Momentum: The Academic and Economic Value of a 15-Credit First-Semester Course Load for College Students in Tennessee

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Abstract

Many students fail to complete college because the pathways they take through college are not optimal. One example is that their initial course loads are often too low. When students take too few courses in the first semester or academic year, it negatively affects their "momentum." Compounded over semesters, these students accumulate insufficient credits to graduate within the conventional time frame. In this paper, we explore the academic and economic consequences of taking higher or lower credit loads. Using student-level data from the Tennessee Board of Regents, we estimate differences in award completion and credit accumulation across students according to their first-semester and first-year credit loads. We apply ordinary least squares and propensity score matching estimation to adjust for differences in student characteristics. Using an economic model, we estimate improvements in cost per completion (i.e., cost efficiency) and additional spending by students who take 15 credits in their first semester ("momentum students") compared with those who take 12 credits. We find strong positive academic impacts on credits and degree completion for momentum students in community colleges and four-year colleges. These impacts are financially valuable to students: Over their time in college, momentum students pay 4–14 percent less per credit and 9–19 percent less per degree in tuition and fees. These savings also produce gains for colleges, because more tuition revenue is generated as more students persist. The academic and economic effects are even stronger for students who sustain momentum through the first year.

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1. Introduction

In the quest to boost completion rates, colleges are now looking at the pathways students take during their college careers and the intensity with which they pursue these pathways (Bailey, Jaggars, & Jenkins, 2015). There are many ways in which students might deviate from a direct route through college—including assignment to remediation, intermittent enrollment, and enrollment in unnecessary courses—and all are likely to reduce their likelihood of graduation (Attewell, Heil, & Reisel, 2011; Bound, Lovenheim, & Turner, 2012). One potentially important factor in students' likelihood of completing college is "momentum," defined in terms of students' course loads when they start college. Students who lack momentum—those who initially take a light course load—fall behind immediately; if this pattern is compounded over several semesters, these students are unlikely to graduate. However, if students take too many courses in their first semester, they may be overwhelmed and consequently earn poor grades, become discouraged, and perhaps drop out at higher rates. This suggests that there may be an optimal initial course load to maximize completion rates.

The evidence on the impact of momentum is growing, with most studies finding that students have too little momentum (see Complete College America, 2013; Complete College America & Postsecondary Analytics, 2013). Adelman (2006) found first-year credit loads to be an important predictor of completion (see also Scott-Clayton, 2011). More recent studies have looked specifically at how course-taking behavior in the first semester influences students' academic trajectories. Using data from the National Education Longitudinal Study of 1988 (NELS:88/2000), Attewell, Heil, and Reisel (2012, Tables 4 and 5) estimated that two-year college students who enrolled part-time in their first semester (taking fewer than 12 credits) were 8–13 percent less likely to complete a degree than students who started full-time; four-year college students who enrolled part-time in their first semester were 5–7 percent less likely to complete a degree. Attewell et al. also showed how first-semester credits were associated with increased credit accumulation in subsequent semesters. However, the positive association for two-year students was not statistically significant in all specifications, and four-year students who took a heavy course load (18 credits or more) were no more likely to complete a degree

than were four-year students taking fewer courses. Using data from the 2004/09 Beginning Postsecondary Students Longitudinal Study (BPS:04/09), Attewell and Monaghan (2016) identified a strong positive effect of attempting 15 instead of 12 credits in the first semester of community college: Students who attempted 15 credits were 9 percentage points more likely to earn a degree, and gains were evident for all student subgroups. There appear to be substantively large impacts from increased momentum—particularly for students who start at community colleges. Klempin (2014) reviewed research on efforts by higher education institutions and systems to redefine full-time at 15 credits and found that the available evidence showed promising signs of effectiveness.

It is worth noting that most of these discussions emphasize the momentum of starting out with a high course load, which has a domino effect on credit accumulation in later semesters. But this depiction is hard to distinguish from a simpler one: Students who take a high course load in every semester will do better. The momentum interpretation would mean that reforms in the first semester or year are critical and perhaps sufficient to improve graduation rates; the sustained-high-course-load interpretation would mean that reforms in the first semester or year are critical but not sufficient. In this paper, we adopt the momentum framework. (Notwithstanding, we recognize that a sustained-high-course-load interpretation may be equally valid, and so we would urge colleges to continue to encourage their students to maintain a high course load throughout their college careers; active advising in this area could reinforce the momentum effect and yield even larger gains.) This choice of framework allows us to compare our results with the existing literature; it also allows us to model the effects of early momentum over time.

Beyond the academic benefits of momentum, there may be economic consequences as student course loads grow and shift over time. Increasing student momentum may improve graduation rates without requiring substantial increases in funding for colleges. The main effect is that students would be taking more courses, which would mean more revenue (Bailey, 2012; Belfield & Jenkins, 2014). However, the economics and efficiency of increasing student momentum have not been explored in depth. The only directly relevant study is an economic model developed by Belfield, Crosta, and Jenkins (2014) based on expenditure data for one community college. In that analysis, higher proportions of students taking 12 or more credits in the first semester

were associated with increased efficiency, measured as expenditures per successful completer.[1] But the link between momentum and efficiency is complex. To get momentum, students have to pay more up front—that is, they are bringing their credits forward intertemporally. Also, momentum students may fail proportionally more credits, and failed courses are an economic waste from the student and college perspectives.[2] Overall, we can calculate the economic consequences of momentum based on how colleges change the pathways students follow and the resource consequences of each pathway. For students, the efficiency of momentum will depend on the labor market returns to accumulating more credits or completing college at higher rates.

Nevertheless, the positive outcomes observed for students who take higher credit loads have prompted college systems to consider ways to increase momentum. Within this context, the Tennessee Board of Regents (TBR) is now urging the state's two- and four-year institutions to encourage students to take 15 credits per semester. This number is above the 12 credits generally considered full-time for financial aid purposes. The main intent of the policy is to help students complete their degrees on time. But there are also economic consequences in terms of student fees and college resources. It is an empirical question as to how effective and efficient this policy will be for Tennessee college students and institutions.

In this paper, we examine both the effectiveness and cost efficiency of early momentum—or what we hereafter call, simply, momentum—for Tennessee's students and colleges. Here, momentum is defined as attempting 15 credits in the first semester instead of 12 credits. We then extend the definition to attempting 27 or more credits in the first year instead of fewer than 27 credits (for students who take at least 12 credits in the first semester). We draw on detailed student-level transcript data on cohorts of students from across the TBR college system. Adapting the method applied by Attewell and Monaghan (2016), we examine the link between first-semester and first-year course loads, on the one

[1] Specifically, if the proportion of students taking 12 or more credits increased by one fifth (from 30 percent to 36 percent of all students), the college completion rate would increase by 8.8 percent, and college expenditures per successful completion would be reduced by 2.2 percent (Belfield et al., 2014, Table 3).

[2] For example, a student may take 15 credits in each of two semesters but only pass 12; the total credit accumulation is 24 credits after two semesters. An alternative pathway to accumulate 24 credits would be to take and pass eight credits in each of three semesters. In the first scenario, the student has paid for six extra credits.

hand, and total accumulated credits and rates of degree completion, on the other hand, up to 18 semesters (six academic years) later. Next, we model the economic consequences of momentum in terms of student price per credit/degree and college expenditure per credit/degree over students' academic careers. Overall, we find momentum has a strong impact on students' performance in college and thus is associated with lower prices (i.e., tuition and fees) to the student and increased efficiency from the college and taxpayer perspective. Retaining more students also increases tuition revenue for colleges. In our conclusion, we review these findings in light of recent discussion of the importance of pathways and policy alternatives for increasing momentum.

2. Modeling Momentum's Effects on College Credits and Completion

Momentum can be defined in several ways (Attewell et al., 2011). Our primary definition is taking 15 credits in the first semester.[3] We compare TBR students who did this ("momentum students") with those who took 12 credits in the first semester.[4] The 12-credit course load is generally considered full-time, so our analysis looks at the advantages of taking more courses than the minimum to be considered full-time. Looking across the first year, we define momentum as attempting 27 or more credits within the first three semesters (fall, spring, and summer). We compare students who did this with students who attempted fewer than 27 credits in the first year but who started their first semester by attempting at least 12 credits. Thus, we are looking at momentum for students who took more than the general full-time course load, which is only 24 credits over the first two semesters.

Students who took fewer than 12 credits in their first semester are not part of the analysis. It may be unrealistic to expect these students to substantially increase (perhaps even to double) their credit load in their first semester, and even less realistic to expect

[3] A small number of students in our dataset took 14 credits or more than 15 credits in the first semester. We include these students as momentum students. Similarly, the 12-credit group includes those who took 11–13 credits in the first semester. For analyses of first-year momentum, we include students who took 27–29 credits in the 27-credit group.

[4] Attewell et al. (2012) specify four indicators of momentum. Two (starting part-time with less than 10 credits, and taking a heavy course load with more than 17 credits) are similar to but do not exactly correspond to our measure.

that they would sustain this over their first year. Hence, our analysis corresponds to a policy where 15 credits—not 12 credits—is the new full-time for students. Looking over the first year, the policy might be described in several ways (such as *12 + 12 + 3* or *15 + 12*) but is similarly intended to represent a new definition of full-time that is meaningfully more intensive than conventional 12-credit definition.

