Is It Really Cheaper to Start at a Community College?
The Consequences of Inefficient Transfer for
Community College Students Seeking Bachelor's Degrees

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Abstract

For many students who intend to complete a bachelor's degree, the savings from starting their undergraduate education at a community college is a major factor in their college choice. Yet, given inefficiencies in pathways through college and in the credit transfer process, initially attending a two-year college may be a false economy. In this paper we investigate whether it is more efficient for students to start at a two-year or four-year college if their intent is to complete a bachelor's degree. We use data from two state systems, including term-by-term course-level information with matching student demographics and degree records on entering cohorts of students at each state's public two- and four-year institutions. We combine these data with cost and tuition data to estimate the relative efficiency of starting at a two-year versus a four-year college. We find that the optimal choice about where to start varies across a number of dimensions: low rates of credit transfer are important, but the most salient factor is the diversionary effect of two-year colleges on ever transferring to a four-year college. Sensitivity testing and break-even analyses illustrate how findings vary across student pathways.

Table of Contents

1. Introduction

Increases in the price of college—and declines in public subsidies—make it imperative that students progress through college as efficiently as possible. Yet, recent investigations have highlighted the various, indirect, and often inefficient pathways that college students take to complete their degrees. Students fail courses; they earn credits they do not need for their programs; and they earn credits beyond the number required for their degrees. Also, students who enroll in multiple colleges often fail to transfer all their credits across these colleges (Monaghan and Attewell 2015; Fink, Kopko, Ran, & Jenkins, 2016). Pathway and transfer inefficiency may have substantial implications for how colleges operate and for the efficiency of the postsecondary sector in the aggregate (Jenkins, Kadlec, &Votruba, 2014).

This inefficiency may be large in light of two related factors. First, many students transfer across colleges. Recent evidence suggests that one third of students who start at a community college transfer to a four-year college. And over 80 percent of community college students indicate that they intend to complete a bachelor's degree at a four-year college; that is, they intend to transfer (Horn & Skomsvold, 2011; Jenkins & Fink, 2016; Simone, 2014 Table 5). Second, many students lose credits when they transfer. In a notable study using transcript data for a nationally representative sample of college students, Monaghan and Attewell (2015) identify credit transfer loss as a significant burden for community college students hoping to earn a bachelor's degree, with one in seven students unable to transfer any of their credits. These non-transferable credits are a barrier to students' completing their programs, potentially jeopardizing their economic futures (Wang, 2012).

In this paper we consider how this inefficiency might influence the economic decision to start at a two-year college instead of a four-year college for bachelor's degree-seeking students. There is an obvious economic trade-off: as an alternative to starting at a four-year college, students may start at community college and then transfer; credits cost less at community college, but if these credits do not transfer, or if the student has taken an inefficient pathway through college, the total cost may be greater. If community college pathways are inefficient, there is both a social trade-off—the cost of completion

may be higher—and a private trade-off—the price a student pays in tuition and fees may be higher. These trade-offs hold even for students who complete their degrees. A separate consideration is the long-debated "diversionary" trade-off, whereby students who enroll at a two-year college may be less likely to earn a degree (e.g., because they become discouraged or lose motivation). Ultimately, it is an empirical question whether, after accounting for all possible inefficiencies and diversions, the cost per degree to either society or the student (in terms of tuition price) is lower by starting at a two-year instead of at a four-year college.

We investigate this economic question here. We use system-wide datasets from two states to examine these trade-offs and calculate whether it is optimal to start at a two-year college. We begin with a review of the evidence on inefficient pathways and set up our economic model of student pathways through college. Next, we derive parameter values for the model. The results of the model are then presented, along with sensitivity tests. Finally, we review the findings and draw policy conclusions about how to improve the efficiency of pathways between two-year and four-year colleges.

2. The Economics of Credit Accumulation in College

2.1 Credit Accumulation

An important recent contribution to research on college completion is the identification of inefficient pathways. Potentially there are many reasons why students might not take the most efficient route through college. As discussed in detail in Bailey, Jaggars, and Jenkins (2015), many community colleges are structured in such a way that students are confused about, or ignorant of, the best pathway to completion. Students may of course fail courses and take remedial courses, and they may also accumulate excess credits beyond or outside those required for their programs. More of these inefficient credits means a higher cost per completion; it also means that students are less likely to complete their programs (Cullinane, 2014; Monaghan & Attewell, 2015; Xu et al., 2016).

The inefficiency of the college pathway is magnified when students attempt to transfer to a four-year college. Two-year and four-year colleges may have credit

articulation agreements, but many students are not aware of them. And even when they are, these agreements are difficult to interpret and to follow (Jaggars & Fletcher, 2014). It is also the case that articulation agreements vary across colleges and states; unless a student knows at the start which four-year college she wants to transfer to—and what field she will major in—she is unlikely to obtain the right credits.

