Stepping-Stones or Roadblocks?

THE IMPACT OF TWO-YEAR COLLEGE ENTRY ON BACCALAUREATE ATTAINMENT AND LABOR MARKET OUTCOMES

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Executive Summary

Two-year colleges have served as vital stepping-stones for students seeking to earn a bachelor's degree. Four out of five students who begin their higher education at a two-year institution aspire to eventually earn a bachelor's degree. To achieve that goal, these students must complete their current program's requirements and then matriculate at a four-year college—a process known as "vertical transfer."

This is commonly extolled as a cost-saving strategy, but it can also create unexpected challenges for students. Indeed, prior studies have shown that beginning college at a two-year institution decreases a student's probability of eventually obtaining a bachelor's degree—even among those who express a clear intent in doing so. Yet relatively little is known about how vertical transfer may affect students' future labor market outcomes.

To shine light on the vertical transfer process, this report compares the outcomes of otherwise similar groups of students who aspire to obtain a bachelor's degree, with the only difference being that one group begins college at a two-year college, while the other begins at a four-year university. We also stratify our sample to study if the effects of initiating college at a two-year institution differ across various student populations.

Given that these students all began college with the same goal in mind—obtaining a bachelor's degree—we would hope that both groups experience similar academic and labor market outcomes. In line with past research, we find that starting at a two-year college sharply reduces students' likelihood of earning a bachelor's degree, and such negative effects are particularly pronounced for students in relatively high quartiles of precollege math ability. In terms of labor market outcomes, female students are less likely to work full time if they started at a two-year college rather than a four-year institution. Male students are also less likely to work full time, conditional on being in the labor market.

The report concludes by examining several potential explanations for the disparities between students who initiate at two-year and four-year colleges. These include a slower accumulation of credits and early academic progress, challenges during the transfer process, a loss of credits at the point of transfer, and post-transfer academic shock. In this regard, two-year institutions may not be the stepping-stone that many policymakers and families have hoped for, unless additional efforts are made to improve the transfer pathway.

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Two-year colleges have served as vital stepping-stones for students seeking to earn a bachelor's degree. In the 2015–16 academic year, more than 8.8 million students enrolled at public two-year colleges, and according to a recent study, 80 percent of them indicated that they intend to earn a bachelor's degree.[1] To achieve that goal, these students must complete their current program's requirements and then matriculate at a four-year university—a process known as "vertical transfer."

This process is often extolled as a cost-saving way to obtain a higher education.[2] Instead of paying for four (or more) years of tuition at expensive universities, students can accumulate two years of credits at more affordable community colleges and then transfer those credits to four-year universities. In theory, students who transfer and then go on to graduate receive the exact same bachelor's degree as their peers while paying just a fraction of the price.

But vertical transfer can also create unexpected challenges. For example, some students face significant logistical and academic hurdles when attempting to switch institutions. Further, researchers have not agreed on the extent to which students face long-term labor market penalties for initiating at two-year colleges.[3] If there are downstream academic or economic consequences, then vertical transfer could leave some students at a disadvantage compared to those who originally began at four-year universities.

Indeed, prior studies have shown that beginning college at a two-year institution decreases a student's probability of eventually obtaining a bachelor's degree—even among those who express a clear intent in doing so.[4] According to data compiled by the National Student Clearinghouse, only 13 percent of students who initiate at a two-year institution earn a bachelor's degree within six years. On average, the baccalaureate-attainment rate is between 17 and 25 percent lower for students who begin at two-year institutions compared to those who start at four-year universities.[5] These averages paint a bleak picture for anyone hoping to vertically transfer as a method for obtaining a bachelor's degree.

Even so, researchers are now challenging the emphasis on "average effects."[6] The characteristics of students who attend two-year colleges vary widely (in age, family background, work experiences, and academic preparation), so there might be little reason to believe that the effects of starting college at a two-year institution are the same across all student populations.[7] Additionally, researchers are exploring how outcomes differ according to the "counterfactual" education pathway.[8] For example, the counterfactual for an academically advanced student at a two-year college could be selective four-year institutions, while the most likely counterfactual for many disadvantaged students is no postsecondary credential at all.

Jennie Brand, Fabian Pfeffer, and Sara Goldrick-Rab studied the postsecondary outcomes of high school graduates from Chicago Public Schools with four different counterfactual conditions—no college at all, nonselective four-year institutions, selective four-year institutions, and highly selective four-year institutions. They found that initiating college at a two-year institution has the largest penalty for academically advantaged students who would otherwise have attended four-year colleges, especially highly selective four-year universities.[9] This suggests that starting at a two-year institution may penalize some students (if the counterfactual is initiating at a four-year institution) and benefit others (if the counterfactual is no postsecondary education at all).

While there is still some scholarly debate in this area, the reality is that many students will continue enrolling at these colleges with the expectation of graduating with an associate degree and then transferring to a four-year university to finish their bachelor's. Without a better understanding of vertical transfer, the promise of two-year institutions as the stepping-stone to a bachelor's degree might be substantially jeopardized for future generations of college students.

To shine light on the vertical transfer process, this report compares the outcomes of otherwise similar groups of students who aspire to obtain a bachelor's degree, with the only difference between them being that one group begins college at a two-year college, while the other begins at a four-year university. We also stratify our sample to study if the effects of initiating college at a two-year institution differ across various student populations.

Given that these students all began college with the same goal in mind—obtaining a bachelor's degree—we would hope that both groups experience similar academic and labor market outcomes. If that is the case, policymakers may rightfully conclude that vertical transfer is a viable pathway for those looking for cost-saving strategies to obtain a bachelor's degree. But if the outcomes between the groups are markedly different, students might want to think twice before pursuing the vertical transfer pathway.

The report concludes by examining several potential explanations for the disparities between students who initiate at two-year and four-year colleges, including the impact of two-year college attendance on early academic progress, challenges related to the transfer process, loss of credits at the point of transfer, and post-transfer academic shock.

Data and Estimation Strategy

Data for this report come from the Educational Longitudinal Study (ELS) of 2002, a nationally representative study of students in 10th grade in 2002 and 12th grade in 2004.[10] The study generated six waves of data that gathered information on academic and labor market outcomes.[11] It includes information about students' demographic characteristics, such as gender, race, and family background; students' precollege academic preparation, such as standardized test scores, grade point average (GPA), and vocational credits; and the students' high schools, such as total enrollment, teacher salary, and the geographic location.

We limit our analysis to students who attended public or private nonprofit institutions. Because two-year colleges serve a broad range of students, we further restrict our sample to include only students who indicated an intent to receive a bachelor's in the baseline ELS survey, which was administered while the student was in high school. Most individuals in our sample began college right after high school, meaning they enrolled during the summer of 2004, fall of 2004, or spring of 2005. However, some students (roughly 12 percent) initiated at a higher education institution before the summer of 2004 through dual-enrollment programs, while others (roughly 11 percent) delayed college entry until after the spring of 2005. We exclude both groups from our analyses.[12]

Finally, note that we observed students' earnings only seven years after they initially enrolled in college.[13] Approximately 6.5 percent of students in our sample who vertically transferred from a two-year to four-year institution were still enrolled at the end of our tracking period.[14] Some of these students may

Table 1. Summary Statistics of the Analytical Sample

	Two-Year College Entrants	Four-Year College Entrants
Demographic		
Male	0.457	0.446
White	0.564	0.658
Black	0.128	0.103
Hispanic	0.155	0.078
Asian	0.104	0.115
Other	0.049	0.047
Academic Preparation		
Standardized Reading Score (Grade 12)	–0.068	0.597
Standardized Math Score (Grade 12)	–0.211	0.613
High School GPA (All Courses)	2.693	3.183
Vocational Units	3.256	2.304
Socioeconomic Status		
First Quartile (Q1)	0.212	0.099
Second Quartile (Q2)	0.259	0.162
Third Quartile (Q3)	0.285	0.260
Fourth Quartile (Q4)	0.245	0.478
High School		
Enrollment (Thousands)	1.330	1.210
General Program	0.356	0.219
College Preparatory Program	0.566	0.740
Vocational Program	0.078	0.041
Percentage Free Lunch	0.248	0.215
Teacher Pay ($1,000s)	42.43	42.01
Urban	0.287	0.377
Suburban	0.525	0.475
Rural	0.188	0.147
N	1,750	5,080

Note: We also include census region controls. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002.

Table 2. Average Outcomes for Two-Year and Four-Year College Entrants

	Full Sample		Male Sample		Female Sample	
	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year
Received Bachelor's or Higher	0.198	0.664	0.202	0.636	0.194	0.687
Earnings (Natural Log)	9.870	10.130	10.080	10.210	9.696	10.070
Employed Full Time	0.758	0.816	0.796	0.834	0.727	0.802
Full-Time Conditional Employment	0.832	0.875	0.857	0.894	0.811	0.860

Note: "Employed Full Time" is the percentage of all workers who are employed full time as opposed to employed part time or unemployed. "Full-Time Conditional Employment" is the percentage of employees who are working full time, as opposed to workers who are employed part time.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

eventually earn a bachelor's degree, but we cannot observe those outcomes in our findings.[15]

Our final sample includes 6,830 students, approximately one-quarter of whom initiated college at a two-year institution. Table 1 presents descriptive statistics of students who initiated at two-year and four-year colleges. On average, a larger proportion of underrepresented student groups initiated at two-year colleges than at four-year colleges. Additionally, two-year colleges enrolled students with lower academic preparation, as measured by standardized test scores and high school GPA. Lastly, about a quarter of students from each family income quartile attended a two-year college, whereas four-year colleges enrolled larger shares of students from the top two income quartiles.

