Capacity and Flexibility in CTE Programs: Program Offerings and Student Success

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Abstract. This article asks whether small changes to community college courses and programs can help improve student outcomes. We use administrative data from the California Community College system, including millions of student records and detailed course-level information for most career-technical education programs in the state. We construct a summary measure of each program's flexibility, incorporating many components of the availability and scheduling of its courses. We show considerable variation in this flexibility measure across programs and over time. An increase in a program's flexibility is associated with increases in enrollment and completions, but not with changes in its completion rate.

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I. Introduction

Efforts to improve college degree completion have increasingly focused on community colleges, which enroll about 35% of the nation's college students (Snyder, de Brey, and Dillow 2019). This focus reflects several fundamental characteristics of these institutions. First and foremost, community colleges, are open access and low cost institutions, and as such are the primary point of access for postsecondary training. Second, community colleges offer a wide range of academic and career-technical education (CTE) programs leading to both bachelor's-transferrable routes as well as a host of sub-baccalaureate degrees and certificates in a diverse set of fields. Third, they offer flexible course-taking options, catering to full-time and part-time enrollees, many of them pursuing higher education while working and/or taking care of families. However, these signature characteristics of community colleges have also come under scrutiny when confronted with low persistence and completion rates. Only about a third of degree seeking enrollees at community colleges complete a degree or certificate (Snyder et al. 2019).

Today's postsecondary market offers an increasing number of flexible opportunities for degrees and certificates, in the form of private nonprofit and for-profit institutions. Many of the CTE oriented programs offered by these institutions advertise optimum flexibility for degree attainment. In fact, for-profits are often celebrated for their student-centered and flexible approach: year-round enrollment, accessibility, and clear pathways to the degree. However, these programs have also been shown to have negligible returns to degree completion (Cellini and Turner, 2018), while CTE programs within public community colleges have been shown to have high returns (Stevens et al. 2017; Jepsen et al. 2014). Nevertheless, the lack of information and flexibility at community colleges—perceived or realized—may discourage enrollment and completion, especially among employed and older students (Bailey, Norena, and Gumport, 2001).

This paper uses variation across programs in the large California Community College system to examine whether empirical measures of program and course flexibility are associated with increased enrollment or completion in CTE degrees and certificates. A closely related policy question is whether there are easily adjustable program, logistical or scheduling choices within community college CTE programs that can be used to better attract and support students, perhaps to compete more effectively with the perceived advantages of for-profit programs. Specifically, we ask two research questions.

First, are there observable indicators of flexibility in community college CTE programs that can be measured and tracked over time? We compile information on the scheduling and timing of each of course in each program, from 2001 to 2014. This includes whether courses are offered multiple times per year, how many times per week, and when during the day. We aggregate all this information into a summary measure of flexibility, which reduces dimensionality.

Second, are these measures of flexibility associated with greater enrollments and better degree outcomes, such as an increase in the number or rate of completions or a shorter time to degree? To preview our results, we find that a one standard deviation increase in a program's flexibility index—a very large increase—is associated with a doubling in the number of new students in the program. However, this size of increase in the flexibility index is also associated with a doubling in the number of completions. Taken together, these two results suggest that although flexibility may induce enrollment, there is no corresponding change in completion rates as a result of the change in flexibility. We also do not find any evidence of changes in time to degree.

II. Prior Research

More students enroll in college than ever before, but increased access to postsecondary education has been met with stagnant completion rates and increasing time to degree completion. Bound, Lovenheim and Turner (2010) suggest that the increases in time to degree occurred mostly among students beginning college at less selective public institutions, such as community colleges. Moreover, Bound, Lovenheim and Turner (2010) find that declines in resources per student at these institutions account for a significant portion in the observed drops in college completion.

National efforts to increase college degree attainment have focused heavily on community colleges (Bosworth, 2010; Holzer & Nightingale, 2009). Growing awareness of the need for post-secondary training beyond traditional academic programs, combined with long-term declines in the real earnings of Americans without college degrees, makes it essential to better understand the supply and demand of CTE programs in community colleges. Moreover, increasing accountability pressures for degree completion provide incentives for community colleges to strengthen CTE programs (Fain, 2018).

Students who enter college, particularly those who attend open-access institutions, may fail to complete an intended degree for many reasons. Some of these reasons may be due to the individual student's background: lack of continuing interest (Manski, 1989); weak information (Deil-Amen & Rosenbaum, 2002; Person, Rosenbaum, & Deil-Amen, 2006); lack of preparation or ability, which may require additional developmental coursework (Bettinger, Boatman, &

Long, 2013; Kurlaender, 2014); or financial constraints that limit participation or require balancing work with school (Singell, 2004; Ehrenberg & Mavros, 1995; Siegfried & Stock, 2001; Glocker, 2011; Bettinger & Long, 2004; Dynarski, 2005; Volkwein & Lorang, 1996). Institutional differences may also matter. Several studies have explored variation in community college quality and its effect on degree completion and transfer rates (Cunha and Miller, 2014; Clotfelter, Ladd, Muschkin, and Vigdor 2013; Ehrenberg and Smith, 2004; Kurlaender, Carrell, and Jackson 2016; Stange 2012; Calcagno et al. 2008).

Research on which specific institutional practices lead to higher retention and degree receipt point to student interaction with faculty and peers, sense of community, active engagement with the institution, and mentoring (Astin, 1993; Braxton, 2000; Habley, Bloom, & Robbins, 2012; Umbach & Wawrzynski, 2005; Lotkowski, Robbins, & Noeth, 2004; Tinto, 1993). Many of these studies fail to adequately control for endogenous selection of students into programs, however, and thus risk overestimating the effect of institutional practices and policies.

Several experimental and quasi-experimental studies have explored specific institutional practices and programs and their impact on persistence and degree attainment. One of the most canonical experiments at community colleges is CUNY's Accelerated Study in Associates Program, which couples tuition waivers with intensive counseling and other structural supports, and finds large positive effects on graduation rates and transfer to four-year colleges (Scrivener et al. 2015). Sommo, Mayer, Rudd, & Cullinan (2012) find generally positive effects of learning communities on long-term outcomes, such as graduation, and modest short-term outcomes. Evans, Kearney, Perry, and Sullivan (2017) evaluate a program called Stay the Course, which is designed to address the "life barriers" that challenge many economically disadvantaged students. The program provides mentoring services and emergency financial assistance to community college students in Texas. Preliminary results show that the mentoring services combined with access to emergency financial assistance for non-tuition expenses improve persistence and completion rates, though results are only statistically significant for women.

One potentially important but less widely understood source of institutional variation in degree completion and time to degree, is institutional resource constraints. Bound, Lovenheim, and Turner (2010) propose that overcrowding at public institutions contributes to reductions in rates of college completion and increases in time to degree. One key mechanism by which resource constraints may impact student completion outcomes at open access institutions is through a shortage of courses or program enrollment caps.

The effect of resource constraints may take other forms a well. Students who confront enrollment constraints early in their careers, especially constraints on required or prerequisite courses, may switch programs or extend their time to degree. This may have a ripple effect for those students forced to defer, as they postpone taking courses that are prerequisites and thus delay taking more advanced courses as well. CTE students are very commonly part time students. If courses are sequenced, and offered only once per year, their progress may be slowed by lack of appropriate course work in a given semester. To date these types of mechanisms have been largely unexplored in the literature.

In this paper we examine whether features of the capacity and flexibility of California community college career technical education (CTE) programs affect student academic progress and success. We focus on several malleable factors of program capacity, such as the timing and frequency of course offerings in a given term, as well as the number of sections or sessions available for a given course. Because these factors have rarely been systematically studied, our empirical examination is somewhat exploratory. Importantly, we begin by examining a number of factors under the regular control of program and college administrators that could potentially contribute to greater flexibility in course offerings. We then examine the association between these indicators of flexibility and a number of student outcomes. While a clear causal relationship running from flexibility to student outcomes is beyond the scope of this study, the empirical relationships we show can reflect both the extent to which program decisions may respond to student demand, and thus, may suggest potential ways in which outcomes can be improved.