The most accurate way to identify inefficient pathways is to look at how students accumulate credits (Washington State Higher Education Coordinating Board, 2012).[1] One component in this is that many students fail courses. On average, the course failure rate for community college students is around 15 percent, such that each associate degree completer is expected to have failed approximately 9 credits (Zeidenberg et al., 2015). Some of these failures may reflect the need for colleges to incentivize student effort: if the course failure rate were zero, many students would likely not work hard. However, some of the failures may reflect inefficiency or at least misperceptions of students as to the effort required for course completion. A second component is that many students take excess credits (Complete College America, 2011). Using student transcript data for one state, Zeidenberg (2012) estimates that excess credits account for 12 percent of college-level credits for community college students who complete associate degrees; these excess credits—approximately 8 per degree—are spread across all courses and not just those in students' majors. Recent studies of college transcripts estimate that the average associate degree completer earns 70 credits, that is, 10 more than the conventional 60-credit requirement (Belfield & Bailey, 2017). Thus, students who complete an associate degree at a community college may accumulate 10 additional credits or 17 percent more credits than are required.[2]

The main component under investigation here is the accumulation of credits for the purpose of transfer. Two recent studies have looked at students' inability to transfer their credits (see also Cullinane, 2014). Using transcripts from the Beginning Postsecondary Survey (BPS), Monaghan and Attewell (2015) find that fewer than 60 percent of transferring students could transfer most of their credits, and that 15 percent of

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[1] Ideally, one would perform a course-by-course degree audit, but often simpler patterns of credits are analyzed because of the complexity of degree audits.

[2] The percentage may be similar for non-completers, but their excess credits are hard to determine given that they never completed their awards. It is unlikely that these students follow pathways that are more structured and efficient than the students who complete their awards.

students could not transfer any credits and were essentially restarting a bachelor's degree. Also using BPS, Simone (2014, Table 6) estimates that transfer students—across all types of colleges—earn 30 credits at their original institution and fail to transfer 13 of them, so that one out of every three courses taken is "wasted." An associate degree holder with 60 credits is therefore expected to have approximately 20 non-transferable credits on entry to a four-year college. Interestingly, the rate at which students are unable to transfer credits does not appear to vary with the number of pre-transfer credits (Simone, 2014, Table 9). However, students with low GPAs transfer credits at very low rates: 67 percent of such students cannot transfer any credits (Simone, 2014, Table 12).[3]

The final component is the student's pathway at his transfer college. On the way to a bachelor's degree, this pathway may include some failed courses and some excess courses. Little is known about any differences in credit pathways between transfer students and four-year starters when both are in a four-year college (i.e., after the transfer). A study of students in Virginia suggests that the transfer students may also be less efficient when they are in the four-year college (than four-year starters), but the magnitude of the inefficiency is unclear (Xu, Jaggars, & Fletcher, 2016).

For students who complete their degrees, the full set of consequences is summarized in Figure 1. Students who start at a four-year college and obtain a bachelor's degree have valid credits (typically totaling 120) but also accumulate failed credits and excess credits. By contrast, students who start at a two-year college and obtain a bachelor's degree have valid credits at the two-year college and at the four-year college (typically totaling 120) but also accumulate failed credits and non-transferable credits at the two-year college as well as failed credits and excess credits at the four-year college.

Thus far, our focus has been on students who complete a bachelor's degree. However, we need to account for the relative diversionary effect of community college on the probability of degree completion. The diversion has two components: one is if students who start at community college never transfer and therefore never have a chance to complete a bachelor's degree; the other component is if students who do transfer have a lower probability of completing a bachelor's degree (perhaps because their community

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[3] Also, transfer problems may be even greater outside the two-year to four-year transfer route: students who start at for-profit colleges transfer only 2 of their 27 credits when moving to a public college (Simone, 2014, Table 9).

college education was not sufficient or appropriate preparation for coursework at the four-year college). This second component appears to be unimportant: students who do transfer graduate at rates that are similar to the rates of those who started at a four-year college (Xu et al., 2016). The first component is more challenging to estimate: we cannot identify which students are discouraged from attempting to transfer.

Overall, these credit accumulation patterns draw attention to the need for reforms and policies that promote more efficient pathways—especially at the point of transfer—for students who start at community college with the intention of earning a four-year degree (see Baker, 2016; Xu et al., 2016). However, the key question is whether the credit accumulation patterns affect the economics of starting at a two-year college.

Figure 1
Credit Pathways to Bachelor's Degree Completion
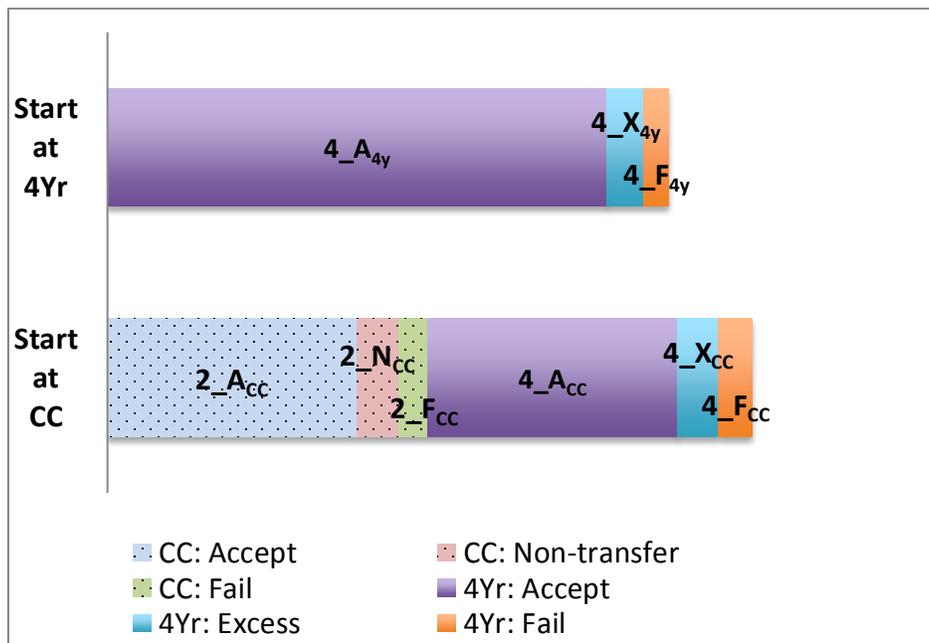
2.2 The Economics of Pathways

