The Effect of Marginal Price on Student Progress at Public Universities*

Steven W. Hemelt
University of North Carolina – Chapel Hill
Department of Public Policy
hemelt@email.unc.edu

Kevin M. Stange
University of Michigan
Ford School of Public Policy
and NBER
kstange@umich.edu

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Abstract

This paper examines the effect of marginal price on students' credit-taking behavior and progress towards degree attainment using rich administrative data on all in-state students attending public universities in the state Michigan. We find that full-time students facing zero marginal price attempt and complete about the same average number of credits as students at institutions that charge for each additional credit above the full-time threshold. However, zero marginal (or "flat") pricing does induce about 8 percent more students to attempt up to one additional class (i.e., 3 credits), but we find little evidence that these attempted credits translate into earned ones. The moderate impact on attempted credits is largest among lower-achieving students, students eligible for free or reduced-price meals, and upper division students. Overall, we find little evidence that eliminating the marginal price associated with credits above the full-time minimum translates into more accumulated credits, a greater likelihood of persistence, or an increased likelihood of meeting "on-time" benchmarks toward timely degree completion. We discuss implications of these findings for students and postsecondary institutions.

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I. Introduction

Only slightly more than half of recent college entrants graduate within six years (Shapiro et al., 2013) and time-to-degree is an important marker for how smoothly students move from college enrollment to completion. Further, time-to-degree among students from lower-income families has increased the most (Bound, Lovenheim, & Turner, 2012), perhaps suggesting difficulty in financing a well-paced college education for these students. Such statistics have propelled those in federal, state, and local policy circles to call for proposals aimed at increasing rates of degree completion and shortening time-to-degree among college-goers (e.g., National Conference of State Legislatures, 2010). Indeed, recent proposals from the Obama administration suggest tying federal aid to graduation rates and timely degree completion (Lewin, 2013). At the same time, public institutions have had to increasingly rely on tuition revenue to supplant declines in state appropriations. In the face of such pressure, many institutions have eschewed sole reliance on across-the-board tuition increases (which may inhibit student success), and instead turned to other forms of pricing and revenue generation. Yet, the effects of these alternative pricing practices on college students are largely unknown.

One such pricing practice is marginal pricing, charging students incrementally for each additional course (or credit) they take in a given semester. Many students only take the minimum course load to achieve full-time status (i.e., 12 credits), which at most institutions would translate to earning a Bachelor's degree in five years or more. At some institutions, the marginal price of credits taken above 12 and some upper bound (usually between 16 and 20 credits) is zero, while at others a linear per-credit marginal price remains. Indeed, some institutions have adopted "flat" pricing (i.e., a zero marginal cost for credits above 12) in explicit expectation that students will respond by attempting and earning more credits. The hope is that this semesterly response accumulates and students graduate more often and more quickly under a “flat” tuition pricing scheme than a “per-credit” one. For example, Adams State in Colorado recently made such a switch from linear to “flat” tuition (dubbed the “Finish in Four” initiative), arguing that it is the reason average credit hours have increased by over one credit in just two years (Mumper, 2012). Yet, is it not clear that changes in student course-taking behavior due to the new “flat” tuition pricing scheme are what caused this increase. The shift to “flat” pricing as a policy mechanism for causally increasing the average number of credits attempted and earned by students, thereby speeding up time-to-degree, is not supported by a strong evidence base.[1]

In this paper we aim to fill this gap in the higher education literature. We examine whether institutions’ marginal pricing structures influence students’ rate of credit accumulation and progress towards degree. Throughout the text, we focus on the effect of exposure to a “flat” tuition pricing scheme, wherein the marginal cost of an additional credit above 12 is zero, relative to a linear tuition pricing scheme across all numbers of credits.

We assess the effect of marginal price using administrative data on all Michigan public high school graduates in the classes of 2008 through 2011 who attended one of the state’s 15 public universities. Eight of these universities charge students per credit taken (ranging from $740 to $1,260 for each additional three-credit course), while students at the other seven pay essentially no additional tuition for courses taken beyond the full-time minimum of 12 credits.[2] Though there are some differences in the characteristics of students attending institutions with per-credit pricing and those with flat pricing (the latter students typically being more advantaged), there is considerable overlap between these two groups. For instance, Central Michigan and Western Michigan Universities have identical interquartile ranges of student ACT

[1] Similar policy shifts have been observed at Montana State, the University of Texas, and many other institutions.
[2] This is not strictly true: even flat pricing institutions charge additional tuition beyond some upper threshold (typically 18 credits) and two charge a very modest additional tuition beyond 12 credits.

scores and similar levels of resources, though different marginal pricing policies. We rely on this overlap, along with the assumption of selection on a rich set of observed characteristics, to identify the causal effect of marginal price on credit accumulation.

To preview results, we find that exposure to flat tuition pricing has no effect on the average number of credits attempted or earned in semester. For these continuous outcomes, our results are generally precise enough to rule out even small effects (i.e., of a bit less than 1 credit). When we look at the effects of flat tuition pricing on the share of students meeting different thresholds of credit-taking, we see evidence that flat tuition pricing induces a relatively small share of students to attempt a few more credits (i.e., up to one course, or 3 credits, more). Yet, we find little evidence that these additional attempted credits translate into more earned credits in a semester. Specifically, exposure to flat pricing increases the likelihood that students attempt more than the full-time minimum number of credits by about 7 to 9 percentage points (relative to a base of 75 percent at per-credit schools). Accordingly, flat pricing is not associated with increased cumulative credits earned, greater persistence, reduced time-to-degree, or greater 4-year completion rates, though estimates of these latter long-term outcomes are admittedly imprecise.

Overall, our results imply that eliminating the marginal price associated with credit intensity will have minimal impacts on students' rate of progress and on-time degree completion. Various approaches to eliminating observed differences – rich controls, sample restrictions, propensity score re-weighting – all suggest similar qualitative results. Our findings suggest that students in the bottom of the achievement distribution among 4-year college-goers and those eligible to receive free or reduced-price meals (FARM) are a bit more responsive to marginal price; but men and women respond similarly. There is no evidence to suggest that this pricing structure influences students' decisions to enroll part- versus full-time, likely because any marginal pricing effect is swamped by discontinuities in financial aid eligibility or other considerations.

These analyses provide the first evidence on the effect of marginal price on students' course-taking behavior, with implications for both students and institutions. Some institutions view marginal price as a tool with which to influence student progress and time-to-degree (e.g., Montana State's "Freshman 15" and Adams State's "Finish in Four" initiatives). Other institutions view charging for the 13^{th} – 15^{th} credit as a revenue source, but with a potential cost in terms of student progress. Our results suggest that eliminating the marginal price associated with credit intensity will minimally affect students' rate of progress towards degree and on-time degree completion and may thus be a non-distortionary way of raising revenue. However, our analysis does not yet address other possible effects of marginal pricing, including major choice, interest exploration, financial burden, or academic performance.

This paper proceeds as follows. The next section discusses previous literature, with a focus on the relationship between tuition pricing and progress through college. Section III provides background on marginal pricing in the Michigan context. Section IV presents a simple theoretical framework to help with the interpretation of the empirical results. Section V describes the data used in the analyses and our empirical strategy. Section VI presents results on credit-taking and explores their robustness, while Section VII explores longer-term outcomes. Section VII concludes.

II. Previous Literature

There is a large body of evidence showing that students' enrollment, persistence, and college choices are influenced by net college price. A consensus estimate is that a $1,000 change in college price (1990 dollars) is associated with an approximately 3-5 percentage point difference in enrollment rates (Kane, 2006; Dynarski, 2003). Evidence on the effect of college price on persistence and degree completion is rarer, but most studies suggest that persistence and completion are modestly responsive to prices for at least some groups (Bettinger, 2004; Turner, 2004; Dynarski, 2008; DesJardins & McCall, 2010; Goldrick-Rab et al., 2011; Castleman and Long, 2013). Tuition price also appears to be a strong predictor of the specific college students choose to attend (Long, 2004; Jacob, McCall, & Stange, 2013), institution-level enrollment (Hemelt & Marcotte, 2011), and major choice (Stange, 2012). While suggestive of modest price response to total tuition costs of attendance in higher education, this literature does not directly speak to the more focused role of marginal price in students' choices of credit loads and time-to-degree.

We are aware of only one study that examines the relationship between marginal pricing and student outcomes. In an NBER working paper, Bound, Lovenheim, and Turner (2010) found that 4-year public institutions with per-credit pricing have lower four-year graduation rates than institutions with flat pricing. Furthermore, much of the increase in time-to-degree between 1972 and 1992 occurred at institutions that charge on a per-credit basis.[3] While suggestive, this relationship may have a number of explanations other than the causal effect of marginal pricing on student progression through college.

Looking more broadly, however, there have been a number of interventions that have been found to increase students' credit load, either intentionally or inadvertently. For instance, the Promise Scholarship in West Virginia explicitly tied aid to number of credits (and GPA), resulted in more students taking 15 credits rather than the full-time minimum (Scott-Clayton,

[3] The analysis of per-credit vs. flat pricing appeared in two footnotes and was not central to their main analysis so was dropped in the subsequent published version of the paper.

2010). A similar result was found for a similar scholarship program at the University of New Mexico (Miller, Binder, Harris, & Krause, 2011). Yet, work on Georgia's HOPE scholarship, which tied eligibility and retention of funds to maintaining a 3.0 GPA, found that HOPE reduced the likelihood that students took full course-loads and increased their propensity to withdrawal from classes and divert credits to the summer (Cornwell et al., 2005).

Other conditional aid grant programs (often in conjunction with advising or coaching) have also had impacts on students' credit loads. For instance, Richburg-Hayes et al. (2009) found that a performance-based scholarship at community colleges in New Orleans increased credit loads, as did an intervention that combined financial incentives and academic support services at a Canadian university (Angrist, Lang, & Oreopoulos, 2009). At a large Italian university, Garibaldi, Giavazzi, Ichino, and Rettore (2012) found that charging students extra for taking too long to graduate speeds up time-to-degree.

Together, these studies make clear that the particular features of scholarship and grant programs can have appreciable effects (positive or negative) on students' credit loads and progression through college. We look at marginal pricing policy as another potential lever capable of influencing students' credit loads – and ultimately their rates of college completion and average time-to-degree. This policy lever is less prescriptive (and perhaps) broader than the literature just reviewed in that scholarship programs that tie awards directly to credit loads explicitly specify credit-taking behavior and only apply to a subset of (often higher-achieving) students entering an institution in a given year.

III. Background on Marginal Pricing in Michigan

During the 2011-2012 academic year, 8 of Michigan's 15 public 4-year universities charged full-time undergraduate students differently based on the number of credits for which they enrolled in a given semester, 7 charged differentially based on undergraduate level, and 3 charged differently for certain programs or majors (Presidents Council, State Universities of Michigan, 2011). Nationally, the enactment of these practices has grown steadily since the mid-1990s with no sign of slowing (Cornell Higher Education Research Institute, 2011). In 2010-2011, 42 percent of public doctoral institutions employed some sort of differential tuition pricing scheme (Ehrenberg, 2012). These practices are less common at non-doctoral institutions, but still prevalent (18% and 30% at master's and bachelor's institutions, respectively). If this trend continues, differential pricing (of all types) will soon be the new standard model for pricing in higher education.

We focus on marginal pricing by credit at 4-year institutions, since this particular form of differential tuition pricing may be a mechanism through which students could be nudged into taking semester course-loads closer to the 4-year degree rate of 15 credits. The evolution of pricing tuition by credit in Michigan is unclear. While per-credit pricing is generally more common at less selective institutions (all of the state's community colleges charge per-credit while the state flagship university, University of Michigan – Ann Arbor, does not), this is not always the case. Further, some institutions have explicitly adopted flat pricing models to encourage students to take 15 credits, while others have switched from the use of flat pricing to charging per credit (e.g., Ferris State in 2008-2009).

Table 1 summarizes the pricing structure at Michigan's fifteen public universities during the 2011-2012 academic year. Eight of the universities charge tuition which is a linear function of the number of credits taken, ranging from a low of $246 per credit at Saginaw Valley State to a high of $421 at Michigan Technological University. By contrast, the tuition schedule for seven institutions has a flat or near-flat range at full-time status (12 credits). Students at these institutions face almost no marginal monetary cost from taking an additional course once they have reached full-time status.[4] The upper limit for which this zero marginal price applies varies from 16 to 18 credits. Table 1 also highlights institutions' use of other differential pricing schemes: differential pricing by level and program or school.

IV. Theoretical Predictions

The most straightforward prediction about the relationship between students' credit loads and marginal price is that students facing no marginal price would be induced to take more credits than observationally similar students at per-credit colleges. A simple static economic model provides a framework for evaluating the effects of marginal pricing and for identifying likely sources of effect heterogeneity. To focus on the main ideas and because our best data are essentially cross-sectional, we describe a static model where students choose an average college credit load, z, which directly determines their time-to-degree, $S(z)$. A larger credit load means that it takes students less time to earn a degree, thus $\frac{dS(z)}{dz} < 0$. Since we focus our analysis on marginal price conditional on full-time status, we normalize $z = 0$ to be the minimum full-time credit load (i.e., 12 credits per semester). Students weigh the benefit from a shorter time-to-degree against the effort and monetary costs associated with their credit load choice.[5]

Upon graduating from college students receive wage w until they retire at age T, thus total lifetime earnings, $w(T - S(z))$, is reduced one-for-one with each additional year taken to

[4] Two institutions, UM-Dearborn and UM-Flint, charge a substantially lower per-credit fee ($75) once students reach full-time status. We characterize these institutions has having "flat" pricing in our analysis.
[5] A richer model would consider the optimal choice of credit intensity dynamically. In this setting, students would choose a credit load in each period making expectations about the future, then update their expectations and decisions as they go along. An alternative static model would permit students to instead choose the entire sequence of credits taken (12 then 15 then 13 then 12 etc.) until graduation. Given the absence of detailed longitudinal data for the entire sample, we instead opted to focus on a basic static model.

graduate.[6] Annual tuition costs have both a fixed and variable (with credit load) component, so total tuition for $S(z)$ years of college is given by $S(z)(c_0 + c_1 z)$. The variable cost differs across institutions (e.g., $c_1 = 0$ for "flat" price institutions). Finally, the utility cost of effort, *E(z)*, is an increasing and convex function of credit intensity. With these preliminaries, students choose average credit load *z* to maximize

$$w[T - S(z)] - \theta\, S(z)[c_0 + c_1 z] - E(z)$$

where θ parameterizes the value students place on direct tuition relative to future earnings. The first order condition requires that

$$w\left(-\frac{dS(z)}{dz}\right) - \theta\, S(z)c_1 - \theta\, \left(\frac{dS(z)}{dz}\right)[c_0 + c_1 z] - \frac{dE(z)}{dz} = 0$$

or

$$\left(-\frac{dS(z)}{dz}\right)\big[w + \theta\,[c_0 + c_1 z]\big] = \theta\, S(z)c_1 + \frac{dE(z)}{dz}$$

This basic model implies that students will choose *z* to balance the marginal benefits associated faster degree completion ($\frac{dS(z)}{dz}$, which results in fewer years of lost wages and fewer years of tuition paid) with the marginal cost of expending additional effort ($\frac{dE(z)}{dz}$) and paying marginal tuition ($\theta\, S(z)c_1$). Simplifying by assuming the time-to-degree function is a linear function of credit intensity ($S(z) = S_0 - z$) and effort cost is quadratic ($E(z) = e_0 + e_1 z + e_2 z^2$) gives an expression for the optimal credit intensity:

$$z^* = \frac{w + \theta c_0 - \theta S_0 c_1 - e_1}{2e_2}$$

where S_0 is the time-to-degree taking the minimum credit load (*z* = 0, or 12 credits). This model implies that students will take larger credit loads when their wage or fixed tuition costs (and thus

[6] This ignores time discounting and assumes that additional time in school (for the same degree) does not enhance productivity.

opportunity and direct costs of attending one more year) are higher or if the marginal effort costs ($e_1$and e_2) are lower. Optimal credit load could be increasing or decreasing with θ, depending on the relative magnitudes of the fixed and variable tuition costs. Importantly students take larger credit loads when the marginal price (c_1) is lower. To understand heterogeneity of effects of marginal pricing, note that the derivative of credit load with respect to marginal price is:

$$\frac{dz^*}{dc_1} = -\frac{S_0\theta}{2e_2}$$

The first thing to note is that $\frac{dz^*}{dc_1}$ is unambiguously negative, suggesting that all students should be compelled to take more courses when the marginal price is reduced. Second, this derivative is increasing in θ and decreasing in e_2. Students that place a large value on current tuition price relative to future earnings (high θ due to credit constraints or other factors) will be particularly responsive to marginal price. On the other hand, individuals with more convex effort costs (i.e., high e_2) will be less responsive. For these students, other constraints (e.g., work, family responsibilities) might mitigate the behavioral response to the opportunity to take 14 or 15 credits for the same marginal price as 12. Thus low-achieving students could be less responsive to flat tuition pricing than their higher-achieving counterparts if they are already taking as many classes as they can handle. A reduction in marginal price thus may not reduce these students' marginal cost by much, which is determined largely by effort costs. Since effort costs and credit constraints likely vary across students, we will explore effects of marginal price on students with different incoming levels of achievement and income.

