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The Earnings of Community College Graduates in California

A CAPSEE Working Paper

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Abstract

In this study, I draw on longitudinal data for 1.1 million students in California to estimate the effects of community college credentials on students' earnings, as compared with students who are not awarded a credential. In contrast to much of the recent work on this subject, which assumed that the effects of credentials on students' earnings are constant over time, I estimate the effects of credentials on the rate of change in students' earnings and allow these effects to vary over time. I find significant earnings gains for all levels of credentials, including low-credit awards requiring fewer than six credits. Returns to associate degrees are the most durable over time, while returns to short- and long-term certificates and low-credit awards are strong initially but begin to flatten or decline by seven years after the award. I find substantial variability in returns by students' race/ethnicity and gender. Black men and Black women experience especially strong returns to associate degrees and long-term certificates, relative to other students of the same gender but different race/ethnicity, and men of all racial/ethnic groups experience much stronger returns to short-term certificates than do women. I also note wide variation by field of study in returns to credentials. The most consistent returns across levels of credentials are found in the biological sciences, engineering and industrial technologies, health, law, and public and protective services. Finally, I find compelling evidence of the need to distinguish returns after a credential is awarded from returns after a student has finished (or otherwise left) postsecondary education, as argued in recent work.

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1. Background

Evidence on the Returns to Community College Credentials

Recent years have seen a resurgence of interest in measuring the returns to a community college education, particularly the returns to community college *credentials*, building on foundational work in the 1990s and early 2000s (e.g., Gill & Leigh, 2003; Grubb, 1997; Kane & Rouse, 1995; Leigh & Gill, 1997; Marcotte, Bailey, Borkoski, & Kienzl, 2005). The growing attention to this subject is driven by a shift in the discourse concerning community colleges from a historical focus on ensuring access to a focus on student success. As Bahr and Gross (2016) explain, "this change reflects the re-envisioning of *access* to higher education as including student *success* in terms of both educational outcomes (e.g., learning, credential completion) and post-college labor market outcomes (e.g., job placement, earnings)" (p. 471, italics in original).

Early research on the returns to a community college credentials provided reasonably consistent evidence that completing an associate degree significantly improves students' earnings (e.g., Gill & Leigh, 2003; Grubb, 1997; Leigh & Gill, 1997; Marcotte et al., 2005) though estimates of the magnitude of this return varied (Belfield & Bailey, 2011; Grubb, 2002). There were considerably fewer studies on the returns to postsecondary certificates (Belfield & Bailey, 2011; Grubb, 2002), and the evidence from these studies was less consistent (compare, for example, Grubb, 1997, and Marcotte et al., 2005). Nevertheless, the findings indicated positive returns to certificates for at least some segments of the community college student population (Belfield & Bailey, 2011). Finally, it was clear that, as one would expect, the returns to community college credentials vary substantially by the field of study in which they are awarded (Grubb, 1997).

Contemporary efforts to quantify the returns to community college credentials (e.g., Bahr, 2014; Bahr, Dynarski, Jacob, Kreisman, Sosa, & Wiederspan, 2015; Carruthers & Sanford, 2015; Dadgar & Trimble, 2014; Jaggars & Xu, 2015; Jepsen, Troske, & Coomes, 2014; Liu, Belfield, & Trimble, 2014; Stevens, Kurlaender, & Grosz, 2015; Xu & Trimble, 2015) have benefited from the availability of data that link quarterly earnings records drawn from states' unemployment insurance (UI) databases with community college transcript records, frequently from many or all of the community colleges in a state. The longitudinal nature and large sizes of these datasets have allowed researchers to investigate returns to community college credentials using an individual fixed effect approach, controlling statistically for time-invariant student characteristics, in contrast to the Mincerian approach used in much of the early research on the subject. In combination with the most recent data, this analytical approach has provided both a new lens through which to examine the returns to community credentials and the capacity to make stronger claims than could be supported by the methods used in most prior work.

Among the states in which comprehensive investigations of the returns to community college credentials have been conducted are Kentucky (Jepsen et al., 2014), Michigan (Bahr et al., 2015), North Carolina (Liu et al., 2014; Xu & Trimble, 2015), Virginia (Jaggars & Xu, 2015;

Xu & Trimble, 2015), Tennessee (Carruthers & Sanford, 2015) and Washington (Dadgar & Trimble, 2014). Not surprisingly, estimates of returns vary somewhat across states and studies. Yet, a coherent picture still has begun to coalesce. In particular, evidence suggests that, on average, associate degrees provide significant earnings gains to students, and that women tend to benefit more from associate degrees than do men (e.g., Bahr et al., 2015; Dadgar & Trimble, 2014; Jepsen et al., 2014; Liu et al., 2014). Postsecondary certificates requiring a year or more to complete (i.e., long-term certificates, sometimes called diplomas) tend, on average, to provide smaller gains in earnings than do associate degrees (e.g., Bahr et al., 2015; Xu & Trimble, 2015) and, in some studies, benefit women more than they do men (Dadgar & Trimble, 2014; Jepsen et al., 2014; Liu et al., 2014). Evidence regarding the average effect on earnings of postsecondary certificates requiring less than one year to complete is considerably less clear, however. Some studies indicate a small positive effect on earnings for both men and women (Jepsen et al., 2014; Xu & Trimble, 2015), other studies suggest a negative effect on earnings for women and no effect for men (e.g., Dadgar & Trimble, 2014), and still other studies have results that are internally inconsistent, varying by model specification (e.g., Bahr et al., 2015; Liu et al., 2014). Across levels of credentials, virtually all of the recent work demonstrates that the return to a particular credential is highly dependent on the field of study in which that credential was awarded (e.g., Bahr et al., 2015; Dadgar & Trimble, 2014; Jepsen et al., 2014; Liu et al., 2014; Xu & Trimble, 2015).

Limitations of Recent Research

Although the recent proliferation of research has added much to our understanding of the labor market returns to community college credentials, it also exhibits a number of important limitations that I seek to rectify with this study. Among these limitations, despite frequently drawing on data for entire states, the samples employed in prior work still have been too small to speak clearly and definitively on certain important issues concerning the returns to a community college education. For instance, the samples have been majority White with small absolute numbers of students in minority groups (e.g., Bahr et al., 2015; Carruthers & Sanford, 2015; Dadgar & Trimble, 2014; Jaggars & Xu, 2015; Jepsen et al., 2014; Liu et al., 2014; Xu & Trimble, 2015), preventing the studies from shedding light on how the returns experienced by students of specific minority groups may differ from those of majority students.

Likewise, the wide array of fields of study offered by community colleges, combined with the typically low rate at which credentials are awarded to community college students, has resulted in samples with small absolute numbers of students receiving each type of credential in each field. Though there are a few programs in which community colleges tend to award many credentials, such as nursing and administration of justice, researchers generally have had to either collapse the fields in which credentials are awarded into relatively gross categories to reduce the imprecision of estimates resulting from small cell sizes or, alternatively, set unreasonably low thresholds for what constitutes too few credentials of a given type to achieve reliable estimates of returns.

Concerning the latter, much of the recent research has assumed that reliable estimates of returns can be achieved for credentials that are awarded to as few as 10 students (e.g., Bahr et al., 2015; Dadgar & Trimble, 2014; Xu & Trimble, 2015), relying on unjustified assumptions about the consistency of returns to particular awards. This low bar has important implications for educational policy. For the many fields of study in which comparatively few credentials of a particular level are awarded, scholars have been unable to distinguish with confidence between credentials that do not improve students' economic position and credentials for which the returns cannot be measured precisely enough to achieve statistical significance. Said another way, in many cases it has been unclear whether the return to a particular credential is statistically insignificant because it is approaching zero or because too few credentials of that type were awarded to achieve statistical precision. Compounding this problem, scholars sometimes have not reported the number of credentials of each level that were awarded to students in each field, leaving readers unable to evaluate the reliability of reported returns to credentials.

To address these limitations, in this study I draw on a sample of more than 1.1 million students from California's community colleges. This sample is about seven times the size of that used in the next largest state-specific study (Xu & Trimble, 2015) and is majority non-White, allowing precise estimates of the returns to credentials for students of historically disadvantaged groups. This large sample also allows the fields in which credentials are awarded to be measured with greater precision than has been possible in prior work, distinguishing between 23 fields of study as compared with 13 fields of study in the most comprehensive of recent studies (Dadgar & Trimble, 2014). Finally, the large sample allows me to set a much higher threshold for what constitutes a sufficient number of credentials of a given type to achieve reliable estimates of returns. In contrast to the threshold of 10 students used in much of the prior work, I report estimates only for credentials that were awarded to at least 100 students. As a practical matter, this means that the estimates reported here offer a greater level of confidence than most of the prior work. Despite this much higher threshold, it still is feasible in this study to differentiate the returns to credentials that require very few credits (< 6 credits) from the returns to short-term certificates (6-29 credits), which is a distinction that was not possible to address in prior work.