We focus on a number of academic and labor market outcomes, including baccalaureate completion, employment status, and self-reported earnings. Table 2 summarizes these measures for students who initiated at two- and four-year institutions. On average, we observe a large degree-attainment gap between students who began at a two-year institution and those who began at four-year universities.[16] Similarly, we find differences between average employment rates and earnings, favoring students who initiated at four-year universities.[17]

But these gaps might be attributable to underlying differences in the behaviors, characteristics, and circumstances of the students who choose to enroll in certain types of colleges. Data from the National Education Longitudinal Study suggest that students who are seeking a bachelor's degree but initiate at a two-year college are significantly more likely to be of lower socioeconomic status, to be married or have a child at the time of enrollment, to be a racial minority, and to have demonstrated lower high school math and reading performance than those who initiate at a four-year institution.[18] Moreover, studies have shown that these factors are associated with lower rates of college completion, even after adjusting for a student's academic preparation.[19]

To account for these underlying differences, we use a propensity score matching strategy to simulate a comparison group of students who initiated at four-year institutions but otherwise resembles our sample of two-year college entrants.[20] This approach allows us to assess the impact of initiating at a two-year college on academic and labor market outcomes and has two major advantages over alternative estimation methods, such as ordinary least squares. Methodologically, propensity score matching can avoid data extrapolation by making inferences only from data on students who are similar

regarding observed characteristics. Practically, this estimation strategy directly addresses the policy concern of using two-year colleges as a pathway to baccalaureate attainment by focusing on the types of baccalaureate-aspiring students who are most likely to take the two-year college route.

Using this strategy, we relate the outcomes of student *i* to the level of institution in which the student initially enrolled (i.e., a two-year or a four-year institution). The model also incorporates a rich set of controls, denoted by the vector X_i, which includes student demographic attributes, socioeconomic status, and academic preparedness.

$$Logit\ (Y_i) = \alpha + \beta\ Twoyear_i + X_i + \mu_i \qquad (1)$$

The propensity score matching estimation was obtained using a three-step process, which is outlined in Appendix A. Our estimates are presented in Table 3, which predicts a student's baseline probability of initiating at a two-year college instead of a four-year college.

As expected, a number of precollege academic variables are highly predictive of initiating at a two-year college. For example, students who begin at a two-year institution were more likely to earn lower high school grades, take vocational classes, and have lower math and verbal test scores than those who initiated at a four-year institution.[21]

Results

We find large gaps in the academic and labor market outcomes of students who begin college at two- and four-year institutions.[22] Table 4 presents our estimates based on five different model specifications. Column 1 uses the full analytical sample and provides a raw comparison between the two-year and four-year institution entrants without any covariates. Column 2 uses the same sample but adds controls for baseline differences between the two groups in terms of demographic characteristics, prior academic achievement, and high school characteristics. Column 3 shows the estimated impacts based on the post-match sample constructed using the propensity score matching technique. Finally, Columns 4 and 5 present post-match results for males and females, respectively.

We find that students who initiated at a two-year college were significantly less likely to receive a bachelor's within six years, and this negative effect is consistent across all five model specifications. However, the magnitude of the estimated effects was smaller in the post-match sample than in the full sample.[23] Specifically, the gap in the baccalaureate-attainment rates between students who initiated at two- and four-year institutions narrowed by half—from 44 percentage points to 23 percentage points—after we controlled for observable student characteristics (Column 2). The difference was further reduced to 19 percentage points after propensity score matching (Column 3). Based on the post-match sample, the impact of two-year college entry on baccalaureate attainment is similar for males and females.

In terms of labor market outcomes, estimates are generally negative, although the estimated negative effects are substantially smaller after controlling for baseline differences between students who initiate at two-year and four-year institutions. Further, the negative effects lose significance in the post-match sample. The only exception is full-time employment for female students; female students who initiate at a two-year college are less likely to be employed full time (versus employed part time or unemployed), compared to their four-year institution counterparts.[24]

Thus far, we have focused on the average effects of initiating at two-year colleges compared to four-year universities. However, the average may mask heterogeneous impacts for different student populations at two-year colleges. To explore this possibility, we split the student sample into quartiles using students' SAT math scores. That is, we look at how the average effects might vary across different populations based on students' levels of academic preparation. Table 5 reports the results for each subsample.[25]

We find that the baccalaureate-attainment gap (Panel A) is smallest for students in the lowest math score quartile. For male students with the lowest

Table 3. Probability of Attending a Two-Year College Among Baccalaureate-Seeking Students (Logit Model with Marginal Effects Reported)

	Full Sample	Male Sample	Female Sample
Demographic			
Male	–0.001	—	—
	(0.011)	—	—
Black	–0.106***	–0.111***	–0.107***
	(0.013)	(0.019)	(0.018)
Hispanic	0.010	0.022	–0.000
	(0.020)	(0.031)	(0.026)
Asian	–0.028	–0.054**	–0.009
	(0.018)	(0.025)	(0.027)
Other	–0.045**	0.004	–0.081***
	(0.021)	(0.038)	(0.025)
Academic Preparation			
Standardized Reading Score (Grade 12)	–0.037***	–0.030***	–0.046***
	(0.008)	(0.011)	(0.011)
Standardized Math Score (Grade 12)	–0.074***	–0.074***	–0.072***
	(0.008)	(0.011)	(0.012)
High School GPA (Standardized)	–0.116***	–0.118***	–0.115***
	(0.008)	(0.009)	(0.012)
Vocational Units (Standardized)	0.025***	0.019**	0.030***
	(0.005)	(0.008)	(0.007)
Socioeconomic Status			
Second Quartile (Q2)	0.002	–0.019	0.014
	(0.019)	(0.032)	(0.024)
Third Quartile (Q3)	–0.023	–0.029	–0.021
	(0.019)	(0.031)	(0.023)
Fourth Quartile (Q4)	–0.090***	–0.101***	–0.084***
	(0.018)	(0.030)	(0.023)
High School			
Enrollment (Thousands)	0.016**	0.008	0.021**
	(0.008)	(0.012)	(0.010)
College Preparatory Program	–0.047***	–0.050***	–0.047***
	(0.012)	(0.019)	(0.016)
Vocational Program	–0.016	–0.035	–0.004
	(0.024)	(0.034)	(0.033)
Percentage Free Lunch	0.001**	0.001	0.001**
	(0.000)	(0.001)	(0.001)

(continued on the next page)

Table 3. Probability of Attending a Two-Year College Among Baccalaureate-Seeking Students (Logit Model with Marginal Effects Reported) (continued)

Teacher Pay ($1,000s)	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
Urban	–0.096***	–0.078***	–0.109***
	(0.017)	(0.026)	(0.024)
Suburban	–0.012	–0.008	–0.013
	(0.015)	(0.022)	(0.019)
N	6,830	3,070	3,770

Note: Treatment effects are reported as marginal effects estimated at the mean of observables characteristics. For easier interpretation, we convert the log odds into marginal effects. Omitted categories include female, white, socioeconomic status Q1, general high school, and rural high school. A dummy variable approach is used to retain sample size. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table 4. Impact of Initiating at a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes

			Matched Sample		
	Full Sample		All Students	Male Students	Female Students
	(1)	(2)	(3)	(4)	(5)
Received Bachelor's Degree or Higher	–0.442***	–0.234***	–0.194***	–0.200***	–0.225***
	(0.013)	(0.015)	(0.021)	(0.031)	(0.028)
N	6,820	6,820	2,687	1,216	1,441
Earnings (Natural Log)	–0.231***	–0.076*	–0.004	0.073	–0.134
	(0.037)	(0.040)	(0.060)	(0.073)	(0.089)
N	5,680	5,680	2,140	960	1,160
Employed Full Time	–0.057***	–0.018	–0.003	–0.032	–0.063**
	(0.014)	(0.016)	(0.023)	(0.028)	(0.030)
N	5,780	5,780	2,220	1,000	1,190
Full-Time Conditional Employment	–0.040***	–0.026*	0.000	–0.041*	0.018
	(0.013)	(0.014)	(0.021)	(0.024)	(0.033)
N	5,360	5,360	2,010	920	1,070
Covariates		X	X	X	X

Note: First-term fixed effects are included in all models. The regional unemployment rate is used as a control for labor market outcomes. (See Table B4, which uses region fixed effects.) Sampling weights are used in all models. A dummy variable approach is used to retain sample sizes. The full set of controls listed in Table 1 is used in models 2–5. Robust standard errors are used. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines. *p < 0.10; **p < 0.05; ***p < 0.01. "Employed Full Time" is the percentage of all workers who are employed full time as opposed to employed part time or unemployed. "Full-Time Conditional Employment" is the percentage of employees who are working full time, as opposed to workers who are employed part time.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table 5. Impact of Initiating in a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes, by Student Math Ability (Matched Sample)

	Male Sample			Female Sample		
			N			*N*
Panel A. Outcome = Baccalaureate Attainment						
Math Q1	–0.139***	(0.046)	500	–0.180***	(0.043)	640
Math Q2	–0.217***	(0.060)	340	–0.258***	(0.056)	380
Math Q3	–0.249***	(0.071)	200	–0.193***	(0.068)	240
Math Q4	–0.210**	(0.092)	100	–0.348**	(0.140)	90
Panel B. Outcome = Employed Full Time (vs. Part Time or Unemployed)						
Math Q1	–0.034	(0.042)	390	–0.006	(0.048)	520
Math Q2	–0.032	(0.055)	290	–0.079	(0.049)	310
Math Q3	0.031	(0.079)	180	–0.126**	(0.064)	200
Math Q4	–0.406***	(0.116)	90	–0.115	(0.136)	90
Panel C. Outcome = Earnings (Natural Log)						
Math Q1	0.110	(0.130)	380	–0.042	(0.137)	510
Math Q2	–0.018	(0.106)	290	–0.212*	(0.118)	300
Math Q3	0.160	(0.130)	160	–0.078	(0.134)	210
Math Q4	–0.267	(0.209)	80	0.103	(0.253)	90

Note: First-term fixed effects are included in all models. The regional unemployment rate is used as a control in models in which labor market measures are used as outcome measures. Sampling weights are used in all models. A dummy variable approach is used to retain sample sizes. The full set of controls listed in Table 1 is used in all models. Robust standard errors are used. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines. *p < 0.10; **p < 0.05; ***p < 0.01.

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

math scores, initiating at a two-year college reduces baccalaureate attainment by approximately 14 percentage points compared to students who initiate at four-year universities. The baccalaureate-attainment gap increases to approximately 22 percentage points for male students in the second quartile of math scores and to 25 percentage points for male students in the third quartile. With labor market outcomes, the pattern is clearer: Males with the highest math ability (Quartile 4) are associated with the largest full-time employment and earnings penalty when compared to their peers who began at a four-year university. (See Panels B and C.)[26]

In contrast, the baccalaureate-attainment gap for female students is much more substantial when broken out by math score quartiles. Females in the bottom quartile of math scores are 18 percent less likely to obtain a bachelor's degree if they begin at a two-year institution, compared to similar students who begin at a four-year university. The gap nearly doubles when comparing female students in the highest math quartile. These students are 35 percent less likely to obtain a bachelor's degree if they started college at a two-year university compared to similar students starting at four-year universities.