V. Empirical Approach

A. Data and Samples

We combine student-level data from several different administrative sources. From the Michigan Consortium for Education Research (MCER), we begin with information on the entire universe of Michigan public high school graduates from 2008 through 2011. These data include demographic information (sex, race, ethnicity, FARM status, LEP, special education), 11th grade achievement scores,[7] and high school (n = 443,588 students). We then use data from the National Student Clearinghouse (NSC) to restrict our sample to students appearing in college (anywhere up to August 2012; n = 345,527 students).[8]

To examine credit accumulation at Michigan public institutions, we next merge these records of college-going Michigan high school graduates onto data from the Michigan Student Transcript and Academic Record Repository (STARR). STARR contains full, historical transcript records (course-level data) for all individuals enrolled in 2-year or 4-year public colleges in Michigan in the 2011-2012 academic year.

While the state of Michigan mandated the collection of the entire transcripts of students enrolled at any Michigan public college during the 2011-2012 academic year, there is some (small) variation in the degree to which institutions supplied course-taking information from prior years. Therefore, we mainly focus on STARR data from the fall 2011 and spring 2012. These semesters occur at different points in an "on-time" college trajectory for students, depending on the year of their high school graduation. For example, the 2011-2012 academic year corresponds to the on-time third year of college for the high school class of 2009. While not

[7] For these classes, we use a student's composite ACT score since the ACT became a mandatory part of Michigan's high school testing in 2007.
[8] For an extensive overview of the coverage and use of National Student Clearinghouse (NSC) data for research, please consult Dynarski, Hemelt, and Hyman (2013). For the state of Michigan during our timeframe, enrollment coverage is quite high (i.e., between 95 and 97 percent), and highest among 4-year publics (100 percent).

all students in all classes will move through college at this on-time pace, the broader point is that these samples allow us the ability to estimate the effect of flat pricing on students' credit loads at different points in their college careers, and not just upon entry. In addition, the use of NSC data allows us to explore persistence of students from the Michigan high school classes of 2008 through 2011 related to per-credit versus flat pricing schemes of their initial institution.

Our main analysis is limited to full-time students (those attempting at least 12 credits in a semester) from one of these cohorts enrolled in the fall or spring of the 2011-2012 academic year. This results in 194,375 student-by-semester observations (over 107,000 unique students) when pooling all cohorts and 52,131 observations (over 28,000 unique students) from the high school class of 2011. Table 2 presents mean demographic and achievement characteristics, as well as college-level credit outcomes for the pooled sample (i.e., 2008 – 2011 high school graduates) and for only the class of 2011, by institutional pricing structure. There are some small to moderate differences in the average characteristics of students attending per-credit versus flat pricing institutions. Generally speaking, students attending flat pricing schools are more advantaged (less likely to be eligible for free or reduced-price meals, less likely to be minority) and have higher college admissions scores. Though, as illustrated by the final three columns in Table 2, the achievement advantage of students at flat schools is largely driven by the fact that the University of Michigan – Ann Arbor uses a flat tuition pricing schedule.

When we look to mean outcomes by pricing policy, we see that on average, credit loads of students at flat schools are a bit higher than those at per-credit schools. Indeed, the share of students attempting more than 12 credits in a semester is about 8 to 10 percentage points higher at flat schools than at per-credit institutions. Some mean differences vary more than others as a function of the sample: For example, the share earning 15 or more credits in a semester is about

7 percentage points higher at flat colleges with all high school classes are pooled, but about the same (or slightly lower) when only looking at the high school class of 2011 and excluding the University of Michigan – Ann Arbor. Obviously, these raw differences in means do not control for other attributes of students and schools that are likely correlated with course-taking behavior and progress through college.

B. Empirical Approach and Identification Strategy

Our basic approach is to compare the credits taken by students attending "flat" pricing schools (at which the marginal price is zero for credits above the full-time minimum) to those attending per-credit pricing schools using a linear probability model estimated via OLS:

$$Y_{ijct} = \alpha + \beta_1 Flat_j + \beta_2 X_{ijt} + \beta_3 Z_j + \delta_t + \theta_c + \varepsilon_{ijct} \quad (1)$$

In this specification, Y_{ijct} is a measure of credits attempted or earned by individual *i* from cohort *c* attending school *j* during semester *t*. Our primary outcome variables are total credit load and indicators for attempting or earning a credit load greater than certain thresholds (e.g., more than 12 credits or at least 15 credits). $Flat_j$ is an indicator for whether school *j* has flat pricing, X_{ijt} is a vector of student-level measures of achievement and demographics during high school, δ_t is a set of semester fixed effects, θ_c represents cohort fixed effects, and ε_{ijct} is a stochastic error term. Some specifications control for a limited number of institution-level covariates (Z_j). The primary coefficient of interest is β_1, the effect of flat pricing on student credit-taking. To account for the nesting of students within colleges, we cluster standard errors at the institution level.[9]

[9] Our preferred estimates account for the potential lack of independence between students attending the same college by estimating cluster-robust standard errors that generalize the White (1980) heteroskedasticity-robust OLS standard errors. Given concerns in the literature about the performance of such clustering when the number of clusters is small (Cameron, Gelbach, & Miller, 2008), we explore of number of alternative methods for calculating our standard errors in the appendix. Since most of these alternative approaches increase our estimated standard errors slightly, our qualitative findings of mostly null effects are robust to most these alternative methods.

As an alternative, we also use a re-weighting approach described by Dinardo, Fortin, and Lemieux (1996) to construct a counterfactual of the entire distributions of credits attempted and earned at per-credit schools if flat pricing were implemented. That is, we estimate distributions of credits at per-credit schools if those schools and their students were re-weighted to mirror the observable characteristics of students at flat-pricing institutions.

There are at least three possible sources of bias in our approach. First, students attending "flat" schools may possess different characteristics that are correlated with college performance than those attending per-credit schools. While this is certainly true overall, it is worth noting that there is considerable student overlap on observable characteristics across institutions. Figure 1 depicts the inter-quartile range of ACT scores for all fifteen institutions. With the exception of the University of Michigan – Ann Arbor (a flat pricing school), every flat school has several non-flat schools with considerable test score overlap. Further, we control for a rich array of student-level characteristics, which include 11th grade test scores.

Second, it is theoretically possible that additional financial aid would offset the additional tuition and fees associated with additional credits, diminishing the treatment. Grant programs may explicitly increase in value as number of credits increase or cost-of-attendance could be adjusted upwards (increasing eligibility) when additional credits are taken. Max Pell amount increases discretely at quarter-time, half-time, three-quarters-time, and full-time, but does not increase in value beyond 12 credits. Further, most students are tapped out of their Pell grant, so increases in their costs of attending will not increase the amount of grant aid for which they are eligible. We are not aware of any institution, state, or federal programs that explicitly increase aid for additional credits taken beyond 12.

Finally, it is possible that schools' pricing schemes coincide with other college-level attributes or policies that may influence outcomes, such as resources or advising. We cannot entirely rule out this possibility, but offer four approaches for addressing it. First, we include an institution-level control for median ACT composite scores of incoming freshman. Second, we examine differences in credit-taking among students taking less than a full-time load (whose behavior should be minimally affected by the pricing scheme for full-time students) as a falsification test. Third, we explore the sensitivity of our findings to the exclusion of UM-AA, which is an outlier both in terms of student characteristics and institutional resources. Finally, for the class of 2011 we can identify students eligible to receive the Kalamazoo Promise scholarship, which pays all tuition and fees at public Michigan institutions. These students should be insensitive to marginal price and thus serve as a control group in a difference-in-differences analysis, permitting us to account for other non-price institutional factors that may be correlated with both marginal pricing policies and credit-taking outcomes.

VI. Results

A. Distribution of Credits Attempted and Earned

Figure 2, panels A and B plot the fraction of all students at or above each credit threshold for our complete pooled sample, which includes full- and part-time students from the high school classes of 2008 through 2011. These figures can be thought of as inverted cumulative density plots. In each panel, we plot distributions separately by pricing policy. We see little difference in the distribution of credits taken (and earned) by part-time students regardless of pricing policy – but, differences emerge right at the point where the marginal price diverges between the two sets of institutions (i.e., 12 credits). Students that face no marginal tuition price of a heavier course load are more likely to take (and possibly earn) credits beyond the full-time minimum.

Figure 3 shows this pattern a slightly different way. This figure plots a histogram of credits attempted for all students in our pooled sample (Panel A) and among those attempting at least 12 (Panel B), separately for students attending per-credit and flat schools. These graphs show that the distribution of credits attempted is shifted to the right at schools that make it less costly to take more courses. The analogous figures for credits earned look quite similar.[10] At first glance, these striking patterns suggest that marginal pricing policy may have some impact on credit intensity and credit accumulation.

B. Main Results

We now turn to estimates from our regression models, presented in Tables 3 through 5. In Table 3, the outcomes of interest are indicators for whether a student attempted more than 12 or more than 15 credits. In Table 4 the outcomes measure earned (rather than attempted) credits above these same thresholds. In Table 5 we estimate effects of flat pricing on the number of credits attempted (earned) in a semester as well as on a wider range of credit thresholds.

Table 3 examines whether attempted credits exceed two important thresholds: more than 12 (indicating movement from the full-time minimum) and at least 15 (the typical number needed each semester in order to graduate within four years). Each row corresponds to a different sample, including all years of observations for all cohorts (row one), all cohorts attending in the 2011-2012 academic year (row two), and each cohort separately (rows three to six). The first specification includes no controls and replicates the visual finding depicted in Figure 2A: the fraction of students that attempt more than the full-time minimum is 9 to 10 percentage points higher at flat pricing schools than at per-credit schools. This raw difference likely overstates the true causal effect of flat pricing because students attending flat pricing schools tend to be higher achieving and more advantaged, which are likely to have independent effects on course-taking.

[10] These figures are available from the authors upon request.

To address this, column (2) controls for a rich set of individual covariates, including sex, race, reduced-price lunch eligibility, English proficiency, special education, and ACT composite score.[11] Focusing on the estimate for all cohorts (row two), the magnitude of the coefficient decreases by about one-fifth to 8.3 percentage points, but is still statistically significant and quite large, considering the fraction of full-time students that take 12 units exactly at per-credit schools is 25 percent. Column (3) is our first attempt to address the possibility that institutions with flat pricing may be different in other dimensions that may influence course-taking. In this regression, we control for the median ACT composite score of incoming students at the institution level. Across all samples, this reduces the coefficient estimate further by about one-quarter, but the estimates remain large and statistically significant.[12] Column (4) confirms that this result is not driven by the outlying flat-pricing school, University of Michigan – Ann Arbor. Across these columns that differ in specification and/or sample, the point estimates are very similar.

Columns (5) through (8) examine whether flat pricing induces students to attempt 15 credits, the typical number needed each semester in order to graduate in four years. Though the estimates are less precise (and thus fewer are significant), we see magnitudes and a pattern similar to that for the more-than-12-credit outcome. Students at flat pricing schools are about 8 to 9 percentage points more likely to attempt a 15 credit load. Adjusting for individual and institutional characteristics does not alter this conclusion.

Table 4 examines credits earned at these same two thresholds using the same samples and specifications. We find that credits earned are much less responsive to flat pricing than credits

[11] To illustrate the importance and magnitude of each of these controls individually, Appendix Table A1 presents point estimates for all these coefficients for one sample (2011 graduates) and outcome (attempt 13 or more credits). Including many subject tests rather than the ACT composite produces very similar results, quantitatively and qualitatively.
[12] Estimates are not as diminished if instructional spending per student rather than median ACT composite score is used as the institutional control.

attempted. Though there are still sizable (but statistically insignificant) raw differences in the fraction of students above these credit earned thresholds between flat and per-credit schools, these differences are about half as large as the differences in credits attempted. Further, controlling for individual characteristics and institutional characteristics reduces this magnitude considerably.

Table 5 presents results for average credits attempted (and earned) and for an even wider range of credit thresholds, with columns (1) and (3) repeating the results just discussed. Flat pricing does not appear to push many students to attempt beyond 15 credits (Panel A) and does not have much effect on credits earned at any threshold (Panel B) once we account for individual and especially institutional characteristics. This pattern of results is reflected in the fact that we see little evidence of any impact of flat pricing on average credits attempted and even less evidence that flat pricing affects average credits earned (column (7)). These results are quite precise and our standard errors on these null findings imply that we could detect an effect of around 0.5 to 0.6 credits. Further, there is little evidence to support the notion that flat pricing is associated with a greater likelihood of meeting on-time benchmarks toward a college degree, though the estimates for 30 credits in a year are incredibly imprecise, so we cannot rule out fairly sizeable effects.

We see a few collective take-away findings from Tables 3 through 5. First, flat tuition pricing is associated with an increase in the likelihood that students attempt more than the full-time minimum number of credits of about 7 to 9 percentage points (relative to a base of 75 percent at per-credit schools across all cohorts). Since estimates at both the 13 and 15 credit thresholds are similar, this implies that these students are taking about 3 additional credits, or approximately one course. Second, the impact of flat pricing on earned credits is much weaker (i.e., half the magnitude or less of the effect on credits attempted) and insignificant. This leads us to conclude that even if students at institutions with flat tuition pricing schemes attempt several more credits, they are unlikely to translate those attempted credits into earned ones, which ultimately determine degree progress. Finally, in almost all cases the point estimates are larger for earlier cohorts (typically upper division students) than for the 2011 cohort (freshmen). One explanation is that students are not well informed about the pricing schedule when they first enroll, but come to understand the subsidy implicit in flat pricing in later years. However, even for this group additional credits attempted only weakly translate into credits earned.