With a few notable exceptions (e.g., Jaggars & Xu, 2015; Liu et al., 2014), much of the recent work on the labor market returns to community college credentials has assumed that the effect of a particular credential on a student's earnings trajectory is constant over time (Bahr, 2014). This is an important limitation because it masks the evolution of students' earnings after receiving an award. For example, earnings gains from some awards may be low initially but grow over time, while earnings gains from other awards may grow rapidly at first but then decline. Such variation in earnings trajectory would be overlooked in most of the recent research.

Here, I address this limitation by combining the individual fixed effects approach used in most of the recent literature with sensitivity to the length of time that credentials have been held by students, which allows me to measure the effect of credentials on the rate of change in students' earnings over time. The capacity of this study to model variation over time in the effect of credentials on earnings is strengthened by the exceptionally lengthy period over which

students' earnings were observed, from eight to nearly 14 years depending on when a student entered college.

Finally, although not a limitation of prior work, this study is among the first to offer a *comprehensive* analysis of the returns to community college credentials in California, complementing similar work in Kentucky, Michigan, North Carolina, Tennessee, Virginia, and Washington.[1] In this respect, this study offers insights into the returns to a community college education in an important and very different economic and sociopolitical context. Additionally, the period of time in which earnings were observed in this study ended in the fourth quarter of 2013, bridging the dramatic economic recession of 2007–2009 (Bureau of Labor Statistics, 2012) and providing valuable information about the returns to a community college education before, during, and after a period of unfavorable labor market conditions.

2. Data and Methods

Data Source

The data for this study were drawn from the database maintained by the Chancellor's Office of the California Community College (CCC) system, which addresses all students who enrolled in the system from the early-1990s to nearly present day. These data include detailed transcripts, student demographic characteristics, the award of credentials, application for and receipt of financial aid, and the like. The data also include information on enrollment by CCC students in postsecondary institutions outside of the CCC system, derived from a match with National Student Clearinghouse data (Dynarski, Hemelt, & Hyman, 2013; Schoenecker & Reeves, 2008). Lastly, the data include information on students' quarterly earnings, derived from a match with the state's unemployment insurance (UI) data (Aspen Institute, 2013; Feldbaum & Harmon, 2012), maintained by the California Employment Development Department.

Sample

The focal student sample encompasses all first-time college students who reported a valid social security number at college entry and who entered any of the semester-based community colleges of the CCC system from the fall term of 2002 through the summer term of 2008 (a period of six years).[2] Students' course-taking in the CCC system was observed through the fall term of 2013. Enrollments in postsecondary institutions outside of the CCC system were

[1] Other work on labor market returns to a community college education in California include work by Bahr (2014, 2016), which focused largely on the returns to credits, and work by Stevens, Kurlaender, and Grosz (2015), which focused on the returns to credentials in select career and technical education fields.

[2] In the fall 2002, the CCC system included 105 semester-system community colleges and three quarter-system community colleges. By summer 2008, there were 107 semester-system colleges and three quarter-system colleges.

observed through December of 2013. Quarterly earnings were observed for each student from 10 quarters prior to entering the CCC system through the fourth quarter of 2013.

A total of 1,877,360 first-time students who reported valid social security numbers entered the semester-based colleges of the CCC system in the specified terms, accounting for approximately two-thirds (64 percent) of all new students (both first-time students and other students who were new to the CCC system) who reported valid social security numbers. For the purposes of this study, I restricted the sample to the 86 percent of first-time students who were between the ages of 18 and 50 years at college entry. I then further restricted the sample to the 69 percent of the remaining students who had at least one non-zero quarterly earnings record in the 10 quarters prior to college entry *and* at least one non-zero quarterly earnings records during or after enrollment in the CCC system.[3] The final analytical sample included 1,115,386 students, or about three-fifths (59 percent) of the larger body of first-time students. Distributions of selected student characteristics and outcomes are provided in Table 1.

[3] Dropping students who did not have at least one quarterly earnings record prior to entering the CCC system and at least one quarterly earnings records during or after enrolling in the CCC system resulted in a modestly disproportionate loss of the youngest and oldest students. For example, at the ends of the age continuum, 32 percent of 18-year-olds were dropped, as were 37 percent of 50-year-olds. In contrast, 28 percent of students between the ages of 19 and 24 years were dropped.

Table 1: Distributions of Selected Characteristics of All First-Time Students Who Reported Valid Social Security Numbers and the Subset of These Students Who Composed the Analytical Sample

	All First-Time Students (*N* = 1,877,360)	Analytical Sample (*N* = 1,115,386)
Gender		
Male	48.8%	49.5%
Female	50.6%	50.0%
Not Reported	0.6%	0.5%
Race/Ethnicity		
White	37.0%	37.5%
Black	9.5%	8.9%
Hispanic	34.1%	36.9%
Asian	9.0%	7.2%
Pacific Islander	0.9%	0.9%
Filipino	3.3%	3.2%
Native American	1.1%	1.1%
Not Reported	5.0%	4.3%
Age at Entry to CCC System		
< 18	8.2%	----------
18-19	43.5%	50.7%
20-22	10.8%	13.3%
23-25	5.7%	6.8%
26-30	6.3%	7.2%
31-35	5.4%	6.2%
36-40	5.3%	6.0%
41-45	5.0%	5.6%
46-50	4.0%	4.3%
51-60	4.1%	----------
> 60	1.6%	----------
Not Reported	0.2%	----------
Citizenship		
U.S. Citizen	85.1%	85.6%
Not U.S. Citizen	14.1%	13.6%
Not Reported	0.8%	0.7%
Self-Reported Goal		
Transfer with or without a Credential	37.6%	37.6%
Terminal Credential	10.6%	11.3%
Non-Credential Employment-Related Goal	15.6%	17.4%
Personal Development	8.3%	7.4%
Remediation	4.9%	4.4%
Undecided	17.4%	17.1%
Not Reported	5.6%	4.9%
Mean Number of Credits Completed	30.6	29.3
Awarded Low-Credit Award (< 6 Credits)	0.4%	0.4%
Awarded Short-Term Certificate (6–29 Credits)	2.6%	2.6%
Awarded Long-Term Certificate (> 29 Credits)	2.4%	2.5%
Awarded Associate Degree (> 59 Credits)	10.3%	9.5%
Transferred to Four-Year Institution	21.8%	19.9%

Data Structure

The data for this analysis were assembled in a *person-quarter* structure: multiple records for each student, each of which addresses a particular quarter of a given year. Assembling the data in this manner required that I reconcile information recorded in semester units of time with the desired quarter units of time. I discuss my approach to reconciling units of time in Appendix A.

The students of interest in this study entered college from fall 2002 (2002Q4) through summer 2008 (2008Q3). Students' earnings were observed beginning 10 quarters prior to entering the CCC system. Therefore, the first quarter in which earnings were observed fell between 2000Q2 and 2006Q1, depending on when a student entered the CCC system. For all students, the last quarter in which earnings were observed was 2013Q4. Consequently, the total length of time in which earnings were observed was between 32 and 55 quarters (8.00 to 13.75 years), with the earnings of students who entered the CCC system later in the observation period (e.g., 2008) being observed for a shorter amount of time than were the earnings of students who entered the system earlier in the observation period (e.g., 2002).

Method of Analysis

I employed individual fixed effects linear regression models with robust (clustered) standard errors to analyze these data. Models were estimated with Stata's *xtreg, fe vce(cluster)* command, clustering on a unique student identifier. I confined the analysis to quarters in which students had non-zero earnings to avoid confounding earnings with employment. Confining the analysis in this manner reduced the number of person-quarters included in the analysis by 37 percent, from 49,331,548 to 30,877,882, with an average of 28 quarterly earnings records per student. However, it did not change the number of students in the analytical sample (N = 1,115,386) because students who had no records of earnings already had been excluded, as noted earlier.

Model Specifications

Model 1. I tested three specifications of the individual fixed effects model, the first of which is presented as Model 1. This model is similar in many ways to the fixed effects specifications used in recent studies of community college students' earnings (e.g., Dadgar & Trimble, 2014; Jepsen et al., 2014).

$$Earnings_{it} = \alpha + \beta_j\left(Credential_{ji(t-1)}\right) + \gamma_p(Course\ Credit\ Load_{it}{}^{p}) +$$

$$\delta(Enroll\ Four\ Year_{it}) + \zeta(Enroll\ Other\ PSI_{it}) + \eta(After\ Four\ Year_{it}) +$$

$$\theta(After\ Other\ PSI_{it}) + \vartheta_f\left(Financial\ Aid_{fit}\right) + \lambda_r(Time_{it}{}^{r}) +$$

$$\nu_{sr}(Student\ Characteristics_{si} * Time_{it}{}^{r}) +$$

$$\xi_{qr}\left(Quarter\ of\ College\ Entry_{qi} * Time_{it}{}^{r}\right) + \rho_i + \varepsilon_{it} \qquad \text{(Model 1)}$$

The dependent variable, represented by $Earnings_{it}$, is the inflation-adjusted earnings of individual *i* in quarter *t*, conditional on being employed in quarter *t*.[4] The primary independent variables ($Credential_{ji(t-1)}$) are dichotomous indicators of whether a postsecondary credential of level *j* had been awarded to individual *i* by the end of the prior quarter (*t* – 1). The *j* levels of credentials include low-credit awards (< 6 credits), short-term certificates (6 to 29 credits), long-term certificates (> 29 credits), and associate degrees. These indicators were assigned a value of zero in all quarters up to and including the quarter of first receipt of a credential of a particular level. A value of one was assigned beginning in the quarter immediately following the quarter in which the credential was awarded. For students who never received a credential of a particular level, the variable representing that credential retained a value of zero in all quarters.