We include all courses taken (not necessarily passed) in our definition of momentum. One concern is that students are pushed into taking extra courses but fail some of them. For instance, a student who takes 15 credits but passes 12 will be worse off than a student who just takes and passes 12 credits. We also include developmental education courses in our count of credits attempted. These courses are high-stakes in terms of momentum. A student who fails a college-level elective can take other elective courses in the subsequent semester, but a student who fails developmental English might not be able to take any other courses.[5]

There are several potential mechanisms by which momentum might work to increase the likelihood students will complete their programs, although at present there is little evidence on which ones are effective. Students' initial credit load may foster a behavioral norm or habit, so the momentum student may start at 15 credits per semester and keep going at that rate until completion or dropout. Alternatively, if a decay effect on credit accumulation is present, momentum may slow that effect: If a student starts college and then takes progressively fewer credits until exit, then the higher the initial credit load, the longer the student is likely to stay enrolled. Finally, enrolling in 15 credits may allow a student to focus on studying rather than dividing his or her time between responsibilities (e.g., working while enrolled in college); with fewer distractions, a student may have higher course pass rates. In this investigation, we focus on the associations between momentum and college outcomes, although given our results, it is an important area of inquiry as to why and how momentum is influential.

Our estimation approach follows that of Attewell and Monaghan (2016). We estimate a series of regression models of the form:

$$\text{Outcome}_i = \alpha_i + \beta_i MOMENTUM + \gamma_i \boldsymbol{X} + \varepsilon_i \quad (1)$$

[5] For both assumptions, our analysis corresponds with that in Attewell et al. (2012).

For each outcome *i* of awards and credits, we estimate the effects of *MOMENTUM*, controlling for a vector of individual characteristics $\boldsymbol{X}$.[6] We estimate Equation 1 using ordinary least squares (OLS) and propensity score matching techniques. These techniques were used in the prior studies cited above. However, we caution that there may be some unobserved characteristics of momentum students that we have not included in our model. In particular, we are not able to control for financial constraints or employment status while enrolled, and we can only partially control for differences in ability. Students who chose to take 15 credits may therefore be systematically different from those who took 12 credits.

The data for analysis are student-level records by semester for cohorts of first-time college students entering public colleges within the TBR system. For cohorts of students entering college in 2008, we have information on demographics, courses enrolled in and completed within the Tennessee public colleges (including transfers across TBR colleges), and award receipt during the period up to 2014 (i.e., up to six years after initial entry). Very few students earn their first credential beyond this six-year time point, but it may be short for some students who get an associate degree and then attempt a bachelor's degree.

Our sample is restricted to students who attempted at least 12 credits in the first semester. As shown in Table A.1 in the appendix, this restriction is important for community college students; it excludes 17 percent of all first-time students.[7] However, for four-year college students, the excluded proportion is 2 percent. In addition, the momentum student populations vary significantly by sector: 28 percent of all community college students are first-semester momentum students; in the four-year sector, the proportion is 71 percent. Looking at first-year momentum, almost two thirds (64 percent) of community college students attempted less than 27 credits in their first year despite attempting at least 12 credits in their first semester. Only one fifth of community college students managed to maintain their momentum by attempting 27 or more credits in their

[6] We do not have information on students' work and family obligations outside of college. These obligations may constrain their ability to take a full course load as well as reduce their ability to pass all the courses they attempt. However, our sample is restricted to students who took at least 12 credits in their first semester.
[7] There are many more part-time students in community college, but most of these students are not part-time in their first semester.

first full year. For four-year college students, momentum was much higher: Exactly half of these students attempted 27 or more credits in their first year.

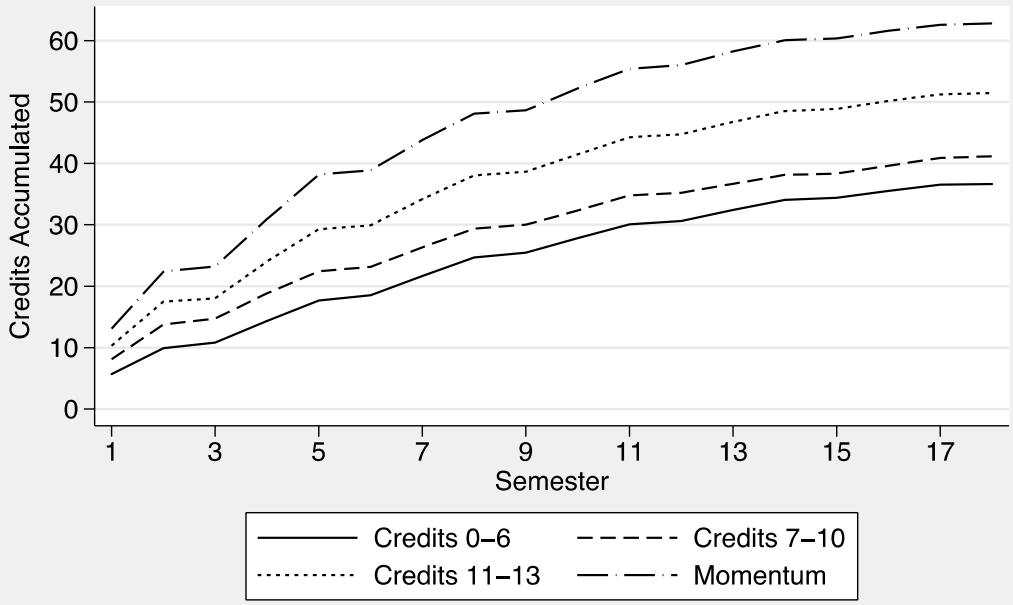
For illustration, we show the patterns of credit accumulation in Figures 1–6. These figures show students grouped according to their first-semester momentum. We show credits accumulated over 18 semesters (six academic years). (The figures show credits earned; generally, the patterns for attempted and earned credits are similar, except with the former being a couple of credits higher than the latter in each semester.)

Figure 1 shows the average credits accumulated by community college students. The lines represent students with different credit loads in their first semester and include all credits earned at any TBR institution (two- or four-year). The advantage for momentum students is very large. After two years (six semesters), the typical momentum student was 10 credits ahead of the typical student taking 11–13 credits, and after six years (18 semesters), the average credit accumulation for momentum students was just over 60—sufficient credits to get an associate degree. Students who started at lower credit loads accumulated far fewer credits; on average, a student taking less than 11 credits in the first semester had about 40 credits six years after first enrollment.

Figures 2 and 3 show the ranges of credit accumulation for momentum starters and low-credit starters at community colleges. Figure 2 shows the accumulation rate for students at the 25th percentile in each semester. Except for momentum students, students in the 25th percentile of each group accumulated very few credits (less than 20 after six years). Almost none of the students in the 25th percentile of the low-credit starter groups would have completed an award, and most dropped out after the first year (and so have flat lines). By contrast, students in the 25th percentile of the momentum group kept accumulating credits over at least four years; by the two-year point, these students had as many credits as a typical student who started part-time. Figure 3 shows the credit accumulation for students at the 75th percentile within each group in each semester. Again, there are clear gaps, with the 75th percentile of momentum students accumulating credits very rapidly and reaching 60 credits within two years. Comparing Figures 1 and 3, the average momentum student accumulated credits as fast as students in the 75th percentile of all other groups.

Figure 1. Credits Accumulated by Semester

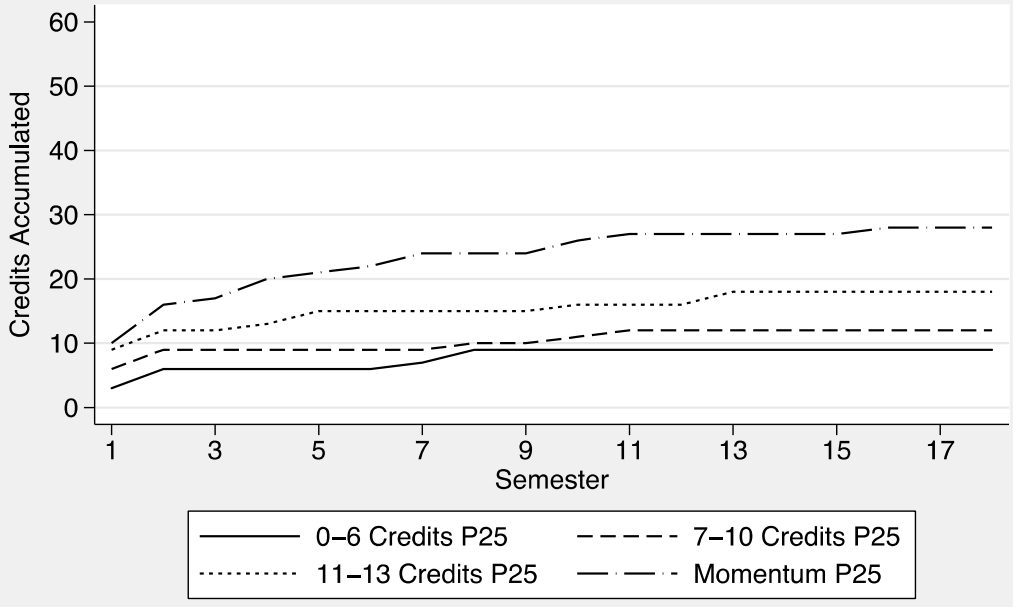
Community College Students



TBR data, fall 2008 cohort.

Figure 2. Credit Accumulation: 25th Percentile

Community College Students



TBR data, fall 2008 cohort.