Evidence of inefficient pathways and non-transferable credits does not necessarily establish that starting at a community college is a bad investment relative to starting at a four-year college. That decision depends on the total cost to the student (tuition price) of completing a bachelor's degree from each starting point. The trade-off is between attending a low-cost community college (with potentially inefficient credit accumulation) and attending a higher-cost four-year college (with potentially efficient credit accumulation). Certainly, the more inefficient the pathway through community college— and the lower the rate of credit transfer—the greater will be the cost of starting at community college. But it may still be less expensive to start at a community college than at a four-year college.

Our contribution is to analyze these cost consequences. To our knowledge no study has looked directly at the economic consequences of inefficient pathways in terms of excess and transfer credits. Romano and Djajalaksana (2011) examine the efficiency of community colleges and four-year colleges in general. Using detailed cost data for one community college, Belfield, Crosta, and Jenkins (2014) examine a range of inefficiencies such as higher remediation rates and failure in passing particular gateway courses. The most relevant study is by Reynolds (2012) from analysis of the National Education Longitudinal Study of 1988 (NELS:88). Reynolds (2012, Table 7) calculates significant cost savings from starting at a two-year college (but he also estimates much lower future earnings; see also Belfield, 2013). However, this calculation does not address the mediating effect of transfer on the cost of college (although it does include in the analysis all starters regardless of whether they complete). Hence, it is an open question whether starting at a community college is lower in cost, whether pathway and transfer inefficiency outweighs any cost savings, and what the economic significance of this inefficiency is more generally.

For students, the optimal decision about whether to start at a community college depends on tuition and fees, not college expenditures. Given the different rates of subsidy and credit accumulation patterns, it is not immediately clear if the findings from an analysis of college expenditures will carry over to an analysis based on tuition and fees.

Therefore, we undertake a parallel analysis of pathway and transfer inefficiency using price (tuition and fees) instead of costs (total expenditures).

To perform our economic calculations we create a basic economic model that incorporates inefficient credits. Our model compares the cost and price per degree for students who complete a bachelor's degree having started at a four-year college versus those having started at a two-year college. The basics of the comparison are depicted in Figure 1. Students who start at a four-year college accumulate valid, excess, and failed four-year credits (and some reverse-transfer credits at community college as well). For students who start at a two-year college and complete a bachelor's degree, there are six possible types of credit. Courses taken at the two-year college are either accepted for transfer, not transferable to the four-year college, or are courses the student failed; and courses taken at the four-year college are either valid, excess, or failed. For each of these two-year and four-year credits, we assign a cost/price to derive the economic consequences of starting at a two-year versus a four-year college.

3. Data

To populate the model for credit accumulation we use student-level transcript data from two statewide community college systems. The statewide datasets cover entering community college students across the academic years 2007–08 and 2008–09 with transcript information for these students for up to six years after initial entry. This information includes all courses attempted, passed, and transferred across public institutions within the state, as well as whether the student received a bachelor's degree. State *Alpha* has more than 10 community colleges and moderately strong links to the four-year colleges within the state, and it has created major-specific articulated transfer pathways. State *Omega* has more than 30 community colleges and weaker articulation in the form of course equivalency between its public two-year and four-year colleges.

Data from the two state systems on the number of credits by type is reported in Table 1.[4] These numbers include only those students who completed a bachelor's degree.

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[4] The number of excess credits reported for Texas by Cullinane (2015) is very similar to that for *Alpha* and *Omega*. Also, the BPS data shows that students who transfer from an associate degree to a bachelor's

The top panel of Table 1 shows the credit accumulations of students who started at a two-year college. These accumulations vary by state: in state *Alpha* students transfer with 61 accepted credits; in state *Omega* the average number of credits accepted through transfer is 29. Therefore, transfer students still require between 60 and 90 four-year college credits in order to complete a bachelor's degree. Table 1 shows clear evidence of pathway inefficiency. In both states students obtain a sizeable number of non-transferable credits (12 and 9 respectively) and failed credits at the two-year level (5 and 1); at the four-year level they also obtain failed credits (3 and 13) and accumulate excess credits (13 and 15). In total, students who start at a two-year college attempt 153 or 161 credits respectively in the two states, on average, in order to complete their degrees—approximately one third more than is necessary according to program requirements.

Table 1
Credit Accumulations of Bachelor's Degree Completers by Pathway

Pathway	*Alpha* Community College System		*Omega* Community College System	
	Credits	[SD]	Credits	[SD]
Two-year starter:				
Accepted from community college (2A$_{CC}$)	61.2	20.3	29.4	29.2
Non-transfer from community college (2N$_{CC}$)	12.2	15.7	9.3	13.6
Failed at community college (2F$_{CC}$)	5.2	7.1	1.1	3.4
Earned at 4-year college (2A$_{4y}$)	58.8	-	93.8	29.2
Failed at 4-year college (2F$_{4y}$)	3.2	3.2	12.6	14.6
Excess at 4-year college (2X$_{4y}$)	13.2	20.1	14.8	17.6
Total credits attempted	153.8		160.9	
Four-Year Starter:				
Accepted from community college (4A$_{CC}$)	0.8	5.2	..	..
Non-transfer from community college (4N$_{CC}$)	0.0	0.3	..	..
Failed at community college (4F$_{CC}$)	0.1	5.2	..	..
Earned at 4-year college (4A$_{4y}$)	119.2	-	..	..
Failed at 4-year college (4F$_{4y}$)	7.8	10.0	..	..
Excess at 4-year college (4X$_{4y}$)	11.2	13.0	..	..
Total credits attempted	129.1		..	..