I accounted for the opportunity cost of enrolling in community college at differing levels of intensity by controlling for the number of course credits attempted ($Course\ Credit\ Load_{it}{}^{p}$) in the CCC system by individual *i* in quarter *t*. The superscript *p* denotes the inclusion of both the identity and square of course credit load to accommodate nonlinearity in the relationship between enrollment intensity in a given quarter and earnings in that quarter. In particular, at some unknown level of enrollment intensity, average earnings presumably will approach the natural floor of zero.

Unfortunately, the data used for this study do not include information about enrollment intensity in institutions outside of the CCC system. However, the data do capture *when* students attended these "external" institutions. Therefore, I included separate dichotomous indicators of enrollment in the present quarter *t* in a four-year postsecondary institution ($Enroll\ Four\ Year_{it}$) or a less-than-four-year postsecondary education institution other than a college in the CCC system ($Enroll\ Other\ PSI_{it}$). Each of these two dummy variables was assigned a value of one in quarters in which a student was enrolled in an institution of that type and assigned a value of zero otherwise, thereby controlling for the average effect on earnings of being enrolled in one of these types of external postsecondary institutions.

[4] I adjusted earnings for inflation using the CPI-U (as reported by the Bureau of Labor Statistics) and set them to 2013Q4-equivalent dollars. After adjustment for inflation, I set quarterly earnings that exceeded the 99.9th percentile of earnings across all quarters ($71,180) to be equal to the 99.9th percentile to reduce the effect of the most extreme values on the estimates.

Though attending another postsecondary institution after leaving the CCC system may depress earnings in the short run, one would expect that students who receive further education often would reap a labor market return for this investment. To the extent that the receipt of a community college credential is correlated with students' pursuit of further postsecondary education, an estimate of the return to that credential will be confounded with the return to the education received at other institutions. The data used for this study, however, do not include information about credentials awarded to students by postsecondary institutions outside of the CCC system.

As a redress for this limitation, I include dichotomous indicators to distinguish the period of time *after* an individual attended a four-year institution (*After Four Year*$_{it}$) or a less-than-four-year institution other than a college in the CCC system (*After Other PSI*$_{it}$), which is when an individual presumably would begin to reap the return to this additional postsecondary education. These indicators were assigned a value of one beginning in the quarter after a student's last quarter of enrollment in external institutions of a given type and otherwise were assigned a value of zero. They capture the average return to education provided by postsecondary institutions outside of the CCC system.

Many community college students maintain employment while attending college (National Center for Education Statistics, 2011). However, financial aid may reduce the need for employment and, therefore, students' earnings. Hence, I controlled for the total dollar value of *f* types of financial aid (*Financial Aid*$_{fit}$) received by individual *i* in quarter *t* while enrolled in the CCC system. The *f* types of aid include grants and scholarships (combined), loans, work-study, and tuition waivers, each of which was treated as a separate variable in the models under the assumption that funds from different sources have different effects on students' decisions about employment and earnings. Information about financial aid in postsecondary institutions outside of the CCC system was not available.

Model 1 also includes a series of variables to represent time ($Time_{it}^{r}$) in order to capture the underlying trend in earnings. The identity is a naturally ordered enumeration of quarters from 10 quarters prior to college entry through the fourth quarter of 2013.[5] The superscript *r* denotes the inclusion of the square and cube as well, accommodating multiple points of inflection in the relationship between time and earnings. Each of these variables—identity, square, and cube—was interacted with *s* time-invariant student characteristics (*Student Characteristics*$_{si}$) and a dummy variable for each of the *q* absolute (not relative) quarters of first entry to the CCC system in this study (*Quarter of College Entry*$_{qi}$).

The *s* student characteristics include gender, race/ethnicity, age at college entry, citizenship status, and academic goal at college entry. Gender and citizenship each were coded as

[5] To elaborate, the quarter in which a student entered the CCC system was assigned a value of 11. The earliest quarter in which a student's earnings could be observed occurred 10 quarters prior to entering the CCC system. This quarter was assigned a value of one. The next quarter (the ninth prior to entering the CCC system) was assigned a value of two, and so on.

three-category nominal variables, including one value in each variable to represent "not reported." Race/ethnicity was coded as an eight-category nominal variable: White, Black, Hispanic, Asian, Pacific Islander, Filipino, Native American, and not reported. Age at college entry included eight categories to represent ages between 18 and 50 years: 18–19, 20–22, 23–25, 26–30, 31–35, 36–40, 41–45, and 46–50 years. Lastly, academic goal at college entry included seven categories: transfer to a four-year institution with or without a community college credential, a terminal community college credential, an employment-related goal other than a credential (e.g., preparing for a new career, advancing in a current career, maintaining a certificate or license), personal discovery or development, remediation of skill deficiencies, undecided, and not reported. The interaction of each of these time-invariant characteristics with the identity, square, and cube of the time variable allows for a different earnings trend for each demographic group, for students who reported each of the several academic goals, and for students who entered college in each q quarter.

One will note, however, that main effects of the time-invariant variables are excluded from the model. These main effects are absorbed into the individual fixed effects (ρ_i), which control for observed and unobserved time-invariant differences between individuals that are correlated with earnings. Finally, ε_{it} represents the error for individual i in quarter t.

Model 2. In Model 2, I present one of the two preferred model specifications for this study. Model 2 differs from Model 1 in the operationalization of [1] postsecondary credentials awarded by the CCC system and [2] the period of time following an individual's attendance of an external postsecondary institution. In Model 1, the award of a community college credential of a particular level is treated as a dichotomous variable indicating whether that credential had been received by a student in a quarter prior to the present quarter t. In contrast, in Model 2, the award of a credential is treated as a continuous measure of the number of quarters that have passed since the award of that credential ($Time\ Since\ Credential\ Award_{jit}^{p}$), measured at time t. More specifically, in all quarters up to and including the quarter in which a particular credential was awarded, the variable representing that credential was assigned a value of zero. In the first quarter immediately after the award of the credential, the variable was assigned a value of one. In the second quarter after the award, the variable was assigned a value of two, and so on. For students who never received a particular level of credential, the variable representing that credential was assigned a value of zero in all quarters. The superscript p indicates that both the identity and the square of time since the credential award were included in the model.

$$Earnings_{it} = \alpha + \beta_{jp}\left(Time\ Since\ Credential\ Award_{jit}{}^{p}\right) +$$

$$\gamma_p(Course\ Credit\ Load_{it}{}^{p}) + \delta(Enroll\ Four\ Year_{it}) +$$

$$\zeta(Enroll\ Other\ PSI_{it}) + \eta_p(Time\ Since\ Four\ Year_{it}{}^{p}) +$$

$$\theta_p(Time\ Since\ Other\ PSI_{it}{}^{p}) + \cdots + \rho_i + \varepsilon_{it} \qquad \text{(Model 2)}$$

In a similar manner, Model 1 includes two dichotomous variables to distinguish the period of time after a student's last quarter of enrollment in a four-year institution or a less-than-four-year institution other than a college in the CCC system, respectively. Contrastingly, in Model 2, these variables have been replaced with continuous measures of the number of quarters that have passed since a student exited these types of external institutions (*Time Since Four* $Year_{it}{}^{p}$ and *Time Since Other* $PSI_{it}{}^{p}$), as measured at time *t*. Again, both the identity and square are included.

Comparing the interpretations of the two models, Model 1 estimates the average effect of a community college credential on students' earnings, and it assumes that this effect is constant over time, which is consistent with the bulk of the recent work on the returns to a community college education (e.g., Dadgar & Trimble, 2014; Jepsen et al., 2014; Xu & Trimble, 2015). For students who attended one or more colleges outside of the CCC system, Model 1 controls for the average return to postsecondary education received in a four-year institution and, separately, the average return to postsecondary education received in a less-than-four-year institution other than a college in the CCC system.