III. Data and Sample

a. Data Sources

The California Community Colleges system is the largest public higher education system in the country. We use detailed administrative records from the California Community College Chancellor's Office (CCCCO) for over 2.6 million students enrolled at any of the 114 colleges in the system between 2001 and 2016. For each student in each semester, we observe each course taken, grades in that course, and term-level financial aid information. We also have information on demographic characteristics of students and degrees or certificates received. We group degrees and certificates into associate's degrees, large certificates (comprising at least 30 units), and small certificates (between 12 and 29 units). In general, 30 units is a full year's worth of coursework for full-time students, so large versus small certificates can also be interpreted as lasting approximately more or less than a year.

We categorize students as enrolling in "programs," which we define as a combination of a field of study, type of degree or certificate (i.e. associate degree, small certificate, or large certificate), and a college. We define fields of study by their Taxonomy of Programs (TOP) code, a system unique to California's community colleges but similar to the more commonly used Classification of Instructional Programs (CIP) codes. All community colleges in the state are required to use the TOP code, which grants us a uniform categorization of the topical content of degrees and courses across time that is common across all of California's community colleges. The CCCCO identifies a specific set of TOP codes as CTE, which allows us to note students who take such courses and earn CTE-identified degrees. In this analysis we focus exclusively on CTE programs. An example of a program is an associate's degree in Registered Nursing (TOP Code 1230.10) at Sacramento City College, or a small certificate in Cosmetology and Barbering (TOP Code 3007.00) at American River College. Many programs exist throughout the entire time period we study, while some programs start after 2001 or end before 2016[1]

The CCCCO data also include detailed information on each course offered at every college in every term. Each course is identified by a unique number that allows us to link it across terms within a college, even if the course name or number changes.[2] Each course is also identified with a TOP code, allowing us to link courses to the programs for which they train students.[3] There are additional records for each section of each course each term, with information on time and days of the week each section is offered, and the mode of instruction.

b. Sample Construction

[1] We define a program existing as having a nonzero number of completers in a year.

[2] Some colleges change their internal course numbering schemes, so a class might be called Welding 1A in one term but Welding 101 in another. Similarly, Welding 1A might be named "Introduction to Welding" in one year and "Welding Principles" in another. The CCCCO's system-wide identification number remains the same across time as long as the content of the class is the same.

[3] We are not able to identify the set of required courses for each degree or certificate, so it is likely the case that certain courses are required for programs in a separate TOP code. We focus on CTE programs, however, where this is less likely to occur than in academic programs. For example, math classes are required for many CTE programs, but we ignore math classes for the purposes of this analysis because it is not a CTE field.

Our sample consists of CTE programs that offered at least one course between the 2001 and 2014 academic years. Some programs are quite small, and there are some colleges that may offer courses in a TOP code but no degree or certificate. We exclude TOP codes for which at least 75 percent of the programs in the TOP code had no completers in any year. Table 1 shows the number of programs in the sample in the 2001 and 2010 academic years. In 2010 the data include approximately 2700 programs, half of which are AA degrees or certificates requiring 60 or more units. An average program is offered across 27 different colleges each year. In our analyses, we make use of differences in the characteristics of course offerings across colleges and TOP codes, as well as over time. The table also shows the number of degrees and certificates per program in those years.

For each program we focus on four separate outcomes. The first is the number of entrants to the program, which we define as the number of students who enroll in a course in the program for the first time that semester. A student may be an entrant at more than one program. Because the set of courses in a program do not depend on the award type, two programs in the same TOP code in the same college will have the same number of entrants that term.[4] The second outcome is the number of completers that term. The third outcome is the mean time to degree for completers that term. We define time to degree as the number of years since a student's first term taking a course in the TOP code and the spring of the completion year, since all degrees and certificates are coded in the dataset as having been awarded in the spring semester. The final outcome is the share of entrants in a particular term who ultimately complete the program within 200 percent of the time required. We define the amount of time required as how long it would

[4] For example, consider a college that offers a large and a small certificate in Cosmetology and Barbering (3007.00). The course list for both types of awards will be the same at that college, so we consider any student who enrolls in a course in the 3007.00 TOP code at that college to be an entrant for the large as well as the small certificate programs.

take to complete the program as a full-time student. For an associate's degree, 200 percent time is four years; for a large certificate it is also four years, and for a small certificate it is two years. We select entering cohorts for which we are able to observe students until the calendar years representing at least 200 percent of normative time for completion to avoid excessive censoring of degrees still in progress.

c. Explanatory Variables

We are interested in how a program's flexibility affects its size and the academic outcomes of its students. We compile a long set of course-level characteristics, and take the program-level mean for each academic year. We initially construct a large set of characteristics to describe the timing and flexibility of courses in these programs. For example, we create a number of variables to summarize the terms, days, and times of each unique course offering. For the timing of courses, we define the morning as starting before noon, the afternoon as starting between 12-4pm, and the evening as starting after 4pm. One advantage often cited by for-profit institutions is that enrollment occurs year-round, so that students do not have to wait until the beginning of a traditional academic year to begin a program (Deming et al. 2012). To mimic the potential advantage of year-round enrollment, we calculate, for each program, the fraction of classes that are offered 3 times in a given year—fall, spring, and summer sessions. The idea is that students may be particular attracted to programs in which more courses are offered multiple times per year. This is particularly important if programs have required course sequences and prerequisites. We also include the fraction of courses offered both fall and spring, which would provide two opportunities per year to take required introductory courses. Working individuals may prefer programs that offer evening courses, or meet fewer times per week, or provide multiple day and time options. Thus, we also include a number of variables describing both time of day and the number of course meetings per year.

Panel A of Table 2 shows program-level means; on average, each program offered approximately 20-25 courses, with around 3 sections of each course. Panel B of Table 2 shows course-level means. For example, 81 percent of classes are offered during the spring term, 68 percent during spring as well as fall terms, and 20 percent of its classes in all three terms (fall, spring, and summer). Around 40 percent of courses are offered in a format with only a single course meeting per week, and 41 percent are offered during the evening. Weekend offerings are relatively rare, with just 8 percent of courses offered on weekends as of 2010.

To avoid a multiple comparisons problem and to improve interpretation of the results, we use the program characteristics to form a summary measure of flexibility. Following the commonly used approach to form an index of characteristics (e.g. Kling et al. 2007, Hoynes et al. 2016), we first create program-by-year means of each of the components from panel B of Table 2. We then standardize each of these components to have mean zero and standard deviation one. The flexibility index for each program each year is the mean of these individual standardized components. Column 1 of Table 3 shows the correlation between the index and its components. Some correlations are negative; we flip the sign of these variables when constructing the index, so that a higher value of the index indicates a more flexible program. In general, the sign of the sub-components is intuitive. For example, there is a negative correlation between the flexibility index and having a higher share of courses being offered only in the Fall, only once per week, or only on weekdays.

As the first column of Table 3 makes clear, however, not all the components of the index are strongly correlated with the resulting index. This means that some components may not contribute much to the index. To use just the components that are strongly correlated with each other, we calculate the Cronbach's alpha for each combination of components, removing each component at a time. We then create an index that uses only the components that do not increase the alpha when they are left out. The resulting set of components for this selective index is shown in the second column of Table 3. The correlation between the two indices is high, at 0.91, so for the main analysis we use the full index from the first column.