Note. Data from 2011–12 (*Alpha*) and 2010–12 (*Omega*). Data on four-year starters in *Omega* not available. Sources: Statewide community college systems.

degree program have on average 11 non-transfer credits; this rate is again very similar to estimates applied in our model (Simone, 2014, Table 12).

By comparison, the bottom panel of Table 1 shows credit accumulation of four-year starters in state *Alpha* (data are not available for state *Omega*). Four-year starters in state *Alpha* earn close to zero credits at the two-year level (as expected) and earn 120 credits toward a bachelor's degree (as required). Yet four-year starters do not always follow the most efficient pathway: on average they earn 11 excess credits and attempt but fail an additional 8 credits. In total, four-year starters who complete a degree attempt 129 credits. Over 99 percent of these credits are completed at the relatively expensive four-year college.

To calculate the efficiency of each pathway we combine these credit accumulations with expenditures per credit based on Integrated Postsecondary Education Data System (IPEDS) data.[5] Per credit expenditures (including public subsidies and tuition/fees) and prices (tuition/fees alone) are shown in Table 2. Costs are significantly lower at two-year colleges: the national average cost per credit of $440 is 62 percent of the cost at a four-year public college ($710); and the variation in cost within the two-year sector is lower. Similarly, the national price per credit of $110 at two-year colleges is 53 percent lower than at four-year colleges ($260). Costs and prices across the two states differ somewhat from the national average: *Alpha* has a lower cost but charges higher tuition; *Omega* has a higher cost but charges lower tuition.

The combination of credit accumulation patterns from Table 1 with the cost/price per credit information from Table 2 yields the cost/price to complete a bachelor's degree starting at either a two-year or four-year college. The difference is expressed as the cost/price saving from starting at a two-year college. To calculate the distribution of cost/price per pathway and cost/price savings, we perform a Monte Carlo simulation of 10,000 trials. The simulation uses the distributions of each parameter (normally distributed but with each type of credit accumulation bounded at zero and with costs bounded between the maximum and minimum cost per credit as per columns 3 and 4 of Table 2). This simulation allows us to calculate the probability of positive cost/price savings for completers who started at a two-year college.

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[5] The model uses data on costs and prices from public colleges: these are the primary destinations of most community college transfers.

Table 2
Cost and Price per Credit at Public Colleges

	Cost per Credit			
	Mean	**[SD]**	**Min**	**Max**
Four-year college:				
State *Alpha*	$510	180	$300	$1,270
State *Omega*	$870	490	$490	$2,440
National	$710	390	$120	$2,450
Two-year college:				
State *Alpha*	$390	40	$340	$450
State *Omega*	$510	150	$360	$1,500
National	$440	140	$70	$1,720
	Price (Tuition and Fees) per Credit			
	Mean	**[SD]**	**Min**	**Max**
Four-year college:				
State *Alpha*	$250	30	$220	$310
State *Omega*	$200	40	$140	$270
National	$260	90	$20	$590
Two-year college:				
State *Alpha*	$120	10	$120	$120
State *Omega*	$80	10	$40	$90
National	$110	40	$30	$300

Note. National estimates, 2015 dollars; rounded to nearest $10. Source: IPEDS 2015.

In additional analysis we include in the model the diversionary effect from starting at a community college. This allows us to calculate the cost/price savings conditional on the lower probability of completion. As noted above, this diversionary effect requires calculation of the probability of completion once the student has transferred. Studies of the completion probabilities of transfer students have found them to be equivalent to those of students who start at four-year colleges (Long & Kurlaender, 2009; Melguizo, 2011; Xu et al., 2016). For this analysis, we use transfer-out bachelor's completion rates from analysis of National Student Clearinghouse data by Jenkins and Fink (2016, Figure 9): the national average is 42 percent, with the rate for *Alpha* at 45 percent and *Omega* at 40 percent.[6] The diversionary effect also requires calculation of the probability of transfer. This probability is difficult to estimate precisely: it is hard to identify the students who are genuinely diverted from starting at a four-year college. For

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[6] This rate is rounded to the nearest 5 percent to retain anonymity of the states.

this analysis we use evidence from Reynolds (2012): compared to students who start at a four-year institution, those who start at community college are 30 percent less likely to complete a bachelor's degree. Therefore, with a baseline community college completion rate of 30 percent, the overall diversionary effect is 9 percent. This diversionary effect is applied in our adjusted estimates of the cost differences.

As well as sensitivity testing, we estimate a series of break-even parameter values. These are parameter values at which the cost-saving metric switches sign, that is, when the economic decision favors the alternative starting point for college. We focus on two key parameters. One is the value for the likelihood that a community college student who does not get a degree would have done so if she had started at a four-year college. The other is the rate at which a student fails to transfer credits; as a comparison, we also model course failure at the four-year college by two-year starters.

