

Matched Transfer & Native 4-Year

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	6,200	6,200	1,886	1,886	-$4,314	-$4,314
2005 - 2006	8,424	14,624	6,382	8,269	-$2,042	-$6,356
2006 - 2007	11,342	25,967	8,706	16,975	-$2,636	-$8,992
2007 - 2008	13,673	39,640	9,825	26,799	-$3,848	-$12,840
2008 - 2009	11,898	51,537	10,691	37,490	-$1,207	-$14,047
2009 - 2010	8,480	60,017	12,234	49,724	$3,754	-$10,293
2010 - 2011	6,320	66,337	14,031	63,755	$7,711	-$2,582
2011 - 2012	4,292	70,630	16,367	80,122	$12,074	$9,492
2012 - 2013	2,392	73,021	18,668	98,790	$16,277	$25,769

4-Yr Entrants

Matched Transfer & Native 4-Year

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	19,183	19,183	619	619	-$18,563	-$18,563
2005 - 2006	14,640	33,822	4,544	5,163	-$10,095	-$28,659
2006 - 2007	12,558	46,380	5,623	10,787	-$6,935	-$35,594
2007 - 2008	12,925	59,305	7,623	18,410	-$5,302	-$40,896
2008 - 2009	7,780	67,085	9,833	28,243	$2,054	-$38,842
2009 - 2010	4,882	71,967	12,367	40,610	$7,485	-$31,357
2010 - 2011	3,238	75,205	14,592	55,202	$11,354	-$20,003
2011 - 2012	2,196	77,401	16,061	71,264	$13,865	-$6,138
2012 - 2013	1,323	78,724	17,651	88,915	$16,328	$10,191

Matched Transfer & Native 4-Year, Conditional on Bachelor's Completion

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	6,289	6,289	1,865	1,865	-$4,424	-$4,424
2005 - 2006	9,110	15,400	6,218	8,083	-$2,892	-$7,316
2006 - 2007	13,238	28,637	8,472	16,555	-$4,766	-$12,082
2007 - 2008	16,774	45,411	9,318	25,873	-$7,456	-$19,538
2008 - 2009	14,689	60,100	9,959	35,833	-$4,730	-$24,267
2009 - 2010	9,809	69,908	11,558	47,390	$1,749	-$22,518
2010 - 2011	6,449	76,357	13,758	61,148	$7,309	-$15,209
2011 - 2012	3,614	79,971	16,995	78,143	$13,381	-$1,828
2012 - 2013	1,174	81,145	19,774	97,916	$18,600	$16,771

Matched Transfer & Native 4-Year, Conditional on Bachelor's Completion

Academic Year	Year Costs	Accumulated Costs	Year Wages	Accumulated Wages	Year Benefits	Accumulated Benefits
2004 - 2005	19,825	19,825	627	627	-$19,197	-$19,197
2005 - 2006	17,797	37,622	4,368	4,995	-$13,429	-$32,627
2006 - 2007	17,447	55,068	5,291	10,286	-$12,156	-$44,782
2007 - 2008	18,973	74,042	6,747	17,034	-$12,226	-$57,008
2008 - 2009	10,931	84,973	9,042	26,076	-$1,889	-$58,897
2009 - 2010	6,220	91,193	12,187	38,263	$5,967	-$52,930
2010 - 2011	3,542	94,735	15,455	53,718	$11,913	-$41,016
2011 - 2012	2,173	96,908	17,484	71,202	$15,311	-$25,706
2012 - 2013	1,080	97,987	19,606	90,808	$18,527	-$7,179

Table 12 and Figure 4 show that vertical transfer students also entered college with lower costs and higher earnings than their four-year entrant peers, but at the fourth year of enrollment, vertical transfers were paying similar costs and had only slightly higher earnings than their four-year entrant peers. Overall, by 2012, vertical transfer students remained ahead of their four-year peers in terms of accumulated net benefits ($25,769 versus $10,191). When restricting the analysis of matched transfer and native four-year students to those who earned a bachelor's by 2012, we again find that two-year entrants faced lower costs while earning higher salaries. This pattern remains consistent until the fifth year, when many vertical transfers were still paying the costs of four-year college attendance while many of their four-year peers had completed their bachelor's degrees, resulting in lowered costs and a jump in earnings to nearly match those of vertical transfers. By the following year, however, both vertical transfers and four-year natives began to see positive annual net benefits. By 2012, vertical transfers and matched four-year natives experienced similar annual costs and earnings. Overall by 2012, vertical transfers who earned bachelor's degrees had reaped the benefits of lowered costs and stronger earnings over the first years of enrollment, resulting in positive accumulated net benefits ($16,771), while native four-year students were still paying off their accumulated costs (-$7,179).

We acknowledge that other factors may influence the interpretation of this cost-benefit analysis, such as financial aid cost discounting. Yet the analysis provides a straightforward interpretation of the actual costs and short-term earnings benefits that students may expect when they make the decision to enter the two-year versus the four-year sector.

7. Discussion and Conclusion

Concomitant with the surge in tuition and fees associated with higher education attendance, community colleges have increasingly served as the starting point for many baccalaureate-aspiring students, especially students from lower income and minority groups. In this paper, we contribute to the current literature on the transfer function of community colleges by estimating the impacts of entering community college on students' probability of attaining a bachelor's degree, as well as on their short-term labor market performance. We used a propensity score matching strategy set forth by previous researchers in this field, but extended it by controlling for credit accumulation and the specific four-year institution to which each community college entrant transferred. We also extended Reynolds's (2012) cost-benefit analysis by using data on individual colleges' costs matched to individual students' patterns of enrollment, and using labor market estimates based on UI data.