The use of this type of index has advantages and disadvantages. The advantage is that it avoids spurious conclusions that could come from the seemingly endless number of individual measures of flexibility that could be constructed—some of which would likely be statistically significant simply by chance. The index also provides an empirical representation of the vague notion of "flexibility" that is often touted by for-profit programs. For this reason, we begin our empirical explanation with the flexibility index. The disadvantage of the flexibility index is that it obscures the concrete factors that community college leaders have the ability to control and that may actually drive any potential effects on enrollment or completion. Thus, we follow the index-based empirical results with some analysis of key individual components, to add to our understanding of what specific scheduling strategies may contribute to effects on student outcomes.

Our expectation is that the extent of flexibility in programs—as proxied by the index—will be related to the nature of the field of study. For example, more scientific, or technical, CTE fields might have more required courses and prescribed course sequences and as such have less flexibility. Areas of study for which workers face continuing education requirements may have a greater number of non-required courses that are offered outside of strict sequences and so may appear to be more flexible according to the index. To provide a glimpse into how the flexibility index varies across disciplines, Table 4 lists the disciplines (by length of degree and certificate) with the highest and lowest levels of flexibility. A number of technical health fields (dental assistant, phlebotomy, medical assisting, veterinary technician) are among the lowest flexibility disciplines. In contrast, business administration programs, family and consumer sciences, and cosmetology show up as among the most flexible CTE programs.

Before detailing the regression analysis we use to understand the relationship between flexibility, enrollments and other outcomes, Figure 1 plots the time pattern of our flexibility index, including the 25th, 50th, and 75th percentile of the index, separately by length of the degree.[5] Figure 1 also separately shows one component of that index, the fraction of courses offered on-line. As we discuss below, the online course measure is unique in that all colleges begin the period with no online offerings and so the variation over the years in that component deserves some separate discussion. For the flexibility index as a whole, the time patterns are consistent across different degree lengths and are similar at different parts of the distribution, suggesting that common factors are likely driving flexibility changes over time for a variety of programs.

The general pattern in panels a through c of Figure 1 shows slight increases in flexibility between 2001 and the start of the recession and state budget crisis in 2008. The median of the flexibility measure fell starting in 2008, but then reversed and began to rise again as the state economy recovered in the last few years of our sample. This suggests the important role that budget constraints may play in what we are measuring as flexibility. Increased flexibility may also reflect the relaxation of constraints on course offerings driven by resource constraints. In the descriptive results below, we attempt to pull apart these broad trends to better understand how

[5] The figure weights by the size of each program. Since larger programs tend to have higher flexibility index, this means that the median (and also the mean) are above zero.

flexibility may be related to enrollment and program completion numbers, time to degree, and rates of completion. In particular, we ask whether programs at colleges with greater flexibility in their course schedules and offerings are associated with greater enrollments or completions. We also estimate regressions that control for all cross-sectional differences across colleges and programs and ask whether enrollments and outcomes improved in the programs that were increasing their degree of flexibility.

IV. Empirical approach

Our flexibility index summarizes key aspects of course timing and flexibility. Next, we use some simple regressions to better summarize the relationship between CTE enrollments and completion and these aspects of flexibility. We are not in a position to make strong causal claims, but can use regression techniques to understand the association between these measures of student access and progress and the timing and logistics of CTE course offerings. Specifically, we collapse our individual data to field of study *p*, by year of cohort entry *t*, by community college *c*, and estimate several regressions of the following form:

$$(1)\ \mathrm{Y}_{p,c,t+s} = \alpha_p + \gamma_t + \theta_c + \pi flex_{p,c,t+r} + \beta D_{pct} + +\varepsilon_{pct}$$

We consider several outcomes. The first is the number of entrants into the program, defined as the number of students who enroll in a course within the program for the first time during semester *t*. The second outcome is the number completing the certificate or degree. The third outcome is average time to completion among degree/certificate recipients; the fourth is the number completing the degree within 200% of the normative time for full-time enrollment. We present results for a variety of specifications including different sets of controls to understand how the association changes as covariates are added. We also estimate separate regressions for programs of different lengths. To avoid excessive volatility in the flexibility index, we use 3-year moving averages for the index, so that flexibility at time t is a function of the average of the program's index across years *t-1*, *t*, and *t+1*.

The relative timing of the dependent variable varies across different outcomes. For specifications examining the number of new enrollments in a program, we set *s* and *r* to 0 in equation 1 and look at the relationship between entrants in year *t* and the 3-year average flexibility index centered at year *t*. For the numbers of students completing, we set s equal to twice the normative time for completion of the particular degree or certificate (1 year, or 2 years) and set *r* so that the flexibility measure is centered at the expected midpoint of enrollment in the program.[6] Time to completion and number completing at a certain time are defined similarly.

Our empirical approach makes use of two sources of variation in our data. In specifications without program-level fixed effects, we are using variation across colleges as well as variation within programs over time. When we add program effects to the specification, variation in the flexibility index comes from differences in the evolution of flexibility over time in different programs and on different campuses. Essentially, this uses the interaction between program and year to identify the correlation, with fixed effects to control for cross sectional differences in any given year and statewide annual changes.

Before presenting regression results, we provide some evidence of the extent of variation available in our data. If fields of study are highly standardized across campuses or change together in response to discipline-specific mandates, we may lack variation over time or across disciplines within a specific college. Because we rely heavily on the interaction of time and

[6] Our results are not sensitive to alternative specifications of the timing of flexibility and enrollment.

program effects, we examine how much variation exists in our data in year-to-year changes across programs. To do this, we plot the distribution of program-level changes over time (from 2001-2003 to 2012-2014) in the flexibility index. These are displayed in Appendix Figure 1. These changes have means close to zero but display substantial variation around the mean. For example, among small certificates, there are substantial changes both below -0.25 and above 0.25 standard deviations of the index. There is a similar distribution around a mean of zero for larger certificates and AA programs.

These figures show substantial variation in the flexibility index within program over time, but raise the question of what types of changes in the individual components of the index drive these changes. In Table 5 we display the components of the index for the five largest observed changes in flexibility over the full length of our sample (2001 to 2014). This exercise provides a glimpse of what size of program-level changes would lead to large increases in flexibility as measured here. To illustrate, column 1 shows a program in Business Management that increases the flexibility index by 1.24 over the period. This is driven largely by a big change in the number of courses that are offered spring, summer, and fall. Essentially, the program seems to initiate a full offering of courses during the summer term, which raises that element of the index substantially. Another large change, of approximately 1, in the flexibility index is shown in column 3 with the introduction of on-line offerings. This program goes from offering no online courses to being fully online, with the fraction of courses offered online equal to 1. Most changes in the index will be driven by less extreme changes in the individual components, but these examples serve to illustrate what types of changes can drive large changes in measured flexibility.

V. Results

a. Measuring flexibility through the index

Table 6 shows the results from regressions of the number of entering students in a program and the degree of flexibility. The first column shows results when we include only year and program fixed effects. In this specification, variation in the degree of flexibility comes from the interaction of program, college and time. The identification comes from differences in the evolution of flexibility measures over time in different programs and from variation across college campuses. For programs of all sizes, results suggest that increased flexibility is associated with increased numbers of students enrolling in those programs. The point estimates here reflect the effect a one standard deviation change in the flexibility index. Recall, from the exercise above, that a change of this magnitude in flexibility would reflect a substantial change in the availability or timing of course offerings. For such a change, results indicate an increase in entrants to the program of between 400 and 550 students, a large change given the average number of entrants (the mean of the dependent variable) of 380 to 500 students.

In some sense the positive relationship between flexibility and enrollment should not be surprising since many of the elements of flexibility may be associated with having growing demand for the program. For example, offering more classes during every academic semester (fall, winter, and summer) is not likely to occur in programs with shrinking enrollments, and so this should not be viewed as evidence of a causal relationship operating from changes in flexibility to changes in enrollments. Still, other elements of the index are less obviously tied to growth in overall student demand, such as scheduling courses on weekends, or in the evening, and as such may point to the possibility that greater flexibility in this community college setting can help attract new students.

