MEMORANDUM

TO: Tristan Denley
FROM: Lori Hagood
DATE: September 25, 2018
SUBJECT: Momentum Analysis: Updated Momentum Groups & Course Load Combinations

This memo describes the momentum course load analysis with updated momentum categories as well as an exploration of course load combinations in the first year. This analysis is modeled after Belfield, Jenkins, and Lahr (2016).

First-term momentum students refers to those attempting at least 15 hours in their first term; these students' outcomes are compared to those who took only 12-14 hours in their first term. First-year momentum students attempted at least 30 hours in their first year (fall, spring, summer) and are compared to students who attempted less than 30 hours in their first year. All analyses described in this memo are based on cohorts of first time freshmen in 2008, 2009, 2010, and 2011 and are limited to students who took at least 12 hours in their first term. The momentum year analysis excludes first time freshmen that were not enrolled for the full academic year (fall and spring or fall, spring, and summer).

It is important to note that the change in definition of momentum term/year led to a difference in the make-up of the groups. At the outset of this analysis, I defined course load groups as non-momentum: 11-13 hours in the first term (less than 27 in the first year) and momentum: 14+ in the first term (27 or more in the first year). There were 25,866 first-time freshmen who attempted 14 credit hours in their first term who are now included in the non-momentum group. In addition, there were 3,968 first-time freshmen who attempted 11 credit hours in the first term who are no longer included in this analysis.

Table 1. Comparison of Updated Momentum Groups

11-13 hrs	14+ hrs	12-14 hrs	15+ hrs
59,465	88,264	81,363	62,398

Overall, the results of this updated analysis are consistent with the findings resulting from the former definitions of momentum. When accounting for the differences between students who choose to take 15+ hours versus 12-14 hours in the first term, I find that first-term momentum students are 6 percentage points more likely to graduate in six years than students who attempt 12-14 credit hours in the first semester. Likewise, first-term momentum students earn 7 more credit hours within six years compared to non-momentum students, when controlling for baseline differences between the two groups. Larger effects are found for first-year momentum students: students taking at least 30 credits in their first year are 13 percentage points more likely to graduate and earn 16 more credit hours on average in six years than students taking less than 30 credits in the first year. Results vary somewhat across sector.

I also explored outcomes associated with various combinations of first and second term course load. It seems that students are better off on average when they attempt 15 or more hours in both the fall and spring terms of their first year. Interestingly, students who attempt 12-14 hours in the first fall and then 15 or more hours in the following spring term are perform better on average than students who start

out with a momentum course load (15 or more in the first term) and then take a non-momentum course load in the second term.

Descriptive Information

Students attempting at least 15 credit hours in the first term maintain their momentum through 18 terms of enrollment and earn more credits compared to students taking fewer hours in the first term (Figure 1). For example, in their ninth term, momentum term students earned an average of 63.3 credit hours, whereas students attempting 12-14 hours in the first term did not reach 63 hours earned until their 11th semester. Note: the first 18 terms in Figure 1 include summer semesters.

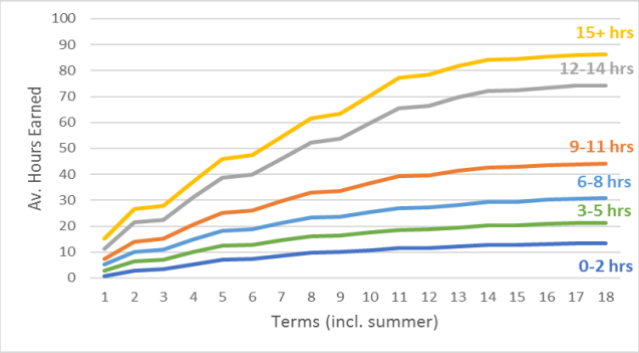

Figure 1. Average Cumulative Hours Earned in 18 Terms by 1st Term Course Load

Table 2 shows the student characteristics for first-term momentum versus non-momentum students. While there are similarities in student characteristics across both groups, it should be noted that there is a greater proportion of Pell recipients and slightly smaller proportion of HOPE recipients among the non-momentum students. Additionally, the non-momentum students have lower HS GPA and SAT scores on average than momentum students. The baseline differences between the first-term momentum and non-momentum students are somewhat diminished compared to the former momentum definition (11-13 and 14+).