In contrast, Model 2 estimates the effect of a particular credential on the rate of change in the return to credentials, and it allows for variation (nonlinearity) in this effect, as observed in some prior research (e.g., Jaggars & Xu, 2015). Similarly, Model 2 controls for the effect of postsecondary education received from external institutions on the rate of change in students' earnings. Taken as a whole, Model 2 describes the evolution of earnings in a manner that is more consistent with an intuitive understanding of how the returns to postsecondary credentials unfold, distinguishing, for example, between credentials that result in a rapid but short-lived increase in earnings and credentials that result in a slow but steady increase in earnings.

Model 3. In Model 3, I present the second of the two preferred specifications. Model 3 is identical to Model 2 save for the fact that the measures of credentials distinguish between *k* fields of study in which credentials are awarded, in addition to distinguishing between the *j* levels of credentials addressed in Models 1 and 2. The *k* fields include 23 of the 24 broad fields of study described in the CCC Taxonomy of Programs (TOP; Chancellor's Office, 2009).[6] Only the field

[6] The Taxonomy of Programs is a system of numerical codes and standardized names used to describe the courses and programs of study offered by California's community colleges. The coding scheme draws on a six-digit number in which the first two digits capture 24 broad fields, the second two digits capture a widely varying number of

of military studies was excluded because no credentials were awarded in this field in the period of observation for this study.

$$Earnings_{it} = \alpha + \beta_{jkp}\left(Time\ Since\ Credential\ Award_{jkit}{}^{p}\right) + \cdots$$
$$+\rho_i + \varepsilon_{it} \qquad \text{(Model 3)}$$

As noted earlier, returns to credentials (combinations of level and field) that were awarded to fewer than 100 students were estimated in this study but are not reported. This is a much more conservative exclusion rule than has been used in prior work, but a more conservative rule is preferred to avoid erroneous conclusions of no returns to particular credentials simply due to imprecision in the estimates. Table 2 provides the number of students who received each combination of credential level and field.

Limitations

This study has several limitations that should be noted. The first is a limitation faced by nearly all studies that draw on UI earnings data, namely a problem of sector coverage. State-level UI earnings data generally do not include earnings from self-employment, military employment, federal civilian employment, railroad employment, employment in other states, employment through informal cash arrangements, or employment in a select number of other sectors (Feldbaum & Harmon, 2012). To the extent that a given field of study is associated strongly with employment in one of these sectors, the estimated returns to credentials in that field likely are inaccurate.

To illustrate this problem, Hipple (2010) observed that the beauty and construction industries, among others, have comparatively high rates of self-employment. Between fall 2002 and fall 2013, the subfield of cosmetology & barbering accounted for more than three-quarters (77 percent) of credentials awarded by the CCC system in the field of commercial services, and nineteen out of twenty (95 percent) long-term certificates in this field (see Appendix B). The subfield of construction crafts technology accounted for more than one in nine (12 percent) credentials awarded in the field of engineering & industrial technologies, and more than one-fifth (22 percent) of long-term certificates in this field. Because earnings from self-employment are not observed in the UI data, estimates of returns to credentials in the parent fields in which these subfields are located are subject to bias in proportion to the share of credentials represented by these subfields.

subfields within each field, and the last two digits capture a branch of a subfield when a finer level of granularity is necessary.

Table 2: Number of Students in the Analytical Sample Who Were Awarded Credentials of Each Combination of Level and Field

Field of Study	Low-Credit Award (< 6 Credits)	Short-Term Certificate (6–29 Credits)	Long-Term Certificate (> 29 Credits)	Associate Degree (> 59 Credits)
Agriculture & Natural Resources†	125	418	205	647
Architecture & Related Technologies†	37	200	85	273
Environmental Sciences & Technologies†	156	53	11	47
Biological Sciences	1	129	8	1,365
Business & Management†	540	3,844	1,488	9,697
Media & Communications†	9	485	275	838
Information Technology†	17	791	211	824
Education	0	375	115	676
Engineering & Industrial Technologies†	398	4,847	4,724	2,320
Fine & Applied Arts	3	424	483	1,841
Foreign Languages	1	194	1	472
Health†	1,966	4,471	5,183	9,037
Family & Consumer Sciences†	220	6,256	1,987	3,479
Law†	1	236	266	453
Humanities	11	555	8	1,930
Library Science†	2	127	7	34
Mathematics	0	20	4	732
Physical Sciences	0	64	7	588
Psychology	0	21	1	2,074
Public & Protective Services†	1,336	5,229	2,299	6,195
Social Sciences	0	85	22	10,173
Commercial Services†	29	1,098	2,835	307
Interdisciplinary Studies	14	261	7,958	67,058
Any Field of Study	4,651	29,333	27,898	105,895

Note. † Indicates a field that is oriented primarily toward career and technical education (CTE).

Second, this study considered only one labor market outcome—quarterly earnings, adjusted for inflation. It did not consider hourly wages, employment status (i.e., employed versus unemployed), the number of jobs held by an individual in a given period of time (e.g., one full-time job versus knitting together earnings from multiple part-time jobs), or fringe benefits like employer-funded healthcare or retirement programs, all of which are important aspects of the overall labor market return to a community college education (Belfield & Bailey, 2011). It also did not differentiate between the quarterly earnings of individuals who were employed for part of a given quarter and those who were employed for the full duration of that quarter (Mullin, 2013), nor did it consider the many non-economic returns to education, such as improved health outcomes, civic engagement, reduced involvement in criminal activities, and the like (Belfield & Bailey, 2011).

Third, this study estimates effects on earnings of multiple credentials of *different levels* in the *same field*, as well as the effects of multiple credentials of the *same level* in *different fields*. However, it does not distinguish the effect of a single credential of a given level and field from the effect of multiple credentials of the same level and field. This is a limitation because some students earned more than one credential of a given level in a single field (e.g., two low-credit awards in the field of public & protective services), and this study cannot differentiate the effect on earnings of a second, third or subsequent credential of a given level and field from the effect of the first credential of that level and field.

To understand the scope of this limitation, I present in Table 3 the repeat rate of awards, which is the ratio of [1] the number of credentials of a particular level and field awarded to students in the analytical cohort and [2] the number of unique students who received a credential of that particular level and field. A value of one indicates a one-to-one correspondence between the number of credentials of a particular type that were awarded to the analytical cohort and the number of students who received a credential of that type. Larger numbers indicate credentials with a higher incidence of repeated awards to students (i.e., multiple credentials of the same level and field received by a single student).

One observes in Table 3 that low-credit awards and short-term certificates have a higher repeat rate than do long-term certificates and associate degrees. For example, among students who received a short-term certificate, the average number of such certificates received was 1.36: 29,333 students received 39,892 short-term certificates. The highest rate of repeated credentials is observed with low-credit awards in public & protective services, in which students who received at least one award of this type received, on average, two (1.98) such awards: 1,336 students were awarded a total of 2,648 low-credit awards in public & protective services.

Table 3: Repeat Rate of Credential Awards, by Level and Field

Field of Study	Low-Credit Award	Short-Term Certificate	Long-Term Certificate	Associate Degree
Agriculture & Natural Resources†	1.00	1.27	1.71	1.22
Architecture & Related Technologies†	-----	1.10	-----	1.08
Environmental Sciences & Technologies†	1.44	-----	-----	-----
Biological Sciences	-----	1.24	-----	1.06
Business & Management†	1.15	1.35	1.17	1.11
Media & Communications†	-----	1.26	1.21	1.06
Information Technology†	-----	1.44	1.10	1.10
Education	-----	1.06	1.06	1.05
Engineering & Industrial Technologies†	1.29	1.60	1.18	1.12
Fine & Applied Arts	-----	1.43	1.08	1.07
Foreign Languages	-----	1.04	-----	1.05
Health†	1.29	1.10	1.06	1.09
Family & Consumer Sciences†	1.57	1.44	1.18	1.08
Law†	-----	1.04	1.04	1.05
Humanities	-----	1.17	-----	1.04
Library Science†	-----	1.05	-----	-----
Mathematics	-----	-----	-----	1.03
Physical Sciences	-----	-----	-----	1.10
Psychology	-----	-----	-----	1.05
Public & Protective Services†	1.98	1.20	1.08	1.10
Social Sciences	-----	-----	-----	1.06
Commercial Services†	-----	1.07	1.03	1.22
Interdisciplinary Studies	-----	1.17	1.07	1.14
Any Field of Study	1.54	1.36	1.11	1.27

Note. The *repeat rate* for a given credential is the mean number of credentials of a given level and field awarded to students in the analytical sample who received at least one credential of that level and field. Results for credentials that were awarded to fewer than 100 students are not shown.

† Indicates a field that is oriented primarily toward career and technical education (CTE).

Importantly, to the extent that *each* credential of a given level and field (whether the first, the second, the third, etc.) provides a return in earnings, this study will overestimate the return to that credential in proportion to its repeat rate because the model attributes to a single award the cumulative returns of multiple awards. For instance, the return to low-credit awards in public & protective services, with a repeat rate of 1.98, presumably will be overestimated to a greater extent than will the return to associate degrees in public & protective services, with a repeat rate of 1.10.