Consistent with previous literature, we found that the community college pathway substantially reduces students' likelihood of earning a bachelor's degree. Regardless of whether students transferred or not, community college entrants seemed to fare similarly to their four-year entrant peers in the labor market by 2012 (eight years after college entry). These results accord with those of Reynolds (2012), who found no labor market penalty for community

college students at approximately seven years after entry. Our cost-benefit analysis suggests that two-year entrants' strong short-term earnings are due at least in part to their stronger attachment to the labor market during college; in addition, some two-year entrants who did not transfer may have earned vocational associate degrees or other types of credits that provided high short-term labor market payoffs.

It should be noted that this estimated null effect on earnings was based on a lower-bound strategy that matched the two groups of entrants based on first-semester characteristics. If community college entry negatively influences student progression as early as the first semester, then these labor market results may be biased in a conservative direction. Our examination of this diversion hypothesis suggests that community college policies do tend to depress students' college-level credit accrual, which in large part may be due to the common policy of referring most students to lengthy remedial sequences from which few emerge (Bailey, Jeong, & Cho, 2010). In addition, community college students (even those who attend full-time) enroll in fewer credits overall compared with their matched four-year peers. While community colleges could potentially rethink their policies to encourage students to maintain higher credit loads (Klempin, 2014), community college students' lower credit loads are also associated with higher during-college earnings, which help maintain community colleges' relatively strong cost-benefit profile. However, our lower-bound estimate of community colleges' impact on students' early academic progress is consistent with recent rigorous research using a national dataset (Monaghan & Attewell, 2015) that found only small diversionary effects that grew slowly across time.

Overall, less than one fourth of baccalaureate-aspiring community college entrants ever made it to the four-year sector. Even very successful community college students often failed to transfer, and among students who did transfer, the idiosyncratic patterns and timing of transfer seem to suggest that they had no clearly structured transfer pathway to follow. In addition, we found that vertical transfers had typically earned more college credits at graduation, supporting the notion that they suffer from either credit loss at the time of transfer or excess crediting requirements. Moreover, the fact that transfer students typically experienced a decline in GPA immediately at the point of transfer (from which they later partially recovered) suggests that transfer students may have difficulty adjusting to the receiving institution after transfer.

These findings echo a wide variety of recent work arguing that community college transfer pathways are insufficiently structured and supported (e.g., Bailey et al., 2015; Baker, 2015; Jaggars & Fletcher, 2014; Scott-Clayton, 2011). As states and colleges search for new strategies to increase transfer rates and the success of transfer students, our results suggest that the responsibility should not rest solely with community colleges: Transfer destinations must also take responsibility for working with community colleges to build strong transfer pathways, and to provide support for their transfer students' success. For example, four-year transfer destinations may need to work with their key feeder community colleges to create agreements in which students who earn a transfer-oriented associate degree in a given field are guaranteed junior-level standing in a matching major at the four-year college (Baker, 2015). Such policies may have a salutary effect on credit loss, given that studies in three different public college

systems have found that vertical transfer students who earn transfer-oriented associate degrees have higher rates of bachelor's degree attainment than do similar vocationally oriented associate degree holders or non-degree holders, even after controlling for the number of credits accumulated before transfer (Crook, Chellman, & Holod, 2012; Crosta & Kopko, 2014; Ehrenberg & Smith, 2004). In addition, transfer destinations may need to orient, advise, and provide support services to transfer students in order to facilitate their academic and social integration into the new educational setting (Jenkins, Wyner, Shapiro, & Fink, 2016).

Among students who made it to the four-year sector, we found that the majority transferred to an institution defined as either selective or more selective according to IPEDS. As a result, previous studies restricting the sample to open-access or nonselective colleges are likely to distort the representativeness of the transfer student population, at least in some states, such as Virginia. Yet we also found that vertical transfers were less likely than native four-year students to attend more selective and more highly resourced colleges. As a result, failure to control for institutional differences between vertical transfers and native four-year students would likely bias estimates in favor of native four-year college students. In order to include students who transferred to selective colleges while identifying appropriate matches within the native four-year population, we matched vertical transfers with native students in the same institution who had earned a similar number of credits at the time of transfer. In terms of bachelor's degree attainment, this strategy resulted in strong positive estimates for vertical transfer students, compared with near-zero estimates under more traditional matching strategies. Further analyses (as part of our cost-benefit calculations) suggested that later-transferring students were matched with native students who were relatively low-performing, which may help explain the positive estimate we observed. In any case, the sharp differences between across-institution and within-institution matching strategies highlight the importance of taking into account the comparability of four-year institutions attended by vertical transfers versus native four-year entrants.

Finally, community college students who successfully navigated the transfer barrier were equal to matched native four-year students in terms of their labor market performance, at least in the short term (eight years after entry). Our cost-benefit analyses suggest that vertical transfers reap strong financial benefits from the community college pathway—in part due to two-year colleges' lower expenses, but also in part due to these students' stronger attachment to the labor market during their community college enrollment period. However, we were able to observe students' earnings for only eight years. Approximately 40 percent of the vertical transfer students and 30 percent of the matched native four-year students were still enrolled in college at the end of our tracking period, and many of these students may eventually earn a bachelor's degree. Even among students who earned their baccalaureate during the time period under study, most did so only a few years before the end of the study. Prior research on Virginia community college students suggests that the bulk of positive returns to bachelor's degrees are due not to immediate increases in earnings levels but to accelerations in students' earnings growth over time (Jaggars & Xu, 2016). If we measured earnings further into the future, we might find that some students reach an earnings plateau (for example, those who did not graduate or who earned

only a certificate), while those with a bachelor's degree experience sharp increases in their earnings over time. Accordingly, future studies may wish to examine the long-term impacts of community college attendance on students' labor market performance.

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