4. Results

4.1 *Alpha* College Students

The results from applying the model are reported below, along with the sensitivity tests and break-even scenarios. Results for state *Alpha* are given in Table 3 and Figures 2–5.

The top panel of Table 3 presents the baseline results for cost (total expenditures) and price (tuition and fees) per bachelor's degree. Overall, the cost for a completed bachelor's degree is $72,390 if the student starts at community college and $74,630 if the student starts at the four-year college. The savings per community college starter are therefore positive but modest (at $2,240 or 3 percent). However, the cost difference is not precisely identified. As shown in Figure 2, the cost savings distribution is centered close to zero but has a wide variation between +/-$50,000. The likelihood that the cost per bachelor's degree will be lower at community college is 51.5 percent, that is, only slightly more than an even chance. However, as shown in the right-hand panel of Table 3, starting at a community college is significantly cheaper from a student perspective: tuition and fees total $29,880 per degree, which is $6,330 or 17 percent lower than at a

four-year public college. This difference is also more precisely estimated: the likelihood that a student will pay less at a community college is 83.6 percent.

Table 3
Pathway Efficiency: *Alpha*

	Cost per Bachelor's Degree		Price per Bachelor's Degree	
	Mean	**SD**	**Mean**	**SD**
Unadjusted:				
Starting at community college	$72,390	[17300]	$29,880	[5660]
Starting at four-year college	$74,630	[24240]	$36,210	[5250]
Savings from community college	*$2,240*	*[16920]*	*$6,330*	*[6540]*
Probability (Saving > 0)	*51.5%*		*83.6%*	
Adjusted for diversion effect:				
Starting at community college	$88,710	[20790]	$34,980	[6630]
Starting at four-year college	$74,630	[24240]	$36,210	[5250]
Savings from community college	*-$14,080*	*[20400]*	*$1,230*	*[7400]*
Probability (Saving > 0)	*23.0%*		*57.3%*	

Note. Parameter values from Tables 1 and 2. Rounded to nearest $10. Source: Simulation 10,000 trials.

Figure 2
Cost Savings per Bachelor's Degree Completer
Starting at Two-Year College
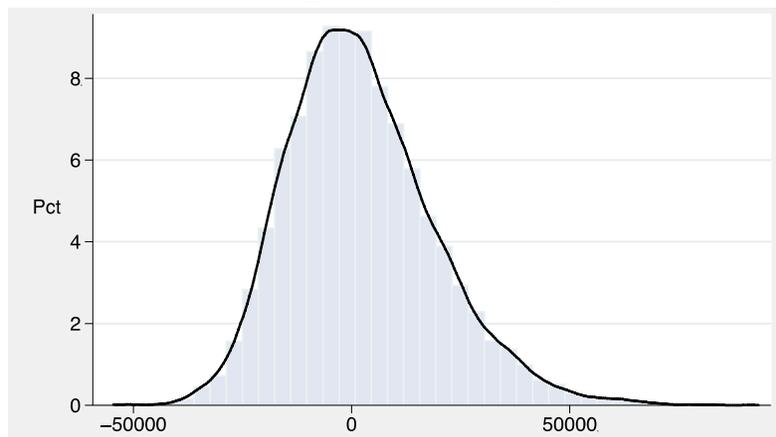
Note. Monte Carlo simulation, 10,000 trials; kernel density plot.
Sources: IPEDS, State *Alpha* postsecondary system transcripts.

The bottom panel of Table 3 shows the cost and price per bachelor's degree adjusted for the diversionary effect of starting at community college. Unsurprisingly, this adjustment reduces the economic motive for attending community college. Starting at community college is now higher in cost relative to a four-year degree: the gap is $14,080 and the probability of cost savings is reduced to 23.0 percent. However, the adjusted private price paid is still lower for community college starters: the difference is $1,230 and the probability it is positive is 57.3 percent.

Still, the variation in savings is very wide. Thus there are many likely scenarios in which cost savings are negative. Also, because the distributions of many variables are not normal and are often censored at zero, the range of outcomes is hard to predict *ex ante*. These distributional anomalies lead to wide variations in results but also provide strong motivation for employing the Monte Carlo simulation.

The diversion rate is an important influence on cost savings. Figure 3 shows the relationship between cost savings and the percentage of students diverted from a four-year college. If the diversion rate is zero, there are positive cost savings. However, cost savings quickly become negative as the diversion rate increases. There are potentially large cost consequences from starting at community college if the diversion rate climbs above 20 percent. (The maximum loss of $40,000—at which all non-completers would have completed a bachelor's degree if they had attended a four-year college— corresponds to a diversion rate of approximately 50 percent.)

Non-transfer of credits also has a significant influence on cost savings from starting at a community college. Figure 4 shows how cost savings vary with the number of credits that do not transfer and with the number of courses community college students fail when they attend a four-year college. Clearly, with fewer transferable credits and more course failures, cost savings are reduced. As shown in Figure 4, if students can transfer all their credits (non-transfer is zero), there are substantial positive cost savings from community college. These cost savings remain positive until the number of non-transferable credits equals 20. Thus, as long as the student can transfer two thirds of his associate degree credits, there are cost savings from starting at a two-year college. In contrast, the impact of failing four-year courses is cumulatively stronger: if a transfer

student fails 8 or more course credits, there are cost savings from starting at the four-year college.