C. Density re-weighting and the Distributional Concentration of Flat Pricing Impacts

As an alternative and flexible way to investigate where on the credit distribution the effect of marginal pricing is concentrated, we compare full credit distributions (i.e., attempted and earned) at flat schools to counterfactual distributions at per-credit schools, where counterfactuals are estimated using propensity score re-weighting. First we estimate the probability of attending a flat school conditional on individual-level covariates using a logit model.[13] We then construct weights for students attending per-credit institutions, with weights equal to p/(1-p) and where p is the predicted probability of attending a flat school from the estimated logit model. The credit distributions of students at per-credit schools using these weights form counterfactual distributions: what students at per-credit schools would have taken (or earned) had they had similar observed characteristics as students at flat pricing schools.

Figure 4 plots the counterfactual densities (attempted and earned credits) along with the actual (observed) densities of students at flat and per-credit institutions. Controlling for observed characteristics in this manner narrows, but does not eliminate, the gap in credit load between per-credit and flat pricing schools.

[13] Estimates of this model are available upon request form the authors.

To see this more clearly, Figure 5 plots the density *difference* between flat- and per-credit institutions at every level of attempted (Panel A) and earned (Panel B) credits. In each case, the left panel calculates the raw (unadjusted) difference, while the right panel calculates the difference between the actual flat distribution and the counterfactual per-credit distribution. 95% confidence intervals of this difference are also shown, calculated from 100 bootstrapped replications that permit clustering by institution. As we saw in the regression analysis results in Table 5, marginal pricing has its largest effects on the likelihood of attempting up to 15 credits, but has a much more modest impact on the likelihood of earning credits above this threshold. Figure 5 also provides a suggestive falsification test. Since all fifteen institutions charge per-credit up to the full-time minimum of 12 credits, flat pricing for full-time students should have no impact on the distribution of credits up to this point. Indeed there are only small (and insignificant) differences in the distribution of credits taken and earned by less-than-full-time students. The sizeable effects on credits attempted and modest effects on credits earned appear precisely at the full-time threshold.

D. Heterogeneity

We explore potential heterogeneity in the effect of flat pricing on students' credit-taking by student sex, poverty status (measured by eligibility for free or reduced-price meals), and high school academic achievement level. There is a sizable literature that documents that women are more responsive to many different types of educational interventions than men. Further, these differences appear throughout the educational pipeline. For example Anderson (2008) finds that the impacts of intensive preschool programs affect long-run educational and employment outcomes much more for girls than boys. Women have also overtaken men along both the college entry and completion margin in the past 30 years (Goldin, Katz, & Kuziemko, 2006).

Therefore, it is important to understand any sex-differences in price response during this time of gap reversal in higher education enrollment and completion by sex. We also know that low-income students generally respond more strongly to changes in college price than their peers from more advantaged backgrounds (Kane, 1994; Dynarski, 2002) – and therefore may also respond to marginal pricing in unique ways.

Table 6 presents estimates separately by sex and FARM status on credits attempted (Panel A) and earned (Panel B). While the point estimates are slightly higher for females than males, they are not statistically different. A more striking difference emerges when we compare the effects of flat pricing on FARM versus non-FARM students. Focusing on the rows for all cohorts, we see that effect of flat pricing on the likelihood of non-FARM students to take more than 12 credits is indistinguishable from the average effect (e.g., increases of 6.5 and 6.2 percentage points, respectively). But, FARM students exposed to flat pricing are between 12 and 15 percentage points more likely to attempt more than 12 credits and between 10 and 12 percentage points more likely to attempt at least 15 credits. Yet, there is once again little evidence to suggest that FARM students translate additional attempted credits into earned ones. For example, for all cohorts and with the ACT institutional control, we find FARM student exposed to flat pricing are 12.1 percentage points more likely to attempt more than 12 credits, but an insignificant 1 percentage point more likely to earn more than 12 credits.

We next explore differences in effects by students' levels of high school performance. Figure 6 presents estimates of treatment effect for attempting (Panel A) and earning (Panel B) 12 credits, separately for each unique ACT score from 16 to 32.[14] The ACT has been required for all students in the state of Michigan since 2007. The figure plots the point estimates and 95% confidence intervals for these seventeen regressions. We present models that do and do not

[14] This range captures 95% of all students.

control for the middle ACT composite score of the institution. For credits attempted, treatment effects are monotonically decreasing with ACT score: our results suggest that the lowest-achieving students are most susceptible to marginal price structure. Controlling for institutional selectivity does little to dampen this relationship. For instance, among students in the bottom quartile of the ACT distribution (below 20), those attending "flat" pricing schools are 10 to 20 percentage points more likely to be taking more than 12 credits compared to similar students at per-credit pricing institutions. Effects for credits earned are qualitatively similar, though much smaller in magnitude and seldom significant.

There are two interpretations of the results in Figure 6. It is possible that the lowest-achieving students are most susceptible to marginal price structure regardless of the type of institution they attend. Alternatively, it is also possible that the treatment effect varies with institutional resources or quality such that marginal pricing policy does not matter at well-resourced institutions, but does at less-resourced institutions (holding student achievement fixed). Our setting does not provide an opportunity to strongly distinguish between these two explanations.[15]

E. Falsification Check

One limitation of our main analysis is that, given the limited number of institutions, we are not able to control for many institutional characteristics that may correlate with the marginal pricing policy and students' credit-taking behavior. One way to control for such institutional characteristics is to identify a set of control students that should be insensitive to the marginal

[15] The ideal way to separate these two explanations would be to randomize pricing policy for students of different achievement levels at schools of identical quality. In results available from the authors, we attempted to approximate this by estimating effects by ACT quartile separately for three groups of institutional quality. Excluding the outliers (Wayne State, EMU, and UM-Ann Arbor), we grouped institutions into three groups of four based on their ACT interquartile range. Institutions within each group are roughly similar in terms of selectivity and institutional resources. We found that the pattern of larger effects for students with lower achievement test scores is replicated in the two most advantaged groups, but not for the bottom group. This analysis does not conclusively distinguish between these two possible explanations.

pricing structure of the institution they attend, but would be affected by other college characteristics and policies. Their responsiveness to flat pricing can be used to net out the effects of these unobserved institutional characteristics.

The Kalamazoo Promise Scholarship potentially provides just such a set of students. As described by Bartik and Lachowska (2012), the Kalamazoo Promise provides a generous scholarship to graduates of the Kalamazoo Public School (KPS) system. The scholarship covers up to 100% of all tuition at public universities and colleges in Michigan, depending on how long a student was enrolled in KPS.[16] The scholarship was announced in 2005, so all the students in our study were potentially eligible. From the Michigan high school classes of 2008 through 2011, we identify students eligible for the KPS (as determined by their enrollment in KPS since 9th grade) attending one of the universities in our analysis.

Table 7 presents difference-in-differences estimates of the effect of flat pricing on credits attempted and earned using Promise-ineligible students as the treatment group (since pricing structure should affect their behavior, but not that of Promise-eligible students). For each outcome, we present two difference-in-differences specifications. In both specifications, non-Kalamazoo graduates are re-weighted to resemble Kalamazoo graduates (via the use of a first-stage logistic regression where we estimate the likelihood a student is KPS eligible as a function of our vector of student-level characteristics). Therefore, non-Kalamazoo students that look the most like KPS-eligible students along this set of observable dimensions are weighted the most heavily in our second stage difference-in-differences model.

The first difference-in-differences specification includes student-level controls and dummies for college semester and high school graduation cohort. We add institution fixed effects

[16] The generosity ranges from 65% for students enrolled in KPS from 9th grade onwards to 100% for those enrolled since Kindergarten.

to the second specification. Across both models, the coefficient on the interaction between flat pricing and Promise-ineligible provides an estimate of the effect of flat pricing netting out the effect of other institutional characteristics. The institution fixed effects model compares the average within-institution differences in credit-taking behavior between KPS-eligible and non-KPS-eligible students across flat and per-credit institutions. This specification allows us to net out institution-specific effects on credit-taking unrelated to marginal price.

We interpret our findings from this exercise as generally consistent with our earlier results. We see relatively modest impacts of flat pricing on attempted and earned credits, with larger responses along the credit-taking (rather than earning) margin. Though, depending on the specification, we see a bit more evidence here than in earlier results that a relatively modest share of students may indeed translate additional attempted credits into earned ones. Yet, we caution against reading too deeply into these results. This difference-in-differences exercise is arguably identifying a treatment effect for a very specific subgroup of students: those who look like Kalamazoo high school students (i.e., more likely to be black and/or eligible for free or reduced-price meals) and are disproportionately concentrated at particular schools. For example, nearly half of Promise-eligible Kalamazoo students attend Western Michigan University, representing 62 percent of all KPS-eligible students at flat institutions. Among KPS-eligible students at per-credit schools, over 88 percent attend Michigan State University.[17] This unique distribution of Kalamazoo students (relative to non-Kalamazoo students) at particular colleges also illustrates how any effects we observe (and any biases we net out) are unique to certain "treatment" and "control" institutions. Finally, even if these results were interpreted to suggest that our earlier results may have underestimated the degree to which this particular subgroup of

[17] See Appendix Table A2 for a breakdown of the institutions initially attended by Kalamazoo Promise-eligible students.

students translates additional attempted credits into earned ones (as a consequence of being exposed to flat pricing), the results on average credits attempted and earned in a semester are relatively small (in terms of practical significance).

F. Interpreting Effects on Credits Attempted and Earned

To better understand the nature of the modest impact of flat pricing on credits attempted and whether this may translate to faster degree completion (a subject we explore more rigorously in the next section), we also estimate treatment effects separately by subject area. We characterized each course taken into one of 12 broad subject areas based on CIP codes (available at some institutions), academic department/subject, and/or course title. Figure 7 depicts our findings graphically. The left bar depicts the mean number of credits attempted in each subject area by all students at per-credit schools in the 2011-2012 academic year. The average course load includes about one course each in Humanities/English and Social Science and two or three other courses collectively across the other ten subjects. The right bar adds to this our subject-specific estimated treatment effect of flat pricing. Though students at flat pricing schools do take slightly more credits in these two main areas, the difference is modest and not statistically significant. Students at per-credit schools do take more credits in Other Professional/Technical subjects, which appears to be driven by more credit-taking in communications and journalism at these schools. In results not reported in the figure, we found that additional credits are taken both in subjects we categorize as "non-degree-related" and all other subjects.[18] We thus conclude that the additional courses students are induced to take in response to a subsidized marginal price are not substantively different than their typical courses and, if anything, are in the core subjects of Humanities/English and Social Science.

[18] "Non-degree-related" includes CIP codes 31 through 37, including Parks, Recreation, and Leisure Studies, Basic Skills/Remedial, Citizenship Activities, Health-related Knowledge and Skills, Interpersonal and Social Skills, Leisure and Recreational Activities, and Personal Awareness and Self-Improvement.

Table 8 examines whether the modest effect on attempted credits we observe is due to a shift in the relative distributions of 3- versus 4-credit courses that comprise students' credit loads. That is, do students shift from 3-credit to 4-credit courses in response to marginal price? We run very similar models as in Table 3, but the outcomes are now total number of courses attempted and the number of courses attempted that are worth 1, 2, 3, 4, or 5 credits. We find minimal effects of marginal price on the overall number of courses taken an on the credit-level mix of those courses. While imprecise, our estimates suggest that there is small to little systematic substitution among students at flat-pricing schools from 3- to 4-credit courses. Coupled with our earlier findings, the collective implication is that flat pricing induces the average student to attempt up to one course more (i.e., 3 credits) than she would have under a per-credit tuition scheme – likely in Humanities/English or the Social Sciences – and not to simply switch three of her 3-credit courses to 4-credit ones.

VII. Long-term Outcomes

We now explore the impact of marginal pricing on the longer-term outcomes of persistence and credit accumulation. We first track entry into and persistence through postsecondary education using the National Student Clearinghouse (NSC). For each member of the high school cohorts of 2008 through 2011, we identify students that enrolled in a Michigan public 4-year university in the fall term immediately following high school graduation.[19] Figure 8 plots the fraction of these students enrolled in any college (Panel A) or a MI public 4-year university (Panel B) over time, separately by high school cohort and the pricing policy of the first institution attended. Across all institutions, 96% of students attend any college (including

[19] This sample includes 116,581 individuals, approximately 29,000 students from each of these four cohorts. Very few students enter one of these institutions in the Spring term, so the Fall enrollment restriction is not too binding. Students that delay entry into or eventually transfer to a MI public university from private or community colleges are also excluded to ensure that the sample is similar across cohorts, given that later cohorts would mechanically have few delayed or transfer entrants.

Michigan universities, community colleges, and private colleges) in their second semester, though enrollment drops to 82% by the start of the fourth academic year. Comparable rates for enrollment at a Michigan public university are 93.5% and 72.4%, respectively. Rates of persistence beyond the first year at any college are only barely higher for students starting at institutions with a flat pricing policy than with per-credit policy. However, rates of persistence at any Michigan public university are much higher among students starting at flat pricing schools (Panel B). Taken at face value, these graphs suggest that flat pricing encourages students to remain at a Michigan public university (rather than enroll in either a community college or private college), but has minimal impact on overall persistence. However, we've seen evidence that flat institutions and their students have different characteristics from per-credit institutions, which could potentially explain these patterns.

Table 9 probes the robustness of these patterns to various sets of individual and institutional controls. Each cell in the table reports the coefficient on an indicator for flat pricing at the first institution attended from a separate regression that includes all cohorts. The outcomes are indicators for enrolled in any college or a Michigan public university at various points after initial enrollment. Columns (1) and (6) reproduce the patterns observed in Figure 8. After one and a half years, there are very modest (about 1 or 2 percentage points) and statistically insignificant gaps in persistence at any college between flat and per-credit schools. However, a large (but imprecise) 6-point gap in enrollment rate at MI universities emerges after the same amount of time. This gap appears to be driven primarily by the selection of higher-achieving students into flat schools. Columns (2) and (7) include controls for female, black, Hispanic, other race, limited English proficiency, special education, free and reduced-price lunch, and composite ACT score. These characteristics are highly predictive of persistence and including them reduces the estimated gap between flat and per-credit schools significantly.[20] Columns (3) through (4) and (8) through (10) attempt to adjust for the role of other institutional characteristics by either controlling for institution-level ACT score, excluding UM-Ann Arbor (which has a very high persistence rate and is a flat school), or both. In anything, after these adjustments students at flat institutions have *lower* rates of persistence than would be predicted by their individual traits. We conclude from this that flat pricing does not appear to alter students' rates of persistence, either overall (at any institution) or at MI public universities.