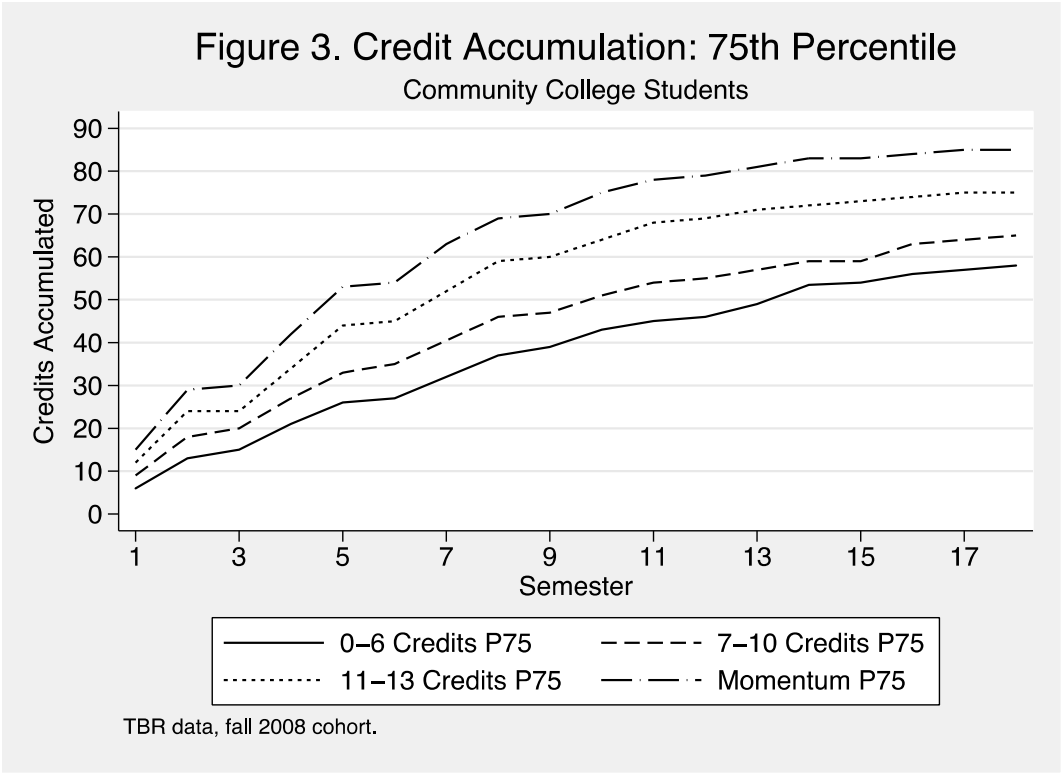


Figure 3. Credit Accumulation: 75th Percentile
Community College Students
Credits Accumulated
0
10
20
30
40
50
60
70
80
90
1
3
5
7
9
11
13
15
17
Semester
0–6 Credits P75
7–10 Credits P75
11–13 Credits P75
Momentum P75
TBR data, fall 2008 cohort.

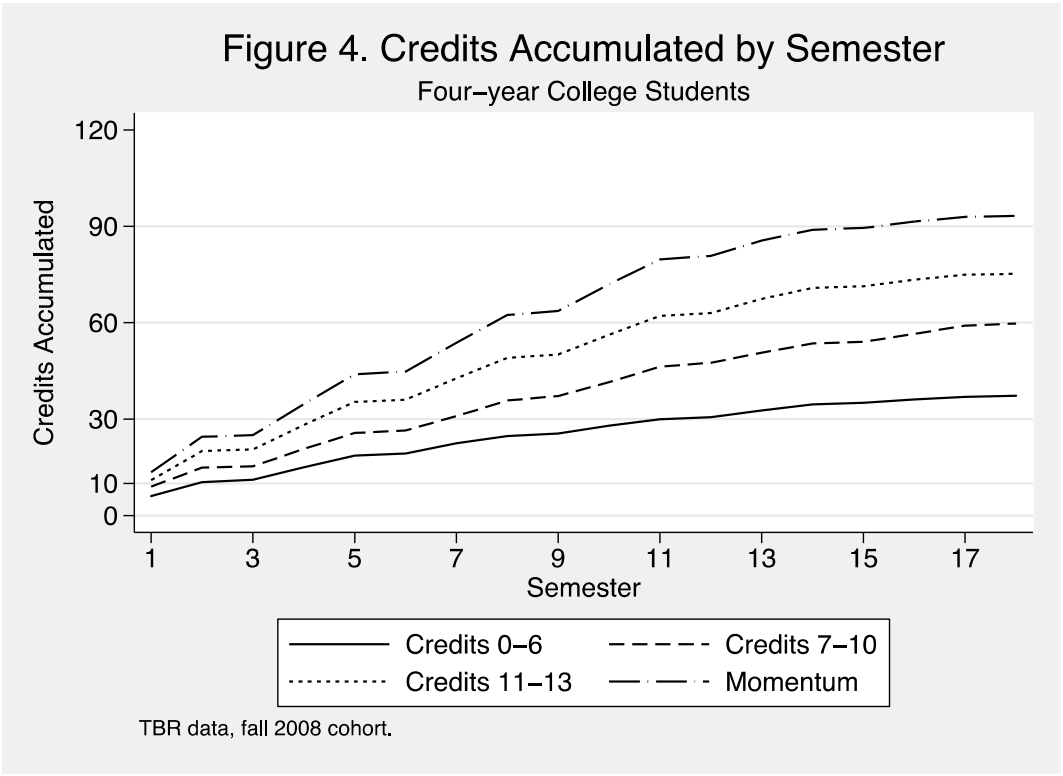


Figure 4. Credits Accumulated by Semester
Four–year College Students
Credits Accumulated
0
10
30
60
90
120
1
3
5
7
9
11
13
15
17
Semester
Credits 0–6
Credits 7–10
Credits 11–13
Momentum
TBR data, fall 2008 cohort.

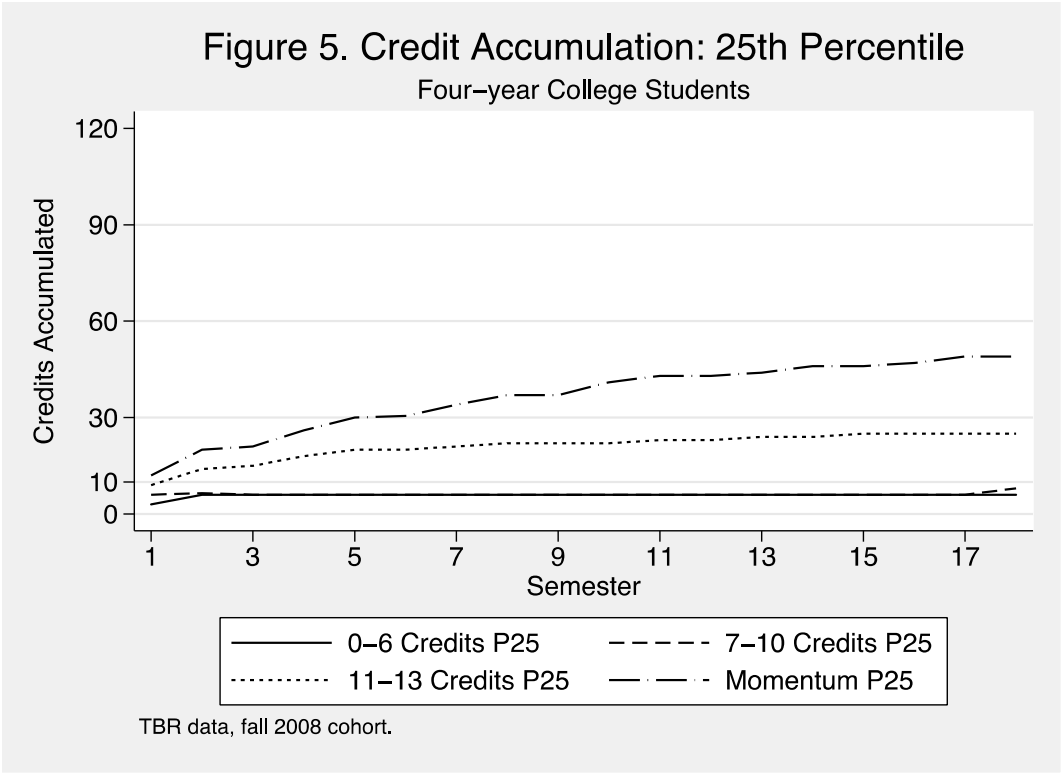


Figure 5. Credit Accumulation: 25th Percentile
Four–year College Students
Credits Accumulated
120
90
60
30
10
0
1
3
5
7
9
11
13
15
17
Semester
0–6 Credits P25
7–10 Credits P25
11–13 Credits P25
Momentum P25
TBR data, fall 2008 cohort.

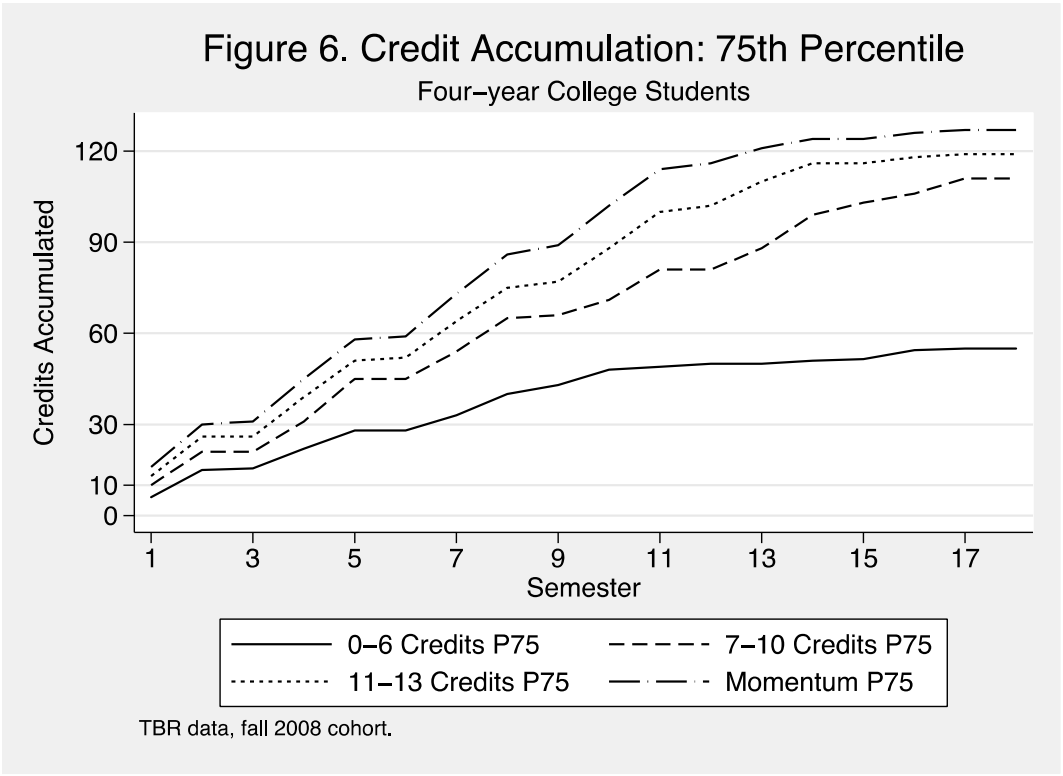


Figure 6. Credit Accumulation: 75th Percentile
Four–year College Students
Credits Accumulated
120
90
60
30
10
0
1
3
5
7
9
11
13
15
17
Semester
0–6 Credits P75
7–10 Credits P75
11–13 Credits P75
Momentum P75
TBR data, fall 2008 cohort.