The pattern for female students' labor market outcomes is less clear. The results suggest that female

students with math scores between the 50th and 75th percentile are 13 percentage points less likely to gain full-time employment than otherwise similar students who initiate at a four-year institution, but there appears to be no discernable difference in labor market outcomes for female students from the other three quartiles.

Why do bachelor's degree–seeking students fare more poorly if they initiate at a two-year college instead of a four-year institution? Theoretically, both groups of students entered college with the same aspirations to obtain a bachelor's degree, yet they face substantially different outcomes. The following two sections explore the mechanisms leading up to and immediately following the vertical transfer process to provide a better understanding of the different challenges that exist between the two groups.

Pre-Transfer Challenges for Students at Two-Year Institutions

The disparity in academic and labor market outcomes may be attributable to factors leading up to the vertical transfer process. We explore student supports at two-year institutions, remedial coursework requirements, difficulties navigating the transfer process, and the failure to transfer as potential mechanisms that contribute to the gaps in students' academic and labor market outcomes.

Lack of Student Supports. One possible explanation for the academic and labor market gaps that we observe could be the amount of available supports. Compared to four-year institutions, two-year colleges often offer fewer student support services,[27] and few offer on-campus residence, both factors thought to be crucial for college integration, motivation, and persistence.[28]

Students who begin at four-year universities may also have greater access to nonacademic support services than similar students at two-year colleges. Research has increasingly emphasized the importance for colleges to provide students with not only academic support and resources but also psychologically oriented supports that can activate students' motives, foster growth mindsets, and help students develop a sense of meaning and purpose in college.[29]

Remedial Coursework Requirements. In addition, students who begin at a two-year institution often must fulfill various remedial requirements—classes that may not count toward degree completion but are required among all freshmen who are perceived as not adequately prepared for college-level coursework. At four-year institutions, students are more likely to receive credit for these courses, allowing them to make faster progress toward their degree.[30]

The existing literature on developmental education fails to find consistent evidence concerning the benefits of receiving college remediation, particularly for students at two-year institutions.[31] In fact, recent studies indicate that remedial coursework may hinder students' persistence[32] and that developmental education may divert students from college-level coursework, ultimately resulting in fewer college-level credits earned.[33]

Navigating the Transfer Process. Students may also have difficulty navigating the challenges inherent in selecting and enrolling at a four-year transfer destination. Four-year institutions often have distinct application and financial aid processes; as a result, students need to manage their transfer applications for each destination institution separately. Further, two-year colleges and four-year universities typically do not have a formal agreement on transfer policies, resulting in a lack of awareness among students regarding the specific courses required to transfer to a four-year institution.

While academic advising is available at two-year colleges, the typical student-to-adviser ratio is approximately 1,000:1 due to financial constraints.[34] As a result, students often select redundant courses or those not applicable to their major.[35] Further complicating the transfer process, advisers are often knowledgeable about only one or two popular transfer destinations. For example, at one large two-year college, the transfer process to four-year institutions bewilders and frustrates students. One student complains:

> They [academic advisers] basically only know [the top two transfer schools] because they have the best relationship with them; but other than that, you're more or less just on your own. And that's where a lot of us go through word-of-mouth or people that we know, because there really is no clarification or reassurance in the website or just in [the two-year institution's] people in general.[36]

Similar student complaints about the transfer process are well-documented in a variety of qualitative studies.[37] Given the logistical work required to successfully navigate the transfer process and the lack of structure and standardization, it is unsurprising that many academically successful two-year college students struggle with the transfer process.[38]

Failure to Transfer. Obviously, students who fail to vertically transfer do not have a shot at obtaining a bachelor's degree. By itself, this is likely one of the largest contributors to the gaps in academic outcomes that we observe between otherwise similar students beginning college at two- and four-year institutions. As shown in Table 6, only about 40 percent of students in our sample ever transferred to a four-year institution. Additionally, 40 percent of students who either completed an associate degree or accumulated more than 60 credits from a two-year college failed to transfer.

Traditionally, students at two-year colleges are expected to transfer at the beginning of their third academic year after earning approximately 60 credits. However, when examining the timing of transfer in our data set, we find that few students followed such a pattern and that there were striking variations in students' transfer trajectories. For example, only a quarter of students transferred during their first or second year, and almost 50 percent transferred four or more years after entry.

Similarly, students who vertically transfer varied widely in the number of college-level credits accrued at the time of transfer. Credit totals ranged from 0 to 144, with the average being 49 credits.[39] Still more worrisome, roughly 35 percent of students transferred with more than 65 credits, implying that students may be required to take more credits than needed to transfer to a four-year institution.

These patterns suggest that there is no well-trodden, highly structured transfer pathway for students to follow. Instead, two-year college students seem to be left to discover their own idiosyncratic path to a four-year institution.

Post-Transfer Challenges for Students from Two-Year Institutions

Students who manage to transfer to a four-year institution may face an entirely new set of challenges upon arrival at their new campus. After transferring, students still must finish the final two years of their bachelor's degree. We explore an additional set of challenges that students face after the vertical transfer process, including loss of credits during transfer, academic shock, and academic momentum. These mechanisms may further explain why we observe large gaps in academic and labor market outcomes between otherwise similar students who begin college at two- and four-year institutions.

Loss of Credits During Transfer. Another key barrier to academic success for students who vertically transfer is the loss of credits at the time of transfer. Losing credits due to the transfer process (meaning the four-year institution does not accept certain credits obtained at students' two-year institutions) can increase the time it takes for students to earn a bachelor's degree. In turn, this can contribute to dropout, especially when students do not have the financial means to stay at the destination institution for more than two years. Indeed, the students in our sample who vertically transferred lost an average of 15 credits (equivalent to five three-unit courses) at the time of transfer.[40]

Although many states have policies requiring public four-year institutions to accept an agreed-upon set of credits from two-year colleges, most agreements do not guarantee that two-year college credits will apply to students' intended majors. As a result, students who vertically transfer often either lose credits at

Table 6. Transfer Patterns Among Two-Year College Baccalaureate-Seeking Students

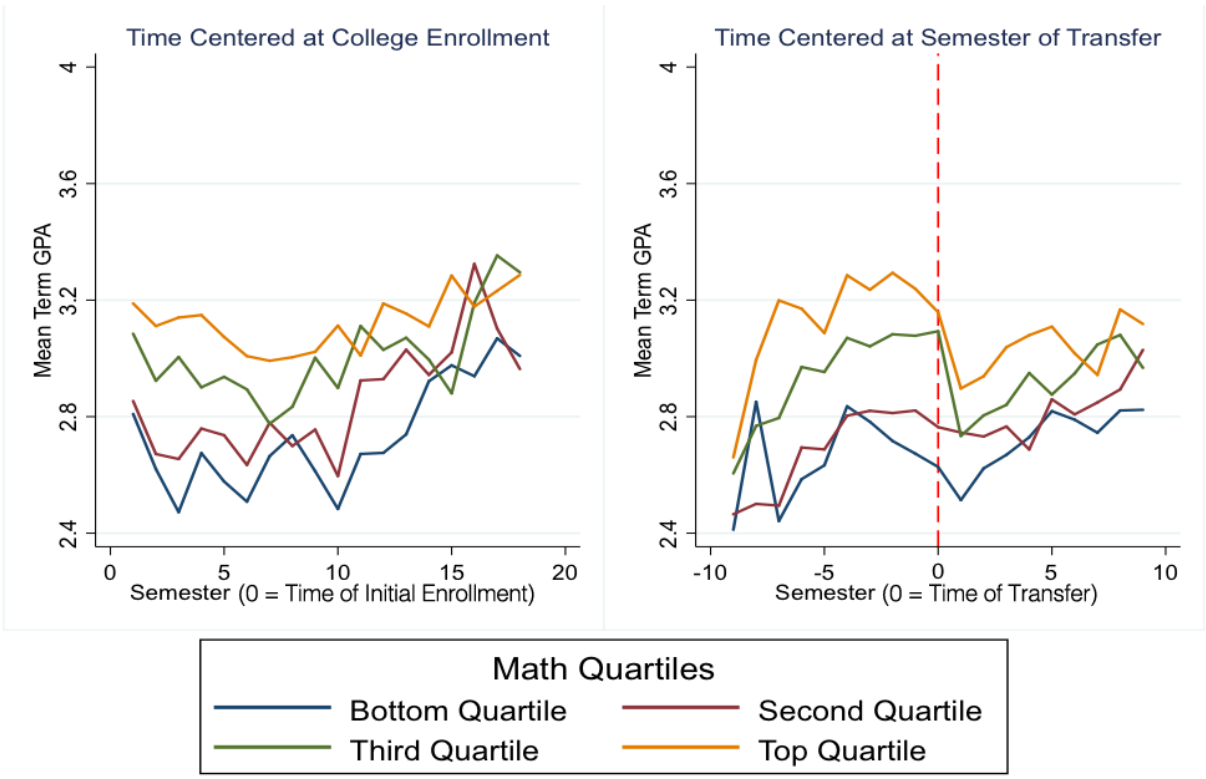
Outcome	Count	Percentage	*N*
Transfer Rate			
All Baccalaureate-Seeking Two-Year Entrants	640	39	1,630
Associate Earners	230	58	390
Diploma or Certificate Earners (No Associate Degree)	10	27	40
No Community College Award	400	34	1,200
College-Level Credits Earned from Two-Year Colleges			
< 20	140	23	620
20–39	100	36	290
40–59	120	52	230
> 60	290	53	530
Timing of Transfer (Among Vertical Transfers, *n* = 650)			
1st Academic Year	70	10	
2nd Academic Year	110	17	
3rd Academic Year	170	26	
4th Academic Year	120	18	
5th Academic Year	60	9	
6th Academic Year	50	7	
7th Academic Year	40	6	
8th Academic Year or Beyond	40	7	
College-Level Credits Earned upon Transfer (Among Vertical Transfers)			
< 20	140	22	
20–39	100	16	
40–59	120	18	
> 60	280	44	

Note: Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

the time of transfer or are required to acquire unnecessary credits. For example, using college administrative data from Virginia, Xu et al. find that among students who received a bachelor's degree, those who vertically transferred earned 10 more credits on average than their peers who originally began college at a four-year institution peers, and they earned 16 more credits than what is necessary for a traditional four-year degree.[41]