Though the analysis in Table 9 suggests that pricing policy has minimal impact on students' rate of persistence (which likely will lead to minimal impact on degree attainment or time-to-degree), we now directly examine impacts on credits accumulated over several years. Recall that STARR data are supposed to contain information about all courses taken in 2011-2012 and in all prior terms, among students still enrolled in the 2011-2012 academic year. Thus for all students in the 2008, 2009, and 2010 cohorts that persist to 2011-2012, we calculate the cumulative credits attempted and earned as of Spring 2012. We make two important sample restrictions. First, we restrict our analysis to only students enrolled (at least part time) in a Michigan public 4-year in all Fall and Spring semesters since high school graduation (as indicated by the NSC).[21] This restriction is intended to permit us to abstract from the students' decisions to persist and to instead focus on credits accumulated among those that have decided to persist in all periods. Furthermore, our intention is to construct markers of on-time credit accumulation that are only relevant for students that have already chosen to enroll. Given the minimal impact on persistence identified in Table 9, we do not believe this restriction creates

[20] The coefficients on these individual controls are very significant and in the expected direction in most of the regressions.
[21] So members of the high school class of 2008 (2009, 2010) must be enrolled in a MI public university for all 8 (6, 4) fall and spring terms since high school graduation.

grave concerns about sample selection bias. Second, we only keep students with complete consistency between NSC and STARR enrollment data. NSC-STARR consistency is desired so that we are certain we have accumulated all credits attempted and earned by an individual.[22] Nonetheless, we find similar estimated effects on credits attempted in 2011-2012 with this restricted sample as with the full sample reported earlier.[23]

In Table 10 we analyze cumulative credits attempted, cumulative credits earned, and whether cumulative credits earned are above the threshold for on-time, all as of Spring 2012. Since these on-time thresholds differ by student level (sophomore, junior, senior), we present estimates separately by cohort. Overall we find little evidence that flat pricing encourages students to attempt or accumulate more credits over time. On average, students have attempted 58.5 credits and earned 55.4 by the end of their second year in college, but there is little difference between students at per-credit and flat pricing institutions. Nor are students at flat institutions more likely to have earned 60 credits, a marker for graduating within four years.[24] Results for the 2009 and 2008 cohorts are qualitatively similar: the typical student is attempting and earning fewer credits than the on-time benchmark and there is minimal difference between students at flat and per-credit schools. Any modest average attempted credit advantage seen among students at flat pricing institutions is eliminated (and in some cases reversed) when looking at credits earned.

Finally, we turn to some suggestive evidence on graduation rates and time-to-degree among graduates, The students for which we have detailed transcript information are still early in

[22] Though NSC-STARR consistency is quite high in the 2011-2012 academic year (98%, similar for flat and per-credit schools), it deteriorates in earlier years and becomes slightly worse at per-credit institutions. Thus results for the 2008 and 2009 cohorts that rely on historical data (such as cumulative credits) should be interpreted with some caution.

[23] These are available from the authors upon request.

[24] Though not reported in the table, we find similar results when cumulative credits in fall or spring terms only (excluding summer) are used or if the University of Michigan – Ann Arbor is excluded.

their college careers so long-term outcomes are not yet available. Instead, we analyze students from the high school class of 2005, for whom follow-up information from the National Student Clearinghouse (NSC) is available seven years after college entry. For this cohort, we analyze four different outcomes using the same OLS models discussed above: indicators for graduation within 4, 5, and 6 years of college entry and time-to-degree among those that graduate within seven years. Column (1) in Table 11 presents the raw differences in these outcomes between students starting at flat and per-credit schools. Students entering flat pricing schools are 5.8 percentage points more likely to graduate within 4 years and 3.7 percentage points more likely to graduate within 6 years, and graduate about one month more quickly, though none of these differences are statistically significant. This pattern echoes that seen in Figure 6 for persistence, where students starting at flat institutions were about six percentage points more likely to be enrolled in a Michigan public university in the fourth year. However, point estimates are reduced considerably (and remain imprecise and insignificant) when individual controls are included (column (2)). It is worth noting that our estimates for these outcomes are incredibly imprecise, so we view this analysis of graduation outcomes only as suggestive. However, small point estimates are consistent with the overarching finding that marginal pricing policies have little impact on students' accumulation of earned credits and thus rates of timely degree progression.

VIII. Implications and Conclusions

How should higher education be priced? As public colleges and universities replace lost state support with tuition revenue from students, many have re-examined the common practice of charging a flat rate regardless of students' credit load, level, or program. At the same time, pressure from policymakers and the public has compelled institutions to find ways to improve student progress and reduce time-to-degree. These twin objectives appear to be at odds: raising prices may generate revenue but could also deter enrollment, slow student progress, and ultimately reduce the number of college graduates. Charging full-time students differentially based on the number of credits taken – pricing at the margin – is a specific policy about which similar institutions have articulated different views. Some have stressed the detrimental effects of marginal price on student success by, for instance, reducing the marginal price to zero in order to get students to "Finish in Four," as Adam's State's plan is called. Others see marginal pricing as an equitable way of raising revenue from students who consume more resources; "flat" pricing is viewed as a subsidy to students who would have taken large course loads anyways. These divergent views are unsurprising given the complete lack of evidence on the subject.

This paper provides the first evidence on the impacts of marginal pricing on student's course-taking behavior and progress through college. Using rich administrative data on all in-state students at the fifteen public universities in Michigan, we estimate that facing no marginal price (above the full-time minimum) has no detectable effect on the average number of credits attempted or earned in a semester. We find that exposure to flat pricing compels about 8 percent of students to attempt about one class more (i.e., 3 additional credits). Yet, we see little evidence that these additional attempted credits translate into more credits earned in a semester or cumulatively, greater persistence, or reduced time-to-degree, though estimates of these longer-term outcomes are admittedly less precise.

Since eliminating the marginal price associated with credit intensity appears to have minimal impact on students' progress, marginal pricing may be a non-distortionary way for institutions to raise revenue. Additional revenue could be used to finance other interventions with a stronger track record of improving student success, to increase financial aid, or possibly to lower the average tuition price faced by students taking lower credit loads. Simulating just how much tuition revenue could be generated if Michigan's seven current "flat" institutions adopted marginal pricing is an important extension we will explore in future work, along with the incidence of such a policy change.

Our null finding stands in contrast to the rather large literature that documents substantial student responses to price in other choice settings, such as the decision to enroll or the choice of college (though, such choices are largely along the extensive margin). Our results suggest a need to dig deeper into the choices students make after entering college, as price responsiveness at the enrollment margin does not appear to imply a comparable responsiveness once students have already enrolled (at least when it comes to credit-load decisions). Thus policies designed with large student price elasticities in mind (informed by the enrollment and college choice literature) may not translate well to the problem of supporting and speeding up student progress.

There are also several other possible effects of marginal price that we have not yet explored, namely major choice, interest exploration, financial burden, or academic performance. These too are important questions for future research.

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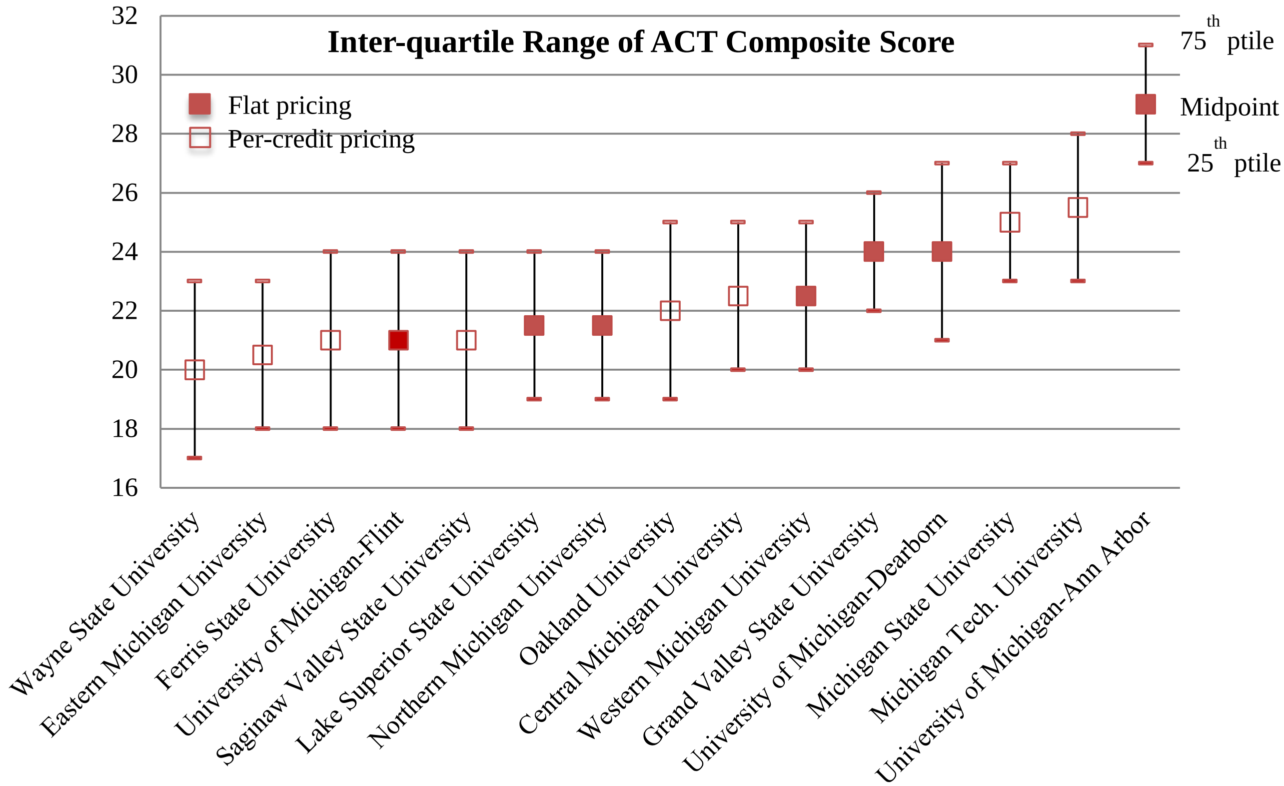
Clustering Appendix

Our baseline estimates account for the potential lack of independence between students attending the same college by estimating cluster-robust standard errors that generalize the White (1980) heteroskedasticity-robust OLS standard errors. Several authors have raised concerns about the performance of clustering when the number of clusters is small (Donald and Lange, 2007; Cameron, Gelbach, & Miller, 2008).

Table A3 presents estimates of our main results using alternative approaches to estimating the standard errors or conducting inference. Column (1) reports our baseline results, where standard errors are estimated using cluster-robust standard errors and college is the clustering group. To illustrate the importance of addressing within-college correlation, the next three columns report estimates that do not fully address the clustering problem, either ignoring it entirely (2 and 3) or defining the clustering group by cohort-college. Interestingly, even if cohort-college is used as the clustering group (likely not conservative enough), the estimated effects of marginal pricing on earning at least 13 or 15 credits are still insignificant. Column (5) estimates standard errors using a bootstrap method that resamples complete clusters with replacement and uses bootstrap estimates of the coefficient to estimate standard errors. This increases the standard errors by 20-30%. Columns (6) and (7) implement the "wild bootstrap-t" method proposed by Cameron, Gelbach, and Miller, 2008). In this case, pseudo-samples are created based on the within-cluster residuals and holding regressors constant, bootstrapping the Wald test statistic. A drawback of this approach is that it does not estimate standard errors, but rather performs inference using the bootstrapped test statistic. Finally, in column (8) we present results of a two-step procedure using group data, suggested by Wooldridge (2003). This procedure first estimates college fixed effects in a model with all individual regressors, then regresses these 15 fixed effects on an indicator for flat pricing and institution ACT composite, weighting by the inverse of the estimated fixed effect variance. Estimates and inference come from this second stage regression. The estimated standard errors and p-values from these alternative inference procedures tend to be larger than the cluster-robust estimates, though our main significant finding (on attempting at least 13 credits) holds for all but the final of these approaches.

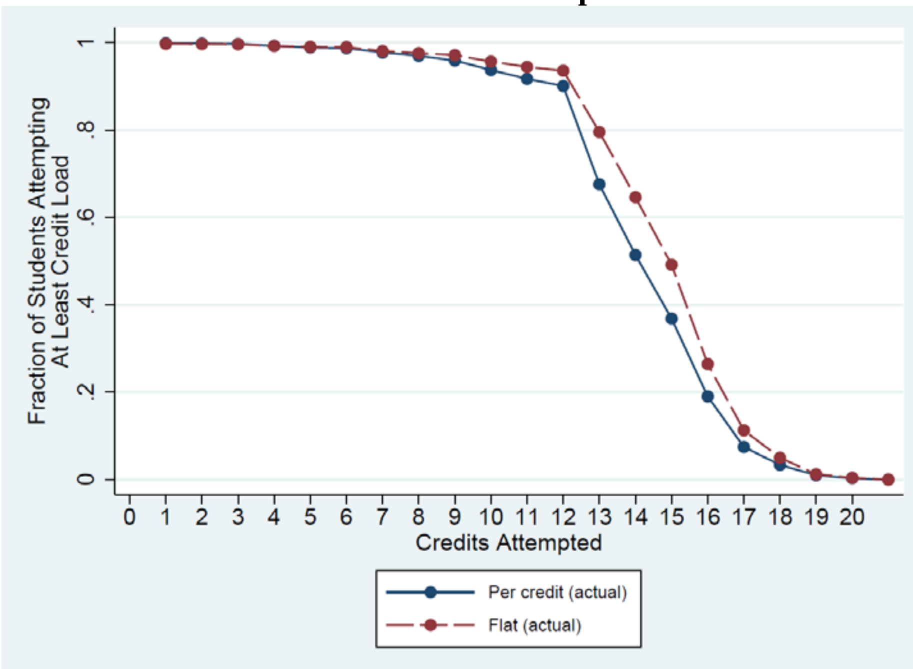
Figure 1. ACT Score Ranges at Michigan Public Universities, by Pricing Policy



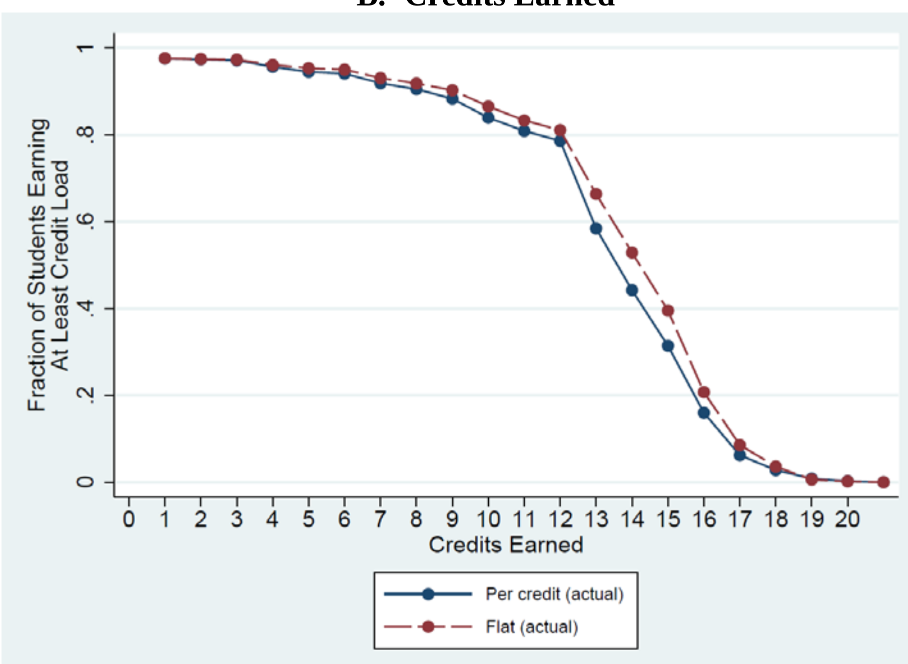
Source: Integrated Postsecondary Education Data System (IPEDS), data for 2009-2010 incoming class

Figure 2. Fraction of Students at or above Credit Threshold at Michigan Public Universities