Figure 3
Cost Savings From Starting at Two-Year College
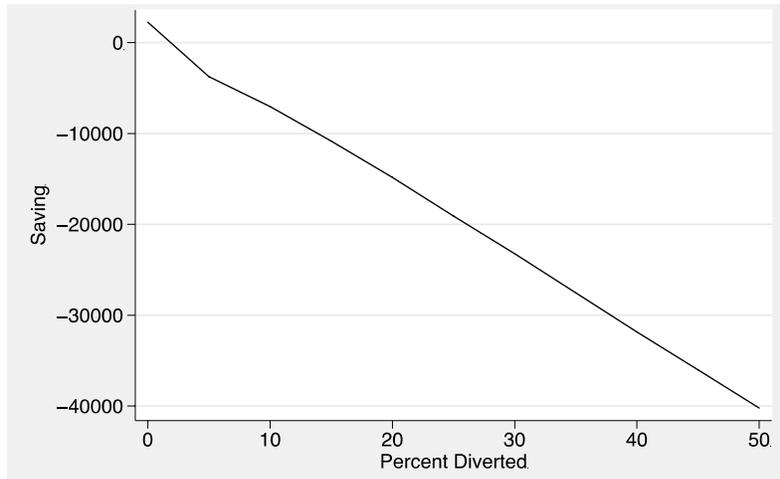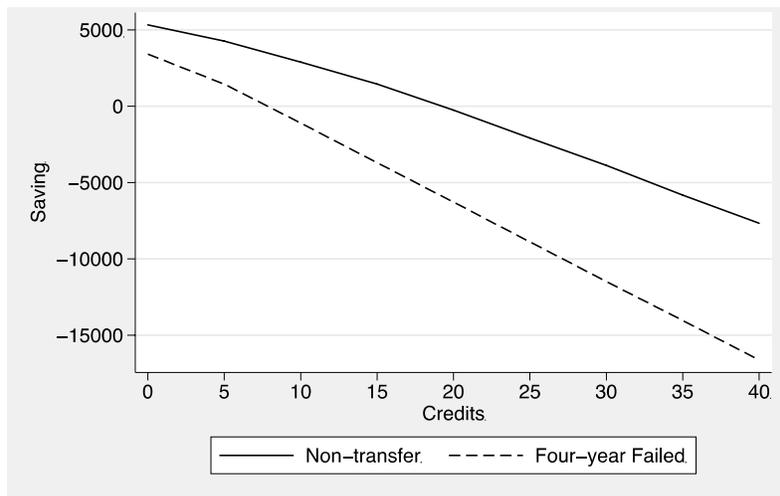**by Diversion Rate**

Figure 4
Cost Savings From Starting at Two-Year College
by Credit Levels

14

From the student perspective, the economic impact of non-transfer credits is not substantial. As shown in Figure 5, community college students who transfer all their credits reap significant private savings (as do those students who pass all their courses at the four-year college). Nevertheless, the price of completing a bachelor's degree for students who start at a community college remains positive even if the student fails to transfer 40 or more credits. Students can "afford" not to transfer significant numbers of credits and will still be better off starting at a two-year college. Failing four-year courses has a stronger impact on the price of completing a bachelor's degree. But the break-even point—at 30 credits failed—still allows for high rates of course failure before the price per degree becomes lower by starting at a four-year college.

Figure 5
Price Reduction From Starting at Two-Year College
by Credit Levels
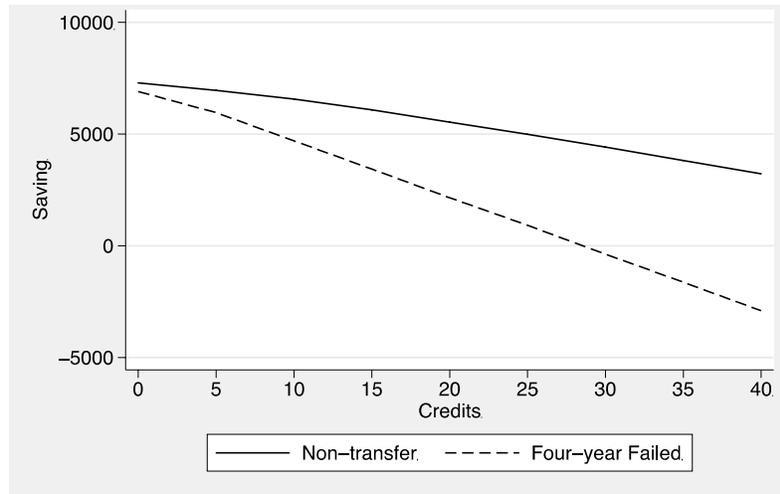
4.2 *Omega* College Students

Results for state *Omega* college students are shown in Table 4 and Figures 6–9. The results for *Omega* show more consistent cost savings from starting at a four-year college. Overall, the patterns are similar to those for *Alpha*.

The baseline results show cost savings from starting at a four-year college. As shown in Table 4, the baseline cost difference is $3,650; starting at a four-year college costs 3 percent less per bachelor's degree. Again, however, the savings are imprecisely

identified. As shown in Figure 6, the possible cost savings are widely dispersed, and a large part of the distribution includes zero (no difference) savings. The probability of cost savings from starting at a community college is 41 percent of simulated cases. In contrast to results for cost savings, the price per degree is lower for those starting at a community college. As shown in the right-hand panel of Table 4, however, the price gap is small ($750) and the probability of savings is close to one half (55 percent). Overall, from a financial perspective, it is reasonable if *Omega* students are indifferent about starting at a two-year versus a four-year college.