Similar gaps are evident on average and across the distributions for students in four-year colleges, as shown in Figures 4–6. Figure 4 shows the average accumulation for students in each of the four groups. Momentum students accumulated 90 credits on average after six years. Students who started with lower credit loads accumulated credits at a slower rate over their time in college and ended up with approximately half the credits needed to graduate. This cumulative growth is partly explained by the higher dropout rate of low-credit starters. As shown in Figure 5, most students in the 25th percentile dropped out very quickly; only momentum students kept accumulating credits throughout the tracking period, such that a momentum student at the 25th percentile progressed more rapidly than the average student who started by enrolling in six or fewer credits and almost as rapidly as the average student who started with 7–10 credits. The 75th percentile of each student group is shown in Figure 6. Momentum students in the top quarter reached 120 credits within four years. For the 75th percentile of students who initially enrolled in 11–13 credits, it took six years to reach that benchmark. For students who attempted 0–6 or 7–10 credits in their first semester, even those at the 75th percentile did not reach 120 credits; students in the former group accumulated just sufficient credits for an associate degree.

Overall, these six figures illustrate several patterns of gaps among students by first-semester credit load. First, momentum students accumulated credits faster (the slopes of the lines are steeper). Second, this credit accumulation was affected by the greater persistence of momentum students, particularly across years (as shown by the jump in credits at semesters 4 and 7). The slopes also show how the gap evolved across time: Students at four-year colleges who initially enrolled in 11–13 credits reached 60 credits after 11 semesters; momentum students reached the same point after eight semesters. Finally, momentum students were more likely to reach award milestones (60 or 120 credits); there may be a motivation effect for students who are close to a milestone.

In the appendix figures, we show credits per semester (not cumulative); credits are averaged across all students (Figures 1A and 2A) and averaged across only those who enrolled in a given semester (Figures 1B and 2B). These figures show that the rate of credits earned fell at a similar rate for momentum and other students, with few students taking summer session courses. The persistence effect is again clearly evident:

Momentum students earned more credits in the second year—both in the first and second semesters. These effects are shown clearly in Appendix Figures 1B and 2B, where average credits are only reported for students enrolled in that semester. Momentum students maintained a 1–3 credit advantage every semester until the fifth year (semester 14 for community college students and semester 13 for four-year students). The gap is robust in the second year: Momentum students returned to their community colleges on average to earn 11 or 12 credits each semester, compared with nine or 10 credits for the comparison group. Momentum students in four-year colleges had a 1–2 credit advantage each semester in the second, third, and fourth years.

Frequencies for individual-level covariates are shown in Appendix Table A.2. There are significant differences between momentum students and comparison students. Compared with students taking lighter credit loads, momentum students were more likely to have gone straight from high school to college and, in the community college sector, were somewhat less likely to be African American and less likely to be female. Their aid receipt was different: Momentum students were less likely to receive Pell Grants but more likely to receive the Tennessee HOPE Scholarship.[8] The most salient difference is in prior academic performance: Momentum students were much more likely to have performed well in high school (earning at least a 3.0 grade point average [GPA]). These differences are evident for both first-semester and first-year momentum students.

Table 1 shows the unadjusted differences in credits and award completions for momentum students versus their respective comparison groups.[9] One notable feature is the large gap between credits attempted and credits earned: Students failed approximately one in five courses. In itself, this high failure rate may contribute to the momentum effect. Students who took 15 credits were actually only passing at the old full-time rate; students who take and pass fewer courses will make very slow progress and may easily become discouraged.

[8] To qualify for a Tennessee HOPE Scholarship, which is a "merit" aid program (as opposed to a need-based program), students must, among other things, score at least a 21 on the ACT or have a high school GPA of at least 3.0.

[9] These include credits earned at any two- or four-year institution in the TBR system, not just at students' starting institution.

Table 1
Descriptive Statistics: Credit and Award Outcomes

	Community Colleges				Four-Year Colleges			
Outcome	**12-Credit First Semester**	**First-Semester Momentum**	**< 27-Credit First Year**	**First-Year Momentum**	**12-Credit First Semester**	**First-Semester Momentum**	**< 27-Credit First Year**	**First-Year Momentum**
Credits								
Semester 1 attempted	12.3 [0.5]	15.6 [1.4]	12.8 [1.3]	15.1 [2.1]	12.5 [0.5]	15.3 [1.0]	13.7 [1.4]	15.4 [1.3]
Semester 1 earned	8.2 [4.4]	12.0 [5.1]	8.3 [4.7]	12.5 [4.0]	9.2 [4.2]	12.2 [4.5]	9.5 [4.8]	13.1 [3.6]
Semester 9 attempted	51 [26]	63 [26]	50 [25]	74 [22]	63 [29]	77 [27]	61 [28]	86 [22]
Semester 9 earned	39 [25]	49 [27]	37 [25]	58 [26]	50 [30]	64 [31]	48 [30]	72 [28]
Semester 18 attempted	68 [42]	80 [43]	65 [41]	94 [41]	93 [52]	113 [48]	91 [52]	124 [42]
Semester 18 earned	52 [39]	63 [41]	49 [38]	74 [41]	75 [49]	93 [48]	73 [49]	103 [44]
Award (%)								
Associate degree	20	25	18	32	1	1	2	1
Bachelor's degree	7	12	7	16	37	52	36	60
Associate or bachelor's degree	27	37	25	48	39	53	38	60
Any award (incl. certificate)	30	40	28	50	39	53	38	61
n	4,235	2,114	4,889	1,460	2,741	7,209	4,963	4,987

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First-semester momentum is defined as attempting more than 13 credits in first semester. First-year momentum is defined as attempting more than 26 credits in first year (including summer session), conditional on attempting at least 12 credits in first semester. Semester count includes summer session. Standard deviations in square brackets.

The left-hand portion of Table 1 shows performance outcomes for community college students. First-semester momentum students failed slightly fewer credits in their first semester than did 12-credit students (3.6 versus 4.1). The credit advantage for momentum students at the end of the semester was therefore larger than at the start. By semesters 9 and 18, the gap was 10 credits in favor of momentum students. Yet, the course pass rates were similar: Community college students attempted approximately 12–15 more credits than they earned. Thus, momentum students seem no more overloaded with coursework than students who initially enrolled in the old full-time course load. Despite the high course failure rate, by the end of the sixth year, first-semester momentum students at community colleges had passed on average 63 credits, enough for an associate degree. As shown in the bottom rows of Table 1, momentum students were much more likely to earn awards. They were 5 percentage points more likely to earn associate degrees and bachelor's degrees; overall, then, they were 10 percentage points more likely to get a degree. If certificates are included as awards, the gap remains at 10 percentage points.

The patterns are similar for first-year momentum students. The gaps for these students are also very large: First-year momentum students had 21 more credits by the end of three years and 25 more credits by the end of six years. Again, interestingly, momentum students did not pass their courses at a higher rate. Nevertheless, the gain in credits was so large that first-year momentum students were almost twice as likely to get a degree within six years.[10]

The right-hand portion of Table 1 shows descriptive statistics for four-year public university students. For first-semester momentum students, the initial gap in credits earned is three credits over the comparison group. Over subsequent semesters, momentum students simply took more courses, passing them at a similar rate to the comparison group. The result is that first-semester momentum students had on average 64 credits after nine semesters and 93 credits after 18 semesters; credit accumulations for the comparison group were 50 and 75, respectively. Correspondingly, there is a large gap

[10] Our definitions of first-semester momentum and first-year momentum are not proportionate—the latter is not twice as intensive as the former—so we do not compare the two types of momentum.

in award completion: First-semester momentum students were 14 percentage points more likely to earn degrees than the comparison group.

Gains for first-year momentum students were also large. After nine semesters, the gap was 24 credits, and after 18 semesters, it was 30 credits. After six years, 60 percent of first-year momentum students had earned a degree; the rate for the comparison group was 38 percent. These large gaps are strongly suggestive of the benefits of taking more credits.

3. Momentum's Effects on College Completion: Results

3.1 Main Results

Results on the effects of momentum on awards and credits earned are given in Table 2. These results are OLS estimations, controlling for student covariates (as shown in Appendix Table A.2). Each row shows a separate estimation for the outcome variable in the first column; the coefficient for momentum shows momentum's effect on that outcome. For comparison, we also report the coefficients for two well-established influences on performance in college—prior academic performance and gender (Goldin, Katz, & Kuziemko, 2006). Overall, the associations show a statistically significant and strongly positive effect of momentum on college outcomes. Each coefficient is statistically significant at the 1-percent level.