A. Credits Attempted



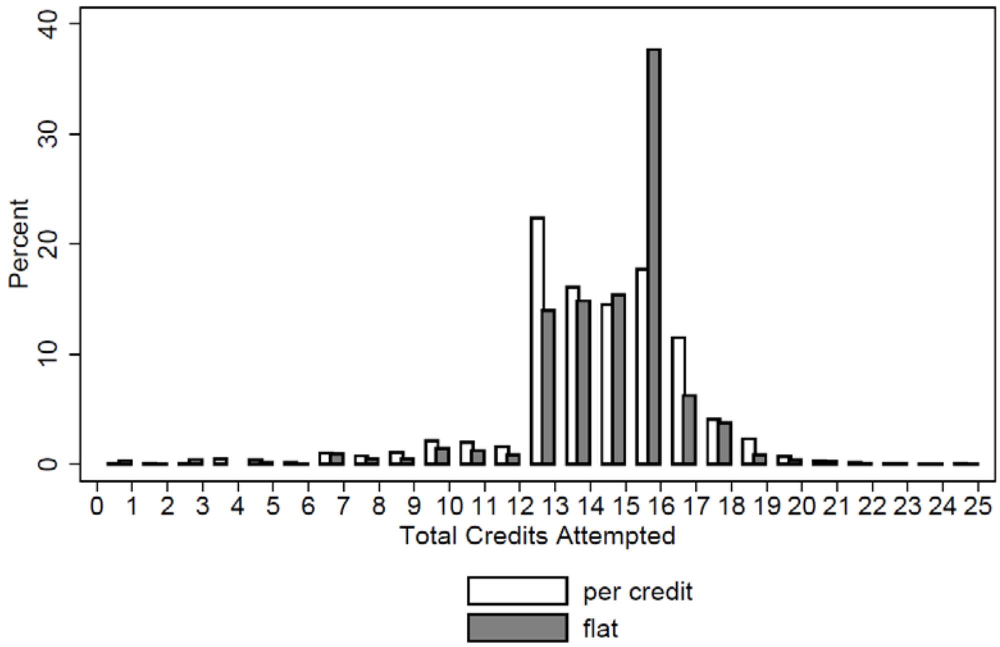
B. Credits Earned



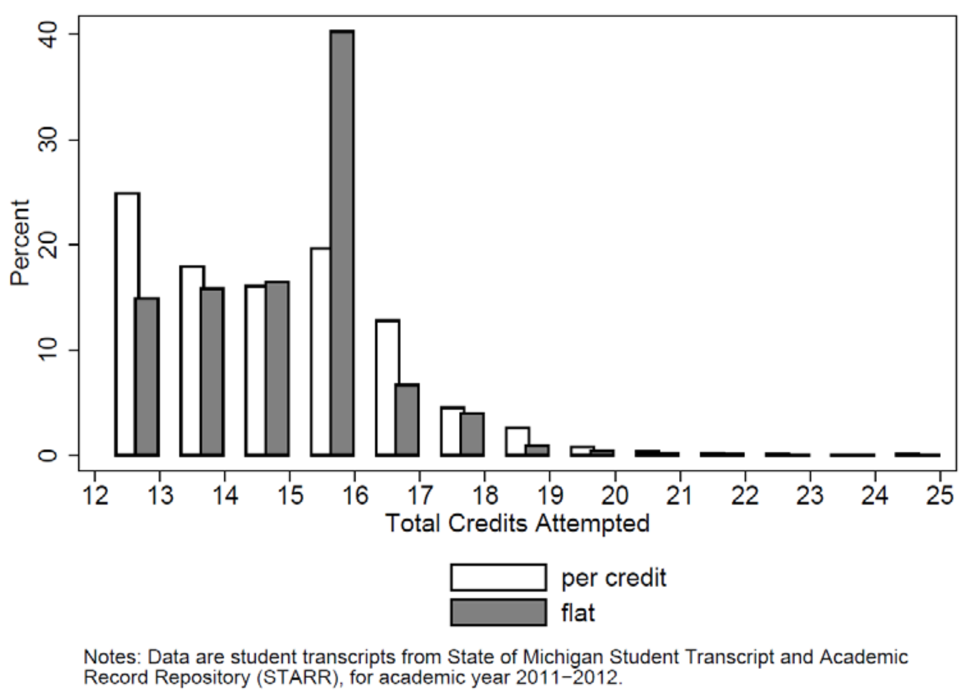
Notes: Figure plots the fraction of students at Michigan public universities that attempt (or earn) at least x credits in the term, separately by the pricing structure of the university. Sample include college-going Michigan high school graduates form the classes of 2008 through 2011. Credit-taking is observed in the fall and spring of the 2011-2012 academic year.

Figure 3. Histograms of Credits Attempted at Michigan Public Universities, by Institutional Pricing Policy and Student Enrollment Intensity

A. All Students



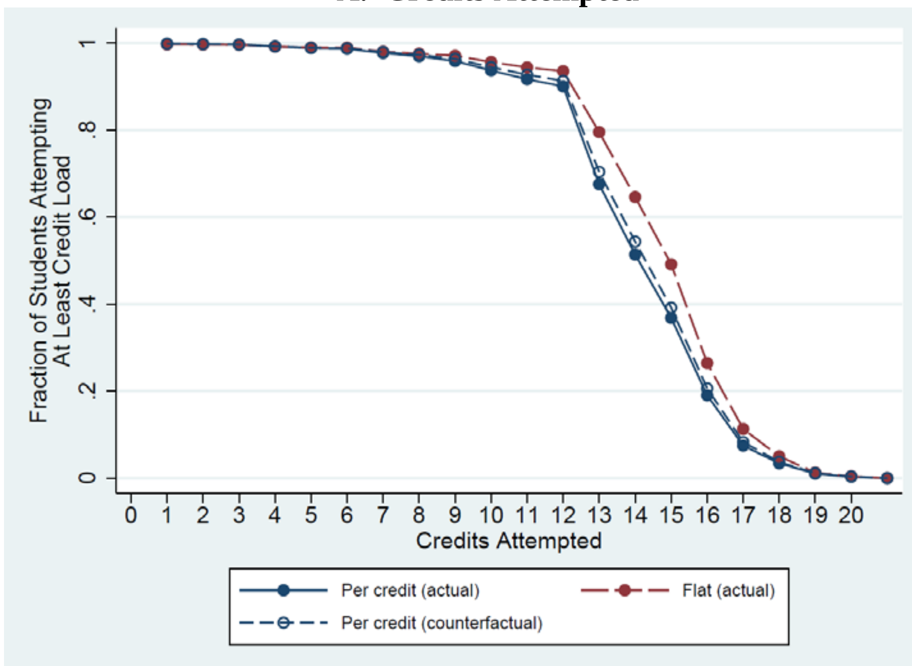
B. Full-time Students Only (>= 12 credits)



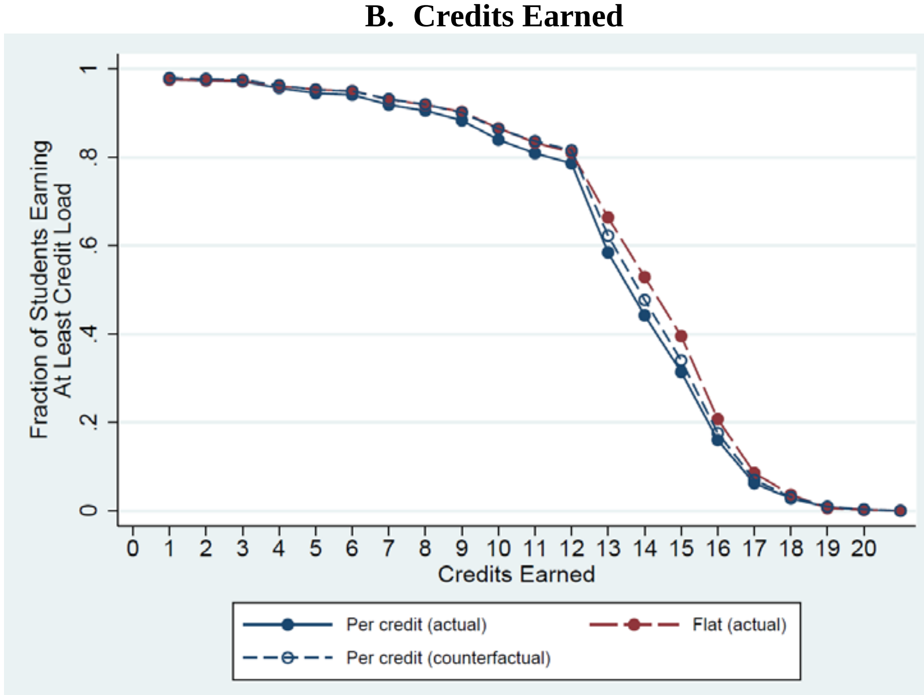
Notes: Figures plot the fraction of students at Michigan public universities that x credits in the term, separately by the pricing structure of the university. Sample include college-going Michigan high school graduates form the classes of 2008 through 2011. Credit-taking is observed in the fall and spring of the 2011-2012 academic year.

Figure 4. Fraction of Students at or above Credit Thresholds, Michigan Public Universities: DFL Re-weighting

A. Credits Attempted



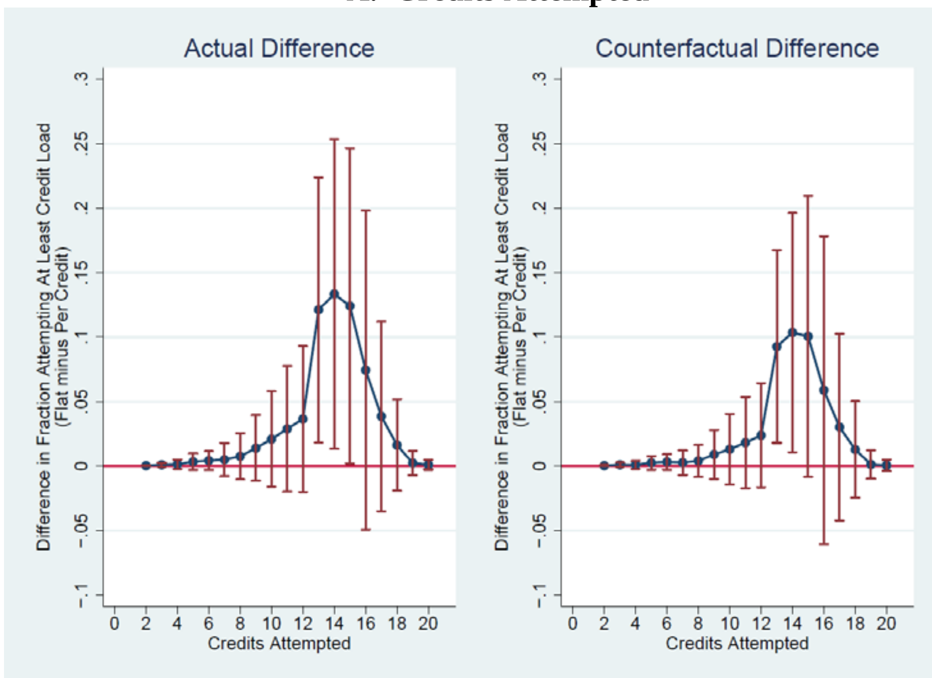
B. Credits Earned



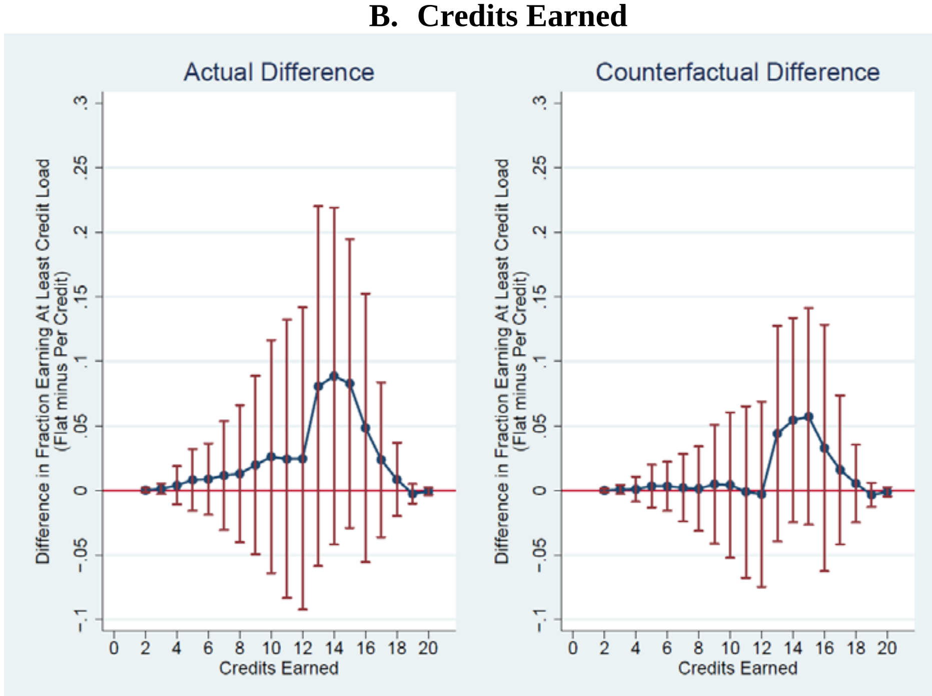
Notes: Figures plot the fraction of students at Michigan public universities that attempt (or earn) at least x credits in the term, separately by the pricing structure of the university. Counterfactual distribution is estimated by weighting per-credit schools by p/(1-p) where p is the predicted probability of attending a flat school based on covariates. Credit-taking is observed in the fall and spring of the 2011-2012 academic year. See text for additional details.