In column 2 we add controls for the demographics of students enrolled in the program, including gender, race, and mean age. Because differences in student populations across colleges and programs may affect our outcomes, it is important to test for sensitivity to these characteristics. For enrollment, adding demographic controls, in addition to time and program fixed effects, does not substantially change the magnitude of the estimated association between flexibility and entrants. Finally, in column 3 we add dummy variables for the community college. This isolates time series variation in the degree of flexibility within colleges and specific programs as the key source of identification. The effect of flexibility is identified from differences in the evolution of flexibility over time in different colleges and programs. The coefficients fall slightly, but remain sizeable relative to the mean number of entrants and are strongly statistically significant. This suggests that increases in flexibility within a program are associated with growth in the size of entering cohorts. Consistent with the notion that for-profit colleges are able to attract students partially through their flexibility with respect to timing and start dates, public community college programs are also able to grow enrollments by, or meet growing enrollments with, increased flexibility in their offerings and scheduling.

Table 7 summarizes our estimates of the relationship between the number of students completing a program in a given year and the extent of flexibility over that cohort's normative years of enrollment. For this outcome, we relate completions in the years after an entering cohort's expected completion year to the extent of flexibility measured between their entry year and the expected year of completion. As was the case for entrants, the coefficients are fairly stable across the three specifications and so we focus primarily on column 3 including the full set of fixed effects for year, program, and college, along with controls for student demographics. These results show a strong positive correlation between flexibility and the number of completions in a given year. The magnitude of the coefficients suggests that a standard deviation increase in flexibility is associated with between 11 and 27 additional students completing degrees or certificates. Scaled as a percentage of the mean number of students this represents approximately a doubling of the number of students in a given program-college combination. Given the increases in program enrollments noted in Table 7, this suggests that completion *rates* remain roughly constant; that is, as flexibility increases, completions increase in roughly the same proportion as enrollments.

Two key points are important in interpreting the results from Table 7 on completion. First, the coefficients are large, and if viewed as a causal response, would suggest a very large change in the number of students entering and completing degrees due to increased flexibility. We caution that these coefficients are likely to reflect reverse causality, as programs increase course offerings and flexibility in those programs and years with high student demand. Second, this interpretation of reverse causality is also important on its own. Specifically, this suggests that individual programs can be quite responsive to increased demand, or larger entering cohorts, and adjust the scheduling and offering of classes in a way that, at worst, seems to keep completion rates constant.

Tables 8 and 9 address the issue of completion rates and time to degree more directly, examining time to completion among those who do complete certificates and degrees, and the probability of completing a program within twice the standard time to completion. Examining time to degree is necessarily estimated on a censored sample of only those who do complete before the end of our sample, and thus should be interpreted accordingly. Looking at completion within twice the expected length of the degree is appropriate given that more than half of community college students enroll in community college programs part-time (Snyder et al. 2019). Thus, we would expect, for example a program with one year of full-time course work to take at least two years for many students.

Our results confirm that there is little association between the speed of students' completion of degrees and the extent of flexibility in the program offerings. Table 8 shows no statistically significant association between flexibility and time to completion for any degree types, and regardless of the controls included. The point estimates themselves are very small relative to the mean completion times, which range from just over three years for the shortest certificates to more than four years for AA degrees. In table 9, small certificates and AA degrees show no evidence of a statistically significant correlation between flexibility and the probability of completion. For longer certificates there is a positive and statistically significant coefficient on the flexibility index that suggests an increase in the probability of completion of approximately 30%. Overall, these tables provide little consistent evidence that changes in flexibility are related to changes in the likelihood or speed of completion.

Taken together, Tables 6 through 9 show that flexibility may attract more students to a particular program, and those additional students seem to complete these programs at roughly the same rate, or over the same time frame, as those attending prior to the increased flexibility. The pattern of findings is not sensitive to the nature of the variation used. In some specifications we focus on variation across different colleges that may differ from one another in their overall scale or enrollment management practices, and so also differ systematically in the extent of flexibility they offer. Results are similar, however, if we eliminated the cross-sectional variation across colleges and rely instead on differences in the evolution of flexibility over time within programs and colleges. That is, differences across program-college pairs in the evolution of flexibility over time are positively associated with changes in enrollments and completions over time.

Many students enrolled in CTE programs are older than traditional college ages and frequently combine substantial employment with part- or full-time study. For these older students, flexibility may be particularly important. In Table 10 we show stratifying the sample according to age at students' initial enrollment. We find no evidence that students entering CTE programs at age 30 and beyond are more responsive to various types of flexibility. Point estimates are often smaller for the over 30 students, but this seems to reflect the smaller means for entrants and completions among that group.

We have also estimated regressions that isolate individual components of flexibility that may affect the same student outcomes.[7] Specifically, we consider the effect of the fraction of courses offered online, the fraction offered spring, summer and fall, those offered just once per week, and those offered on weekends on the number of students completing programs of study. There are significant and positive effects of offering programs on line for longer certificates and for AA/AS degrees, but this result is not robust to the addition of college fixed-effects, which focuses variation purely on differences in the timing of online offerings. In contrast, all program types show increased numbers of students completing as a result of offering courses in all parts of the academic year, and this is robust to the inclusion of college fixed effects. Other components of the index are statistically significant on their own only in fairly isolated cases—some types of programs or in some specifications. This supports our decision to focus on the composite index, which increases the statistical power and avoids problems of multiple coefficient testing.

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

b. Event-study approach

To provide a richer description of how changes in components of flexibility may be related to changes in student outcomes, we also estimated event-study models for two types of events—introduction of online courses and shifts to offering a year-round curriculum, with most courses offered fall, spring, and summer. This can show whether discrete changes in these components of flexibility are associated with similarly discrete changes in enrollments or completion. Specifically, we estimate event-study models summarized by:

$$y_{ict} = \alpha_1 + \sum_{Gmin,g\neq 0}^{\neq Gma} \beta_g \, \mathrm{I(t{=}g)} + X'_{ict}\gamma + \delta_i + \delta_t + \delta_c t + e_{ict}$$

Here, y_{ict} represents a student outcome in program i, at college c in year t. We include indicators for years prior to and after the year of the event in question (i.e. introduction of online-courses or a move to offering most classes in all semesters). We also include student demographic controls and fixed effects for the program and year. Finally, we include college fixed effects interacted with a time trend.

Figure 2 summarizes the event study for student outcomes before and after the introduction of online coursework in specific colleges and programs. For all outcomes there are two clear patterns. First, the introduction of online courses seems to occur in programs that are experiencing positive trends in enrollment and completion numbers. There is a clear upward trend in enrollment and completion prior to the year in which online courses are introduced. This trend generally continues in the years after online courses are offered. Relatedly, there is little evidence in these event study figures to suggest that the addition of online courses changes the level or trend of student outcomes. This suggests that additional flexibility through online offerings will not lead to increased enrollment. Instead, it suggests that online options are a response by colleges to accommodate growing programs with high demand. Thus, these results provide a negative answer to the question of whether online courses automatically improve student outcomes, but also show that they are an important part of how CTE programs are now managing enrollment demand.

Figure 3 repeats this event study approach for programs that switch to year-round enrollment. In this case we define the event as programs that have an increase of more than 50 percentage points in the fraction of their courses offered in all three academic terms (fall, spring, and summer). There is little evidence of a sharp break in any of the outcome trends around this change in the fraction of courses offered in every term. Trends in the outcomes are less clear here, and sometimes suggest a negative correlation between flexibility and student success. These results should be viewed cautiously. In addition to the small sample sizes, this event-study set up does not account for the possibilities that these events are reversed in subsequent years.