Fourth, as noted earlier, the data employed in this study do not include information about postsecondary credentials awarded outside of the CCC system, of which the most common is a baccalaureate degree. Insofar as the completion of particular levels of community college credentials (e.g., associate degrees) or the completion of credentials in particular fields of study (e.g., physical sciences) are associated with the subsequent completion of a baccalaureate degree, the estimated returns to these levels of credentials or fields of study may be biased. To partially redress this issue, I control for the return to participation in a four-year institution. However, among students who transferred to a four-year institution, this control does not distinguish between those who completed a baccalaureate degree and those who did not, nor does it account for differences in field of study at the baccalaureate level.

To explore the community college credentials most likely to be affected by this limitation, I present in Table 4 the percentage of students who transferred to a four-year institution, by level of credential and field of study. Two-thirds (64 percent) of the students who completed an associate degree transferred to a four-year institution, as compared with about one-third (35 percent) of the students who completed a long-term certificate, one-fifth (20 percent) of the students who completed a short-term certificate, one-sixth (18 percent) of the students who completed a low-credit award, and one-seventh (15 percent) of the students who did not complete a credential. Transfer to a four-year institution was particularly common among students who completed associate degrees in math (88 percent), the physical sciences (86 percent), psychology (79 percent), the humanities (73 percent), interdisciplinary studies (73 percent), and foreign languages (71 percent).

Finally, as with other recent work on this subject (e.g., Dadgar & Trimble, 2014; Jepsen et al., 2014; Liu et al., 2014; Xu & Trimble, 2015), the comparison group in this study against which the labor market returns of credentials were measured was composed of community college students who did not receive an award, as opposed to students who did not attend college at all. On average, students who complete community college credits but do not receive a community college credential experience a significant, positive labor market return to their investment in a college education (Bahr, 2016). Consequently, estimates of the returns to awards in this paper, measured against the average returns experienced by non-completing students, likely are smaller than would be observed if the comparison group were composed of individuals who have not enrolled in college.

Table 4: Percentage of Students in the Analytical Sample Who Transferred to a Four-Year Institution Within the Period of Observation for This Study, by Level of Credential and Field of Study

Field of Study	Low-Credit Award	Short-Term Certificate	Long-Term Certificate	Associate Degree
Agriculture & Natural Resources†	3.2%	15.8%	16.6%	37.2%
Architecture & Related Technologies†	-----	33.0%	-----	61.9%
Environmental Sciences & Technologies†	20.5%	-----	-----	-----
Biological Sciences	-----	32.6%	-----	61.9%
Business & Management†	26.7%	23.0%	37.4%	60.0%
Media & Communications†	-----	36.1%	29.5%	54.3%
Information Technology†	-----	19.6%	24.6%	38.2%
Education	-----	33.1%	34.8%	56.5%
Engineering & Industrial Technologies†	7.8%	7.9%	6.1%	26.5%
Fine & Applied Arts	-----	33.0%	21.5%	54.4%
Foreign Languages	-----	60.8%	-----	70.8%
Health†	17.8%	17.4%	14.6%	28.4%
Family & Consumer Sciences†	8.2%	19.9%	21.3%	33.6%
Law†	-----	25.0%	29.3%	34.0%
Humanities	-----	68.8%	-----	73.3%
Library Science†	-----	10.2%	-----	-----
Mathematics	-----	-----	-----	88.4%
Physical Sciences	-----	-----	-----	85.7%
Psychology	-----	-----	-----	79.4%
Public & Protective Services†	18.5%	21.6%	24.6%	41.4%
Social Sciences	-----	-----	-----	70.3%
Commercial Services†	-----	9.2%	5.7%	41.0%
Interdisciplinary Studies	-----	62.8%	83.0%	73.0%
Any Field of Study	17.9%	20.3%	34.7%	63.6%

Note. Students who completed more than one credential are counted in more than one cell except when the two (or more) credentials awarded to the student are of precisely the same level *and* field (e.g., two low-credit awards in public & protective services). Figures for credentials that were awarded to fewer than 100 students are not shown.

† Indicates a field that is oriented primarily toward career and technical education (CTE).

3. Findings

Returns by Level of Credential

In Table 5, I present an initial investigation of the returns in quarterly earnings to community college credentials, comparing estimates from Models 1 and 2. Recall that Model 1 describes the average return to a credential, while Model 2 describes how the return to a credential unfolds over time. In both models, the return is measured as the difference in earnings between a student who received a particular community college credential and a similar student who did not receive *any* community college credentials. A positive return to a credential indicates that recipients earn more, on average, than do non-completing students, while a negative return indicates that recipients earn less, on average.

In Model 1, one observes that average returns to low-credit awards and short-term certificates are similar at $851 per quarter and $778 per quarter, respectively, in 2013Q4-equivalent dollars. The average return to long-term certificates is somewhat stronger at $1,004. Surprisingly, however, the average return to an associate degree, at $417, is about half that of low-credit awards and short-term certificates. On the face, this finding would suggest that associate degrees, which require substantially more credits to complete than do low-credit awards or short-term certificates, are not an especially good investment.

Model 2 helps to explain this counterintuitive finding. Here, one observes that, while the relative rate of growth in earnings following the receipt of a low-credit award, short-term certificate, or long-term certificate initially is quite strong, the rate of growth declines over time. Conversely, the relative rate of growth in earnings per quarter for an associate degree initially is low, but it increases with time. Consequently, by seven years after an award is received, the predicted earnings advantage of a student who received an associate degree ($1,650 per quarter), over a student who did not receive a credential, rivals or exceeds that of a student who received any of the other credentials. The average earnings advantage of a student who received a low-credit award ($1,301) or short-term certificate ($1,436) is flattening by seven years after the award, and the advantage of a student who received a long-term certificate ($1,664) is in decline. In sum, all four credentials have a positive influence on earnings, but, over the long haul, the associate degree provides the strongest and most durable earnings gain.

Table 5: Model 1 and 2 Estimates of the Return in Quarterly Earnings to Community College Credentials

		Model 2 Rate of Change in Return		Predicted Advantage in Quarterly Earnings vs. No Credential (Based on Estimates from Model 2)			
	Model 1 Average Return	Identity	Square	One Year After Award	Three Years After Award	Five Years After Award	Seven Years After Award
Low-Credit Award	850.97***	85.42***	-1.39***	$319	$825	$1,152	$1,301
	(78.21)	(9.82)	(0.32)				
Short-Term Certificate	778.16***	87.46***	-1.29***	$329	$863	$1,232	$1,436
	(32.14)	(4.50)	(0.16)				
Long-Term Certificate	1,003.56***	151.08***	-3.27***	$552	$1,342	$1,712	$1,664
	(35.67)	(5.61)	(0.21)				
Associate Degree	416.53***	30.34***	1.02***	$138	$511	$1,015	$1,650
	(17.68)	(2.88)	(0.12)				

Note. Dollars are adjusted for inflation to 2013Q4. Standard errors are provided in parentheses. $N_{students}$ = 1,115,386; $N_{student}$-quarters = 30,877,882.

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

An important question to ask about the findings from Model 2 is whether the data will support predictions of earnings seven years after receipt of an award. In Table 6, I present the distribution of the length of time that students' earnings were observed following the receipt of each level of award. In the top panel of Table 6, one observes that earnings following the receipt of an associate degree were observed for an average of 4.50 years among the 105,895 students who received this degree. The earnings of at least 25 percent of these students were observed for 6.25 years or longer following the award, while at least 10 percent were observed for 7.50 years or longer. The distribution of the length of time that earnings were observed following the receipt of the other levels of credentials are similar or longer, indicating that the data do support predictions of earnings seven years after the receipt of an award.

Returns by Race/Ethnicity and Gender

Prior work on the returns to community college credentials has been limited with respect to the capacity to disaggregate effects by the race/ethnicity of a student, but the size and heterogeneity of the sample used in this study supports such disaggregation. In Table 7, I provide the results for Model 2 estimated on the subsample of students defined by each combination of gender and race/ethnicity, focusing on the four largest racial/ethnic groups in the CCC system.

Reviewing Table 7, only White men, White women, and Hispanic women experience a significant labor market return to low-credit awards. Returns to the other five groups do not differ significantly from zero. The strongest return is found among White women, with an estimated earnings advantage over non-completing White women of $1,562 per quarter at seven years post-award. The smaller return to low-credit awards among White men ($1,225) is similar to that of Hispanic women ($1,169).

Statistically significant returns to short-term certificates are observed for all groups except Black women and Asian women. However, the returns among the male groups are substantially greater than they are among the female groups. For example, at seven years post-award, Hispanic men who complete a short-term certificate are estimated to have an average earnings advantage of $2,351 per quarter over Hispanic men who do not complete a credential, while the parallel figure for Hispanic women is $96. The strongest return to short-term certificates is found among White men ($3,194), followed by Hispanic men, and then Asian men ($1,777) and Black men ($1,464). Relative to men, White women experience a modest return to a short-term certificate ($486), but this return is considerably stronger than that observed among Hispanic women.