Table 2. Comparison of Means by First Term Course Load

	12-14 hrs	15+ hrs
Female	55.8%	52.7%
Black	21.8%	24.7%
Hispanic	5.5%	5.0%
Asian	5.4%	7.3%
White	61.3%	57.3%
Other race	6.0%	5.7%
Received Pell in 1st term	38.1%	35.3%
Received HOPE in 1st term	56.6%	57.8%
HS GPA	3.22	3.28
SAT math	536	553
SAT verbal	532	543
ACT composite	23	23
Instate	93.2%	90.8%
N	*81,363*	*62,398*

The data presented in Table 3 suggest that most of the first-term momentum students are also first-year momentum students: 74 percent of students who took at least 15 hours in the first term also attempted

at least 30 hours in the first year. Similarly, non-momentum term students are also non-momentum year students[1]. This pattern is consistent across sectors.

Tables 4a and 4b compare credit hours attempted and earned at certain points in time for momentum and non-momentum students. First-term momentum students earn approximately 89 percent of their attempted credits in the first term, while non-momentum students earn 88 percent. First-year momentum students, on the other hand, earn about 94 percent of their attempted hours in the first term while non-momentum year students earn about 88 percent of their first term attempted credits.

Regression Results (Table 5)

According to the logistic and OLS regression models in Tables 5a and 5b, students taking a first-term momentum course load (15+ credits) are 6.2 percentage points more likely to graduate within six years ($p < 0.001$) compared to non-momentum students. Students taking a first-year momentum course load (30+ credits) are 12.0 percentage points more likely to graduate within six years ($p < 0.001$). Likewise, first-term momentum students earn 7.5 more credit hours on average ($p < 0.001$) than non-momentum students, while first-year momentum students earn 15 more credit hours on average ($p < 0.001$). Across all of the regression models, larger effects are observed at comprehensive and state universities and smaller effects are observed at research universities and state colleges. It may be the case that students at research universities already have a higher likelihood of graduating in the first place so that initial course load does not make as much of a difference. At state colleges, a smaller percentage of students were counted as momentum students (30 percent compared to 40-50 percent in the other sectors), which may have resulted in a smaller effect than seen in the other sectors.

Propensity Score Matching Results (Table 6)

To better compare momentum and non-momentum students, I used propensity score matching (PSM) to estimate the average treatment effect of taking at least 15 credit hours in the first semester compared to taking 12-14 credits as well as the effect of taking at least 30 hours in the first year relative to less than 30 hours in the first year. According to the average treatment effect presented in Table 6, students are 6.1 percentage points more likely to graduate within six years if they attempt at least 15 credits in the first term compared to only 12-14 credits ($p < 0.001$). Likewise, students are 13.0 percentage points more likely to graduate if they attempt at least 30 credits in the first year instead of less than 30 hours ($p < 0.001$). Students earn 7.2 more credit hours on average within six years if they take at least 15 hours in the first term compared to only 12-14 credit hours ($p < 0.001$) and earn 16.4 more credit hours on average if they attempt at least 30 credit hours in the first year compared to less than 30 hours. As with the regression results, effects vary across sector such that larger effects emerge in comprehensive and state universities and smaller effects are observed at research universities and state colleges.