VI. Conclusion

As CTE programs within community colleges attempt to improve both the number of students they serve, and the degree outcomes of those students, a number of potentially effective levers may be available. This paper examines whether program and course scheduling and formatting features are associated with student enrollments and completion. Our goal was to examine the possibility that these mutable features of programs can together affect the flexibility of programs and thus affect student interest and success. We find strong evidence that flexibility and program-level student enrollment and completion are positively correlated.

Our results show that offering most classes multiple times per year, at different times of the day, and having online options—among other individual factors—can increase the degree of flexibility for CTE students. In turn, greater flexibility is associated with higher numbers of students both enrolling in and completing CTE programs. We find no association between flexibility and time to degree or completion of degrees within a specified time frame. Increased flexibility thus seems to be associated with more students entering, and these additional students are able to complete programs at approximately the same rate. These results need to be interpreted carefully and as preliminary descriptive information about the empirical relationship between flexibility and student outcomes. This information is important even if we view it as evidence of CTE programs responding to actual or anticipated student demand or student needs, and not as exogenous changes that causally affect student outcomes. Our analysis shows that changes in program features and scheduling can, at times, be used to accommodate or respond in the short-term to changes in program demand or enrollments.

The fact that year-over-year changes in the extent of flexibility are positively correlated with the numbers of students who complete CTE programs is similarly important. As we note above, previous research has found mixed evidence on the idea that capacity constraints and overcrowding can slow student progress. Our results on flexibility hint that there is also a danger that small programs with plenty of capacity for additional growth could also slow progress. If, for example, programs are too small to offer key courses more than once per year, they may not be able to offer the type of flexible, year-round, offerings we analyze here. One of the major concerns with interpreting our positive association between flexibility and outcomes in a causal way is that we do not know under what conditions programs choose to increase flexibility. If programs become more flexible in response to high student enrollments, we cannot attribute increased completions to the flexibility, but may want to focus on flexibility along with concerns about capacity to reach conclusions about how best to serve the most students.

Finally, our results point to the possibility that online programs can improve flexibility, but we see little evidence that they have improved student completion rates. These results, in particular, should provide the basis for additional research, and perhaps experimentation in program or course flexibility, that can help community colleges use scheduling and other factors optimally to increase student degree and certificate completion.

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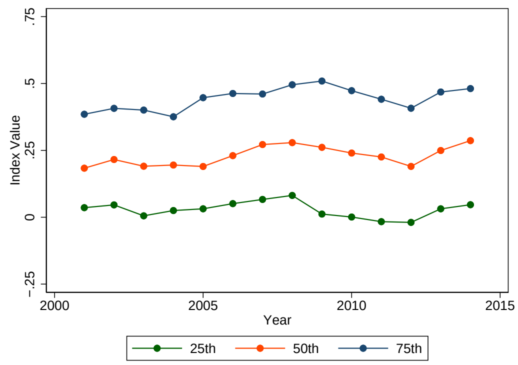
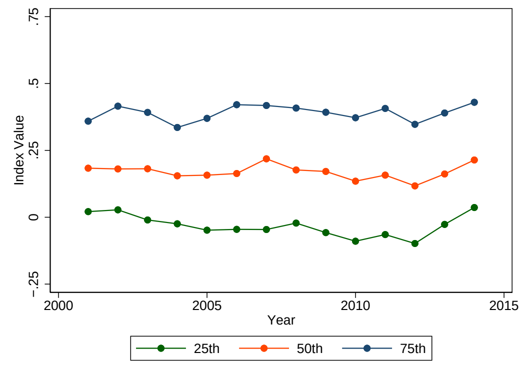
1 Figures and Tables

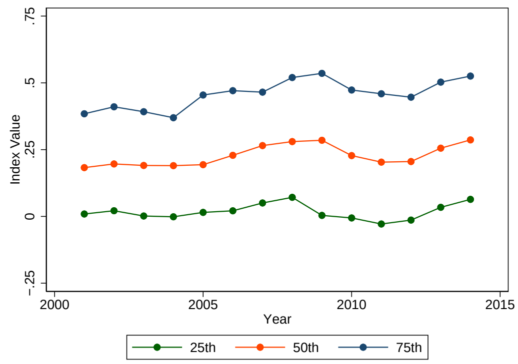
Figure 1: Trends in Flexibility Index and Programs with an Online Course



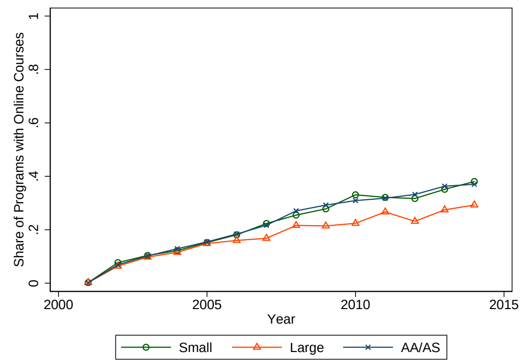
a) Small Certificate Programs



b) Large Certificate Programs



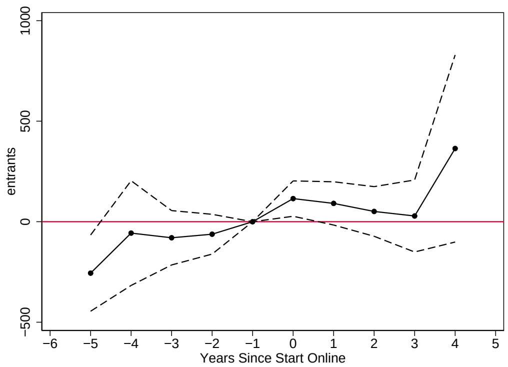
c) AA/AS programs



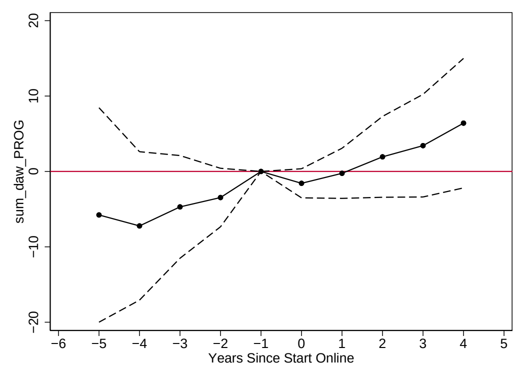
d) Online

Notes. Panels a, b, and c show the median, 25th and 75th percentile at the program level, with one observation per program per college per year. Results are weighted by the number of entering students. Panel d shows the share of programs with at least one online course.