Table 6: Univariate Descriptive Statistics for the Length of Time in Years That Students' Earnings Were Observed After Receiving a Particular Credential and, Separately, After Receiving a Particular Credential and Exiting all Postsecondary Education

		Length of Time (in Years) that Students' Earnings Were Observed					
	Number of Students	Mean	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
After Receiving Credential							
Low-Credit Award	4,651	6.21	1.50	4.25	6.50	8.50	10.00
Short-Term Certificate	29,333	5.20	1.50	3.00	5.25	7.25	8.75
Long-Term Certificate	27,898	4.15	1.00	2.25	4.00	5.50	7.50
Associate Degree	105,895	4.50	1.50	2.50	4.50	6.25	7.50
After Exiting College							
Low-Credit Award	3,738	3.94	0.50	1.50	3.25	6.00	8.50
Short-Term Certificate	23,255	3.54	0.50	1.50	3.00	5.25	7.50
Long-Term Certificate	21,463	3.22	0.50	1.25	2.50	5.00	7.00
Associate Degree	79,328	2.71	0.50	1.00	2.50	4.00	5.50

Note. The smaller number of students in each row of the lower half of the table (after exiting college), relative to the upper half of the table (after receiving credential), indicates that some students who received a credential still were enrolled in college at the end of the observation period in 2013Q4.

Table 7: Gender- and Race/Ethnicity-Specific Estimates of the Rate of Change in Return in Quarterly Earnings

		Male				Female			
		White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
LC Award	Identity	82.51***	95.44	-0.87	94.51	137.79***	18.79	90.35***	-7.87
	Square	-1.38*	-0.85	0.71	-0.75	-2.93***	-1.61	-1.74**	0.86
Short Certificate	Identity	187.88***	160.08***	127.55***	60.69*	19.20*	20.24	22.86**	2.59
	Square	-2.64***	-3.85***	-1.56***	0.10	-0.07	-0.85	-0.69*	-0.35
Long Certificate	Identity	173.22***	231.40***	136.48***	117.53***	130.63***	203.54***	102.30***	96.34***
	Square	-3.19***	-4.02**	-2.99***	-1.66	-3.57***	-4.84***	-1.99***	-1.54
Associate Degree	Identity	-35.25***	14.37	-33.67***	-2.39	71.78***	60.29***	39.51***	57.96***
	Square	3.28***	2.88*	3.42***	0.65	-0.69**	0.83	0.94***	-0.02
LC Award	1 Year	$308	$368	$8	$366	$504	$49	$334	-$18
	3 Years	$791	$1,023	$91	$1,027	$1,232	-$6	$834	$30
	5 Years	$1,097	$1,570	$265	$1,591	$1,584	-$268	$1,113	$187
	7 Years	$1,225	$2,007	$529	$2,061	$1,562	-$735	$1,169	$455
Short Certificate	1 Year	$709	$579	$485	$244	$76	$67	$80	$5
	3 Years	$1,875	$1,367	$1,306	$743	$221	$120	$174	-$19
	5 Years	$2,703	$1,662	$1,928	$1,254	$358	$63	$179	-$87
	7 Years	$3,194	$1,464	$2,351	$1,777	$486	-$103	$96	-$200
Long Certificate	1 Year	$642	$861	$498	$444	$465	$737	$377	$361
	3 Years	$1,620	$2,198	$1,208	$1,171	$1,054	$1,745	$941	$934
	5 Years	$2,189	$3,019	$1,535	$1,685	$1,185	$2,135	$1,251	$1,310
	7 Years	$2,351	$3,326	$1,480	$1,987	$859	$1,904	$1,307	$1,488
Associate Degree	1 Year	-$89	$104	-$80	$1	$276	$254	$173	$231
	3 Years	$49	$587	$88	$65	$762	$843	$609	$692
	5 Years	$607	$1,440	$694	$212	$1,159	$1,538	$1,164	$1,150
	7 Years	$1,584	$2,661	$1,737	$443	$1,469	$2,339	$1,840	$1,605
N (students)		210,969	45,853	203,889	38,732	205,775	52,670	206,729	41,397
N (student-quarters)		5,738,409	1,060,059	5,889,533	1,009,719	5,767,612	1,319,091	5,951,764	1,118,995

Note. Results were derived by applying the Model 2 specification to segments of the analytical sample defined by race/ethnicity and gender. Dollars are adjusted for inflation to 2013Q4. Standard errors are available upon request.

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

Statistically significant returns to long-term certificates are observed among all eight groups. Black men experience the greatest return to long-term certificates, with an earnings advantage over non-completing Black men of $3,326 per quarter at seven years post-award, followed by White men ($2,351), Asian men ($1,987), and then Black women ($1,904). Estimates indicate that Asian women, Hispanic men, and Hispanic women all experience approximately the same return to long-term certificates at $1,488, $1,480, and $1,307, respectively, while the return to White women ($859) trails behind that of the other groups. Overall, men receive a somewhat greater return to long-term certificates than do women, with the notable exception of Black women for whom the return to long-term certificates rivals that of men.

Seven of the eight groups experience significant returns to associate degrees; only Asian men are estimated to experience no return, on average, to associate degrees. Black men and Black women experience the greatest return to associate degrees, with advantages over their non-completing counterparts of $2,661 and $2,339 per quarter at seven years post-award. Hispanic women and men experience average returns that are similar to each other at $1,840 and $1,737, respectively. Likewise, Asian women, White men, and White women also experience similar but lower returns at $1,605, $1,548, and $1,469, respectively. Notably, the pattern of delayed return to associate degrees (i.e., comparatively low returns in the few years immediately after receipt of the degree, followed by much stronger returns later) holds true for all groups but is more pronounced for men than it is for women.

Viewing Table 7 holistically, low-credit awards provide a strong return to select groups of students. Short-term certificates provide a strong return to men but little or no return to women. The return to long-term certificates is more equitable than is the return to short-term certificates, but still is somewhat stronger for men. Importantly, Black men experience an especially strong return to long-term certificates, relative to men of other racial/ethnic groups. Likewise, Black women experience an especially strong return, relative to women of other racial/ethnic groups. The return to associate degrees does not appear to differ greatly between men or women, but, again, Black men and Black women experience especially strong returns to associate degrees.

Returns by Field of Study

Despite the public and political appetite for simple claims about the labor market return to credentials (e.g., Baron, 2013), such claims can be misleading. Returns vary substantially by field of study (Bailey & Belfield, 2011; Grubb, 2002; Webber, 2014), and the fields of study in which awards are made vary substantially across the four levels of credentials. For example, nearly three-quarters (73 percent) of the low-credit awards received by students in the analytical sample were in the field of health or public & protective services, resulting in estimates of returns to low-credit awards that are weighted heavily toward earnings in these fields. In

contrast, only one-eighth (12 percent) of associate degrees awarded to students in the analytical sample were in one of these two fields.

To investigate how the return to each level of credential varies across fields of study, I present in Table 8 the estimated coefficients and predicted returns for Model 3. As before, predictions describe the expected difference in earnings at a given point in time between a student who received a given credential and a student who did not receive *any* community college credentials. As noted earlier, I estimated effects for all credentials but do not report those that were awarded to fewer than 100 students.

Table 8: Model 3 Estimates of the Rate of Change in Return in Quarterly Earnings to Community College Credentials, by the Field of Study in Which the Credential Was Awarded

	Rate of Change in Return		Predicted (Dis)Advantage in Quarterly Earnings vs. No Credential			
	Identity	Square	One Year	Three Years	Five Years	Seven Years
Low-Credit Award						
Agriculture & Natural Resources†	-39.94	0.12	-$158	-$462	-$752	-$1,027
Environmental Sciences & Tech†	-29.89	2.81*	-$75	$46	$527	$1,369
Business & Management†	38.14	-1.46	$129	$247	$179	-$76
Engineering & Industrial Tech†	-45.36	1.19	-$162	-$373	-$430	-$335
Health†	49.11***	-0.36	$191	$538	$839	$1,095
Family & Consumer Sciences†	-60.75	1.35	-$221	-$535	-$677	-$646
Public & Protective Services†	155.66***	-4.59***	$549	$1,207	$1,278	$762
Short-Term Certificate						
Agriculture & Natural Resources†	38.11	-0.54	$144	$380	$547	$645
Architecture & Related Tech†	-49.03	3.53	-$140	-$80	$432	$1,395
Biological Sciences	219.31***	-4.03	$813	$2,052	$2,776	$2,984
Business & Management†	15.12	0.01	$61	$183	$307	$433
Media & Communications†	-65.93	2.14	-$229	-$482	-$461	-$165
Information Tech†	48.98	-0.64	$186	$495	$723	$868
Education	-167.33***	5.94**	-$574	-$1,153	-$971	-$30
Engineering & Industrial Tech†	106.64***	-1.95***	$395	$999	$1,353	$1,458
Fine & Applied Arts	-124.71***	3.55	-$442	-$985	-$1,073	-$706
Foreign Languages	-26.21	0.60	-$95	-$228	-$285	-$264
Health†	28.75**	0.12	$117	$362	$623	$899
Family & Consumer Sciences†	-1.70	0.01	-$7	-$19	-$31	-$42
Law†	123.21**	-3.34*	$439	$997	$1,127	$830
Humanities	-3.53	2.22	$21	$277	$817	$1,642
Library Science†	79.98*	-1.82	$291	$697	$870	$809
Public & Protective Services†	331.06***	-6.16***	$1,226	$3,085	$4,157	$4,439
Commercial Services†	-33.96*	0.51	-$128	-$334	-$476	-$553
Interdisciplinary Studies	-122.20**	3.33*	-$436	-$987	-$1,112	-$812