First-semester momentum students were more likely to get an award. Controlling for covariates, first-semester momentum students in community colleges were 6.4 percentage points more likely to earn any award than 12-credit students; for those in four-year colleges, the effect size is 11 percentage points.[11] These are very large effects, especially as the community college momentum effect extends to bachelor's degrees. Momentum also compares favorably to other factors influencing completion: Its effect is approximately half as large as that of high school prior academic performance, and it is as important as the college gender gap.

[11] The results are almost identical if we include certificates with degrees. For simplicity, we focus on the results for degrees.

Table 2
Momentum Effects

Outcome	Momentum		High School GPA ≥ 3.0		Female	
	Coefficient	(*SE*)	Coefficient	(*SE*)	Coefficient	(*SE*)
First-Semester Momentum						
Awards						
Community college students: Associate degree[a]	0.031	(0.011)	0.083	(0.011)	0.046	(0.010)
Community college students: Bachelor's degree[a]	0.035	(0.008)	0.042	(0.007)	0.012	(0.007)*
Community college students: Any degree[a]	0.065	(0.012)	0.125	(0.012)	0.058	(0.011)
Community college students: Any award	0.064	(0.013)	0.120	(0.013)	0.054	(0.012)
4-year students: Any degree[b]	0.110	(0.011)	0.190	(0.011)	0.052	(0.010)
Credits						
Community college students: 9 semesters[c]	7.6	(0.7)	9.9	(0.8)	3.1	(0.7)
Community college students: 18 semesters[c]	8.1	(1.0)	11.5	(1.1)	3.7	(1.0)
4-year students: 18 semesters[d]	14.4	(1.1)	23.5	(1.1)	4.5	(1.0)
First-Year Momentum						
Awards						
Community college students: Associate degree[a]	0.112	(0.014)	0.082	(0.011)	0.047	(0.010)
Community college students: Bachelor's degree[a]	0.083	(0.010)	0.031	(0.007)	0.012	(0.007)
Community college students: Any degree[a]	0.195	(0.014)	0.113	(0.012)	0.059	(0.011)
Community college students: Any award	0.188	(0.015)	0.111	(0.013)	0.055	(0.011)
4-year students: Any degree[b]	0.189	(0.010)	0.171	(0.011)	0.048	(0.010)
Credits						
Community college students: 9 semesters[c]	18.3	(0.7)	9.1	(0.7)	3.1	(0.6)
Community college students: 18 semesters[c]	21.5	(1.2)	10.5	(1.0)	3.9	(1.0)
4-year students: 18 semesters[d]	26.6	(0.9)	21.1	(1.0)	4.0	(0.9)

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First-semester momentum is defined as attempting more than 13 credits in first semester. First-year momentum is defined as attempting more than 26 credits in first year (including summer session), conditional on attempting at least 12 credits in first semester. Each row shows separate model for outcome in first column; models control for gap year, race (3), aid receipt (2), in-state student status, and cohort year. Results are OLS estimations with robust standard errors in parentheses. All coefficients are statistically significant at $p < .01$ except where marked.

[a] $n = 6{,}349$. [b] $n = 9{,}950$. [c] $n = 5{,}920$. [d] $n = 9{,}638$.

* $p < .05$.

Momentum is also strongly positively associated with credit accumulation. In community colleges, momentum students had 7.6 more credits after nine semesters and 8.1 more credits after 18 semesters. At four-year colleges, the gap was 14.4 credits after 18 semesters. Again, all of these effects are statistically significant and compare favorably with prior academic performance and gender effects. Also, these momentum gains are relative to students who were initially classed as full-time (who attempted 12 credits in their first semester).[12]

Looking at first-year momentum—that is, students who attempted at least 27 credits in the first year compared with those who started with 12 credits in term 1 but took fewer than 27 credits in a year—the effects are even larger in terms of credits and awards. Among community college students, first-year momentum students were 11 percentage points more likely to get an associate degree and 8 percentage points more likely to get a bachelor's degree. For four-year students, the overall gain was an increased probability of completion of 19 percentage points. These advantages are substantively meaningful when compared with the effects of high school GPA and gender: Based on these results, a college advisor should be more concerned about a student who chooses to take 12 credits or fewer each term than about one who enters with a low high school GPA. After 18 semesters, first-year momentum students at community colleges had 21.5 more credits, and those at four-year colleges had 26.6 more credits. The credit gap is very large; however, this result is perhaps not so surprising, given that the groups are separated according to the number of credits attempted in the entire first year of college.

3.2 Sensitivity Tests

To test these results, we apply a series of robustness checks. First, we perform propensity score matching on personal characteristics to estimate the average treatment effect and the average treatment effect on the treated. As shown in Table 3, the results for degree awards are lower for first-semester momentum but are unchanged for first-year momentum. For credit accumulation, the results for the average treatment effect and the average treatment effect on the treated are almost identical to the OLS results in Table 2.

[12] Not reported here, we find the effects of momentum are even larger when compared to all students taking less than 15 credits.

Table 3
Momentum Effects: Propensity Score Matching Estimates

	Any Degree		Credits After 18 Semesters	
Effect	**Community College**	**Four-Year College**	**Community College**	**Four-Year College**
First-semester momentum				
Average treatment effect	0.064	0.106	7.9	14.2
	(0.013)	(0.011)	(1.1)	(1.1)
Average treatment effect on treated	0.061	0.107	7.9	14.2
	(0.013)	(0.012)	(1.1)	(1.1)
First-year momentum				
Average treatment effect	0.199	0.186	21.5	26.0
	(0.015)	(0.010)	(1.2)	(1.0)
Average treatment effect on treated	0.193	0.185	21.4	26.2
	(0.015)	(0.010)	(1.3)	(1.0)
n	6,349	9,950	5,906	9,636

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First-semester momentum is defined as attempting more than 13 credits in first semester. First-year momentum is defined as attempting more than 26 credits in first year (including summer session), conditional on attempting at least 12 credits in first semester. Each row shows separate model with coefficient on momentum reported; models match for gap year, race (3), aid receipt (2), in-state student status, and cohort year. Results are propensity score matching logit estimations, with robust standard errors in parentheses. All coefficients are statistically significant at $p < .01$.

Second, we separate the groups by prior academic performance, racial/ethnic minority status, gender, and completion status and reestimate the results as per Table 2. Attewell and Monaghan (2016) found greater momentum effects for both minority students and those with poorer previous educational achievement, such that a "new full-time" policy should reduce gaps in college performance. As shown in Table 4, our estimates indicate stronger momentum gains for minority students but weaker gains for students with lower high school GPAs. Interestingly, our results show momentum to be more beneficial for female students than for male students. For all of these subgroups, momentum was strongly advantageous in terms of degree completion and credit accumulation. Finally, momentum helped with credit accumulation both for degree completers and for those who did not complete their program. These patterns are similar for first-semester and first-year momentum students.

Overall, momentum in the first term and over the first year exhibits strong positive associations with college outcomes. Thus, we might expect momentum to yield savings to students and efficiency gains.

Table 4
Momentum Effects: Subgroups of Students

Subgroup	Any Degree		Credits After 18 Semesters	
	Community College	Four-Year College	Community College	Four-Year College
First-semester momentum				
White	0.061	0.105	7.8	13.5
	(0.014)	(0.013)	(1.2)	(1.3)
Racial/ethnic minority	0.079	0.114	8.8	16.0
	(0.027)	(0.019)	(2.6)	(2.0)
High school GPA ≥ 3.0	0.072	0.120	9.2	15.5
	(0.017)	(0.014)	(1.5)	(1.3)
High school GPA < 3.0	0.051	0.088	6.0	12.0
	(0.017)	(0.017)	(1.6)	(1.9)
Female	0.090	0.111	9.2	14.5
	(0.017)	(0.015)	(1.4)	(1.4)
Male	0.033	0.107	6.4	14.2
	(0.018)*	(0.016)	(1.7)	(1.7)
Completed degree			2.5	3.5
			(1.5)	(0.7)
Did not complete degree			5.5	10.6
			(0.9)	(1.2)
First-year momentum				
White	0.198	0.188	21.3	25.5
	(0.016)	(0.012)	(1.3)	(1.1)
Racial/ethnic minority	0.175	0.184	22.0	28.0
	(0.031)	(0.017)	(2.7)	(1.7)
High school GPA ≥ 3.0	0.190	0.191	20.8	26.7
	(0.019)	(0.012)	(1.5)	(1.1)
High school GPA < 3.0	0.196	0.180	21.8	25.8
	(0.023)	(0.017)	(1.9)	(1.8)
Female	0.217	0.184	21.8	26.3
	(0.019)	(0.013)	(1.5)	(1.3)
Male	0.164	0.194	20.9	26.7
	(0.022)	(0.015)	(1.9)	(1.4)
Completed degree			6.5	6.4
			(1.5)	(0.6)
Did not complete degree			14.8	24.2
			(1.1)	(1.3)

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First-semester momentum is defined as attempting more than 13 credits in first semester. First-year momentum is defined as attempting more than 26 credits in first year (including summer session), conditional on attempting at least 12 credits in first semester. Each row shows separate model with coefficient on momentum reported; models control for gap year, race (3), aid receipt (2), in-state student status, and cohort year. Results are OLS estimations with robust standard errors in parentheses. All coefficients are statistically significant at $p < .01$, except where marked.

*$p < .1$.

4. Economics of Momentum

4.1 Momentum Models: Student and College

Our economic models follow the pathway cost model developed by Belfield et al. (2014). We model the economic consequences per student based on credit accumulation or award completion over 18 semesters (six academic years). We use the above evidence on the effectiveness of momentum to derive pathways of credit accumulation. Then, we overlay the resource consequences in terms of tuition and fees (i.e., prices paid by students) and college expenditures for these different pathways. We derive a set of efficiency metrics that help compare costs to effects. If momentum is associated with a lower cost per effect, it is more efficient.