Figure 5. Actual and Counterfactual Differences in Fraction of Students at or above credit thresholds, by Pricing Policy

A. Credits Attempted



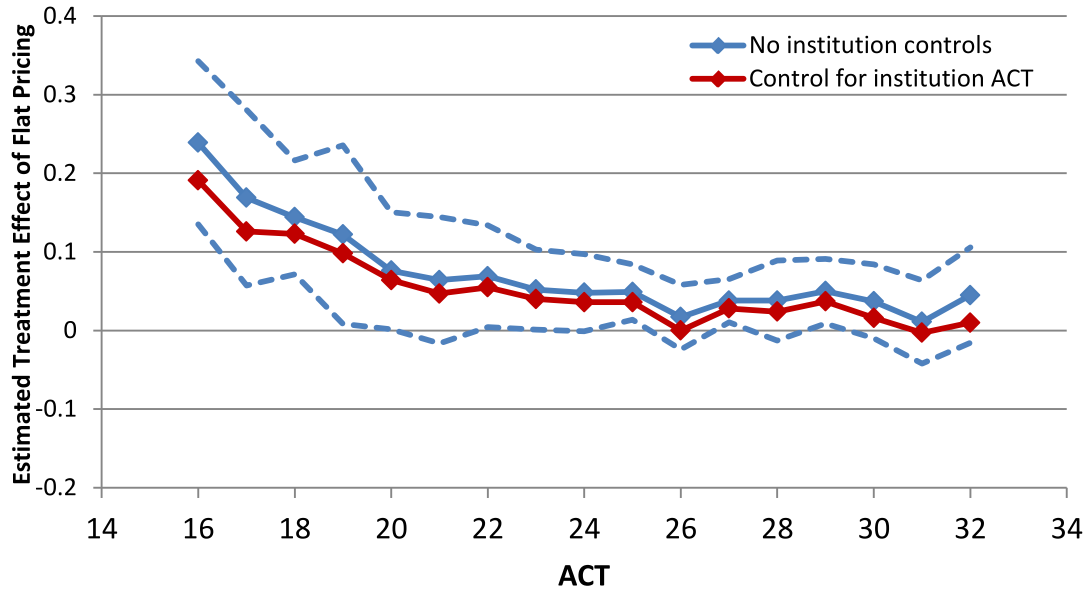
B. Credits Earned



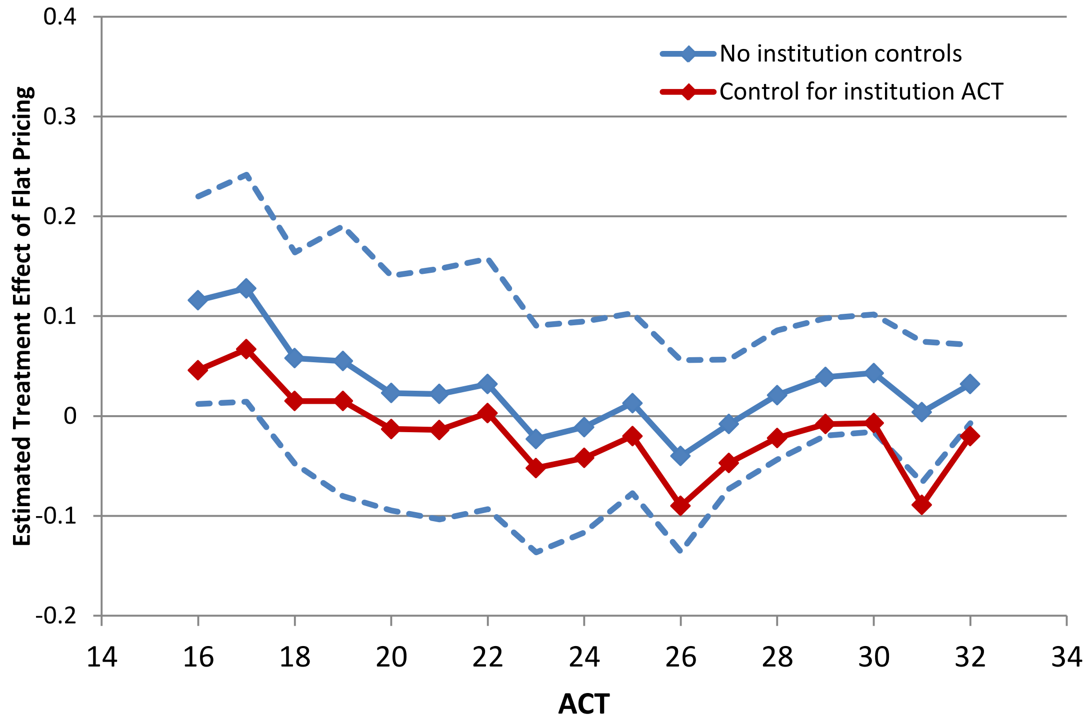
Notes: Figures plot the difference in fraction of students at Michigan public universities that attempt (or earn) at least x credits in the term between universities with flat pricing and per-credit pricing schemes (along with 95% confidence band). Confidence interval is estimated with 100 bootstrapped replications, resampling within university. Counterfactual distribution is estimated by weighting per-credit schools by p/(1-p) where p is the predicted probability of attending a flat school based on covariates. Credit-taking is observed in the fall and spring of the 2011-2012 academic year. See text for additional details.

Figure 6. Effect of Flat Pricing, by ACT Score

A. Attempting More than 12 Credits

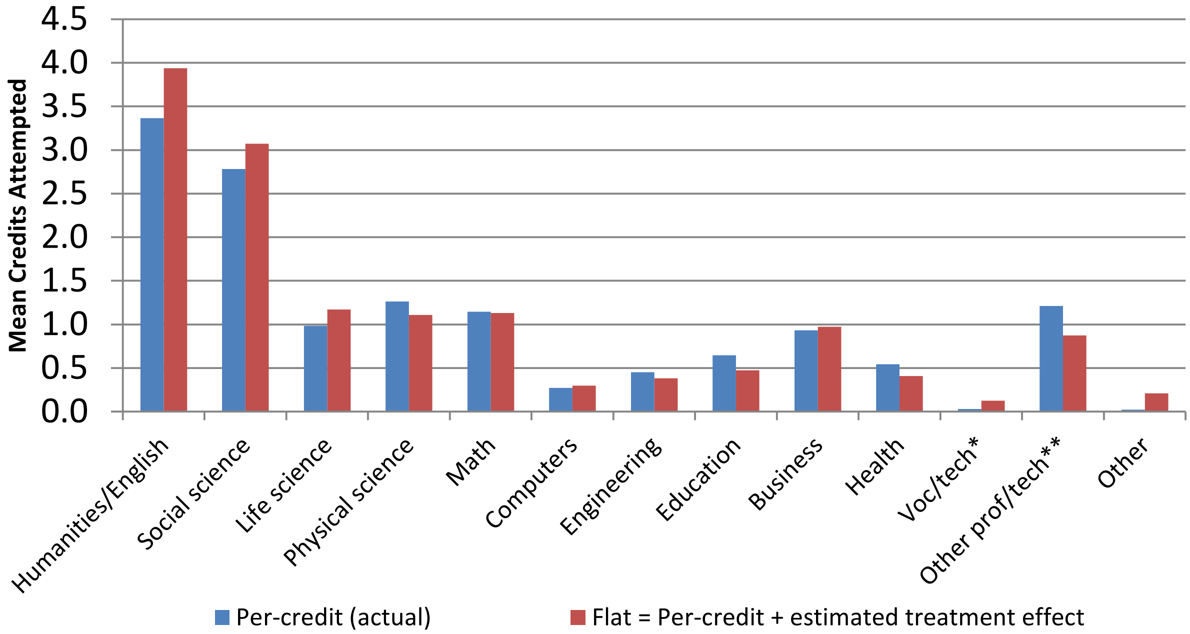


B. Earning More than 12 Credits



Notes: Graph plots the point estimate and 95% confidence interval for seventeen regressions of dummy for more than 12 credits attempted or earned on flat pricing, controlling for individual-level covariates. Standard errors are clustered by institution. Regressions were run separately for each ACT score. Confidence interval for model with spending controls is not reported for ease of visibility.

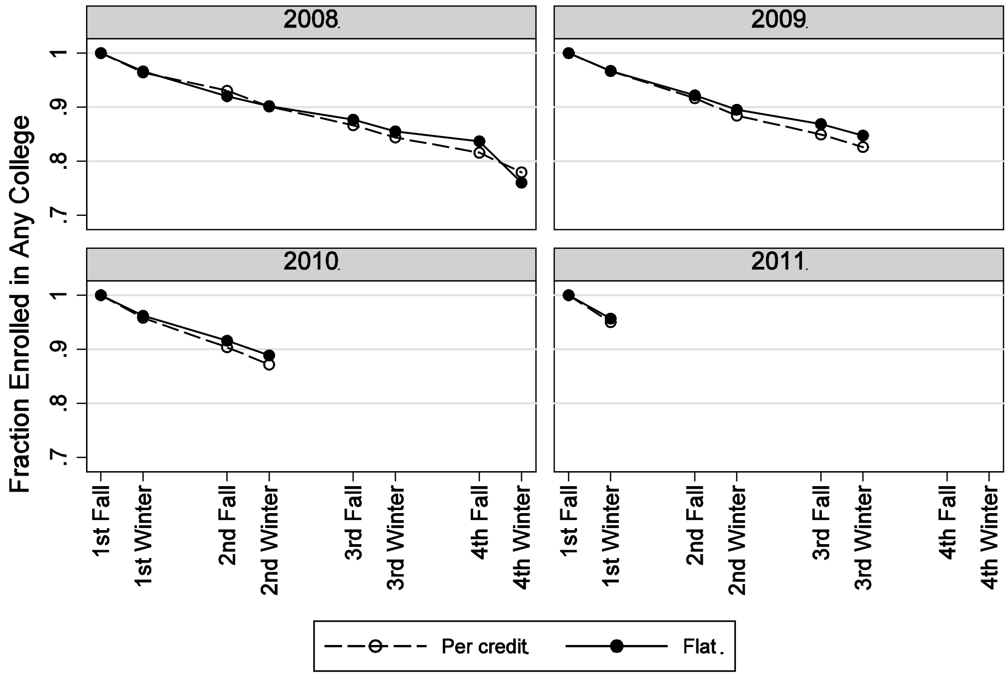
Figure 7. Effects on Mean Credits Attempted by Subject



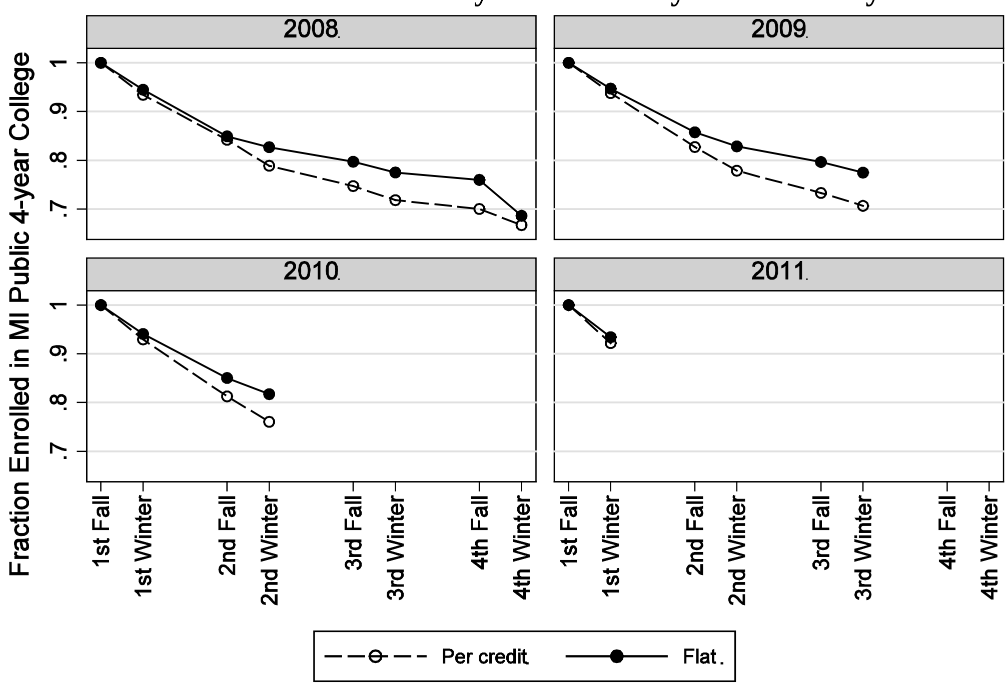
Notes: Per-credit mean is for all cohorts during 2011-2012 academic year. Flat (counterfactual) mean is per-credit mean plus estimated effect of flat pricing on average credits taken in subject. Model includes indicators for each unique term (e.g. Fall 2011), individual controls, institution-level ACT score, and cohort fixed effects. Standard errors (not reported) are clustered by institution. Significance of difference between flat and per-credit schools denoted: *** p<0.01, ** p<0.05, * p<0.1.

Figure 8. Persistence Among Fall Enrollees at MI Public Universities, by High School Cohort and Pricing Policy

A. Persistence at Any College



B. Persistence at Any MI Public 4-year University



Notes: Figures plot the fraction of students enrolled in any college (Panel A) or a MI public university separately by high school cohort and pricing policy of first institution. Restricted to MI public high school graduates from 2008 to 2011 that enrolled in a MI public 4-year university in the fall immediately after high school.

Table 1. Marginal Pricing Practices at Michigan's 4-year Public Universities

				Price differentials by…	
	Type	Per-credit price (2011/2012)	Flat range	level (upper vs. lower)	Program or school
Central Michigan University	per credit	$358			
Eastern Michigan University	per credit	$247			
Ferris State University	per credit	$348			
Grand Valley State University	flat		12-16 credits	yes	
Lake Superior State University	flat		12-17 credits		
Michigan State University	per credit	$407		yes	yes
Michigan Technological	per credit	$421			
Northern Michigan University	flat		12-18 credit		
Oakland University	per credit	$331		yes	
Saginaw Valley State University	per credit	$246			
University of Michigan-Ann	flat		12-18 credits	yes	yes
University of Michigan-Dearborn	flat		> 12		
University of Michigan-Flint	flat		> 12		
Wayne State University	per credit	$287		yes	yes
Western Michigan University	flat		12-15 credits	yes	

Source: Presidents Council, State Universities of Michigan, *Report on Tuition and Fees 2011-2012*

Notes: UM-Dearborn and UM-Flint charge $80 for each credit above 12, though this is substantially lower than the rate charged per credit up to 12.

Table 2. Student Sample Characteristics, by Marginal Pricing Practice: Full-time Students

	2008-2011 High School Graduates			2011 High School Graduates			2011 High School Graduates		
	Per-credit schools (PC)	Flat schools (F)	Difference (F - PC)	Per-credit schools (PC)	Flat schools (F)	Difference (F - PC)	Per-credit schools (PC)	Flat schools (F; exclude UM-AA)	Difference (F - PC)
Demographic and Achievement Characteristics:									
Female	0.554	0.550	-0.004	0.552	0.566	0.014	0.552	0.580	0.028
	(0.497)	(0.497)	(0.002)	(0.497)	(0.496)	(0.004)	(0.497)	(0.494)	(0.005)
Black	0.106	0.073	-0.033	0.123	0.091	-0.032	0.123	0.098	-0.025
	(0.307)	(0.260)	(0.001)	(0.329)	(0.288)	(0.003)	(0.329)	(0.298)	(0.003)
Hispanic	0.015	0.020	0.005	0.018	0.024	0.007	0.018	0.026	0.008
	(0.121)	(0.141)	(0.001)	(0.132)	(0.154)	(0.001)	(0.132)	(0.158)	(0.001)
Other	0.040	0.063	0.023	0.044	0.067	0.023	0.044	0.035	-0.009
	(0.197)	(0.243)	(0.001)	(0.205)	(0.250)	(0.002)	(0.205)	(0.183)	(0.002)
White	0.839	0.844	0.004	0.815	0.817	0.002	0.815	0.841	0.026
	(0.367)	(0.363)	(0.002)	(0.388)	(0.387)	(0.003)	(0.388)	(0.365)	(0.004)
FARM	0.065	0.057	-0.008	0.072	0.069	-0.004	0.072	0.081	0.009
	(0.246)	(0.232)	(0.001)	(0.259)	(0.253)	(0.002)	(0.259)	(0.273)	(0.003)
LEP	0.035	0.034	-0.001	0.041	0.041	0.000	0.041	0.029	-0.012
	(0.184)	(0.182)	(0.001)	(0.198)	(0.198)	(0.002)	(0.198)	(0.168)	(0.002)
Special Education	0.065	0.062	-0.003	0.082	0.074	-0.008	0.082	0.083	0.001
	(0.246)	(0.242)	(0.001)	(0.275)	(0.261)	(0.002)	(0.275)	(0.276)	(0.003)
ACT Composite Score	22.286	23.732	1.446	22.653	23.847	1.194	22.653	22.130	-0.524
	(4.133)	(4.654)	(0.020)	(4.117)	(4.691)	(0.039)	(4.117)	(3.901)	(0.040)
College Outcomes:									
Credits Attempted	14.104	14.579	0.475	14.348	14.735	0.387	14.348	14.544	0.196
	(1.813)	(1.814)	(0.008)	(1.799)	(1.712)	(0.016)	(1.799)	(1.714)	(0.018)
Credits Earned	13.160	13.451	0.290	13.244	13.530	0.287	13.244	13.057	-0.186
	(3.162)	(3.204)	(0.015)	(3.411)	(3.353)	(0.030)	(3.411)	(3.606)	(0.035)
Attempt more than 12 credits	0.751	0.851	0.100	0.821	0.913	0.092	0.821	0.898	0.077
	(0.432)	(0.356)	(0.002)	(0.383)	(0.281)	(0.003)	(0.383)	(0.303)	(0.004)
Earn more than 12 credits	0.650	0.710	0.060	0.699	0.759	0.059	0.699	0.708	0.008
	(0.477)	(0.454)	(0.002)	(0.458)	(0.428)	(0.004)	(0.458)	(0.455)	(0.005)
Attempt 15 or more credits	0.409	0.524	0.115	0.455	0.547	0.092	0.455	0.489	0.034
	(0.492)	(0.499)	(0.002)	(0.498)	(0.498)	(0.004)	(0.498)	(0.500)	(0.005)
Earn 15 or more credits	0.349	0.421	0.072	0.381	0.441	0.059	0.381	0.370	-0.012
	(0.477)	(0.494)	(0.002)	(0.486)	(0.496)	(0.004)	(0.486)	(0.483)	(0.005)
N	115,686	78,689	--	31,293	20,838	--	31,293	14,977	--

Notes: Each observation is a student X semester, so most students are included twice. Sample includes only full-time students (i.e., those attempting 12 or more credits) during the 2011-2012 academic year. The "other" category includes students who identify as American Indian, Asian American, Hawaiian, or Multi-racial. Standard deviations (errors for difference) appear in parentheses.