Long-Term Certificate						
Agriculture & Natural Resources†	-38.08	0.61	-$143	-$370	-$519	-$591
Business & Management†	-0.25	0.10	$1	$11	$33	$68
Media & Communications†	23.81	1.38	$117	$484	$1,027	$1,747
Information Tech†	11.58	0.55	$55	$218	$451	$755
Education	28.87	-1.17	$97	$178	$110	-$107
Engineering & Industrial Tech†	212.75***	-5.72***	$759	$1,729	$1,967	$1,472
Fine & Applied Arts	-28.48	0.96	-$99	-$204	-$187	-$47
Health†	322.57***	-7.91***	$1,164	$2,732	$3,287	$2,831
Family & Consumer Sciences†	-10.05	0.60	-$31	-$34	$39	$190
Law†	99.96*	-1.49	$376	$985	$1,404	$1,632
Public & Protective Services†	181.36***	-2.94***	$678	$1,753	$2,451	$2,773
Commercial Services†	-112.30***	2.94***	-$402	-$924	-$1,070	-$840
Interdisciplinary Studies	-94.94***	4.69***	-$305	-$465	-$25	$1,015
Associate Degree						
Agriculture & Natural Resources†	32.90	1.12	$150	$556	$1,107	$1,801
Architecture & Related Tech†	-155.61**	7.62**	-$501	-$771	-$65	$1,615
Biological Sciences	-92.77**	7.85***	-$245	$18	$1,286	$3,560
Business & Management†	23.27**	0.75	$105	$388	$766	$1,242
Media & Communications†	-92.42***	2.50*	-$330	-$749	-$847	-$625
Information Tech†	109.23***	-1.87	$407	$1,042	$1,437	$1,593
Education	-107.71**	4.71**	-$355	-$614	-$269	$678
Engineering & Industrial Tech†	42.20*	1.61	$195	$739	$1,489	$2,447
Fine & Applied Arts	-121.69***	3.52***	-$430	-$953	-$1,024	-$645
Foreign Languages	-140.03**	5.61*	-$470	-$872	-$555	$480
Health†	1,084.72***	-30.57***	$3,850	$8,614	$9,465	$6,402
Family & Consumer Sciences†	-14.71	-0.10	-$60	-$191	-$335	-$492
Law†	100.15*	-2.31	$364	$869	$1,077	$990
Humanities	-73.11***	2.36**	-$255	-$538	-$518	-$197
Mathematics	-24.98	4.99**	-$20	$419	$1,497	$3,215
Physical Sciences	-68.14	2.96	-$225	-$392	-$179	$412
Psychology	-80.23***	2.81***	-$276	-$558	-$480	-$42
Public & Protective Services†	36.05**	2.02***	$177	$724	$1,531	$2,596
Social Sciences	-68.46***	2.77***	-$230	-$423	-$263	$252
Commercial Services†	-64.16	3.60	-$199	-$252	$155	$1,022
Interdisciplinary Studies	-50.21***	2.85***	-$155	-$192	$137	$830

Note. Dollars are adjusted for inflation to 2013Q4. Standard errors are available upon request. Estimates for credentials that were awarded to fewer than 100 students are not shown.

† Indicates a field that is oriented primarily toward career and technical education (CTE).

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

Only three of the seven fields in which low-credit awards are awarded have returns that differ significantly from zero. The return to low-credit awards in health (78 percent of which are in the subfield of emergency medical services) and public & protective services (71 percent in the administration of justice subfield) are strong and positive, though the return to low-credit

awards in public & protective services is stronger in earlier years and then declines in later years. The return experienced by students who complete a low-credit award in environmental sciences & technologies (100 percent in the environmental technology subfield) is delayed, being low in the early years following the award of the credential but rising sharply in later years.

One of the three low-credit awards that does not have a statistically significant relationship with earnings is especially noteworthy, namely engineering & industrial technologies. As discussed later in this section, all other credential levels in engineering & industrial technologies have statistically significant, positive returns. The majority (54 percent) of low-credit awards in this field are in the automotive technology subfield. Some evidence indicates that community colleges are an important venue for completing skill maintenance education required of workers in the automotive industry (K. Booth, personal communication, October 19, 2015). The absence of a statistically significant effect of these low-credit awards on earnings draws attention to an important limitation of earnings metrics with respect to measuring the contribution of community colleges to workforce development. Specifically, measuring program success solely through the earnings of graduates neglects the critical skill-updating education provided by community colleges that makes it possible for workers in some fields to *maintain* their employment, as well as the re-skilling education that helps workers transition from one industry to another (e.g., Xu & Trimble, 2015).

Turning to short-term certificates, ten of eighteen fields have statistically significant returns. Four of the ten fields have returns to short-term certificates that are consistently negative over the span of time considered here. These are education (52 percent in the physical education subfield), fine & applied arts (24 percent, commercial music; 23 percent, graphic art & design; 20 percent, applied photography), commercial services (67 percent, cosmetology & barbering), and interdisciplinary studies (77 percent, liberal arts & sciences).

Modest positive returns are observed for short-term certificates in the fields of health (25 percent emergency medical services; 21 percent, nursing; 20 percent, medical assisting), law (99 percent, paralegal) and library science (94 percent, library technician). Strong positive returns are observed in biological sciences (76 percent, biotechnology & biomedical technology), engineering & industrial technologies (35 percent, automotive technology; 13 percent, electronics & electric technology; 12 percent, manufacturing & industrial technology), and public & protective services (56 percent, administrative of justice).

Long-term certificates in six of thirteen fields have statistically significant relationships with earnings. Long-term certificates in the fields of engineering & industrial technologies (22 percent, construction crafts technology; 16 percent, automotive technology; 12 percent, electronics & electric technology), health (46 percent, nursing), law (100 percent, paralegal), and public & protective services (39 percent, human services; 36 percent, administration of justice) provide strong positive returns, while long-term certificates in commercial services (95 percent, cosmetology & barbering) have a moderate negative return. The effect on earnings of a long-term certificate in interdisciplinary studies (97 percent, liberal arts & sciences) is somewhat less

clear. The early return to this award is moderately negative, but, by seven years post-award, the return is predicted to be positive.

Similarly ambiguous results are observed for associate degrees in architecture, education (52 percent in the physical education subfield), foreign languages (52 percent, Spanish), the social sciences (78 percent, general social sciences), and interdisciplinary studies (78 percent, liberal arts & sciences). In each of these fields, the predicted earnings advantage of an associate degree over non-completing students is negative in the early years after receipt of the award but positive by seven years post-award. In contrast, the returns to associate degrees in media & communications (35 percent, digital media; 26 percent, radio & television), fine & applied arts (33 percent, art; 14 percent, graphic art & design; 12 percent, music), the humanities (34 percent, speech communication; 34 percent, English), and psychology (94 percent, general psychology) are consistently negative over the span of time considered here.

Positive returns to associate degrees are observed in the biological sciences (94 percent, general biology), business & management (33 percent, business administration; 23 percent, general business and commerce), information technology (30 percent, computer information systems; 22 percent, computer infrastructure & support), engineering & industrial technologies (18 percent, electronics & electric technology; 18 percent, automotive technology; 11 percent, drafting technology), health (69 percent, nursing), law (97 percent, paralegal), mathematics, and public & protective services (59 percent, administration of justice). In two of these fields—biological sciences and mathematics—a positive return is not evident until after the first year following the award of the associate degree.