Course Load Combinations in the First Year (Table 7)

Given the differences in magnitude of effect of *first-term momentum* versus *first-year momentum*, it seems that students with a cumulative momentum year course load outperform non-momentum year

[1] This is somewhat different from the analysis that defined momentum as 14 or more credits and non-momentum as 11-13 credits. In the former analysis, 40-50 percent of the non-momentum students attempted a momentum course load within the first year (with the exception of the state colleges).

students, regardless of first-term momentum status. To better understand the importance of timing the momentum course load, I explored graduation and credit accumulation for various combinations of course loads through the first academic year (fall, spring, summer). I primarily focused on the fall-spring combinations (12-14 and 12-14, 12-14 and 15+, 15+ and 12-14, and 15+, 15+) presented in Table 7, but I also examined the first term/first year combinations provided in Table 10 (12-14 and <30, 12-14 and 30+, 15+ and <30, 15+ and 30+).

The students who attempted a momentum course load in both the fall and spring terms were by far better off than any other course load combination. Fall-spring momentum students earned 95 percent of their attempted hours in the first term, earned an average of 97.3 credit hours in six years, and had a six-year graduation rate of 68.0 percent. Interestingly, the group with the next best outcomes are those that took 12-14 hours in the fall and at least 15 in the spring—they earned 96 percent of the hours attempted in their first term, earned on average 91.9 credit hours within six years, and 63.7 percent students graduated in six years. Students with a momentum course load in the fall but a non-momentum course load in the spring performed worse than students who took a momentum course load in the spring: they earned only 88 percent of their first-term attempted hours, earned an average of 84.4 hours in six years, and 55.4 percent graduated in six years. It may be the case that the students who earned a greater portion of their attempted hours in the first term felt more confident to take the same amount or more hours in the next term. Moreover, this initial success is associated with better long-term outcomes.

It is important to note that there are some demographic and academic differences across the four course load groups (Table 8). In particular, a greater percent of the students who took 12-14 hours in the fall and spring received Pell compared to the students who took at least 15 in both terms. Additionally, students taking 12-14 in both terms had lower high school GPA, SAT, and ACT scores on average compared to the students taking at least 15 in both terms.

Similar patterns emerge across sectors (Table 9) and when looking at the course load across the first year (Table 10).

While the most favorable outcomes are observed for those who take double momentum course loads, it seems to be more important for students to end the first year with momentum rather than simply begin the year with momentum. Moreover, students who are likely earn a smaller portion of their attempted credits might be better off staring the fall term with 12-14 hours and then moving toward momentum course loads in the spring and summer terms.

Table 3. First Term and First Year Course Load by Sector

	All institutions				Research Universities				Comprehensive Universities			
	12-14 hrs (1st term)		15+ hrs (1st term)		12-14 hrs (1st term)		15+ hrs (1st term)		12-14 hrs (1st term)		15+ hrs (1st term)	
	#	%	#	%	#	%	#	%	#	%	#	%
< 30 hrs (1st year)	51,969	70%	15,157	26%	18,864	72%	5,658	30%	13,075	66%	4,884	23%
30+ hrs (1st year)	22,557	30%	43,593	74%	7,319	28%	13,504	70%	6,679	34%	15,963	77%
N	*74,526*	*100%*	*58,750*	*100%*	*26,183*	*100%*	*19,162*	*100%*	*19,754*	*100%*	*20,847*	*100%*

	State Universities				State colleges			
	12-14 hrs (1st term)		15+ hrs (1st term)		12-14 hrs (1st term)		15+ hrs (1st term)	
	#	%	#	%	#	%	#	%
< 30 hrs (1st year)	11,436	67%	3,192	23%	8,594	75%	1,423	28%
30+ hrs (1st year)	5,717	33%	10,486	77%	2,842	25%	3,640	72%
N	*17,153*	*100%*	*13,678*	*100%*	*11,436*	*100%*	*5,063*	*100%*

Note: Students who were not enrolled for the full first academic year (fall and spring or fall, spring, and summer) are excluded

Table 4a. Average Credit Hours Attempted and Earned by First Term Course Load and Sector