Table 4
Pathway Efficiency: *Omega*

	Cost per Bachelor's Degree		Price per Bachelor's Degree	
	Mean	SD	Mean	SD
Unadjusted:				
Starting at community college	$136,670	[56790]	$27,970	[7210]
Starting at four-year college	$133,020	[57770]	$28,720	[5630]
Saving from community college	-$3,650	[32350]	$750	[6530]
Probability (Saving > 0)	40.7%		55.1%	
Adjusted for diversion effect:				
Starting at community college	$158,650	[59800]	$31,120	[7530]
Starting at four-year college	$133,020	[57770]	$28,720	[5630]
Saving from community college	-$25,630	[37040]	-$2,400	[6890]
Probability (Saving > 0)	21.0%		36.1%	

Note. Parameter values from Tables 1 and 2. Rounded to nearest $10. Source: Simulation 10,000 trials.

Figure 6
Cost Savings per Bachelor's Degree Completer
Starting at Two-Year College
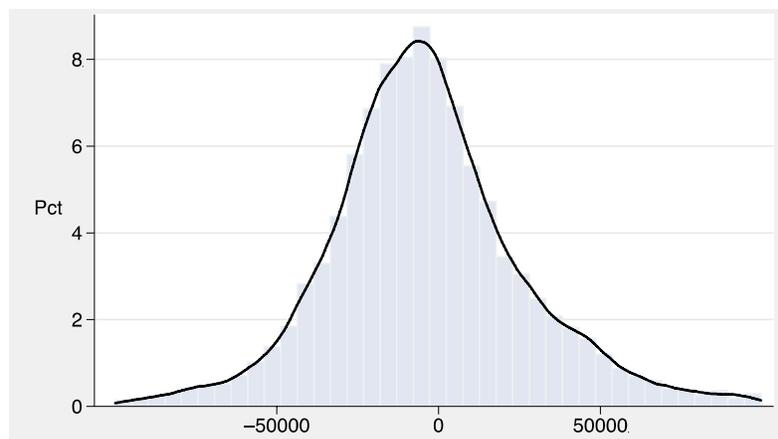
Note. Monte Carlo simulation, 10,000 trials; kernel density plot.
Sources: IPEDS, State *Omega* postsecondary system transcripts.

As in state *Alpha*, the diversionary effect is influential. After adjusting for this effect, there are larger gains from starting at a four-year college. The cost gap is $25,630, and the probability that a cost gap favors the four-year college system is 79 percent. Also, the expected price paid per degree is now lower in the four-year system by $2,400. As shown in Figure 7, the cost difference grows rapidly as the diversion rate increases. If half of all students are diverted, the cost gap is $60,000. By contrast, the impact of transfer credit failure is negative but modest. Figure 8 shows how the cost gap grows with the number of non-transfer credits. Starting at a two-year versus a four-year college is equivalent in cost if students can transfer all their credits (non-transfer equals zero). As the number of non-transferable credits grows, the cost savings from starting at a four-year college grow, albeit relatively slowly. Four-year course failure is more important for *Omega* students than for *Alpha* students. As shown in Figure 8, there are positive cost savings for starting at a community college until the student accumulates 7 failed credits; beyond this break-even point, the cost gap grows significantly.

Similar trajectories are evident when we model changes in the price of college with respect to credits. As shown in Figure 9, there are small price reductions to starting at a community college if the student transfers all credits (or passes all four-year courses). In pursuit of a bachelor's degree, starting at a community college becomes less attractive as the credit transfer rate falls (and as the course failure rate rises). The break-even point for non-transferable credits is 20: beyond that number, it makes financial sense from a student perspective to start at a four-year college. This number is very close to the actual number of failed transfer credits for students in *Omega* colleges: two-year college students are very close to the maximum number of non-transfer credits. Similarly, the break-even point for course failure at the four-year college (16 credits in Figure 9) is close to the actual course failure rate in the state.

Figure 7
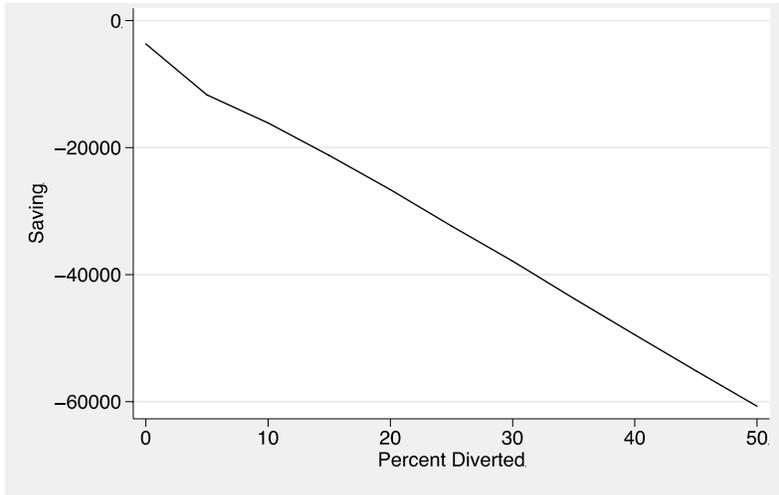**Cost Savings From Starting at Two-Year College**
by Diversion Rate