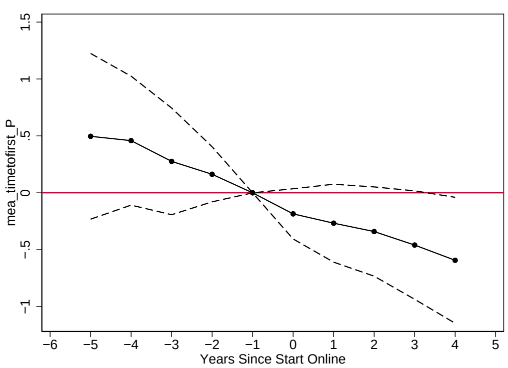
Figure 2: Estimates from Event Study of Introducing an Online Course to a Program



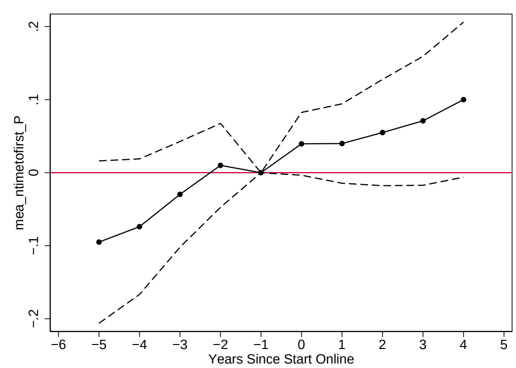
a) Entrants



b) Completions



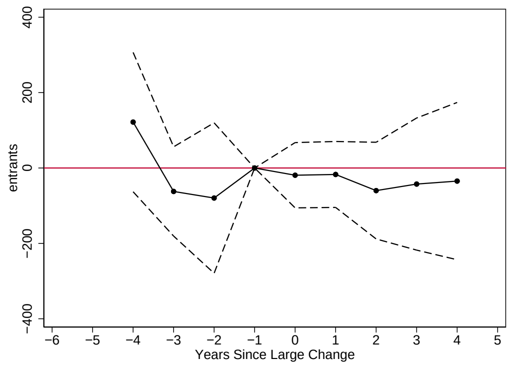
c) Years to Degree



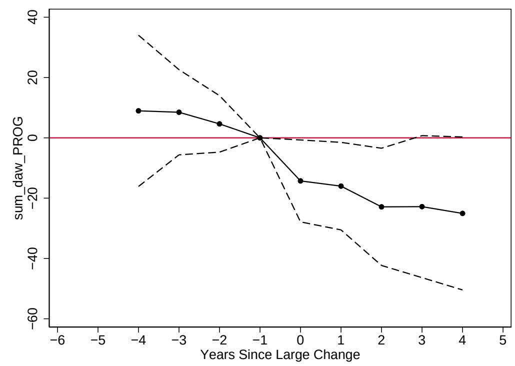
d)<200% Time

Notes. Limited to programs that started their first online class prior to 2008. Regressions control for year and program fixed effects and, except for panel a), weight by the number of entrants. Point estimates and 95 percent confidence intervals shown.

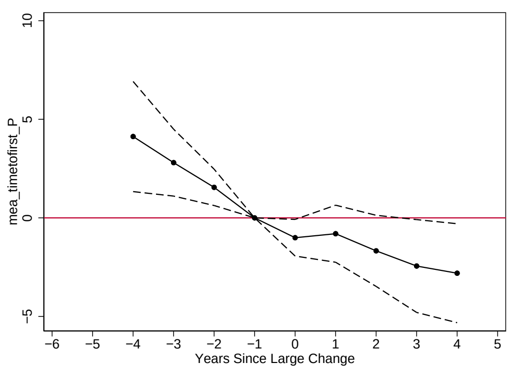
Figure 3: Offering Year-Round Classes Event Study



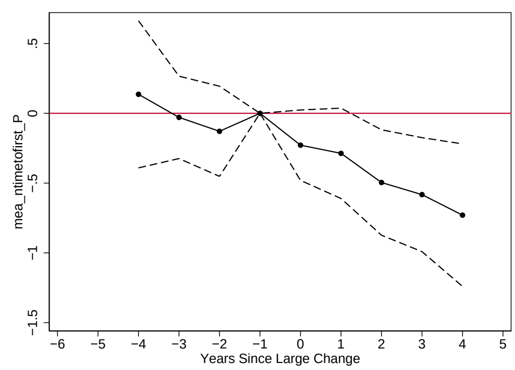
a) Entrants



b) Completions



c) Years to Degree



d)<200% Time

Notes. Limited to programs that had their share of courses offered summer, spring, and fall increase by at least 50 percentage points from one year to the next. Regressions control for year and program fixed effects and, except for panel a), weight by the number of entrants. Point estimates and 95 percent confidence intervals shown

Table 1: Program Summary Statistics

	2001	2010
Programs	2683	2766
6-29 Unit Certificates	794	934
30-59 Unit Certificates	674	430
AA/AS and 60+ Unit Certificates	1215	1402
TOP Codes	52	59
Colleges per Program	26.83	27.66

Notes. Data displayed at the program level, where programs are combinations of TOP code (field of study), academic year, and college.

Table 2: Program and Course Summary Statistics

	2001	2010
A. Program-Level Characteristics		
Courses Offered per Program	24.59	19.92
Units Offered per Program	61.05	55.06
Sections Offered per Program	73.04	52.90
B. Course-Level Characteristics		
Offered Spring	0.814	0.809
Offered Summer	0.287	0.246
Offered Fall	0.788	0.798
Offered Spring, Summer, and Fall	0.238	0.198
Offered Spring and Fall	0.678	0.672
Offered Fall Only	0.100	0.115
Offered Spring Only	0.122	0.127
Offered Spring or Fall Only	0.223	0.242
Units	2.483	2.764
Hours	3.076	2.866
Once per Week Only	0.384	0.394
Offered Online	0.00152	0.183
Offered Morning	0.464	0.422
Offered Afternoon	0.243	0.240
Offered Evening	0.485	0.413
Offered Weekends	0.127	0.0776
Only Offered Weekdays	0.792	0.759
Irregular/Uncscheduled	0.301	0.367
Offered Morning, Afternoon and Evening	0.0628	0.0478
Observations	66310	53287

Notes. Panel A data displayed at the program level and panel B data displayed at the course level. Programs are combinations of TOP code (field of study), academic year, and college. Units are the number of credit hours a student earns for completing the course. Hours are the number of hours per session (for example, three hours if a course is offered 9am-12pm). Mornings are defined as before noon; afternoons are defined as noon to 4pm; and evenings are defined as after 4pm.

Table 3: Correlation between summary indices and individual components, 2009

	All Variables	Selected Variables
Offered Spring	0.266	
Offered Summer	0.516	0.594
Offered Fall	0.407	
Offered Spring, Summer, and Fall	0.601	0.527
Offered Spring and Fall	0.612	0.462
Offered Fall Only	-0.525	-0.511
Offered Spring Only	-0.567	-0.585
Offered Spring or Fall Only	-0.705	-0.711
Once per Week Only	-0.599	-0.564
Has Lab	-0.129	
Offered Online	0.474	0.561
Offered Morning	0.228	
Offered Afternoon	-0.0615	
Offered Evening	-0.207	-0.333
No Timing Information	0.505	0.672
Offered 1x per Week	-0.452	-0.530
Offered 2x per Week	0.166	
Offered 3x per Week	0.156	
Offered 4+x per Week	0.228	
Offered Weekends	0.181	
Only Offered Weekdays	-0.406	-0.572
Irregular/Uncscheduled	0.508	0.675
Offered Morning, Afternoon and Evening	0.273	

Notes. Data displayed at the course level. Programs are combinations of TOP code (field of study), academic year, and college. Units are the number of credit hours a student earns for completing the course. Hours are the number of hours per session (for example, three hours if a course is offered 9am-12pm). Mornings are defined as before noon; afternoons are defined as noon to 4pm; and evenings are defined as after 4pm. Index is defined as a sum of standardized scores across all the listed variables. Variables with negative correlations are entered with the opposite sign into the index. In the "selected variables" index we drop all variables that have a negative effect on the Cronbach's alpha when all other variables are included.