	All Institutions		Research		Comprehensive		State Universities		State Colleges	
	12-14 hrs	15+ hrs	12-14 hrs	15+ hrs	12-14 hrs	15+ hrs	12-14 hrs	15+ hrs	12-14 hrs	15+ hrs
Credit Hours										
hours attempted term 1	12.9	16.9	13.0	16.7	12.9	16.7	12.9	17.1	12.7	18.2
hours earned term 1	11.4	15.1	12.6	15.9	11.0	14.6	10.9	14.7	10.1	15.2
hours attempted term 9	62.1	72.6	73.2	82.0	62.7	72.9	58.0	68.3	44.7	50.8
hours earned term 9	53.7	63.3	66.7	73.5	52.8	63.0	48.7	58.4	35.6	42.4
hours attempted term 18	85.4	98.5	100.9	111.0	92.3	102.9	79.1	91.8	52.3	56.8
hours earned term 18	74.3	86.2	91.8	99.2	78.9	89.6	67.2	79.1	42.0	47.5
N	*81,363*	*62,398*	*27,374*	*19,821*	*21,214*	*21,892*	*19,159*	*14,752*	*13,616*	*5,933*

Table 4b. Average Credit Hours Attempted and Earned by First Year Course Load and Sector

	All Institutions		Research		Comprehensive		State Universities		State Colleges	
	< 30 hrs	30+ hrs	< 30 hrs	30+ hrs	< 30 hrs	30+ hrs	< 30 hrs	30+ hrs	< 30 hrs	30+ hrs
Credit Hours										
hours attempted term 1	13.5	15.9	13.5	15.8	13.5	15.9	13.4	15.9	13.2	16.4
hours earned term 1	11.8	14.9	13.1	15.5	11.3	14.7	11.2	14.5	10.7	15.0
hours attempted term 9	61.4	79.2	71.7	87.9	60.1	79.1	56.0	76.1	46.3	59.7
hours earned term 9	52.8	70.0	66.2	78.4	49.4	69.7	45.9	66.7	36.3	52.2
hours attempted term 18	85.2	106.8	99.9	118.0	89.4	111.3	76.6	102.2	54.3	67.0
hours earned term 18	74.0	94.4	91.9	104.9	75.1	98.3	63.9	89.7	43.0	58.4
N	*67,126*	*66,150*	*24,522*	*20,823*	*17,959*	*22,642*	*14,628*	*16,203*	*10,017*	*6,482*

Notes: All students attempted at least 12 hours in their first term; Table 4b excludes students who were not enrolled for the full first academic year (fall and spring or fall, spring, and summer).

Table 5a. Logistic Regression Models Estimating the Impact of Momentum Course Load Likelihood of Earning Any Degree Within 6 Years (marginal effects presented)

	All Institutions	Research	Comprehensive	State Universities	State Colleges
First-term Momentum					
(15+ hours in 1st term)	0.0615	0.0137	0.0889	0.0931	0.0602
	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)
N	*114,090*	*40,190*	*34,017*	*26,702*	*13,181*
First-year Momentum					
(30+ hours in 1st year)	0.120	0.0517	0.182	0.169	0.135
	(0.00263)	(0.00402)	(0.00485)	(0.00558)	(0.00805)
N	*106,922*	*38,967*	*32,085*	*24,451*	*11,419*

Table 5b. OLS Regression Estimates for Impact of Momentum Course Load on Cumulative hours earned within 6 years

	All Institutions	Research	Comprehensive	State Universities	State Colleges
First-term Momentum					
(15+ hours in 1st term)	7.512	4.207	8.557	9.534	3.498
	(0.250)	(0.357)	(0.498)	(0.558)	(0.607)
N	*112,891*	*39,627*	*33,617*	*26,480*	*13,167*
First-year Momentum					
(30+ hours in 1st year)	15.02	9.402	19.91	20.48	11.69
	(0.243)	(0.344)	(0.490)	(0.549)	(0.586)
N	*105,728*	*38,405*	*31,687*	*24,230*	*11,406*

Notes: standard errors are in parentheses; the momentum term course load is attempting at least 15 credit hours in the first semester (this is relative only to students attempting 12 to 14 credit hours in the first semester); momentum year course load is attempting at least 30 credit hours in the first year (this is compared to students who took less than 30 hours in the first year, but at least 12 hours in the first term); data includes cohorts of first time freshmen in fall 2008, 2009, 2010, and 2011; controls include gender, race, financial aid in the first term (Pell and HOPE), HS GPA, SAT score, residency status, and cohort indicator variables; for Table 3b models, students with cumulative hours earned greater than the 99th percentile were excluded; for momentum year models, students who were only enrolled in the fall term of their first year were excluded; all marginal effects and coefficients are significant at $p < 0.001$.