We perform the efficiency analysis from the perspective of the student and the college. The efficiency gain for momentum students might be thought of like the savings to consumers from bulk-buying (where, e.g., it is cheaper per liter to buy 5 liters of bleach than 1 liter of bleach) and, in other respects, like compounding (where an early investment yields higher returns over time). Spending more in the first semester means better outcomes overall and so lower prices to the student for credits and awards. These lower prices and better outcomes mean greater efficiency for the college and society.

There are two main elements of the cost model for students that allow them to save money. First, for reasons explained below, the cost per credit varies slightly depending on how many credits a student takes each semester. Momentum students can therefore save money by taking more credits per semester. (Momentum students may also save money if they pass more of the courses they attempt, although at least in this dataset, their pass rate is not higher.) The second cost arises because momentum leads students to take more credits; taking extra credits costs more. If these extra credits are sufficient to allow students to graduate, then momentum is clearly valuable: Graduates earn considerably more than college dropouts.[13] However, these extra credits might increase the students' total credit accumulation, albeit not by enough to graduate; for example, a momentum student might leave college with 40 credits instead of 30 credits. Even in this case, momentum is still valuable from the student perspective: Studies have found that

[13] This earnings gap is summarized for two-year college students by Belfield and Bailey (2011) and for four-year college students by Barrow and Malamud (2015).

college credits have labor market value even for students who do not complete an award (Belfield et al., 2014). Looked at in a different way, we can assume that students are accumulating credits up to a threshold (the point at which lost earnings from being in college rise above the returns to credits). A student who accumulates seven extra credits because of momentum presumably values those credits more than the alternative (exiting into the labor market). Hence, the student values those credits at what he or she had to pay in tuition and fees. Put simply, momentum makes students willing to pay for more credits, and more credits are a good investment.

The efficiency gain from the perspective of the college and society is driven by two factors: increases in output of awards and credits, and economies of scale. The latter factor comes again from bulk-buying. If the college charges per-credit tuition and fees that are lower with bulk-buying, then this is presumably because it costs less to provide courses in bulk.[14] Many four-year institutions and some community colleges offer bulk-buying discounts. Some offer discounts based on the number of credits; almost all charge some fixed fees per semester, such that the average cost per credit falls as the number of credits taken goes up.

Increases in awards also contribute to college efficiency, since they mean that the institution is able to produce more graduates with the resources available to it. To put it simply, if momentum leads more students to complete their program, then the cost per completer should fall. The logic is somewhat more complicated for credit accumulation. When the college has more momentum students, it also has higher expenditures because it must offer more courses. Absent economies of scale, college finances are invariant to whether a student accumulates 33 credits or 40 credits before dropping out. However, colleges are motivated to increase the number of credits accumulated, so it is appropriate to look at how much extra is spent as a result of momentum. Overall, for the college, efficiency gains occur when either the cost per completer or the cost per credit falls with momentum; however, extra spending is also important as an indicator of how much society is willing to pay for college.

In developing this model, we emphasize that we have not included the costs of implementing a "momentum policy." Such policies can be implemented in various

[14] If the college has high fixed costs, expanding enrollments should cause the average cost per credit to fall.

flexible ways, including creating financial incentives (e.g., by charging banded tuition where 12 through 18 credits are priced at a flat rate, or tying financial aid to completion of more than 24 credits in the first year); encouraging students to take more courses via social marketing; making 15 credits the default for full-time in program maps used to guide academic planning by students and scheduling by administrators; or simply redefining full-time at a higher momentum level (Klempin, 2014; Scott-Clayton, 2011). To implement these policies—that is, to get students to the point where they have more momentum—would require resources. Moreover, we suspect that these are not single-semester, one-shot policies; they would likely require colleges to encourage momentum each semester (including summer semesters). However, no data are available on what these policies might cost. Here, we assume that a momentum policy has been implemented within college budgets.

We use data from several sources to populate the model. The pathways of momentum and status-quo students are modeled based on student transcript data as described above. The costs/prices per course are calculated from tuition calculators of colleges within the TBR. These calculators show that, in addition to tuition costs per credit, there are also fixed fees and registration fees per semester enrolled. Thus, the more credits a student takes in a semester, the cheaper each credit is. For college expenditures, we use data from the Integrated Postsecondary Education Data System (IPEDS) on education and general spending net of tuition and fees (Desrochers & Hurlburt, 2016). IPEDS data are college-level aggregates and as such do not allow us to adjust for class-level resource differences.[15] Also, we are not able to predict how costs would change if large numbers of students newly enrolled in three-credit courses in their first semester. In the baseline model, we therefore assume that colleges can expand first-semester courses at a constant average cost.

Our primary focus is on first-semester momentum, so we report these results in full here. A parallel analysis for first-year momentum was also performed, and the findings are similar and even larger; this analysis is summarized below.

[15] Information on class composition and size is not available, so class-level resource differences are not calculable.

4.2 First-Semester Momentum Results

Table 5 shows the results from the economic model from the community college student perspective. The top rows show the patterns in the first semester. With a course load of 12 credits, a student will pay $1,170 in tuition and fees. By contrast, a momentum student will take three extra credits and pay $230 more in total. However, because of bulk-buying—as reflected in the tuition and fees policy of the state—the momentum student pays 5 percent less per credit.

The overall gain for momentum students who started at community college is shown in the middle rows of Table 5. After leaving college, the momentum student will have accumulated more postsecondary education. In terms of credits, the momentum student will have on average eight extra; in terms of awards, the momentum student will have a higher probability of graduating with any degree by 7 percentage points. To get to this level, the momentum student will have paid $620 more in tuition and fees ($5,360 versus $4,740 for 12-credit students).

Table 5
Momentum at Community College: Student-Level Cost-Effectiveness

	12-Credit Student	Momentum Student	Interpretation for Momentum Students
First semester			
Course load	12	15	Take 3 more credits
Tuition + fees	$1,170	$1,400	Pay $230 more in tuition and fees
Price per credit	$98	$93	Pay $5 (5%) less per credit
After all semesters			
Credits in total	49	57	Have 8 more credits
Prob. (degree)	0.27	0.34	Are 7 percentage points more likely to graduate
Tuition + fees total	$4,740	$5,360	Pay $620 more in tuition and fees
Economic metrics			
Price per credit	$98	$94	Pay $4 (4%) less per credit
Price per degree	$17,560	$16,000	Pay $1,560 (9%) less per degree

Note. Figures based on TBR student-level data from the fall 2015 semester. Tuition and fee calculations based on tuition/fee prices per community college. Price per degree metric includes associate degrees and bachelor's degrees. Totals rounded to nearest $10, expressed in 2015 dollars.

The economic consequences are given in the bottom rows of Table 5. Looked at in terms of credit accumulation, momentum students pay $4 less per credit than 12-credit students. This is a 4 percent discount on the price per credit. Looked at in terms of expected awards (either associate or bachelor's degrees), the price (tuition cost) per degree is $17,560 for the 12-credit group. For the momentum group, the price per degree is $16,000. Hence, getting a degree is much cheaper for momentum students, with savings of $1,560, or 9 percent.

Parallel results for students at four-year colleges are given in Table 6. The conclusions are similar but in fact are more favorable to momentum students: Momentum is more beneficial for four-year college students, and the economic consequences are higher because tuition and fees are more expensive. In the first semester, momentum students pay $180 more in tuition and fees; however, because of steep nonlinear pricing (banded tuition), the price per credit is 17 percent lower ($295 versus $354). By the end of college, the momentum students are much further ahead: On average, they have 14 more credits and are 11 percentage points more likely to have completed their award (bachelor's degree). For this gain, momentum students only paid $750 more in tuition and fees. Hence, momentum students progress more efficiently through college. Ultimately, they are paying $51 (14 percent) less per credit and $12,800 (19 percent) less per degree. Taking 15 credits in the first semester has a high payoff for four-year students, and it yields considerable savings in tuition and fees.

Table 6
Momentum at Four-Year Colleges: Student-Level Cost-Effectiveness

	12-Credit Student	Momentum Student	Interpretation for Momentum Students
First semester			
Course load	12	15	Take 3 more credits
Tuition + fees	$4,250	$4,430	Pay $180 more in tuition and fees
Price per credit	$354	$295	Pay $59 (17%) less per credit
After all semesters			
Credits in total	71	85	Have 14 more credits
Prob. (degree)	0.39	0.50	Are 11 percentage points more likely to graduate
Tuition + fees total	$25,720	$26,470	Pay $750 more in tuition and fees
Economic metrics			
Price per credit	$362	$311	Pay $51 (14%) less per credit
Price per degree	$65,950	$53,150	Pay $12,800 (19%) less per degree

Note. Figures based on TBR student-level data from the fall 2015 semester. Tuition and fee calculations from tuition/fee price average from University of Memphis and Middle Tennessee State University (Middle Tennessee State University, 2015; University of Memphis, 2015). Totals rounded to nearest $10, expressed in 2015 dollars.

Next, we apply the model from the college-level perspective.[16] The main difference is that the college expenditures are the sum of tuition/fees and public subsidies. Total spending is therefore much higher than tuition/fees, and the efficiency gains are absolutely larger. (Approximately, tuition and fees represent one third of total costs of college in the TBR system, and we adjust for variations between two-year and four-year colleges based on IPEDS reporting.)