Post-Transfer Academic Shock. We also examine the possibility that students experience post-transfer shock due to their new collegiate environment. Students who transfer from two-year institutions and

Figure 1. Term-by-Term Fluctuations in GPA Among Vertical Transfers



Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

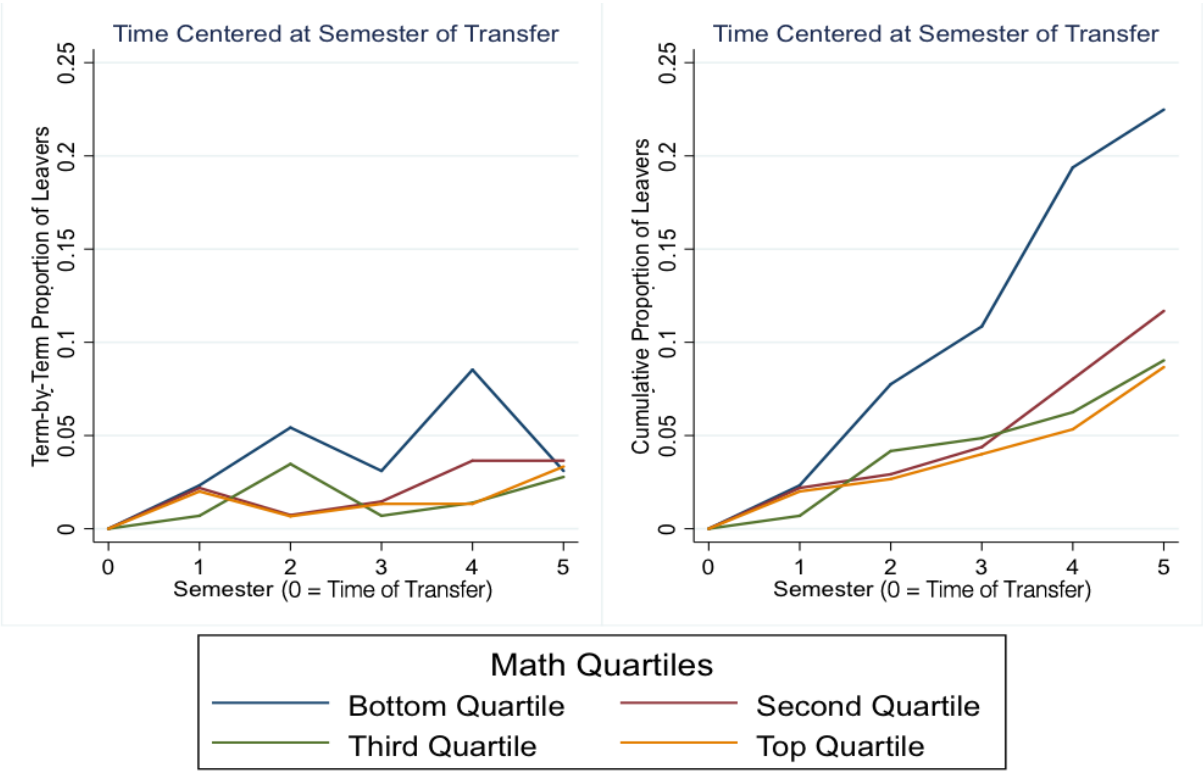
fail to adjust to their new college campus may struggle to succeed compared to students who originally enrolled at the four-year university. Accordingly, academic shock may explain differences between the two groups' academic and labor market outcomes.

To measure academic shock, we use our sample to explore the term-by-term changes in transfer students' GPA, shown in Figure 1. The left panel is centered at the time of initial enrollment, and the right panel is centered at the time of transfer (i.e., time = 0 is the last term at the student's original two-year institution). We plot students by prior math ability using the same SAT math score quartiles described above.

On average, transfer students experienced a noticeable decline in GPA in the term following their arrival at the destination institution, and such a drop was present for students in all four ability groups. However, on average, students who vertically transferred saw their GPA quickly rebound after the first term. This GPA dip and subsequent rebound may be driven by two separate trends. First, the GPA dip may be due to transfer students' social and logistical adjustment, and GPA may gradually recover after students familiarize themselves with the four-year institution. Another possible explanation may be changes in the demographic mix of students over time. For example, if weaker students in our sample were more likely to drop out after their first term at the four-year institution, the stronger students would more heavily influence GPA patterns afterward.

To shed light on these two explanations, we conduct two additional analyses. First, we replicate Figure 1 but restrict the sample to transfer students who remain at the destination institution for more than a

Figure 2. Term-by-Term Fluctuations in the Proportion of Leavers Among Vertical Transfers



Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

single year. We find similar patterns of GPA dip and partial rebound in later terms, providing evidence for the first explanation.

We also directly explore the term-by-term post-transfer dropout rate after transfer students arrived at the four-year institution, based on students' math ability. The pattern presented in Figure 2 suggests that only a small proportion of students leave their destination institution by the end of the first term. The most pronounced dropout rate by the end of the first term is for students in the lowest quartile. But even for this group, only 2.4 percent of students left after their first term.

Academic Momentum. A large body of research indicates that success in introductory courses during the early stage of students' college career is crucial for academic momentum and degree attainment.[42] Therefore, the final mechanism we examine is students' academic progress during their first few terms of college.

To measure academic momentum, we construct four indicators of college credit accumulation during the first two years of enrollment: the number of any type of credits attempted, either college level or remedial; the number of college-level credits attempted; the number of any type of credits earned; and the number of college-level credits earned. We use these indicators to compare students who initiate at two-year colleges with otherwise similar students who initiate at four-year colleges. If the two-year college experience dampened students' early academic success, either by influencing students to attempt fewer credits or diverting students into remedial coursework that did

Table 7. Disparity in Early Academic Progress Between Matched Two-Year and Four-Year Entrants

	Raw Means		Matched Sample		Regression-Adjusted Estimates			
	Two-Year	Four-Year	Two-Year	Four-Year	Full Sample		Matched Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any Credits Attempted								
First Semester	10.64	13.53	10.67	11.83	–1.364***	(0.131)	–1.351***	(0.171)
First Year	23.31	29.70	23.37	26.55	–3.729***	(0.356)	–3.208***	(0.484)
First Two Years	42.67	57.23	42.85	48.83	–7.614***	(0.669)	–6.531***	(0.917)
College Credits Attempted								
First Semester	8.463	12.99	8.53	10.49	–2.377***	(0.144)	–2.211***	(0.187)
First Year	19.84	28.83	19.98	24.31	–5.238***	(0.366)	–4.439***	(0.489)
First Two Years	38.19	56.11	38.51	45.79	–9.400***	(0.678)	–7.940***	(0.927)
Any Credits Earned								
First Semester	8.264	12.28	8.29	9.50	–1.649***	(0.163)	–1.433***	(0.226)
First Year	18.22	26.82	18.31	21.24	–4.051***	(0.386)	–3.136***	(0.532)
First Two Years	33.50	51.67	33.78	39.36	–7.989***	(0.702)	–6.285***	(0.966)
College Credits Earned								
First Semester	6.824	11.90	6.87	8.70	–2.343***	(0.160)	–2.076***	(0.214)
First Year	15.96	26.22	16.12	19.96	–5.082***	(0.382)	–4.111***	(0.515)
First Two Years	30.71	50.92	31.06	37.71	–9.194***	(0.695)	–7.420***	(0.937)
N		6,610		2,560		6,610		2,600

Note: Columns 5 and 7 include the full set of controls listed in Table 1. First-term fixed effects are included in Columns 5 and 7. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines. *p < 0.10; **p < 0.05; ***p < 0.01.

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

not move them toward a degree, we would expect to find the negative influence on credit accumulation in the early years of students' college career.

As Table 7 indicates, the attempted credit gaps between the two groups are evident as early as the first term. The regression-adjusted comparison based on the matched sample (Column 7) indicates that students who initiated at a two-year college attempt slightly fewer credits during their initial term than did their four-year college counterparts and that this credit gap steadily increases over time. By the end of the second year, students who began at a four-year university attempted 6.5 more credits on average compared to otherwise similar students who began at a two-year college—the approximate equivalent of two three-credit courses.

In addition, the divergence in attempted college-level credits is consistently greater than the divergence in total course credits, suggesting that two-year college students were more likely to be referred to remedial courses than their similar four-year institution peers, even though the two groups were matched on their precollege academic preparedness. Students who initiated at two-year institutions attempted

almost two fewer college-level credits in their first term than their counterparts at four-year institutions; this figure increased to four credits by the end of the first year and to eight credits by the end of the second year. The gap in attempted course credits is also reflected in credit accumulation. By the end of the second year, students who began at two-year colleges earned approximately six fewer overall credits and seven fewer college-level credits than similar students who began at four-year colleges.

Conclusion

Given rising tuition prices and a growing worry about if higher education is "worth it," two-year colleges are increasingly viewed as the starting point for many baccalaureate-aspiring students. However, we find that the two-year college pathway substantially reduces students' likelihood of earning a bachelor's degree. In this regard, two-year institutions may not be the stepping-stone that many policymakers and families believe them to be. We also find that female students who initiate at a two-year college are less likely to be employed full time eight years after initial college enrollment compared to otherwise similar females who start at four-year colleges, suggesting there may be negative labor market consequences for some students looking to pursue the vertical transfer pathway.

We also assessed the negative effects of initiating at a two-year college on student academic and labor market outcomes by students' level of academic preparedness. For both academic and labor market outcomes, we find that negative effects are particularly strong for students with high math scores who begin college at a two-year institution. This echoes the findings from Brand, Pfeffer, and Goldrick-Rab, as the two-year college pathway to a bachelor's was found to have the largest penalty for more academically advantaged students.[43]

The gaps might be due to a variety of mechanisms leading up to and following vertical transfer, including lack of adequate student supports, remedial coursework requirements, confusion with the transfer process and failure to transfer, loss of credits, and challenges related to academic shock and momentum. Indeed, only about one-third of the baccalaureate-aspiring students who began at a two-year college ever made it to the four-year sector in our sample. Even students who completed an associate degree (or accumulated more than 60 credits from a two-year college) often failed to transfer—and for the students who did transfer, idiosyncratic patterns and timing of transfer suggest they had no clearly structured transfer pathway to follow.