Table 6. Propensity Score Matching Estimates of Momentum Course Load Effects on Likelihood of Earning a Degree and Hours Earned within Six Years

	All Institutions	Research	Comprehensive	State Universities	State Colleges
Earning any degree within 6 years					
First-term Momentum: 15+ hours in 1st term v. 12-14 hrs					
Av. Treatment effect	0.061	0.015	0.087	0.095	0.063
	(0.003)	(0.004)	(0.005)	(0.006)	(0.009)
Av. Treatment effect on the treated	0.061	0.013	0.089	0.093	0.074
	(0.003)	(0.005)	(0.006)	(0.006)	(0.009)
First-year Momentum: 30+ hours in the 1st year v. < 30 hrs					
Av. Treatment effect	0.130	0.054	0.184	0.175	0.141
	(0.003)	(0.004)	(0.006)	(0.006)	(0.009)
Av. Treatment effect on the treated	0.134	0.060	0.182	0.175	0.140
	(0.003)	(0.005)	(0.006)	(0.007)	(0.010)
Cumulative hours earned within 6 years					
First-term Momentum: 15+ hours in 1st term v. 12-14 hrs					
Av. Treatment effect	7.1	4.5	8.7	9.8	3.7
	(0.260)	(0.380)	(0.519)	(0.588)	(0.629)
Av. Treatment effect on the treated	7.2	4.6	8.7	9.8	4.0
	(0.279)	(0.394)	(0.539)	(0.628)	(0.647)
First-year Momentum: 30+ hours in the 1st year v. < 30 hrs					
Av. Treatment effect	16.0	10.5	20.0	21.0	11.8
	(0.256)	(0.371)	(0.517)	(0.581)	(0.613)
Av. Treatment effect on the treated	16.4	14.0	19.7	27.0	11.1
	(0.280)	(0.424)	(0.539)	(0.599)	(0.653)

Notes: propensity scores were matched based on the nearest neighbor matching algorithm using teffects psmatch in stata; robust standard errors are in parentheses; the momentum term course load is attempting at least 15 credit hours in the first semester and the control group is students who attempted 12 to 14 hours in the first semester; the momentum year course load is attempting at least 30 credit hours in the first year and the control group is students who attempted less than 30 hours in the first year (these models are limited to those who took at least 12 credits in the first term); data includes cohorts of first time freshmen in fall 2008, 2009, 2010, and 2011; variables used to create PS matches include gender, race, financial aid in the first term (Pell and HOPE), HS GPA, SAT score, and residency status; for momentum year models, students who were only enrolled in the fall term of their first year were excluded; all treatment effects are significant at $p < 0.001$

Table 7. Selected Outcomes by First and Second Term Course Load

		12-14 hrs (1st spring)	15+ hrs (1st spring)
Av. Hours attempted in term 1	12-14 hrs (1st fall)	12.8	13.2
Av. Hours earned in term 1		11.6	12.6
% grad in 6 yrs		48.2%	63.7%
Av. Hours earned in term 18 (6 yrs)		75.9	91.9
N		*40,895*	*23,584*
Av. Hours attempted in term 1	15+ hrs (1st fall)	17.1	16.5
Av. Hours earned in term 1		15.1	15.6
% grad in 6 yrs		55.4%	68.0%
Av. Hours earned in term 18 (6 yrs)		84.4	97.3
N		*22,973*	*30,175*