Table 4: Highest and Lowest Flexibility Disciplines

Small Certificate	Large Certificate	AA/AS
A. Low Flexibility		
Licensed Vocational Nursing	Dental Assistant	Dental Hygienist
Sheet Metal and Structural Metal	Sheet Metal and Structural Metal	Other Business and Management
Agric. Power Equipment Tech.	Interior Design and Merchandising	Respiratory Care/Therapy
Dental Assistant	Alcohol and Controlled Substances	Dental Assistant
Water and Wastewater Technology	Plumbing, Pipefitting and Steamfitting	Animal Science
Phlebotomy	Aviation Airframe Mechanics	Veterinary Technician (Licensed)
Travel Services and Tourism	Electronics and Electric Technology	Radiologic Technology
Paralegal	Medical Assisting	Alcohol and Controlled Substances
Other Media and Communications	Environmental Control Technology	Interior Design and Merchandising
Environmental Control Technology	Machining and Machine Tools	Horticulture
B. High Flexibility		
Business Administration	Business Administration	Business Administration
Paramedic	Business and Commerce, General	Business and Commerce, General
Business and Commerce, General	Paramedic	Computer Information Systems
Fire Academy	Accounting	Family and Consumer Sciences, General
Cosmetology and Barbering	Cosmetology and Barbering	Cosmetology and Barbering
Police Academy	Police Academy	Accounting
Management Development and Supervision	Office Technology/Office Computer App	Office Technology/Office Computer App
Office Technology/Office Computer App	Information Technology, General	Health Professions, Transfer Core Curriculum
Accounting	Emergency Medical Services	Information Technology, General
International Business and Trade	Business Management	Business Management

Notes. Table shows the ten disciplines, measured as TOP codes, with the highest and lowest levels of the flexibility index, for each type of award or certificate. Index is created as a sum of the standardized scores for flexibility variables. For more details on which variables are included in the index, see text.

Table 5: Top 5 Largest Index Changes, 2001-2014

College	Cosumnes River	Santa Rosa	Santa Rosa	Sacramento	Modesto
TOP Code	Business Management	Culinary Arts	Management Development	Registered Nursing	Business Management
Entrants, 2014	103	510	45	59	362
Change in Index	1.240	1.071	0.972	0.912	0.896
Offered Spring	0.304	-0.0668	0.200	0.923	-0.250
Offered Summer	0.957	0.768	0	-0.369	0.750
Offered Fall	0.0435	0.965	0.400	0.923	0.667
Offered Spring, Summer, and Fall	1	0.746	0	0.554	0.750
Offered Spring and Fall	0.304	0.913	0.600	0.923	0.417
Offered Fall Only	-0.261	0.0445	-0.200	0	0.250
Offered Spring Only	0	-0.980	-0.400	0	-0.667
Offered Spring or Fall Only	-0.261	-0.935	-0.600	0	-0.417
Once per Week Only	-0.833	-0.488	-1	-1	-0.292
Has Lab	-0.261	-0.542	0	-0.0769	0
Offered Online	0.750	0	1	0	0.750
Offered Morning	-0.130	0.533	0	-0.185	0.0833
Offered Afternoon	-0.438	-0.524	-0.800	-0.815	-0.0417
Offered Evening	-0.873	0.169	0	0	-0.458
No Timing Information	0.304	-0.250	0	0.185	0.417
Offered 1x per Week	-0.833	-0.221	-1	-0.262	-0.458
Offered 2x per Week	0	0.130	0	0.815	0.0833
Offered 3x per Week	0	0.456	0	0	-0.167
Offered 4+x per Week	0	0.186	0	0	0.125
Offered Weekends	-0.130	-0.183	-0.600	0	0
Only Offered Weekdays	-0.790	0.400	-0.400	-0.185	-0.250
Irregular/Uncscheduled	0.304	-0.217	1	0.185	0.417
Offered Morning, Afternoon, Evening	0	0.0668	0	0	0

Notes. Table shows five programs with the largest change in the flexibility index between 2001 and 2014. The index is created as a sum of the standardized scores for flexibility variables. For more details on which details are included, see text. The first two rows of the table show the college and discipline (TOP Code) for the five programs. The next row shows the number of new program entrants in 2014. The next row shows the change in the index between 2001 and 2014. The rest of the rows in the table show the change in each of the components of the index between 2001 and 2014. For example, the row labelled "Offered Spring" shows each program's change in the share of its courses offered in the spring: a value of 0.304 means that the share of courses offered in the spring grew by 30.4 percentage points.

Table 6: Outcome: number of entrants, unweighted

	(1)	(2)	(3)
A. Small Certificates			
Index	529.9***	535.3***	422.6***
	(91.78)	(95.82)	(62.47)
Observations	5072	4670	4670
Programs	940	899	899
R2	0.298	0.331	0.518
Y-Mean	500.8	535.9	535.9
B. Large Certificates			
Index	407.2***	407.8***	406.9***
	(53.55)	(55.45)	(46.87)
Observations	3508	3138	3138
Programs	666	629	629
R2	0.510	0.526	0.661
Y-Mean	388.3	424.9	424.9
C. Degrees			
Index	544.3***	528.6***	469.0***
	(56.70)	(62.11)	(47.48)
Observations	8928	7987	7987
Programs	1401	1353	1353
R2	0.303	0.312	0.472
Y-Mean	438.9	482.1	482.1
Year	X	X	X
Program	X	X	X
Demographics		X	X
College			X

Notes. Outcome variable is the number of new entrants, defined as students taking a course in any of the program's courses. The reported coefficient is on a variable defined as the mean of the flexibility index over the contemporaneous academic year, as well as the year prior and the year after. Demographics include mean age, gender, and race of students. Academic years include 2001-2012. Regressions are not weighted. Standard errors clustered at the program level. *p<0.05, **p<0.01, ***p<0.001.

Table 7: Outcome: number of completers, weighted by number of entrants

	(1)	(2)	(3)
A. Small Certificates			
Index	37.67	30.20*	26.74**
	(21.78)	(14.95)	(8.815)
Observations	6476	5425	5425
Programs	1157	1068	1068
R2	0.151	0.302	0.440
Y-Mean	27.05	29.70	29.70
B. Large Certificates			
Index	10.68***	12.13***	9.522***
	(2.348)	(2.543)	(2.246)
Observations	4455	3536	3536
Programs	810	699	699
R2	0.420	0.451	0.548
Y-Mean	10.41	11.52	11.52
C. Degrees			
Index	22.31***	21.68***	16.63***
	(4.450)	(3.355)	(2.966)
Observations	7410	5896	5896
Programs	1271	1179	1179
R2	0.445	0.494	0.598
Y-Mean	18.19	20.66	20.66
Year	X	X	X
Program	X	X	X
Demographics		X	X
College			X

Notes. Outcome variable is the number of members of an incoming cohort who ultimately complete the program. The reported coefficient is on a variable defined as the mean of the flexibility index over the contemporaneous academic year, as well as subsequent years, depending on the award type. For small certificates, it is the mean over the contemporaneous and next year; for large certificates it is the contemporaneous and two subsequent years; and for associate degrees it is the contemporaneous and three subsequent years. Demographics include mean age, gender, and race of students. Academic years include 2001-2012. Regressions are weighted by the number of entrants. Standard errors clustered at the program level. *p<0.05, **p<0.01, ***p<0.001.

Table 8: Outcome: time to completion, for completers, weighted by number of entrants

	(1)	(2)	(3)
A. Small Certificates			
Index	-0.0201	0.00308	0.147
	(0.204)	(0.175)	(0.160)
Observations	5447	4999	4999
Programs	1035	992	992
R2	0.157	0.191	0.277
Y-Mean	3.310	3.322	3.322
B. Large Certificates			
Index	-0.226	-0.292	-0.144
	(0.170)	(0.154)	(0.160)
Observations	3483	3082	3082
Programs	653	610	610
R2	0.287	0.302	0.414
Y-Mean	3.826	3.849	3.849
C. Degrees			
Index	-0.0289	-0.0574	-0.0181
	(0.0935)	(0.0939)	(0.0909)
Observations	6379	5737	5737
Programs	1188	1149	1149
R2	0.297	0.313	0.387
Y-Mean	4.292	4.306	4.306
Year	X	X	X
Program	X	X	X
Demographics		X	X
College			X

Notes. Outcome variable is the number of years between entrance and completion for students who ultimately complete the program. The reported coefficient is on a variable defined as the mean of the flexibility index over the contemporaneous academic year, as well as subsequent years, depending on the award type. For small certificates, it is the mean over the contemporaneous and next year; for large certificates it is the contemporaneous and two subsequent years; and for associate degrees it is the contemporaneous and three subsequent years. Demographics include mean age, gender, and race of students. Academic years include 2001-2012. Regressions are weighted by the number of entrants. Standard errors clustered at the program level. *p<0.05, **p<0.01, ***p<0.001.