As policymakers and college administrators search for new strategies to increase the transfer rates and success of transfer students, our results suggest that the responsibility should not rest solely with two-year colleges. Instead, transfer destinations must also form stronger partnerships with two-year colleges to build strong pathways and provide additional support for these students. As explicitly indicated by Benjamin L. Castleman, highly structured programs limit student confusion and ensure transfer students face fewer obstacles in ultimately obtaining a bachelor's degree.[44]

To build these institutional supports, four-year institutions may need to work with two-year colleges to ensure that students who earn a transfer-oriented associate degree are guaranteed junior-level standing in a matching major at a four-year institution.[45] Recent evidence suggests that these policies can have salutary effects on credit loss and improve baccalaureate-attainment rates of students who initiate at two-year institutions.[46] Given that academic support is positively associated with transfer student retention,[47] transfer destinations may need to orient, advise, and support transfer students to facilitate their academic and social integration into the destination institution.[48]

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Appendix A. Obtaining Propensity Score Matching Estimates

The propensity score matching estimation was obtained using a three-step process. First, we estimated a student's propensity to initiate at a two-year college given his or her observable characteristics using a logit model, shown in equation (2):

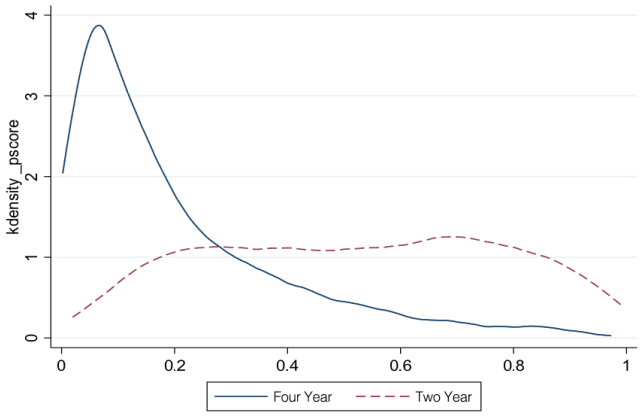
$$Logit\ (Twoyear_i) = \alpha + X_i + \mu_i \quad (2)$$

$Twoyear_i$ is the treatment assignment for student i and is equal to 1 if the student initiated at a two-year college. Based on Equation 2, we predict the probability of initiating at a two-year college for each student in our analytical sample.

Second, we used the estimated propensity scores to match each student who initiated at a two-year college with a similar student who initiated at a four-year college based on the nearest-neighbor method with a caliper of 0.01.[49] As a result, two-year college entrants who had no match within 0.01 standard deviations of the propensity score in the four-year college entrants group were dropped from the analysis. (This includes less than 1 percent of the two-year sample.) Accordingly, the post-match sample consists of only baccalaureate aspirants who are at least somewhat likely to consider the two-year college pathway to a bachelor's.

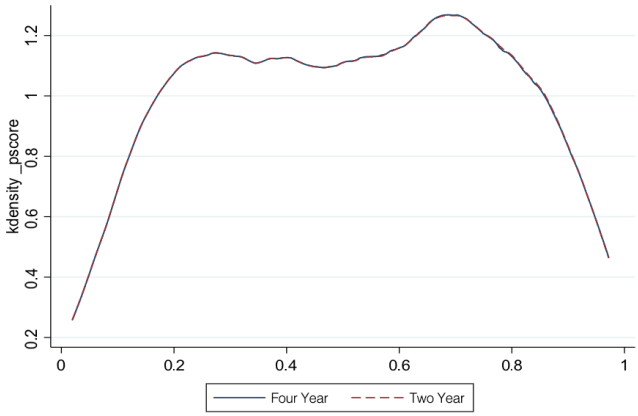
In the third and final step of the analysis, we used Equation 1 to estimate the impact of two-year college entry on student academic and labor market outcomes using the post-match sample.[50] Figure A1 presents the distributions of the predicted propensity of initiating at a two-year college for students who actually initiated at two-year and four-year colleges. The distribution clearly shows the presence of

Figure A1. Distribution of the Predicted Probability of Attending a Two-Year College for Two-Year and Four-Year College Entrants, Pre-Match



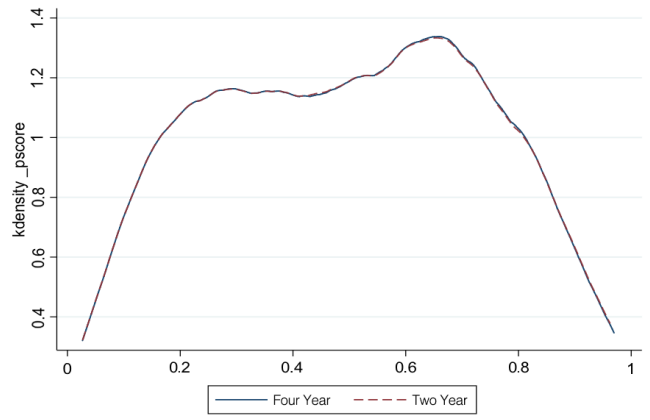
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Figure A2. Distribution of the Predicted Probability of Attending a Two-Year College for Two-Year and Four-Year College Entrants, Post-Match



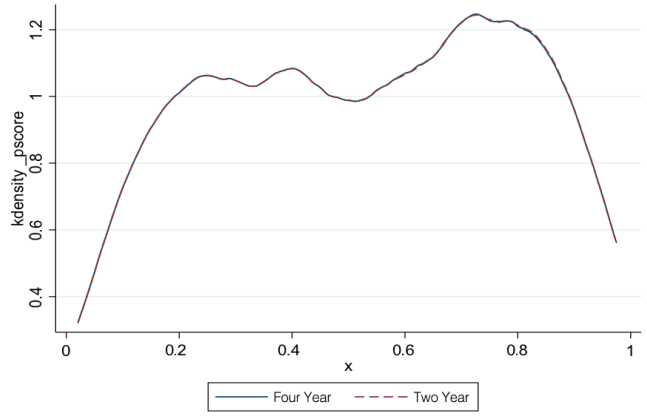
Source: Authors' calculation using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Figure A3. Distribution of the Predicted Probability of Attending a Two-Year College for Two-Year and Four-Year College Entrants, Male



Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Figure A4. Distribution of the Predicted Probability of Attending a Two-Year College for Two-Year and Four-Year College Entrants, Female



Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

differential sorting into two- and four-year colleges. Specifically, the majority of students who initiated at a two-year college had a high probability of choosing the two-year college pathway; almost half have a probability of 0.50 or higher, and a fifth have a probability of 0.75 or higher. On the other hand, the majority of students who ultimately began at a four-year institution had a low probability of choosing the two-year college pathway; about half have a probability of 0.10 or lower, and three-quarters have a probability of 0.25 or lower.

While the majority of two-year entrants have a match within 0.01 standard deviations of the propensity score in the four-year entrants group, approximately 1 percent of the two-year sample was discarded due to lack of support. Figure A2 shows the probability densities for the students who initiate at two-year and four-year institutions after matching. Visually, the matching operations for both groups of students seem to have achieved satisfactory overlap, as the two distributions lie on top of each other almost perfectly. We also depict the overlap between the two groups of students for the male and female subsamples separately in Figures A3 and A4, and the patterns are fairly similar.

Appendix B. Details About the Balance Check

In addition to depicting the common support and matching results, we further checked for satisfactory balance on all covariates statistically. Following P. C. Austin,[51] we use the standardized difference—the absolute difference in sample means divided by an estimate of the pooled standard deviation of the variable, where 0 indicates perfect balance—to check balance in group means.

Some researchers also recommend examining higher-order sample balance.[52] Therefore, we also checked the ratio of standard deviations between the two-year college entrants and four-year college entrants (the S-ratio, where 1 indicates perfect balance). Results for the balance check are presented in Table B1 and indicate that the matching process resulted in satisfactory balance, reducing most standardized difference values to below 0.10, with S-ratios hovering close to 1.

Table B1. Balance Between Two-Year and Four-Year Entrants

Variable	Sample	Unmatched Sample				Matched Sample			
		Mean	Standard Deviation	Standardized Difference	S-Ratio	Mean	Standard Deviation	Standardized Difference	S-Ratio
Demographic									
Male	Two Year	0.46	0.50	0.02	1.00	0.46	0.50	0.01	1.00
	Four Year	0.45	0.50			0.46	0.50		
White	Two Year	0.56	0.50	0.19	1.05	0.57	0.50	0.02	1.00
	Four Year	0.66	0.47			0.58	0.49		
Black	Two Year	0.13	0.33	0.08	1.10	0.13	0.34	0.05	1.06
	Four Year	0.10	0.30			0.11	0.32		
Hispanic	Two Year	0.16	0.36	0.22	1.36	0.15	0.36	0.07	0.94
	Four Year	0.08	0.27			0.18	0.38		
Asian	Two Year	0.10	0.31	0.03	0.96	0.11	0.31	0.04	1.05
	Four Year	0.12	0.32			0.09	0.29		
Other	Two Year	0.05	0.22	0.01	1.02	0.05	0.22	0.03	1.07
	Four Year	0.05	0.21			0.04	0.20		
Academic Preparation									
Reading Score (Grade 12)	Two Year	49.85	8.39	0.78	1.02	50.01	8.33	0.03	1.01
	Four Year	56.37	8.19			50.22	8.25		
Math Score (Grade 12)	Two Year	48.71	8.11	0.94	0.99	48.88	8.02	0.04	1.01
	Four Year	56.36	8.20			48.56	7.98		
High School GPA	Two Year	2.69	0.58	0.85	1.09	2.71	0.57	0.05	1.03
	Four Year	3.18	0.53			2.74	0.55		
Vocational Units	Two Year	3.25	2.29	0.41	1.20	3.22	2.25	0.021	1.00
	Four Year	2.30	1.91			3.27	2.24		
Socioeconomic Status									
First Quartile (Q1)	Two Year	0.21	0.41	0.28	1.37	0.21	0.41	0.05	1.04
	Four Year	0.10	0.30			0.19	0.39		
Second Quartile (Q2)	Two Year	0.26	0.44	0.22	1.19	0.26	0.44	0.05	0.97
	Four Year	0.16	0.37			0.28	0.45		

(continued on the next page)

Table B1. Balance Between Two-Year and Four-Year Entrants (continued)