Note: Students who took less than 12 in spring (n = 12,354) are excluded; only students enrolled for a full first academic year are included (fall and spring, or fall, spring, and summer)

Table 8. Comparison of Means by First and Second Term Course Load

	12-14 in both terms	12-14 in fall, 15+ in spring	15+ in fall, 12-14 in spring	15+ in both terms
Female	55.0%	58.2%	51.7%	53.2%
Black	21.0%	22.9%	24.8%	24.7%
Hispanic	5.5%	5.3%	5.1%	5.0%
Asian	4.8%	7.3%	5.4%	9.2%
White	62.8%	58.8%	59.1%	55.7%
Other race	5.9%	5.7%	5.6%	5.4%
Instate	94.3%	91.4%	93.1%	88.5%
Received Pell in 1st term	39.4%	34.8%	36.9%	33.0%
Received HOPE in 1st term	58.5%	62.2%	59.6%	59.9%
HS GPA	3.22	3.31	3.26	3.32
SAT math	532	550	546	562
SAT verbal	529	543	540	547
ACT composite	22	23	23	23
N	*40,895*	*23,584*	*22,973*	*30,175*

Note: Students who took less than 12 in spring (n = 12,354) are excluded; only students enrolled for a full first academic year are included (fall and spring, or fall, spring, and summer)

Table 9. Graduation Rates and Credit Accumulation by First and Second Term Course Load and Sector

Research Universities		12-14 hrs (1st spring)	15+ hrs (1st spring)
% grad in 6 yrs	12-14 hrs (1st fall)	67.2%	77.2%
Av. Hours earned in term 18 (6 yrs)		93.0	103.8
% grad in 6 yrs	15+ hrs (1stfall)	70.9%	76.5%
Av. Hours earned in term 18 (6 yrs)		99.1	106.9

Comprehensive Universities		12-14 hrs (1st spring)	15+ hrs (1st spring)
% grad in 6 yrs	12-14 hrs (1st fall)	46.9%	61.7%
Av. Hours earned in term 18 (6 yrs)		79.2	92.7
% grad in 6 yrs	15+ hrs (1stfall)	52.0%	69.9%
Av. Hours earned in term 18 (6 yrs)		84.6	100.3

State Universities		12-14 hrs (1st spring)	15+ hrs (1st spring)
% grad in 6 yrs	12-14 hrs (1st fall)	38.8%	58.2%
Av. Hours earned in term 18 (6 yrs)		68.4	87.8
% grad in 6 yrs	15+ hrs (1stfall)	46.9%	61.9%
Av. Hours earned in term 18 (6 yrs)		76.1	91.9

State Colleges		12-14 hrs (1st spring)	15+ hrs (1st spring)
% grad in 6 yrs	12-14 hrs (1st fall)	26.7%	36.0%
Av. Hours earned in term 18 (6 yrs)		48.8	57.0
% grad in 6 yrs	15+ hrs (1stfall)	34.6%	41.1%
Av. Hours earned in term 18 (6 yrs)		52.6	57.0

Note: Students who took less than 12 in spring (n = 12,354) are excluded; only students enrolled for a full first academic year are included (fall and spring, or fall, spring, and summer)

Table 10. Outcomes by First Term and First Year Course Load

		<30 hrs (1st fall, spring, summer)	30+ hrs (1st fall, spring, summer)
Av. Hours attempted in term 1	12-14 hrs (1st fall)	12.8	13.2
Av. Hours earned in term 1		11.4	12.7
% grad in 6 yrs		50.0%	66.4%
Av. Hours earned in term 18 (6 yrs)		73.3	93.1
N		50,339	22,512
Av. Hours attempted in term 1	15+ hrs (1st fall)	15.4	17.3
Av. Hours earned in term 1		13.0	16.1
% grad in 6 yrs		50.6%	67.9%
Av. Hours earned in term 18 (6 yrs)		75.0	95.1
N		*13,647*	*43,483*

Note: Only students enrolled for a full first academic year are included (fall and spring, or fall, spring, and summer); includes data for all institutions.