These gains are reported in Table 7. For the community college system, the expected cost per degree is $61,590 for 12-credit students and $56,150 for momentum students. For the four-year colleges, the cost per degree is $173,310 versus $138,050, respectively. These are substantial efficiency gains from momentum. There are also revenue/expenditure consequences from momentum. As shown in the bottom rows of Table 7, community college momentum students generate $2,180 (13 percent) more in total in additional resources flowing to the college. Similarly, four-year college momentum students generate $1,940 (3 percent) more in total in additional resources flowing to the college. This extra spending is valuable: It reflects greater willingness to

[16] Strictly, the college-level gains are social gains. If revenues equal expenditures, then college surpluses will be largely invariant to changes in momentum. This is why Belfield et al. (2014, Table 4) found college efficiency to be affected much less than revenues and expenditures with increased momentum.

invest in college for momentum students. For the college, it means that helping students build early momentum will yield higher tuition revenue—and concomitant public subsidies—over the long run.

Table 7
Momentum Efficiency Gains: College-Level Analysis

	Community Colleges		Four-Year Colleges	
	12-Credit Student	Momentum Student	12-Credit Student	Momentum Student
First semester				
Course load	12	15	12	15
Expenditure	$4,110	$4,910	$11,040	$11,510
Cost per credit	$343	$327	$920	$767
Economic metrics				
Cost per credit	$342	$328	$939	$809
Cost per degree	$61,590	$56,150	$173,310	$138,050
After all semesters				
Expenditure total	$16,630	$18,810	$66,810	$68,750
Extra expenditure		+$2,180		+$1,940
Extra expenditure (%)		+13%		+3%

Note. Figures based on TBR student-level data from the fall 2015 semester. Tuition and fees calculated as per Tables 5 and 6 above. Public subsidy from IPEDS data on per-college average tuition as a proportion of total education and related expenditures (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2010). For community college students, cost per degree refers to associate or bachelor's degree. Extra expenditure is the difference in total expenditure between 12-credit and momentum students. Totals rounded to nearest $10, expressed in 2015 dollars.

4.3 Sensitivity Tests

We apply two sensitivity tests on these results and compare the findings to our baseline results. The tests are for the student-level analysis; conclusions from the college-level perspective are similar to those at the student-level.

As shown in Table 8, there are significant efficiency gains for momentum students under alternative assumptions. First, if we assume sustained momentum—that is, that the student takes 15 credits each semester when enrolled—the gaps increase. With sustained momentum, community college and four-year college momentum students save 5 percent or 18 percent, respectively. The price per degree with sustained momentum is 10 percent and 24 percent lower, respectively. Second, if we apply an alternative pricing

system (adapted from Walters State Community College, where the savings from enrolling in more credits are greater), the economic gains from momentum are even larger. Students save 12 percent and 23 percent per credit and even larger amounts per degree (17 percent and 28 percent respectively by sector). Given the strength of the effect of momentum and the nonlinear pricing strategies of colleges, it is very likely that there will be efficiency gains and revenue increases from momentum.

Table 8
Momentum Efficiency Gains Sensitivity Testing: Student-Level Analysis

	Community Colleges			Four-Year Colleges		
	12-Credit Student	Momentum Student	% Gap	12-Credit Student	Momentum Student	% Gap
Price per credit						
Baseline	$98	$93	-5%	$362	$311	-14%
Sustained momentum	$98	$93	-5%	$361	$295	-18%
Alternate tuition/fees	$164	$141	-12%	$540	$418	-23%
Price per degree						
Baseline	$17,560	$16,000	-9%	$65,950	$53,150	-19%
Sustained momentum	$17,560	$15,820	-10%	$65,950	$50,200	-24%
Alternate tuition/fees	$29,560	$24,570	-17%	$98,560	$71,040	-28%

Note. Baseline estimates from Table 5. Percentage gap is the difference between price for momentum versus 12-credit students. Sustained momentum assumes enrollment in 15 credits in each semester for momentum students. Alternate tuition/fees assumes deeper discounting of cost per credit (based on Walters State tuition pricing; see ws.edu).

4.4 First-Year Momentum Results

Finally, we calculate the student-level efficiency gains from first-year momentum. These are shown in Table 9. As with first-semester momentum, there are clear efficiency gains: For credits, these gains depend on tuition and fees, and for awards, they depend mainly on higher award completion.

For community college students, first-year momentum entails taking 11 more credits in the first year and spending $1,040 in tuition/fees. By the end of six years, these momentum students will have 22 more credits and are 18 percentage points more likely to graduate with a degree. They will have paid $1,740 more in tuition/fees over this time. The efficiency gains for first-year momentum are significant: Students save 5 percent per

credit, and the expected price per degree is $14,670, or 20 percent less than the price for a student who did not achieve momentum.

For four-year college students, there are also large gains. By the end of the first year, momentum students will have attempted 10 more credits, paying 17 percent less per credit. By the end of their time in college, momentum students will have 27 more credits and are 19 percentage points more likely to graduate. These students will have paid $4,890 more in tuition/fees but are considerably more successful in college. Therefore, momentum students pay 14 percent less per credit and 20 percent less per degree.

Table 9
First-Year Momentum: Student-Level Cost-Effectiveness

	12-Credit Student	Momentum Student	Interpretation for Momentum Students
		Community College Students	
First year			
Course load	18	29	Take 11 more credits
Tuition + fees	$1,660	$2,700	Pay $1,040 more in tuition and fees
After all semesters			
Credits in total	47	69	Have 22 more credits
Prob. (degree)	0.25	0.43	Are 18 percentage points more likely to graduate
Tuition + fees total	$5,570	$6,310	Pay $1,740 more in tuition and fees
Economic metrics			
Price per credit	$98	$93	Pay $5 (5%) less per credit
Price per degree	$18,280	$14,670	Pay $3,610 (20%) less per degree
		Four-Year College Students	
First year			
Course load	20	30	Take 10 more credits
Price per credit	$354	$295	Pay $59 (17%) less per credit
After all semesters			
Credits in total	69	96	Have 27 more credits
Prob. (degree)	0.38	0.57	Are 19 percentage points more likely to graduate
Tuition + fees total	$24,950	$29,840	Pay $4,890 more in tuition and fees
Economic metrics			
Price per credit	$361	$309	Pay $52 (14%) less per credit
Price per degree	$65,660	$52,350	Pay $13,310 (20%) less per degree

Note. Figures based on TBR student-level data from the fall 2015 semester. Tuition and fee calculations from tuition/fee price average from University of Memphis and Middle Tennessee State University (Middle Tennessee State University, 2015; University of Memphis, 2015). Totals rounded to nearest $10, expressed in 2015 dollars.

5. Conclusion

Many students start college with the intention of completing a degree program but fail to do so. At some point, the cost of staying in college outweighs the benefits, and they exit college. The idea of momentum is that if a student starts off intensively, that exit point is delayed (or ideally, is reached after the student has completed his or her program requirements). Consistent with other evidence, this analysis for Tennessee shows that initial momentum does lead to much higher rates of award receipt and credit accumulation. Students who sustain momentum over the first year have even better outcomes. Our research also supports earlier findings that momentum has particularly large benefits for members of racial/ethnic minority groups—these students can handle a higher course load. In a new extension of the research, our results show that momentum also yields substantial economic benefits. For the student, it leads to lower prices per credit and per degree; for society, it leads to lower expenditures per credit and per degree. For colleges, it leads to higher tuition and fees as more students are retained. This is an important consideration for college leaders weighing whether to invest in enhanced advising and other practices necessary to encourage more students to take more credits. The student cost savings and efficiency gains are economically meaningful, and the increase in tuition and fees is sizeable. Moreover, these results are robust to alternative modeling assumptions.

Our findings suggest that colleges should consider introducing policies that encourage momentum or higher credit loads. Such policies might include providing program pathway maps that have 15 credits per semester as the default schedule, using scheduling software that enables students to fit more credits—ideally in the courses on their academic plans—into their schedules, tying financial aid to momentum, implementing tuition pricing that favors momentum, or establishing social norms in favor of more intensive course-taking. Further research is needed to understand the mechanisms that underlie momentum's effects in order to determine which policy—or set of policies—would be most effective. Notwithstanding this analysis, there is no intuitive reason why "running faster at the start" should be more effective and efficient than "pacing oneself." The current study explores several reasons, but the explanation for the strong effects of momentum remains to be determined.

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Appendix

Table A.1
Credits Attempted in First Semester and First Year by Sector

Credits Attempted	Community College (%)	Four-Year College (%)
First semester		
0–7	8.9	1.5
8–10	8.0	0.8
11–13	55.5	26.9
14+ (momentum students)	27.7	70.8
First year		
0–10[a]	16.9	2.3
11–26	64.0	48.7
27+ (momentum students)	19.1	50.0
n	7,636	10,185

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First year is three semesters (fall, spring, and summer).

[a] Includes all students who started their first semester with 0–10 credits attempted.