Variable	Sample	Unmatched Sample				Matched Sample			
		Mean	Standard Deviation	Stan-dardized Difference	S-Ratio	Mean	Standard Deviation	Stan-dardized Difference	S-Ratio
Third Quartile (Q3)	Two Year	0.29	0.45	0.05	1.03	0.29	0.45	0.01	0.99
	Four Year	0.26	0.44			0.29	0.45		
Fourth Quartile (Q4)	Two Year	0.25	0.43	0.54	0.86	0.25	0.43	0.02	1.01
	Four Year	0.48	0.50			0.24	0.43		
High School									
Enrollment (Thousands)	Two Year	1.33	0.90	0.14	1.17	1.33	0.89	0.003	0.99
	Four Year	1.21	0.77			1.32	0.90		
General Program	Two Year	0.36	0.48	0.28	1.16	0.35	0.48	0.01	1.00
	Four Year	0.22	0.41			0.36	0.48		
College Prep Program	Two Year	0.57	0.50	0.35	1.13	0.57	0.49	0.01	1.00
	Four Year	0.74	0.44			0.58	0.49		
Vocational Program	Two Year	0.08	0.27	0.14	1.35	0.08	0.27	0.05	1.09
	Four Year	0.04	0.20			0.07	0.25		
Percentage Free Lunch	Two Year	24.8	15.47	0.22	1.26	24.57	15.25	0.03	1.01
	Four Year	21.45	12.24			24.96	15.11		
Teacher Pay ($1,000s)	Two Year	42.43	8.88	0.05	1.13	42.42	8.89	0.05	1.12
	Four Year	42.01	7.88			41.99	7.90		
Rural	Two Year	0.29	0.45	0.20	0.93	0.29	0.45	0.01	1.00
	Four Year	0.38	0.48			0.29	0.45		
Urban	Two Year	0.53	0.50	0.10	1.00	0.52	0.50	0.02	1.00
	Four Year	0.48	0.50			0.51	0.50		
Suburban	Two Year	0.19	0.39	0.10	1.10	0.19	0.39	0.02	0.99
	Four Year	0.15	0.35			0.19	0.40		

Note: Standardized difference in group means was calculated following the formula by Austin. 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.
Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table B2. Impact of Initiating in a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes (Restricted Sample)

	Full Sample	Matched Sample	
	(1)	(2)	(3)
Received Bachelor's Degree or Higher	–0.424***	–0.249***	–0.187***
	(0.015)	(0.017)	(0.023)
N	6,040	6,040	2,070
Earnings (Natural Log)	–0.245***	–0.108**	–0.044
	(0.042)	(0.045)	(0.060)
N	5,110	5,110	1,730
Employed Full Time	–0.060***	–0.024	–0.029
	(0.016)	(0.017)	(0.025)
N	5,180	5,180	1,740
Full-Time Conditional Employment	–0.045***	–0.032**	–0.032
	(0.014)	(0.015)	(0.020)
N	4,830	4,830	1,620
Covariates		X	X

Note: The sample is restricted to students who earned 24 college-level credits during their college career. First-term fixed effects are included in all models. The regional unemployment rate is used as a control in models in which labor market measures are used as outcome measures. Sampling weights are used in all models. The dummy variable approach to missing is used to retain sample sizes. The full set of controls listed in Table 1 is used in models 2 and 3. Robust standard errors are used. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Statistics reporting guidelines. *p < 0.10; **p < 0.05; ***p < 0.01. "Employed Full Time" is the percentage of all workers who are employed full time as opposed to employed part time or unemployed. "Full-Time Conditional Employment" is the percentage of employees who are working full time, as opposed to workers who are employed part time.

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table B3. Impact of Initiating at a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes (Including Dual-Enrollment Students)

	Full Sample		Matched Sample
	(1)	(2)	(3)
Received Bachelor's Degree or Higher	–0.421***	–0.220***	–0.183***
	(0.013)	(0.015)	(0.020)
N	6,970	6,970	2,880
Earnings (Natural Log)	–0.209***	–0.059	–0.017
	(0.035)	(0.038)	(0.064)
N	5,800	5,800	2,280
Employed Full Time	–0.055***	–0.017	–0.017
	(0.014)	(0.015)	(0.022)
N	5,910	5,910	2,360
Full-Time Conditional Employment	–0.037***	–0.023*	–0.040**
	(0.012)	(0.013)	(0.017)
N	5,480	5,480	2,180
Covariates		X	X

Note: The sample includes students who earned college credits before their first term in college (dual-enrollment students). First-term fixed effects are included in all models. The regional unemployment rate is used as a control in models in which labor market measures are used as outcome measures. Sampling weights are used in all models. The dummy variable approach to missing is used to retain sample sizes. The full set of controls listed in Table 1 is used in models 2 and 3. Robust standard errors are used. Sample sizes are rounded to the nearest 10 following National Center for Education Statistics/Institute of Education Sciences reporting guidelines. *p < 0.10; **p < 0.05; ***p < 0.01. "Employed Full Time" is the percentage of all workers who are employed full time as opposed to employed part time or unemployed. "Full-Time Conditional Employment" is the percentage of employees who are working full time, as opposed to workers who are employed part time.

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table B4. Impact of Initiating at a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes (Using Region of Residence Fixed Effects)

	Full Sample		Matched Sample		
			All Students	Male Students	Female Students
	(1)	(2)	(3)	(4)	(5)
Received Bachelor's Degree or Higher	–0.442***	–0.234***	–0.194***	–0.200***	–0.225***
	(0.013)	(0.015)	(0.021)	(0.031)	(0.028)
N	6,820	6,820	2,687	1,216	1,441
Earnings (Natural Log)	–0.228***	–0.074*	–0.065	0.033	–0.084
	(0.037)	(0.040)	(0.064)	(0.081)	(0.096)
N	5,680	5,680	2,150	960	1,160
Employed Full Time	–0.058***	–0.017	–0.012	0.009	–0.033
	(0.014)	(0.016)	(0.023)	(0.032)	(0.031)
N	5,780	5,780	2,250	1,000	1,190
Full-Time Conditional Employment	–0.040***	–0.026*	–0.012	–0.046*	–0.042
	(0.013)	(0.014)	(0.021)	(0.024)	(0.027)
N	5,360	5,360	2,010	920	1,070
Covariates		X	X	X	X

Note: "Employed Full Time" is the percentage of all workers who are employed full time as opposed to employed part time or unemployed. "Full-Time Conditional Employment" is the percentage of employees who are working full time, as opposed to workers who are employed part time.

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Table B5. Impact of Initiating at a Two-Year College on Student Baccalaureate Attainment and Labor Market Outcomes, by Student Math Ability (Matched Sample)

	Baccalaureate Attainment		Employed Full Time (vs. Part Time or Unemployed)		ln (Earnings)	
	Male Sample	Female Sample	Male Sample	Female Sample	Male Sample	Female Sample
	(1)	(2)	(5)	(6)	(7)	(8)
Two Year	–0.139***	–0.180***	–0.034	–0.006	0.110	–0.042
	(0.046)	(0.043)	(0.043)	(0.049)	(0.135)	(0.142)
Two Year, Math Q2	–0.078	–0.077	0.001	–0.073	–0.128	–0.169
	(0.077)	(0.071)	(0.071)	(0.070)	(0.173)	(0.186)
Two Year, Math Q3	–0.110	–0.012	0.065	–0.120	0.050	–0.036
	(0.084)	(0.079)	(0.088)	(0.079)	(0.184)	(0.193)
Two Year, Math Q4	–0.072	–0.167	–0.372***	–0.108	–0.377*	0.145
	(0.091)	(0.124)	(0.102)	(0.123)	(0.217)	(0.248)
N	1,140	1,350	942	1,130	910	1,100

Source: Authors' calculations using US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/.

Notes

1. US Department of Education, Institute of Education Sciences, National Center for Education Statistics, "Table 308.10: Total 12-Month Enrollment in Degree-Granting Postsecondary Institutions, by Control and Level of Institution and State or Jurisdiction: 2014–15 and 2015–16," Digest of Education Statistics, https://nces.ed.gov/programs/digest/d17/tables/dt17_308.10.asp?current=yes; and Davis Jenkins and John Fink, *Tracking Transfer: New Measures of Institutional and State Effectiveness in Helping Community College Students Attain Bachelor's Degrees*, Community College Research Center, January 2016, https://ccrc.tc.columbia.edu/media/k2/attachments/tracking-transfer-institutional-state-effectiveness.pdf.

2. For examples of this in the press, see *US News & World Report*, "Starting at Community College Can Save Thousands," May 18, 2011, www.usnews.com/education/blogs/student-loan-ranger/2011/05/18/starting-at-community-college-can-save-thousands; Princeton Review, "4 Reasons to Consider Community College," www.princetonreview.com/college-advice/community-college; Heather Levin, "Benefits of Attending Community College for 2 Years to Save Money," Money Crashers, www.moneycrashers.com/benefits-of-community-college/; and Zina Kumok, "Are Community Colleges a Viable Alternative?," College Investor, May 23, 2019, https://thecollegeinvestor.com/18206/community-colleges-viable-alternative/.