Table 3. Marginal Tuition Pricing and College Credits Attempted: Michigan 4-year Institutions

	Outcome = Attempt 13 or more credits				Outcome = Attempt 15 or more credits			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All cohorts, all Fall and Spring terms	0.093**	0.073***	0.055**	0.067**	0.129**	0.103*	0.098	0.082
(max n = 442,317)	(0.034)	(0.023)	(0.026)	(0.026)	(0.059)	(0.056)	(0.066)	(0.057)
All cohorts, only 2011-2012 AY	0.101***	0.083***	0.064**	0.074**	0.116*	0.093	0.090	0.078
(max n = 194,375)	(0.034)	(0.023)	(0.025)	(0.026)	(0.057)	(0.055)	(0.065)	(0.056)
Only class of 2011, only 2011-2012 AY	0.092**	0.075**	0.058*	0.073**	0.092	0.064	0.057	0.040
(max n = 52,131)	(0.037)	(0.028)	(0.028)	(0.028)	(0.076)	(0.073)	(0.086)	(0.075)
Only class of 2010, only 2011-2012 AY		0.075***	0.056**	0.065**		0.098	0.084	0.062
(max n = 48,074)		(0.025)	(0.026)	(0.027)		(0.064)	(0.074)	(0.062)
Only class of 2009, only 2011-2012 AY		0.094***	0.073**	0.081***		0.119**	0.116*	0.110*
(max n = 48,278)		(0.024)	(0.024)	(0.025)		(0.048)	(0.057)	(0.052)
Only class of 2008, only 2011-2012 AY		0.089***	0.071**	0.075**		0.096*	0.108**	0.104**
(max n = 45,886)		(0.027)	(0.031)	(0.033)		(0.047)	(0.050)	(0.048)
Student controls?	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Institution controls?	None	None	ACT composite	ACT composite	None	None	ACT composite	ACT composite
Sample	All schools	All schools	All schools	Exclude UM-AA	All schools	All schools	All schools	Exclude UM-AA

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Individual controls include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Specifications that pool multiple cohorts also include cohort fixed effects. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Marginal Tuition Pricing and College Credits Earned: Michigan 4-year Institutions

	Outcome = Earn 13 or more credits				Outcome = Earn 15 or more credits			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All cohorts, all Fall and Spring terms	0.055	0.018	-0.025	-0.004	0.081	0.047	0.030	0.018
(max n = 442,317)	(0.071)	(0.040)	(0.032)	(0.019)	(0.057)	(0.040)	(0.045)	(0.039)
All cohorts, only 2011-2012 AY	0.061	0.027	-0.018	-0.001	0.072	0.044	0.029	0.020
(max n = 194,375)	(0.069)	(0.039)	(0.030)	(0.020)	(0.053)	(0.039)	(0.044)	(0.039)
Only class of 2011, only 2011-2012 AY	0.059	0.023	-0.021	0.004	0.059	0.025	0.006	-0.006
(max n = 52,131)	(0.080)	(0.046)	(0.039)	(0.022)	(0.072)	(0.053)	(0.060)	(0.055)
Only class of 2010, only 2011-2012 AY		0.015	-0.032	-0.014		0.046	0.018	0.001
(max n = 48,074)		(0.045)	(0.036)	(0.025)		(0.048)	(0.050)	(0.043)
Only class of 2009, only 2011-2012 AY		0.034	-0.013	0.001		0.061	0.046	0.042
(max n = 48,278)		(0.040)	(0.029)	(0.021)		(0.035)	(0.039)	(0.036)
Only class of 2008, only 2011-2012 AY		0.035	-0.005	0.003		0.047	0.048	0.047
(max n = 45,886)		(0.036)	(0.028)	(0.029)		(0.032)	(0.035)	(0.035)
Student controls?	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Institution controls?	None	None	ACT composite	ACT composite	None	None	ACT composite	ACT composite
Sample	All schools	All schools	All schools	Exclude UM-AA	All schools	All schools	All schools	Exclude UM-AA

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Individual controls include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Specifications that pool multiple cohorts also include cohort fixed effects. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Marginal Tuition Pricing and College Credit Accumulation: Michigan 4-year Institutions, 2011-2012

		Outcome = Credits Attempted/Earned							
		>= 13 credits	>= 14 credits	>= 15 credits	>= 16 credits	>= 17 credits	>= 18 credits	Average Credits	>=30 credits in academic year
	Inst Controls?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Credits Attempted									
2011 cohort, 2011-12 AY	None	0.075**	0.085*	0.064	0.031	0.013	0.005	0.267	0.108
		(0.028)	(0.046)	(0.073)	(0.086)	(0.046)	(0.028)	(0.278)	(0.090)
2011 cohort, 2011-12 AY	ACT comp	0.058*	0.070	0.057	0.034	0.018	0.012	0.264	0.119
		(0.028)	(0.052)	(0.086)	(0.095)	(0.052)	(0.028)	(0.314)	(0.102)
2011 cohort, 2011-12 AY, No UM-AA	ACT comp	0.073**	0.083	0.040	0.001	0.001	0.008	0.225	0.086
		(0.028)	(0.055)	(0.075)	(0.068)	(0.038)	(0.027)	(0.279)	(0.076)
Outcome mean		0.86	0.70	0.49	0.26	0.10	0.04	14.50	0.44
All cohorts, 2011-12 AY	None	0.083***	0.096**	0.093	0.056	0.029	0.012	0.373*	0.111
		(0.023)	(0.036)	(0.055)	(0.058)	(0.036)	(0.021)	(0.208)	(0.065)
All cohorts, 2011-12 AY	ACT comp	0.064**	0.081*	0.090	0.057	0.030	0.017	0.350	0.114
		(0.025)	(0.043)	(0.065)	(0.067)	(0.041)	(0.022)	(0.243)	(0.075)
All cohorts, 2011-12 AY, No UM-AA	ACT comp	0.074**	0.081*	0.078	0.032	0.014	0.009	0.299	0.091
		(0.026)	(0.044)	(0.056)	(0.050)	(0.030)	(0.019)	(0.209)	(0.057)
Outcome mean		0.82	0.66	0.49	0.27	0.11	0.05	14.43	0.40
Panel B. Credits Earned									
2011 cohort, 2011-12 AY	None	0.023	0.032	0.025	0.013	0.003	-0.001	0.005	0.053
		(0.046)	(0.043)	(0.053)	(0.067)	(0.038)	(0.024)	(0.250)	(0.066)
2011 cohort, 2011-12 AY	ACT comp	-0.021	-0.004	0.006	0.011	0.007	0.006	0.006	0.053
		(0.039)	(0.041)	(0.060)	(0.074)	(0.042)	(0.024)	(0.024)	(0.075)
2011 cohort, 2011-12 AY, No UM-AA	ACT comp	0.004	0.014	-0.006	-0.016	-0.007	0.003	-0.192	0.028
		(0.022)	(0.039)	(0.055)	(0.052)	(0.031)	(0.023)	(0.193)	(0.055)
Outcome mean		0.72	0.58	0.41	0.22	0.08	0.03	13.36	0.35
All cohorts, 2011-12 AY	None	0.027	0.039	0.044	0.026	0.013	0.004	0.044	0.053
		(0.039)	(0.031)	(0.039)	(0.044)	(0.028)	(0.017)	(0.227)	(0.046)
All cohorts, 2011-12 AY	ACT comp	-0.018	0.005	0.029	0.021	0.013	0.008	-0.235	0.045
		(0.030)	(0.025)	(0.044)	(0.050)	(0.032)	(0.018)	(0.146)	(0.052)
All cohorts, 2011-12 AY, No UM-AA	ACT comp	-0.001	0.011	0.020	0.002	0.001	0.003	-0.174	0.027
		(0.020)	(0.028)	(0.039)	(0.037)	(0.023)	(0.015)	(0.155)	(0.038)
Outcome mean		0.71	0.56	0.41	0.22	0.09	0.04	13.57	0.31
Sample		All schools, full-time students	All schools, full-time students	All schools, full-time students	All schools, full-time students	All schools, full-time students	All schools, full-time students	All schools, full-time students	Students enrolled full-time for 2 semesters

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Individual controls include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Specifications that pool multiple cohorts also include cohort fixed effects. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Number of observations is 52,131 student X terms for columns (1) to (7) for 2011 cohort and 194,375 for all cohorts. Number of observations is 24,097 and 88,992 individuals for column (8) for 2011 and all cohorts, respectively.

Table 6. Marginal Tuition Pricing and College Credit Accumulation: Impacts by Student Gender and Poverty Status

		Outcome = Attempted/Earned 13 or More Credits					Outcome = Attempted/Earned 15 or More Credits				
		All	Female	Male	Non-FARM	FARM	All	Female	Male	Non-FARM	FARM
	Inst Controls?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Credits Attempted											
2011 cohort, 2011-12 AY	None	0.075**	0.083**	0.066**	0.069**	0.158***	0.064	0.078	0.047	0.062	0.097
		(0.028)	(0.029)	(0.026)	(0.027)	(0.042)	(0.073)	(0.074)	(0.074)	(0.074)	(0.069)
2011 cohort, 2011-12 AY	ACT comp	0.058*	0.066**	0.048	0.052*	0.132***	0.057	0.068	0.043	0.056	0.073
		(0.028)	(0.029)	(0.028)	(0.028)	(0.041)	(0.086)	(0.089)	(0.085)	(0.086)	(0.083)
2011 cohort, 2011-12 AY, No UM-AA	ACT comp	0.073**	0.079**	0.064*	0.068**	0.137***	0.040	0.053	0.022	0.037	0.069
		(0.028)	(0.028)	(0.031)	(0.027)	(0.043)	(0.075)	(0.076)	(0.075)	(0.075)	(0.080)
All cohorts, 2011-12 AY	None	0.083***	0.089***	0.076***	0.079***	0.144***	0.093	0.100	0.085	0.092	0.123**
		(0.023)	(0.026)	(0.023)	(0.023)	(0.030)	(0.055)	(0.058)	(0.054)	(0.056)	(0.047)
All cohorts, 2011-12 AY	ACT comp	0.064**	0.070**	0.058**	0.061**	0.121***	0.090	0.096	0.083	0.090	0.102
		(0.025)	(0.027)	(0.025)	(0.025)	(0.032)	(0.065)	(0.069)	(0.061)	(0.065)	(0.060)
All cohorts, 2011-12 AY, No UM-AA	ACT comp	0.074**	0.077**	0.069**	0.070**	0.123***	0.078	0.085	0.068	0.075	0.100
		(0.026)	(0.028)	(0.027)	(0.026)	(0.033)	(0.056)	(0.060)	(0.054)	(0.057)	(0.057)
Panel B. Credits Earned											
2011 cohort, 2011-12 AY	None	0.023	0.037	0.005	0.019	0.079	0.025	0.036	0.012	0.024	0.042
		(0.046)	(0.044)	(0.051)	(0.046)	(0.050)	(0.053)	(0.056)	(0.051)	(0.054)	(0.047)
2011 cohort, 2011-12 AY	ACT comp	-0.021	-0.004	-0.042	-0.025	0.029	0.006	0.016	-0.006	0.005	0.021
		(0.039)	(0.039)	(0.041)	(0.039)	(0.044)	(0.060)	(0.065)	(0.057)	(0.061)	(0.051)
2011 cohort, 2011-12 AY, No UM-AA	ACT comp	0.004	0.019	-0.017	0.001	0.038	-0.006	0.006	-0.023	-0.008	0.019
		(0.022)	(0.019)	(0.032)	(0.022)	(0.034)	(0.055)	(0.058)	(0.054)	(0.056)	(0.051)
All cohorts, 2011-12 AY	None	0.027	0.042	0.008	0.024	0.068	0.044	0.051	0.035	0.043	0.056
		(0.039)	(0.037)	(0.043)	(0.039)	(0.040)	(0.039)	(0.043)	(0.037)	(0.040)	(0.032)
All cohorts, 2011-12 AY	ACT comp	-0.018	-0.003	-0.036	-0.020	0.012	0.029	0.037	0.019	0.029	0.031
		(0.030)	(0.031)	(0.031)	(0.029)	(0.033)	(0.044)	(0.050)	(0.038)	(0.045)	(0.036)
All cohorts, 2011-12 AY, No UM-AA	ACT comp	-0.001	0.012	-0.018	-0.003	0.016	0.020	0.029	0.008	0.019	0.031
		(0.020)	(0.022)	(0.024)	(0.020)	(0.025)	(0.039)	(0.045)	(0.036)	(0.040)	(0.035)

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Individual controls include dummies for female, black, Hispanic, other race, LEP, FARM, and composite ACT score. Specifications that pool multiple cohorts also include cohort fixed effects. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 7. Falsification Test Using Kalamazoo Promise: High School Classes of 2008 to 2011

	Attempt or earn 13 or more credits		Attempt or earn 15 or more credits	
A. Credits Attempted	(1)	(2)	(1)	(2)
Flat	0.041		0.081	
	(0.035)		(0.055)	
NOT Kalamazoo Promise Eligible	-0.025	-0.007	0.039	-0.009
	(0.026)	(0.029)	(0.037)	(0.029)
Flat * NOT Kalamazoo Promise Eligible	0.071*	0.057	0.033	0.080*
	(0.037)	(0.039)	(0.052)	(0.042)
B. Credits Earned				
Flat	-0.099*		-0.003	
	(0.055)		(0.049)	
NOT Kalamazoo Promise Eligible	-0.095***	-0.035	0.007	-0.017
	(0.030)	(0.035)	(0.029)	(0.027)
Flat * NOT Kalamazoo Promise Eligible	0.147***	0.070	0.058	0.076*
	(0.042)	(0.042)	(0.042)	(0.036)
Student controls	Yes	Yes	Yes	Yes
Insitution fixed effects	No	Yes	No	Yes
Sample	All full-time students	All full-time students	All full-time students	All full-time students
Observations	194,369	194,369	194,369	194,369

Notes: Each column in each panel is a separate regression. In all cases, non-Kalamazoo graduates are re-weighted to resemble Kalamzaoo graduates (
vector of student covariates). Sample is restricted to full-time students. All models include fixed effects for each unique term (e.g., Fall 2011) and col
include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Robust standard errors clustered at the college
p<0.05, * p<0.1.