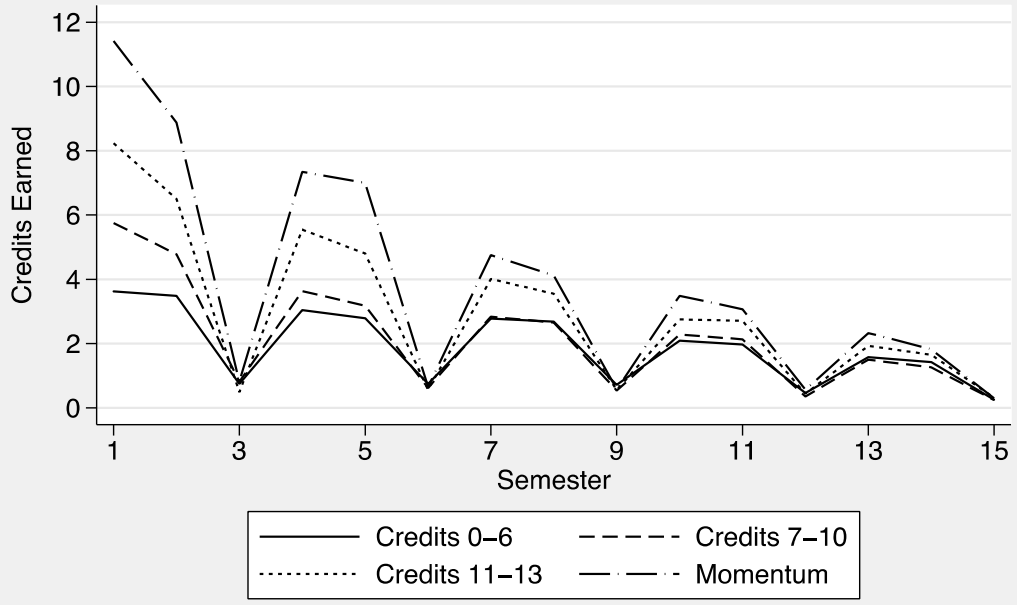
Table A.2
Descriptive Statistics: College Student Characteristics

	Community College				Four-Year Public Universities			
Characteristic	**12-Credit First Semester**	**First-Semester Momentum**	**< 26-Credit First Year**	**First-Year Momentum**	**12-Credit First Semester**	**First-Semester Momentum**	**< 26-Credit First Year**	**First-Year Momentum**
Gap after high school	23	16	22	17	11	4	9	4
White	80	81	80	80	69	68	69	67
African American	11	7	10	9	21	23	21	23
Other race	9	12	10	11	10	9	10	10
Female	61	55	60	57	54	55	53	56
Pell recipient	33	28	32	30	25	29	30	29
HOPE recipient	29	41	30	44	43	51	45	52
In-state resident	98	96	98	95	94	91	94	90
High school GPA ≥ 3.0	50	64	51	66	61	70	61	75
n	4,235	2,114	4,889	1,460	2,741	7,209	4,963	4,987

Note. Figures based on TBR transcript data for the 2008 fall entry cohort. First-semester momentum is defined as attempting more than 13 credits in the first semester. First-year momentum is defined as attempting 12–26 credits in first year (including summer session), conditional on attempting at least 12 credits in first semester. Gap after high school indicates a gap of at least one year.

Figure 1A. Credits Earned per Semester: All

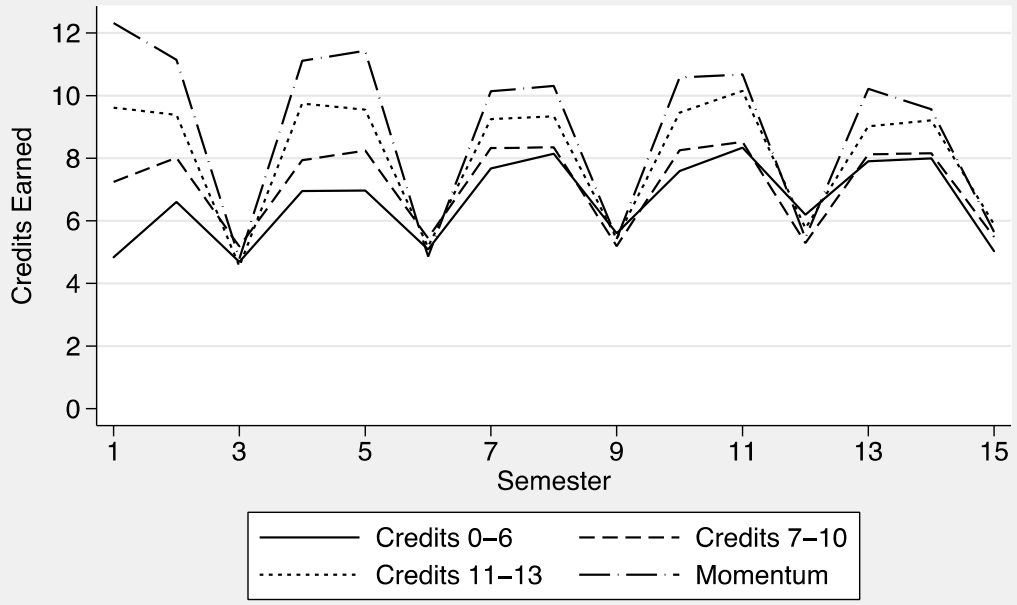
Community College Students



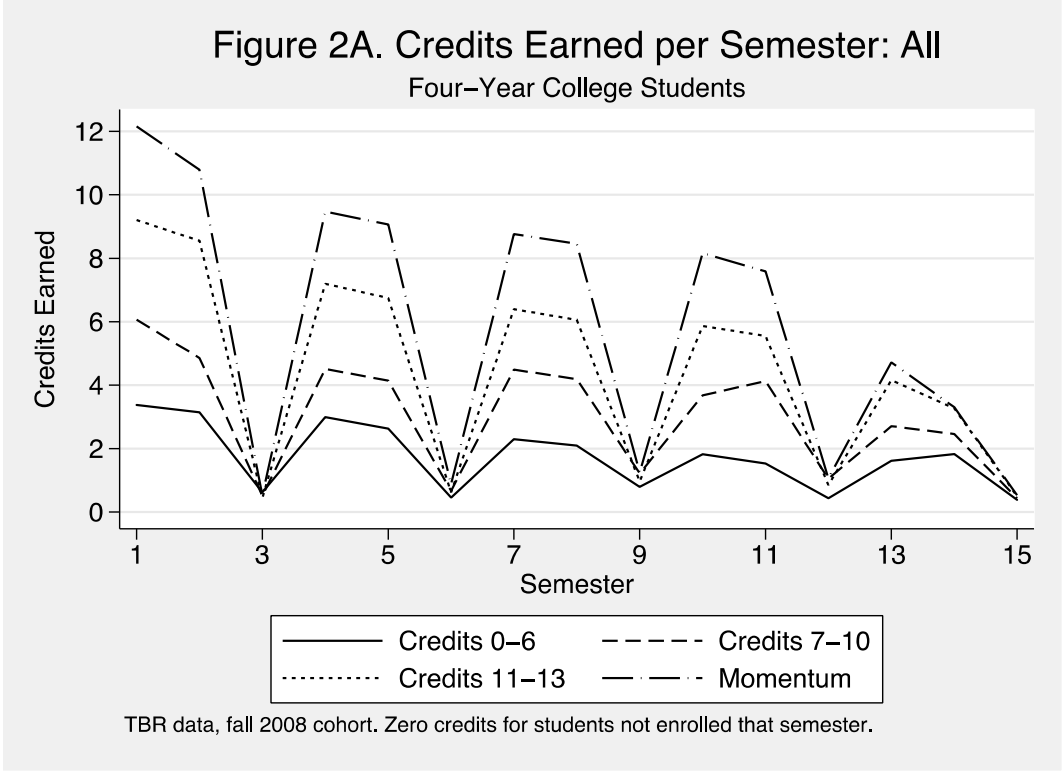
TBR data, fall 2008 cohort. Zero credits for students not enrolled that semester.

Figure 1B. Credits Earned per Semester: If Enrolled

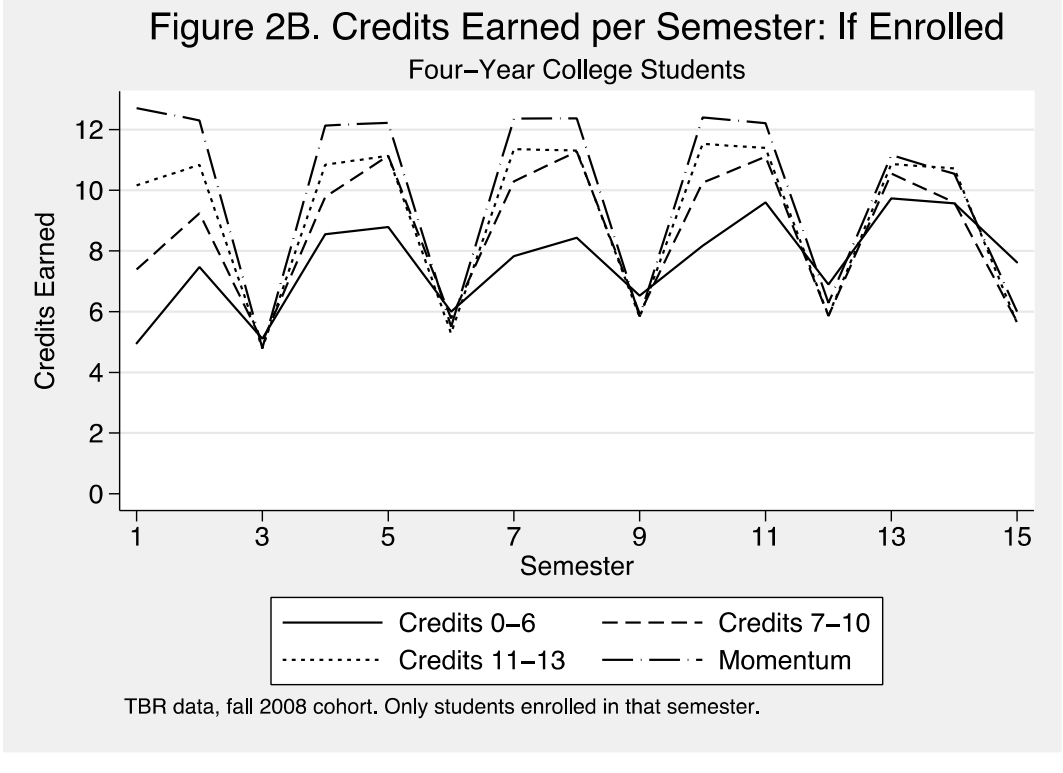
Community College Students



TBR data, fall 2008 cohort. Only students enrolled in that semester.



TBR data, fall 2008 cohort. Zero credits for students not enrolled that semester.



TBR data, fall 2008 cohort. Only students enrolled in that semester.