3. For example, C. Lockwood Reynolds provides evidence that beginning at a two-year institution is associated with only small declines in labor market returns as compared to similar students who initiate at a four-year institution; further, this particular outcome is primarily driven by female entrants. C. Lockwood Reynolds, "Where to Attend? Estimating the Effects of Beginning College at a Two-Year Institution," *Economics of Education Review* 31, no. 4 (August 2012): 345–62, https://www.sciencedirect.com/science/article/abs/pii/S0272775711001774. In contrast, Thomas Miller finds a stronger labor market disadvantage for students who initiate at two-year colleges. Thomas E. Miller, "Will They Stay or Will They Go? Predicting the Risk of Attrition at a Large Public University," *College and University* 83, no. 2 (2007): 2–7, https://scholarcommons.usf.edu/esf_facpub/26/. Other studies limit their focus to students who have ever transferred to—or graduated from—a four-year institution. For example, Di Xu et al. use propensity score matching to compare students in Virginia who vertically transfer from a two-year to four-year institution with otherwise similar students who initiated at a four-year institution. The results suggest that students who transfer from a two-year institution have similar baccalaureate-attainment rates to similar students who originally enrolled at a four-year institution. However, the research finds that these students are subject to a significant earnings penalty eight years after initial college enrollment. The wage penalty was $1,449 per quarter, on average. Drawing on subsequent analyses of student transcript data, the authors indicate that this earnings decrement might be partly due to delayed entry into the labor market because of credit loss at the point of transfer. Di Xu et al., "Are Community College Transfer Students 'A Good Bet' for 4-Year Admissions? Comparing Academic and Labor-Market Outcomes Between Transfer and Native 4-Year College Students," *Journal of Higher Education* 89, no. 4 (February 2018): 1–25, https://ccrc.tc.columbia.edu/publications/are-community-college-transfer-students-good-bet-4-year-admissions.html. For more information, see Michael J. Hilmer, "Does the Return to University Quality Differ for Transfer Students and Direct Attendees?," *Economics of Education Review* 19, no. 1 (2000): 47–61, https://pdfs.semanticscholar.org/e04c/1c7d8b8031fbf53f509c707d341ebfe47b62.pdf; D. E. Leigh and A. M. Gill, "Do Community Colleges Really Divert Students from Earning Bachelor's Degrees?," *Economics of Education Review* 22, no. 1 (February 2003): 23–30, https://www.sciencedirect.com/science/article/abs/pii/S0272775701000577; Audrey Light and Wayne Stayer, "Who Receives the College Wage Premium? Assessing the Labor Market Returns to Degrees and College Transfer Patterns," *Journal of Human Resources* 39, no. 3 (Summer 2004): 746–73, https://eric.ed.gov/?id=EJ717394; and Xing Xia and Zach Brown, "Three Essays on the Economics of Higher Education" (PhD diss., Columbia University, 2016), 99–125, https://search-proquest-com.mutex.gmu.edu/docview/1810195864?accountid=14541.

4. Mariana Alfonso, "The Impact of Community College Attendance on Baccalaureate Attainment," *Research in Higher Education* 47, no. 8 (December 2006): 873–903, https://www.jstor.org/stable/40197515; Bridget Terry Long and Michal Kurlaender, "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?," *Educational Evaluation and Policy Analysis* 31, no. 1 (2009): 30–53, https://journals.sagepub.com/doi/abs/10.3102/0162373708327756; David B. Monaghan and Paul Attewell, "The Community College Route to the Bachelor's Degree," *Educational Evaluation and Policy Analysis* 37, no. 1 (2015): 70–91, https://journals.sagepub.com/doi/

abs/10.3102/0162373714521865; Zach Brown and Xing Xia, "Attending a Four-Year College Directly or Transferring from a Two-Year College: Does the Path to a Bachelor's Degree Matter?" (doctoral thesis, Columbia University, 2016), https://academiccommons.columbia.edu/doi/10.7916/D88K797W; Kristine L. Anderson, "Post-High School Experiences and College Attrition," *Sociology of Education* 54, no. 1 (January 1981): 1–15, https://www.jstor.org/stable/2112508; William R. Doyle, "Impact of Increased Academic Intensity on Transfer Rates: An Application of Matching Estimators to Student-Unit Record Data," *Research in Higher Education* 50, no. 1 (2009): 52–72, https://eric.ed.gov/?id=EJ822600; Leigh and Gill, "Do Community Colleges Really Divert Students from Earning Bachelor's Degrees?"; Miller, "Will They Stay or Will They Go?"; Thomas J. Kane and Cecilia Elena Rouse, "Labor Market Returns to Two- and Four-Year Colleges: Is a Credit a Credit and Do Degrees Matter?," *American Economic Review* 85, no. 3 (February 1993): 600–14, https://www.researchgate.net/publication/24117361_Labor_Market_Returns_to_Two-_and_Four-Year_Colleges_Is_a_Credit_a_Credit_and_Do_Degrees_Matter; Jennifer L. Stephan, James E. Rosenbaum, and Ann E. Person, "Stratification in College Entry and Completion," *Social Science Research* 38, no. 3 (September 2009): 572–93, https://www.scholars.northwestern.edu/en/publications/stratification-in-college-entry-and-completion; William Velez, "Finishing College: The Effects of College Type," *Sociology of Education* 58, no. 3 (July 1985): 191–200, https://www.jstor.org/stable/2112419; Long and Kurlaender, "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?"; Monaghan and Attewell, "The Community College Route to the Bachelor's Degree"; and Lockwood Reynolds, "Where to Attend?"

5. One carefully designed study by C. Lockwood Reynolds restricts the analytic sample to include only baccalaureate aspirants at less-selective colleges. He then uses a propensity score matching technique to identify students with similar academic and demographic characteristics, with the only difference being the level of the institution at which the students first enrolled. He finds that the percentage of students who initiated at two-year colleges and went on to earn a bachelor's degree within approximately eight years was nearly 25 points lower than the percentage of students who initiated at four-year institutions. Lockwood Reynolds, "Where to Attend?" Using similar restrictions and a similar methodological approach, David Monaghan and Paul Attewell use the Beginning Postsecondary Students survey and find that students initiating at a two-year institution were between 17 and 21 percentage points less likely to earn a bachelor's degree within six or nine years than similar students who began at a four-year institution. Monaghan and Attewell, "The Community College Route to the Bachelor's Degree." Bridget Terry Long and Michal Kurlaender also use a propensity score matching strategy and find that students initiating at two-year colleges had nine-year baccalaureate-attainment rates that were 21 points lower than comparable students who began at four-year colleges. To address potential concerns associated with unobserved baseline differences between students who first enroll at two- and four-year colleges, Long and Kurlaender employ an instrumental variable (IV) approach and still find a significant negative effects on baccalaureate attainment, though the magnitude is slightly smaller. Long and Kurlaender, "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?"

6. Jennie E. Brand, "Civic Returns to Higher Education: A Note on Heterogeneous Effects," *Social Forces* 89, no. 2 (December 2010): 417–34, https://academic.oup.com/sf/article-abstract/89/2/417/2235253; Jennie E. Brand, Fabian T. Pfeffer, and Sara Goldrick-Rab, "Interpreting Community College Effects in the Presence of Heterogeneity and Complex Counterfactuals" (working paper, California Center for Population Research, University of California, Los Angeles, 2012), https://www.lafollette.wisc.edu/research/publications/interpreting-community-college-effects-in-the-presence-of-heterogeneity-and-complex-counterfactuals; and Jennie E. Brand and Yu Xie, "Who Benefits Most from College? Evidence for Negative Selection in Heterogeneous Economic Returns to Higher Education," *American Sociological Review* 75, no. 2 (2010): 273–302, https://journals.sagepub.com/doi/abs/10.1177/0003122410363567.

7. Commonly, students enrolled at two-year colleges are older, of lower socioeconomic status, and more likely to work part time and have dependents. For more information, see Jennifer Ma and Sandy Baum, "Trends in Community College Research: Enrollment, Prices, Student Debt, and Completion," College Board, April 2016, https://trends.collegeboard.org/sites/default/files/trends-in-community-colleges-research-brief.pdf; Brand, Pfeffer, and Goldrick-Rab, "Interpreting Community College Effects in the Presence of Heterogeneity and Complex Counterfactuals"; and Brand and Xie, "Who Benefits Most from College?"

8. Brand, "Civic Returns to Higher Education"; Brand, Pfeffer, and Goldrick-Rab, "Interpreting Community College Effects in the Presence of Heterogeneity and Complex Counterfactuals"; and Brand and Xie, "Who Benefits Most from College?"

9. Brand, Pfeffer, and Goldrick-Rab, "Interpreting Community College Effects in the Presence of Heterogeneity and Complex Counterfactuals."

10. US Department of Education, National Center for Education Statistics, Institute of Education Sciences, "Education Longitudinal Study of 2002 (ELS:2002)," https://nces.ed.gov/surveys/els2002/.

11. This includes high school and postsecondary transcripts and earnings measured in 2011. This provides a follow-up seven years after students' initial college enrollment.

12. We further limit our analysis to students enrolled at public and private nonprofit colleges. To determine if a student initiated at a two-year or four-year institution, we use a variable in the ELS:2002 data set that includes the first postsecondary institution a student attended after high school. Students who initiated at a two-year college are categorized as two-year college entrants, and students who initiated at a public or private four-year college are categorized as four-year institution entrants.

13. Prior research examining college students' earnings trajectories indicates that the bulk of positive returns for bachelor's degrees are due not to immediate increases in earnings levels, but instead to acceleration in earnings growth over time. If we measured earnings further into the future, we might find that some students reach an earnings plateau, while others experience sharp increases in earnings over time. See Shanna Smith Jaggars and Di Xu, "Examining the Earnings Trajectories of Community College Students Using a Piecewise Growth Curve Modeling Approach," *Journal of Research on Educational Effectiveness* 9, no. 3 (2016): 445–71, https://www.tandfonline.com/doi/full/10.1080/19345747.2015.1116033.

14. Similarly, 4.5 percent of the matched students who initiated at a four-year institution were still enrolled.

15. Even among students who earned their bachelor's during the period under study, most did so only a few years before the end of the study.

16. Baccalaureate completion was extrapolated from college transcripts. The data include a variable that indicates the highest known degree the student received from any postsecondary institution. We include degree status measured at the end of 2010, which gives us a six-year window, as most students in our sample entered college in 2004. Students who earned a bachelor's or a higher-level degree within that time frame were coded as 1, and all others were coded as 0.

17. Employment was generated from a variable in ELS:2002 that characterizes employment status (full time or part time) for all jobs held as of the third follow-up interview in 2012. Students working full time were coded as 1; students working part time or designated as "unemployed" were coded as 0. Individuals designated as "out of the labor force" were dropped from the analysis. To further differentiate between full-time and part-time employment status, we also created a separate outcome variable conditional on being employed; part-time employment status is coded as 0. Finally, ELS:2002 includes a variable indicating students' self-reported earnings from employment during 2011, seven years after students' initial enrollment in college. We include the natural log of earnings as our outcome measure; students with no earnings (reporting a value equal to 0) were dropped from the analysis.

18. Alfonso, "The Impact of Community College Attendance on Baccalaureate Attainment."

19. William G. Bowen, Matthew M. Chingos, and Michael S. McPherson, *Crossing the Finish Line: Completing College at America's Public Universities* (Princeton, NJ: Princeton University Press, 2009).

20. Long and Kurlaender, "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?"; Monaghan and Attewell, "The Community College Route to the Bachelor's Degree"; Reynolds, "Where to Attend?"; and Xu et al., "Are Community College Transfer Students 'A Good Bet' for 4-Year Admissions?"