Figure 8
Cost Savings From Starting at Two-Year College
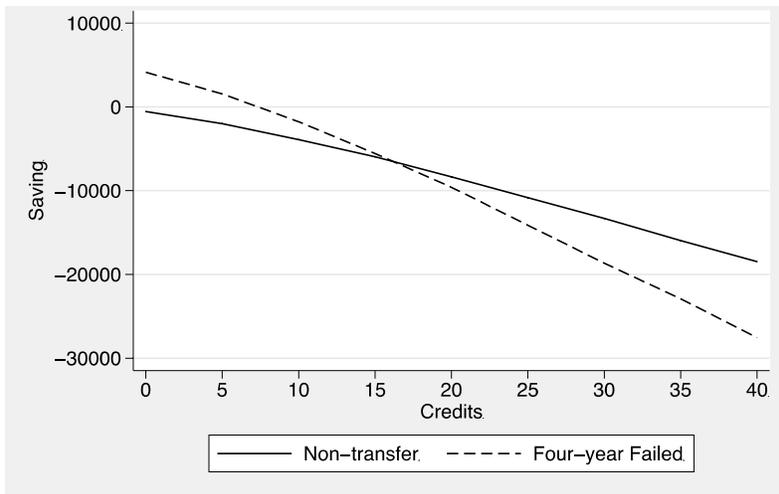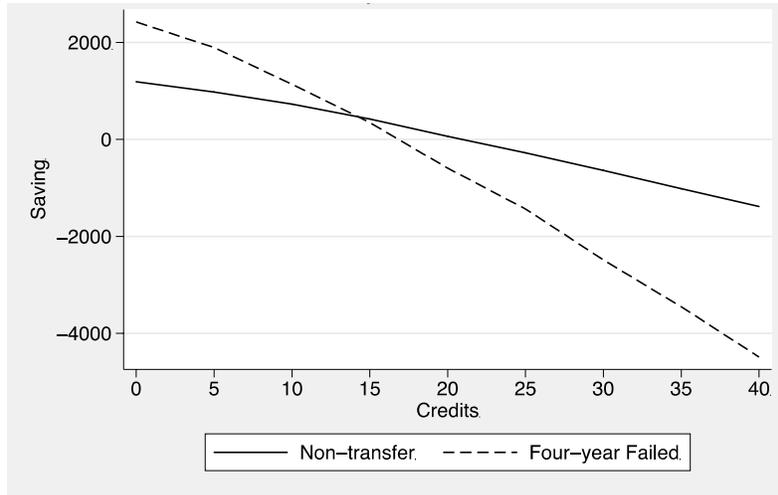**by Credit Levels**

Figure 9
Price Reduction From Starting at Two-Year College
by Credit Levels

5. Conclusion

Many students are not taking the most efficient route through college and—in the two anonymous states examined here—this inefficiency is adding 15–30 percent to the number of credits attempted per bachelor's degree. One significant cause of inefficiency is the transfer from community college to a four-year college and the high number of non-transferable credits students accumulate. Nevertheless, because community college is significantly lower in cost than a four-year college, it may still be worthwhile for students to start at community college; it depends on the number, type, and cost/price of inefficient credits.

Our economic model examines inefficiency to yield several key results. First, cost savings vary across states. In state *Alpha*, even with pathway and transfer inefficiency, students who complete a bachelor's degree after starting at a community college impose lower social costs; and from their own perspective, they incur lower fees by starting at a community college. However, in state *Omega,* it is more efficient to start at a four-year college, both from a social and student perspective. Second, low rates of credit transfer are a concern, but their influence on where to start college is modest. Third, the most important factor is the diversion rate and specifically the low probability that a student

19

will ever transfer to a four-year college. This diversion rate makes a significant difference to the cost and price savings from starting at a two-year college; reducing the diversionary effect would substantially affect college decisions based on financial considerations. Fourth, we find other factors to be less important: it would be very hard for four-year colleges to change their pathways—to make them more efficient—so as to justify more students starting at four-year colleges. Even if a student starting at a four-year college never took any excess credits and never failed any courses, there would still be cost savings from starting at community college in *Alpha* (but not *Omega*).

Finally, these analyses highlight significant variation across students: some transfer very few credits, and for these students the decision about where to start college is important. Given the wide variation in credit accumulations and pathways, the average results may not be fully informative. Understanding this variation is an important next step in research knowledge and may involve a series of new model conditions with respect to costs and prices. For example, we might expect that high-cost (well-resourced) colleges would have fewer pathway inefficiencies (including fewer failures and excess credits). These associations should compress the distribution of cost savings slightly. As another example, the number of transfer credits and excess credits may be collinear: students with few transferable credits may not be able to afford any excess credits later on. With more refined data, it may be possible to identify the cost savings from starting at community college more precisely.

In conclusion, credit accumulation pathways do have economic consequences for colleges and students.[7] Understanding inefficiencies in these pathways is important from an educational perspective. Although these inefficiencies should be added together, it is helpful for educators to distinguish the types of inefficiencies. Excess credits are caused either by students' misunderstanding the requirements for their programs or by colleges' inadequate advising and enrollment management systems. Non-transfer credits are more likely to be caused by misalignment between community colleges and the four-year system. Lastly, the diversionary effect may be caused by a lack of access to four-year

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[7] We acknowledge that the model only looks at costs and not benefits. We do not relate these costs to lower earnings of community college students on completion of their degree (Reynolds, 2012; Andrews, Li, & Lovenheim, 2016).

colleges for some students. Hence, we believe it is necessary to search for different solutions to each inefficiency.

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