Table 9: Outcome: share complete within 200% time, weighted by number of entrants

	(1)	(2)	(3)
A. Small Certificates			
Index	0.0231	0.0210	-0.00880
	(0.0232)	(0.0232)	(0.0245)
Observations	5447	4999	4999
Programs	1035	992	992
R2	0.232	0.242	0.319
Y-Mean	0.170	0.168	0.168
B. Large Certificates			
Index	0.0626*	0.0871**	0.0812*
	(0.0296)	(0.0285)	(0.0333)
Observations	3483	3082	3082
Programs	653	610	610
R2	0.320	0.323	0.419
Y-Mean	0.280	0.274	0.274
C. Degrees			
Index	0.0000544	0.00926	0.00168
	(0.0190)	(0.0189)	(0.0190)
Observations	6379	5737	5737
Programs	1188	1149	1149
R2	0.224	0.243	0.324
Y-Mean	0.620	0.617	0.617
Year	X	X	X
Program	X	X	X
Demographics		X	X
College			X

Notes. Outcome variable is the share of students who complete the program within 200 percent of the expected length of the study. The reported coefficient is on a variable defined as the mean of the flexibility index over the contemporaneous academic year, as well as subsequent years, depending on the award type. For small certificates, it is the mean over the contemporaneous and next year; for large certificates it is the contemporaneous and two subsequent years; and for associate degrees it is the contemporaneous and three subsequent years. Demographics include mean age, gender, and race of students. Academic years include 2001-2012. Regressions are weighted by the number of entrants. Standard errors clustered at the program level. *p<0.05, **p<0.01, ***p<0.001.

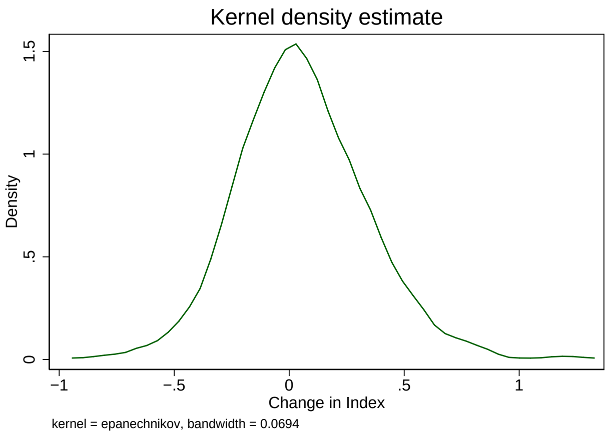
Table 10: Effect of Index, By Age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Entrants		Completions		Time to Complete		Complete in 200% Time	
	<30	30+	<30	30+	<30	30+	<30	30+
A. Small Certificates								
Index	207.7***	81.34***	13.94**	5.160*	0.554*	0.0512	-0.0352	-0.00829
	(26.48)	(19.52)	(5.162)	(2.007)	(0.217)	(0.198)	(0.0285)	(0.0361)
Observations	4679	4679	5425	5425	4319	3723	4319	3723
Programs	903	903	1068	1068	900	835	900	835
R2	0.565	0.463	0.415	0.394	0.290	0.241	0.313	0.282
Y-Mean	253.4	87.98	13.17	6.670	3.478	3.145	0.154	0.186
B. Large Certificates								
Index	211.2***	58.31***	3.078**	1.820***	-0.238	-0.252	0.0940*	0.103*
	(26.09)	(7.917)	(0.980)	(0.444)	(0.180)	(0.226)	(0.0370)	(0.0467)
Observations	3138	3138	3536	3536	2653	2184	2653	2184
Programs	629	629	699	699	552	527	552	527
R2	0.675	0.597	0.486	0.490	0.380	0.318	0.366	0.300
Y-Mean	204.2	64.02	4.845	2.254	3.955	3.796	0.253	0.290
C. Degrees								
Index	232.3***	78.94***	7.735***	1.891***	-0.0121	0.135	0.0263	-0.0169
	(21.39)	(13.98)	(1.651)	(0.412)	(0.111)	(0.171)	(0.0214)	(0.0356)
Observations	8004	8004	5896	5896	5311	3997	5311	3997
Programs	1361	1361	1179	1179	1101	969	1101	969
R2	0.524	0.407	0.539	0.495	0.290	0.245	0.219	0.195
Y-Mean	232.9	72.51	10.21	2.880	4.357	4.279	0.625	0.622

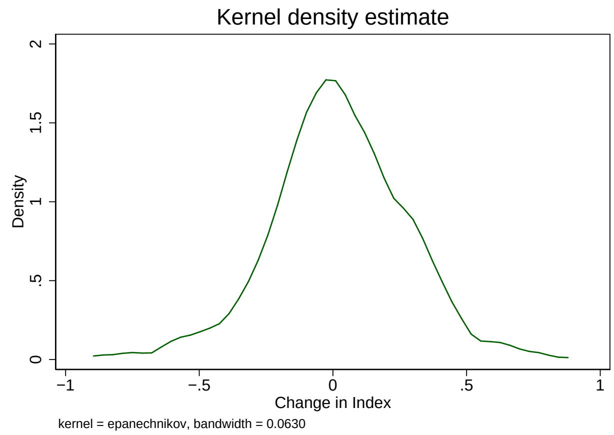
Notes. Outcomes vary by column. Each column shows whether the subset of students was under 30 or at least 30 years old when entering the program. The reported coefficient is on a variable defined as the mean of the flexibility index over the contemporaneous academic year, as well as subsequent years, depending on the award type. For small certificates, it is the mean over the contemporaneous and next year; for large certificates it is the contemporaneous and two subsequent years; and for associate degrees it is the contemporaneous and three subsequent years. All regressions include year fixed effects, program fixed effects, and demographic controls. Demographics include mean age, gender, and race of students. Academic years include 2001-2012. Regressions are weighted by the number of entrants. Standard errors clustered at the program level. *p<0.05, **p<0.01, ***p<0.001.

A Appendix Tables and Figures

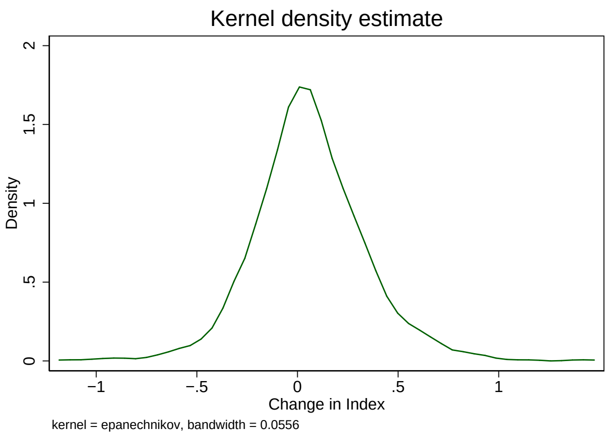
Figure A1: Program-Level Changes in Index, 2001-2003 to 2012-2014



Small Certificates



Large Certificates



AA/AS

Notes. Each plot shows the distribution of the difference in the index between 2001-2003 and 2012-2014. To calculate, computed the mean index for each program in the 2001-2003 academic years, as well as the mean in the 2012-2014 academic years. The figure shows the distribution of the difference between these two.