Table 8. Marginal Tuition Pricing and Number of Courses Taken

		Outcome = Number of Courses Attempted					
		Total number of courses	1 credit courses	2 credit courses	3 credit courses	4 credit courses	5 credit courses
	Inst Controls?	(1)	(2)	(3)	(4)	(5)	(6)
2011 cohort, 2011-12 AY	None	-0.075	-0.040	0.072	-0.410	0.354	0.004
		(0.232)	(0.123)	(0.116)	(0.588)	(0.377)	(0.040)
2011 cohort, 2011-12 AY	ACT comp	-0.101	-0.139	0.072	-0.189	0.202	0.011
		(0.273)	(0.143)	(0.131)	(0.568)	(0.359)	(0.044)
2011 cohort, 2011-12 AY, No UM-AA	ACT comp	-0.067	-0.139	0.072	-0.062	0.105	0.019
		(0.279)	(0.138)	(0.140)	(0.585)	(0.365)	(0.047)
Outcome mean		4.65	0.37	0.25	2.81	1.13	0.08
All cohorts, 2011-12 AY	None	0.025	0.011	-0.016	-0.195	0.229	0.021
		(0.162)	(0.072)	(0.054)	(0.541)	(0.366)	(0.025)
All cohorts, 2011-12 AY	ACT comp	-0.007	-0.031	-0.030	-0.092	0.146	0.024
		(0.187)	(0.091)	(0.062)	(0.551)	(0.371)	(0.028)
All cohorts, 2011-12 AY, No UM-AA	ACT comp	0.034	-0.025	-0.037	0.080	0.023	0.022
		(0.190)	(0.086)	(0.067)	(0.552)	(0.365)	(0.032)
Outcome mean		4.67	0.41	0.25	2.66	1.24	0.08

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Individual controls include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Specifications that pool multiple cohorts also include cohort fixed effects. Robust standard errors clustered at the college level appear in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 9. Marginal Tuition Pricing and College Persistence, First-time Fall Enrollees at MI Public Universities

	Outcome = Enrolled in Any College						Outcome = Enrolled in MI Public 4-year College					
	mean	(1)	(2)	(3)	(4)	(5)	mean	(6)	(7)	(8)	(9)	(10)
Enrolled 1st Spring	0.961	0.003	-0.004	-0.013	-0.008	-0.01	0.935	0.011	-0.001	-0.014	-0.006	-0.009
(max n = 116,581)		(0.015)	(0.011)	(0.011)	(0.013)	(0.011)		(0.022)	(0.014)	(0.013)	(0.017)	(0.011)
Enrolled 2nd Fall	0.918	0.002	-0.015	-0.034**	-0.025	-0.030*	0.837	0.025	-0.006	-0.039*	-0.023	-0.031*
(max n = 87,701)		(0.032)	(0.020)	(0.016)	(0.022)	(0.015)		(0.055)	(0.030)	(0.020)	(0.032)	(0.016)
Enrolled 2nd Spring	0.890	0.009	-0.012	-0.035*	-0.025	-0.030	0.795	0.048	0.011	-0.027	-0.008	-0.017
		(0.038)	(0.023)	(0.017)	(0.026)	(0.018)		(0.062)	(0.033)	(0.022)	(0.035)	(0.015)
Enrolled 3rd Fall	0.864	0.015	-0.013	-0.043**	-0.029	-0.037**	0.763	0.057	0.011	-0.034	-0.011	-0.022
(max n = 58,550)	0.842	(0.047)	(0.026)	(0.018)	(0.029)	(0.016)		(0.072)	(0.037)	(0.025)	(0.038)	(0.016)
Enrolled 3rd Spring		0.016	-0.012	-0.040*	-0.029	-0.035*	0.737	0.062	0.016	-0.028	-0.006	-0.017
		(0.047)	(0.026)	(0.019)	(0.030)	(0.020)		(0.072)	(0.036)	(0.024)	(0.038)	(0.017)
Enrolled 4th Fall	0.824	0.021	-0.008	-0.040*	-0.028	-0.034*	0.724	0.060	0.013	-0.033	-0.011	-0.021
(max n = 29,689)		(0.052)	(0.029)	(0.019)	(0.031)	(0.018)		(0.077)	(0.040)	(0.026)	(0.041)	(0.018)
Enrolled 4th Spring	0.772	-0.019	-0.045	-0.079***	-0.075**	-0.080**	0.675	0.019	-0.022	-0.069**	-0.058	-0.066*
		(0.052)	(0.032)	(0.025)	(0.028)	(0.028)		(0.074)	(0.041)	(0.029)	(0.037)	(0.033)
Individual characteristics			X	X	X	X			X	X	X	X
Institution ACT score				X		X				X		X
Exclude UM-Ann Arbor					X	X					X	X

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" at first institution attended from a separate regression. Sample is restricted to MI public high school graduates from 2008 to 2011 that enrolled in a MI public university in the fall immediately after high school graduation. All models include cohort fixed effects. Individual controls include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Robust standard errors clustered by first college appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 10. Marginal Tuition Pricing and Cumulative College Credits Attempted and Earned as of Winter 2012

	Cumulative credits attempted		Cumulative credits earned		"On-time" cumulative credits earned	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. High school class of 2010 ("On-time" = 60 credits earned by Winter 2012, n = 19,724 students)						
Flat pricing	0.881	0.647	-0.150	-1.283	0.010	-0.019
	(1.026)	(1.193)	(0.942)	(0.798)	(0.048)	(0.050)
Institution controls?	None	ACT composite	None	ACT composite	None	ACT composite
Outcome mean	58.57	58.57	55.42	55.42	0.34	0.34
Panel B. High school class of 2009 ("On-time" = 90 credits earned by Winter 2012, n = 15,152 students)						
Flat pricing	1.745	1.069	0.219	-1.658	0.001	-0.051
	(1.336)	(1.627)	(1.530)	(1.311)	(0.048)	(0.037)
Institution controls?	None	ACT composite	None	ACT composite	None	ACT composite
Outcome mean	88.72	88.72	84.22	84.22	0.36	0.36
Panel C. High school class of 2008 ("On-time" = 120 credits earned by Winter 2012, n = 10,450 students)						
Flat pricing	2.178	1.687	-0.252	-1.980	-0.035	-0.064
	(2.018)	(2.373)	(2.358)	(2.245)	(0.056)	(0.062)
Institution controls?	None	ACT composite	None	ACT composite	None	ACT composite
Outcome mean	118.85	118.85	113.00	113.00	0.37	0.37

Notes: Each cell reports the coefficient on indicator for "Flat Pricing" from a separate regression. Sample is restricted to students enrolled (part-time or full-time) in all fall and winter semesters since high school graduation and for which NSC and STARR data agree on enrollment history. Cumulative credits includes credits taken during summer terms. All models include dummies for female, black, Hispanic, other race, LEP and FARM and composite ACT score. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 11. Marginal Tuition Pricing Policies and Bachelor's Degree Attainment: Michigan's High School Class of 2005

	(1)	(2)
Time to degree (days)	-28.081	-8.459
	(80.647)	(65.097)
Bachelor's degree in…		
4 years or less	0.058	0.015
	(0.139)	(0.104)
5 years or less	0.052	-0.002
	(0.142)	(0.103)
6 years or less	0.037	-0.016
	(0.126)	(0.090)
Student-level covariates?	No	Yes
Institution controls?	No	No
Sample	All schools	All schools
N (time-to-degree outcome)	16729	16729
N (BA degree outcomes)	26808	26808

Notes: Each cell represents a separate regression. Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Student-level controls: female, race, reduced-price lunch eligibility, English proficiency, special education, and ACT composite score. Institutional controls: instructional spending (per FTE) and student support services spending (per FTE).

Table A1. Marginal Tuition Pricing and College Credits Attempted, High School Class of 2011

	Outcome = Attempt 13 or more credits				
	(1)	(2)	(3)	(4)	(5)
Flat pricing	0.092**	0.075**	0.058*	0.073**	0.076**
	(0.037)	(0.028)	(0.028)	(0.028)	(0.028)
Female		0.015**	0.016**	0.017**	0.015**
		(0.006)	(0.006)	(0.007)	(0.006)
Black		-0.140***	-0.146***	-0.141***	-0.138***
		(0.038)	(0.038)	(0.037)	(0.039)
Hispanic		-0.037	-0.041	-0.050*	-0.036
		(0.024)	(0.025)	(0.026)	(0.025)
Other race/ethnicity		-0.015*	-0.022**	-0.016	-0.014*
		(0.008)	(0.009)	(0.010)	(0.007)
Free or Reduced Meal		-0.042***	-0.038***	-0.035***	-0.042***
		(0.007)	(0.006)	(0.007)	(0.007)
Limited English		-0.040***	-0.042***	-0.042***	-0.038**
		(0.013)	(0.009)	(0.011)	(0.013)
Special Education		-0.011	-0.010	-0.010	-0.011
		(0.007)	(0.006)	(0.006)	(0.007)
ACT composite (student)		0.011***	0.008***	0.009***	0.011***
		(0.002)	(0.002)	(0.002)	(0.002)
ACT composite (institution)			0.011*	0.022**	
			(0.005)	(0.007)	
Instructional spending per student ($1000)					-0.001
					(0.002)
Sample	All schools	All schools	All schools	Exclude UM-AA	All schools
Observations	52,131	52,131	52,131	43,270	52,131
R-squared	0.018	0.068	0.072	0.071	0.068

Notes: Sample is restricted to full-time students. All models include indicators for each unique term (e.g., Fall 2011). Robust standard errors clustered at the college level appear in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table A2. Colleges attended by Kalamazoo Promise-eligible vs. Non-Kalamazoo Promise-eligible Students

A. Kalamazoo Students

	Number of students at:			
Institution	Per-credit	Flat	Percent (group)	Percent (total)
Per-credit Institutions				
Central Michigan University	10		6.8	1.9
Eastern Michigan University	13		8.8	2.4
Ferris State University	8		5.4	1.5
Michigan State University	130		88.4	24.5
Michigan Technological	6		4.1	1.1
Oakland University	3		2.0	0.6
Saginaw Valley State University	1		0.7	0.2
Wayne State University	7		4.8	1.3
Flat-pricing Institutions				
Grand Valley State University		33	8.6	6.2
Lake Superior State University		1	0.3	0.2
Northern Michigan University		12	3.1	2.3
University of Michigan-Ann		100	26.0	18.8
University of Michigan-Dearborn		0	0.0	0.0
University of Michigan-Flint		0	0.0	0.0
Western Michigan University		238	62.0	44.8
Total	147	384	--	100.0

B. Non-Kalamazoo Students

	Number of students at:			
Institution	Per-credit	Flat	Percent (group)	Percent (total)
Per-credit Institutions				
Central Michigan University	9676		19.7	11.5
Eastern Michigan University	4370		8.9	5.2
Ferris State University	3672		7.5	4.4
Michigan State University	17869		36.3	21.2
Michigan Technological	2478		5.0	2.9
Oakland University	3869		7.9	4.6
Saginaw Valley State University	2890		5.9	3.4
Wayne State University	4392		8.9	5.2
Flat-pricing Institutions				
Grand Valley State University		9181	26.1	10.9
Lake Superior State University		976	2.8	1.2
Northern Michigan University		2900	8.2	3.4
University of Michigan-Ann		11830	33.6	14.0
University of Michigan-Dearborn		1422	4.0	1.7
University of Michigan-Flint		1478	4.2	1.8
Western Michigan University		7387	21.0	8.8
Total	49216	35174	--	100.0

Notes: College enrollment is limited to the first fall semester after high school graduation and is based on NSC data. Counts include graduates from the Michigan high school classes of 2008 through 2011. Student flagged as simultaneously enrolled in more than one Michigan public 4-year institution in the fall semester immediately following high school graduation are not included in these counts.

Table A3. Robustness to Alternative Inference Methods

	Baseline: Cluster-robust (college)	No SE correction	Heterosk. Robust	Cluster-robust (cohort X college)	Paired-cluster bootstrap	Wild bootstrap-t (no null)	Wild bootstrap-t (zero null)	Two-step group-level
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Attempt 13 or more credits								
Coefficient on flat pricing	0.0649**	0.0649***	0.0649***	0.0649***	0.0649*	0.0649**	0.0649**	0.0559
Standard error	(0.025)	(0.002)	(0.002)	(0.013)	(0.034)			(0.039)
P-value	0.021	0.000	0.000	0.000	0.057	0.008	0.036	0.174
Attempt 15 or more credits								
Coefficient on flat pricing	0.0923	0.0923***	0.0923***	0.0923***	0.0923	0.0923	0.0923	0.044
Standard error	(0.064)	(0.002)	(0.002)	(0.033)	(0.083)			(0.067)
P-value	0.174	0.000	0.000	0.008	0.267	0.364	0.312	0.526
Average credits attempted								
Coefficient on flat pricing	0.350	0.350***	0.350***	0.350***	0.350	0.350	0.350	0.239
Standard error	(0.241)	(0.009)	(0.009)	(0.124)	(0.287)	(0.335)	(0.303)	(0.291)
P-value	0.169	0.000	0.000	0.007	0.222	0.296	0.248	0.428
Earn 13 or more credits								
Coefficient on flat pricing	-0.0166	-0.0166***	-0.0166***	-0.0166	-0.0166	-0.0166	-0.0166	0.005
Standard error	(0.030)	(0.002)	(0.002)	(0.017)	(0.038)			(0.032)
P-value	0.585	0.000	0.000	0.341	0.663	0.668	0.760	0.870
Earn 15 or more credits								
Coefficient on flat pricing	0.0312	0.0312***	0.0312***	0.0312	0.0312	0.0312	0.0312	0.002
Standard error	(0.044)	(0.002)	(0.002)	(0.024)	(0.058)			(0.048)
P-value	0.488	0.000	0.000	0.193	0.589	0.528	0.496	0.967
Average credits earned								
Coefficient on flat pricing	-0.224	-0.224***	-0.224***	-0.224**	-0.224	-0.224	-0.224	-0.0939
Standard error	(0.144)	(0.015)	(0.015)	(0.086)	(0.207)	(0.170)	(0.222)	(0.216)
P-value	0.143	0.000	0.000	0.012	0.278	0.188	0.312	0.671

Notes: Each cell reports results from a separate regression. Sample is restricted to all full-time students enrolled in a Michigan public university in the 2011/2012 academic year. All models include indicators for each unique term (e.g. Fall 2011), cohort fixed effects, dummies for female, black, Hispanic, other race, LEP, FARM, individual composite ACT score, and institution ACT composite score. All specifications are based on 195,829 student-semester observations. Cluster-robust uses T_{14} distribution for critical values (rather than standard normal). Paired-cluster bootstrap resamples complete clusters with replacement and uses bootstrap estimates of the coefficient to estimate standard errors. Wild bootstrap-t (described by Cameron, Gelbach, and Miller, 2008) creates psuedo-samples based on the within-cluster residuals and holding regressors constant, bootrapping the Wald test statistic. The two-step procedure first estimates college fixed effects in a model with all individual regressors, then regresses these 15 fixed effects on indicator for flat pricing and institution ACT composite, weighting by the inverse of the estimated fixed effect variance. Estimates and inference come from this second stage regression. See text for details. Significance *** $p<0.01$, ** $p<0.05$, * $p<0.1$.