21. Specifically, a one standard deviation increase in high school GPA decreases the probability that students would initiate at a two-year college by roughly 11 percentage points. A one standard deviation increase in high school vocational units increases the probability that students would initiate at a two-year college by 2 percentage points. Lastly, a one standard deviation increase in math scores decreases the probability that students would initiate at a two-year college by 7 percentage points. Beyond these academic-preparation variables, parental education—particularly the mother's education level—is also highly predictive of two-year college attendance in our sample.

22. We focus on four specific outcome measures: baccalaureate attainment within six years, earnings in 2011, employment status in 2012 (full-time employment versus part-time or no employment), and conditional employment status (full-time versus part-time employment).

23. As explained in the "Data and Estimation Strategy" section, the post-match sample consists of only baccalaureate aspirants who are at least somewhat likely to consider the two-year college pathway to a bachelor's.

24. For all outcome measures, we estimated treatment effects for a restricted sample of students—those who completed 24 or more credits during college. We did this to assess whether our results are sensitive to a sample of relatively motivated students, as compared to those who do not earn 24 credits. Twenty-four credits represent one year of full-time coursework and serve as an indicator of being "on track" to earn a degree or transfer. Restricting the sample in this way alleviates concerns about whether there are unobservable characteristics not captured in our matching strategy. As shown in Table B2, the results are consistent in both magnitude and statistical significance.

25. Table B5 shows the interaction between the estimated effects of two-year college entrance and students' math ability, using the least-prepared students—that is, those who scored in the lowest math quartile—as the reference group.

26. However, our estimates for earnings are too noisy to be precise.

27. Donna M. Desrochers and Steven Hurlburt, *Trends in College Spending: 2001–2011, A Delta Data Update*, American Institutes for Research, July 2014, https://www.air.org/sites/default/files/downloads/report/AIR_Delta%20Cost_Trends%20College%20Spending%202001-2011_072014.pdf.

28. Susan P. Choy and Antoinette G. Gifford, "Profile of Undergraduates in American Postsecondary Institutions," US Department of Education, Institute of Education Sciences, National Center for Education Statistics, September 1990, https://files.eric.ed.gov/fulltext/ED325483.pdf; Ernest T. Pascarella and Patrick T. Terenzini, *How College Affects Students: Findings and Insights from Twenty Years of Research* (San Francisco, CA: Jossey-Bass, 1991); Vincent Tinto, "Dropout from Higher Education: A Theoretical Synthesis of Recent Research," *Review of Educational Research* 45, no. 1 (Winter 1975): 89–125, https://journals.sagepub.com/doi/10.3102/00346543045001089; and Vincent Tinto, *Leaving College: Rethinking the Causes and Cures of Student Attrition* (Chicago: University of Chicago Press, 1987).

29. Mesmin Destin, *Leveraging Psychological Factors: A Necessary Component to Improving Student Outcomes*, American Enterprise Institute, May 30, 2018, www.aei.org/publication/leveraging-psychological-factors-a-necessary-component-to-improving-student-outcomes/.

30. Research indicates that the high rate of math remediation for two-year college students seems incongruous with the small difference in academic preparation between matched two-year college and four-year institution students. Long and Kurlaender, "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?"; and Monaghan and Attewell, "The Community College Route to the Bachelor's Degree."

31. Juan Carlos Calcagno and Bridget Terry Long, "The Impact of Postsecondary Remediation Using a Regression Discontinuity Approach: Addressing Endogenous Sorting and Noncompliance" (working paper, National Bureau of Economic Research, Cambridge, MA, July 2008), https://www.nber.org/papers/w14194; Paco Martorell and Isaac McFarlin Jr., "Help or Hindrance? The Effects of College Remediation on Academic and Labor Market Outcomes," *Review of Economics and Statistics* 93, no. 2 (2011): 436–54, https://www.mitpressjournals.org/doi/abs/10.1162/REST_a_00098; Judith Scott-Clayton and Olga Rodriguez, "Development, Discouragement, or Diversion? New Evidence on the Effects of College Remediation Policy," *Education Finance and Policy* 10, no. 1 (Winter 2015): 4–45, https://www.mitpressjournals.org/doi/full/10.1162/EDFP_a_00150; Di Xu, "Assistance or Obstacle? The Impact of Different Levels of English Developmental Education on Underprepared Students in Community Colleges," *Educational Researcher* 45, no. 9 (2016): 496–507, https://journals.sagepub.com/doi/full/10.3102/0013189X16683401; and Di Xu and Mina Dadgar, "How Effective Are Community College Remedial Math Courses for Students with the Lowest Math Skills?," *Community College Review* 46, no. 1 (2018): 62–81, https://journals.sagepub.com/doi/abs/10.1177/0091552117743789.

32. Xu, "Assistance or Obstacle?"; and Xu and Dadgar, "How Effective Are Community College Remedial Math Courses for Students with the Lowest Math Skills?"

33. Scott-Clayton and Rodriguez, "Development, Discouragement, or Diversion?"

34. Robert P. Gallagher, *National Survey of Counseling Center Directors 2010*, International Association of Counseling Services, 2010, http://d-scholarship.pitt.edu/28173/1/2010_survey.pdf; W. Norton Grubb, "Vocationalism and the Differentiation of Tertiary Education: Lessons from US Community Colleges," *Journal of Further and Higher Education* 30, no. 1 (2006): 27–42, https://www.tandfonline.com/doi/abs/10.1080/03098770500431973; and James E. Rosenbaum, Regina Deil-Amen, and Ann E. Person, *After Admission: From College Access to College Success* (New York: Russell Sage Foundation Press, 2006).

35. Rachel Baker, "The Effects of Structured Transfer Pathways in Community Colleges," *Educational Evaluation and Policy Analysis* 38, no. 4 (December 2016): 626–46, https://journals.sagepub.com/doi/full/10.3102/0162373716651491; Justin Aaron Hull, "Exploring the Impact of the Associate Degree on Bachelor's Degree Completion for Reverse Transfer Eligible Students Using Propensity Score Matching" (doctoral dissertation, Rowan University, 2018), https://rdw.rowan.edu/cgi/viewcontent.cgi?article=3497&context=etd; and Shanna Smith Jaggars and Jeffrey Fletcher, "Redesigning the Student Intake and Information Provision Processes at a Large Comprehensive Community College" (working paper, Community College Research Center, New York, June 2014), https://ccrc.tc.columbia.edu/media/k2/attachments/redesigning-student-intake-information-provision-processes.pdf.

36. Smith Jaggars and Fletcher, "Redesigning the Student Intake and Information Provision Processes at a Large Comprehensive Community College."

37. Smith Jaggars and Fletcher, "Redesigning the Student Intake and Information Provision Processes at a Large Comprehensive Community College"; Alison Kadlec and Jyoti Gupta, "Indiana Regional Transfer Study: The Student Experience of Transfer Pathways Between Ivy Tech Community College and Indiana University," Public Agenda, 2014, https://files.eric.ed.gov/fulltext/ED560085.pdf; Alison Kadlec and M. Martinez, "Putting It All Together: Strengthening Pathways Between Comprehensives and Community Colleges," in *The University Next Door: What Is a Comprehensive University, Who Does It Educate, and Can It Survive?*, ed. Mark Schneider and K. C. Deane (New York: Teachers College Press, 2013); and Public Agenda and WestEd, *Student Voices on the Higher Education Pathway: Preliminary Insights & Stakeholder Engagement Considerations*, 2012, https://www.publicagenda.org/files/student_voices.pdf.

38. Monaghan and Attewell, "The Community College Route to the Bachelor's Degree."

39. The median number of credits accumulated was 54 credits, and there was a large standard deviation of 30 credits.

40. $N = 647$. For students who vertically transferred in our sample, the standard deviation of the number of credits lost was 23 credits.

41. Xu et al., "Are Community College Transfer Students 'A Good Bet' for 4-Year Admissions?"

42. Clifford Adelman, *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment*, US Department of Education, Office of Educational Research and Improvement, 1999, https://files.eric.ed.gov/fulltext/ED431363.pdf; Paul Attewell, Scott Heil, and Liza Reisel, "What Is Academic Momentum? And Does It Matter?," *Educational Evaluation and Policy Analysis* 34, no. 1 (2012): 27–44; and Juan Carlos Calcagno et al., "Stepping Stones to a Degree: The Impact of Enrollment Pathways and Milestones on Community College Student Outcomes" (working paper, Community College Research Center, October 2006), https://ccrc.tc.columbia.edu/media/k2/attachments/stepping-stones-enrollment-pathways.pdf.

43. Brand, Pfeffer, and Goldrick-Rab, "Interpreting Community College Effects in the Presence of Heterogeneity and Complex Counterfactuals."

44. Benjamin L. Castleman, "Prompts, Personalization, and Pay-Offs: Strategies to Improve the Design and Delivery of College and Financial Aid Information," in *Decision Making for Student Success*, ed. Benjamin L. Castleman, Saul Schwartz, and Sandy Baum (New York: Routledge, 2015), 91–113.

45. Rachel Baker, "Understanding and Affecting Students' Path to Success in Community Colleges" (PhD diss., Stanford University, 2015), https://searchworks.stanford.edu/view/11381252.

46. David Crook, Colin C. Chellman, and Aleksandra Holod, "Does Earning an Associate Degree Lead to Better Baccalaureate Outcomes for Transfer Students?" (working paper, City University of New York, Office of Policy Research, New York, January 2012); Peter M. Crosta and Elizabeth Kopko, "Should Community College Students Earn an Associate Degree Before Transferring to a Four-Year Institution?" (working paper, Community College Research Center, Teachers College, Columbia University, New York, April 2014), https://ccrc.tc.columbia.edu/media/k2/attachments/associate-degree-before-transfer.pdf; and Ronald G. Ehrenberg and Christopher L. Smith, "Analyzing the Success of Student Transitions from 2- to 4-Year Institutions Within a State," *Economics of Education Review* 23, no. 1 (February 2004): 11–28, https://www.sciencedirect.com/science/article/abs/pii/S0272775703000785.

47. Hyekyung Lee and Tetyana Schneider, "Does Posttransfer Involvement Matter for Persistence of Community College Transfer Students?," *Community College Journal of Research and Practice* 42, no. 2 (2018): 77–94, https://www.tandfonline.com/doi/abs/10.1080/10668926.2016.1251351.

48. Joshua Wyner et al., *The Transfer Playbook: Essential Practices for Two-and Four-Year Colleges*, Aspen Institute, 2016, https://

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