To aid in comparing the returns to particular fields of study across levels of awards, I provide in Table 9 a matrix of the estimated return in earnings of each credential at seven years following the award. Focusing on the 17 (of 23) fields of study with reportable results for at least two levels of credentials, one observes fairly consistent, positive returns across levels of credentials in the biological sciences, engineering & industrial technologies (except low-credit awards, in which the return is not significant), health, law, and public & protective services, which account for about 28 percent of all credentials awarded to analytical cohort. Returns that are consistently negative or not significantly different from zero across levels are observed in the fields of agriculture & natural resources, media & communications, fine & applied arts, family & consumer sciences, humanities, and commercial services, collectively accounting for 14 percent of all credentials. Five fields have returns that are positive only at the associate degree-level and otherwise are zero or near zero. These include architecture, business & management, information technology, education, and foreign languages, making up 11 percent of credentials. Returns of mixed direction (positive and negative) are noted across levels of credentials in the field of interdisciplinary studies, which accounts for more of the credentials awarded to the analytical cohort (40 percent) than does any other single field. The remaining six fields with reportable results for only one level of credential make up 7 percent of credentials.

Table 9: Comparison of the Predicted (Dis)Advantage in Quarterly Earnings at Seven Years After the Receipt of a Credential, Relative to Students Who Were Not Awarded a Credential (predictions derived from Model 3, shown in Table 8)

Field of Study	Low-Credit Award	Short-Term Certificate	Long-Term Certificate	Associate Degree
Agriculture & Natural Resources†	NS	NS	NS	NS
Architecture & Related Technologies†	----------	NS	----------	$1,615
Environmental Sciences & Technologies†	$1,369	----------	----------	----------
Biological Sciences	----------	$2,984	----------	$3,560
Business & Management†	NS	NS	NS	$1,242
Media & Communications†	----------	NS	NS	-$625
Information Technology†	----------	NS	NS	$1,593
Education	----------	-$30	NS	$678
Engineering & Industrial Technologies†	NS	$1,458	$1,472	$2,447
Fine & Applied Arts	----------	-$706	NS	-$645
Foreign Languages	----------	NS	----------	$480
Health†	$1,095	$899	$2,831	$6,402
Family & Consumer Sciences†	-$646	NS	NS	NS
Law†	----------	$830	$1,632	$990
Humanities	----------	NS	----------	-$197
Library Science†	----------	$809	----------	----------
Mathematics	----------	----------	----------	$3,215
Physical Sciences	----------	----------	----------	NS
Psychology	----------	----------	----------	-$42
Public & Protective Services†	$762	$4,439	$2,773	$2,596
Social Sciences	----------	----------	----------	$252
Commercial Services†	----------	-$553	-$840	NS
Interdisciplinary Studies	----------	-$812	$1,015	$830

Note. "NS" indicates a return that is not significantly different from zero. Dollars are adjusted for inflation to 2013Q4. The effects of credentials that were awarded to fewer than 100 students were estimated but are not shown.

† Indicates a field that is oriented primarily toward career and technical education (CTE).

4. Sensitivity

Main Tests of Sensitivity

I tested the sensitivity of the results to several alternative specifications of the model and the analytical sample. In the interest of clarity and parsimony, I used Model 2 (Table 5) as the baseline model, rather than Model 3 (Table 8). Model 2 does not distinguish between the fields of study in which credentials were awarded, which simplifies the comparison of results across alternative specifications. I present the results of the sensitivity analyses in Table 10.

One way in which the model specification in this study differs from recent prior research is the manner in which change in exogenous labor market conditions is controlled. Models 1, 2, and 3 all include the interactions of the identity, square, and cube of time with the quarter of a student's entry into the CCC system, which allows the cohort of students that entered in each quarter to have its own unique earnings trend that differs from that of cohorts entering in other quarters. As an alternative approach, some recent research (e.g., Dadgar & Trimble, 2014; Jepsen et al., 2014) has used quarter fixed effects. To determine whether this difference influences the results, in Model 2A I replace the interactions of time and the quarter of a student's entry into the CCC system with dummy variables to uniquely identify each quarter from 2000Q2 through 2013Q4.

As discussed earlier, despite statistical controls for education received from postsecondary institutions outside the CCC system, it is not clear whether the model captures fully the variation in earnings experienced by students who are awarded credentials by such external institutions. Consequently, the estimated returns to community college credentials in this study may reflect, in part, differences in the propensity to transfer and earn additional credentials from external institutions. The greatest potential for bias in this regard lies with community college credentials that are strongly associated with transfer to four-year institutions, and substantial variability in the propensity to transfer by level of credential and field of study was observed in Table 4. To explore this potential source of bias, I exclude in Model 2B all students who transferred to a postsecondary institution outside the CCC system at any point, whether to a four-year institution or a less-than-four-year institution.

Table 10: Tests of Model Sensitivity, Using Model 2 as the Baseline Model for Comparison

		Model 2 Baseline Specification	**Model 2A** Quarter Fixed Effects	**Model 2B** Never Transferred	**Model 2C** Ashenfelter Dip	**Model 2D** Age 20–50 Years	**Model 2E** > 0 Credits
LC Award	Identity	85.42***	84.78***	75.31***	83.99***	76.32***	82.43***
	Square	-1.39***	-1.35***	-1.14***	-1.41***	-1.78***	-1.37***
Short Certificate	Identity	87.46***	88.25***	77.81***	82.53***	69.89***	83.00***
	Square	-1.29***	-1.31***	-1.07***	-1.17***	-1.12***	-1.22***
Long Certificate	Identity	151.08***	152.59***	176.00***	149.82***	169.85***	146.61***
	Square	-3.27***	-3.33***	-4.21***	-3.27***	-3.78***	-3.21***
Associate Degree	Identity	30.34***	36.63***	172.91***	33.55***	120.84***	28.66***
	Square	1.02***	0.79***	-2.48***	0.92***	-1.52***	0.97***
LC Award	One Year	$319	$317	$283	$313	$277	$308
	Three Years	$825	$822	$740	$805	$659	$791
	Five Years	$1,152	$1,154	$1,051	$1,116	$814	$1,099
	Seven Years	$1,301	$1,312	$1,217	$1,247	$741	$1,232
Short Certificate	One Year	$329	$332	$294	$311	$262	$312
	Three Years	$863	$871	$780	$822	$677	$820
	Five Years	$1,232	$1,243	$1,129	$1,183	$948	$1,171
	Seven Years	$1,436	$1,447	$1,340	$1,394	$1,075	$1,366
Long Certificate	One Year	$552	$557	$637	$547	$619	$535
	Three Years	$1,342	$1,352	$1,505	$1,327	$1,494	$1,297
	Five Years	$1,712	$1,722	$1,835	$1,689	$1,884	$1,647
	Seven Years	$1,664	$1,666	$1,625	$1,633	$1,790	$1,586
Associate Degree	One Year	$138	$159	$652	$149	$459	$130
	Three Years	$511	$553	$1,718	$535	$1,232	$484
	Five Years	$1,015	$1,047	$2,467	$1,040	$1,811	$962
	Seven Years	$1,650	$1,643	$2,899	$1,662	$2,195	$1,565
	N (students)	1,115,386	1,115,386	856,480	977,895	550,273	944,561
	N (student-quarters)	30,877,882	30,877,882	24,208,714	26,480,435	15,806,555	26,552,612

Note. Dollars are adjusted for inflation to 2013Q4. Standard errors are available upon request.

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

Two questions could be raised about the influence of students' pre-college earnings on the estimates presented in this study. First, it is possible that depressed earnings experienced by displaced workers immediately prior to beginning college (i.e., Ashenfelter dip) could give the appearance of a stronger return to credentials than otherwise would be observed. To test this possibility, Model 2C excludes the two quarters of earnings information immediately prior to each student's entry into the CCC system. This model also excludes all students who, after excluding these two quarters of earnings information, had no record of earnings prior to college.

Second, one could ask whether low pre-college earnings among the youngest students in the sample, many of whom presumably were enrolled in high school during some or all of the 10 quarters before beginning college, may inflate the estimated returns to credentials. Model 2D addresses this question by excluding all students who were less than 20 years of age when they entered college.

Finally, as discussed earlier, the comparison group in this study is community college students who did not complete credentials. In other words, the average earnings of non-completing students is the point of reference against which the returns to credentials are measured. Prior work has demonstrated a labor market return to community college credits even in the absence of an awarded credential (e.g., Bahr, 2016; Belfield & Bailey, 2011; Grubb, 2002), and, hence, it is expected that the earnings of non-completing students are greater than are the earnings of individuals who did not enroll in college at all. However, a surprisingly large number of community college students *do not complete any credits*, and it is likely that these students are very different from students who *do* complete credits. To explore the implications of this variation in the comparison group, Model 2E excludes the 15 percent of students in the analytical sample who completed zero credits in the CCC system.

Comparing the results presented in Table 10, one finds two models in which some of the results differ substantively from the baseline Model 2. A *substantive* difference is defined here as a difference of more than 15 percent in the predicted return to a credential at a particular point in time.

In Model 2B, which excludes all students who transferred, one observes considerably stronger returns to associate degrees at all points in time following the award of the degree. This finding suggests at least two possibilities that are not mutually exclusive. First, Model 2 may not adequately account for the depression in earnings caused by enrollment in external institutions, resulting in a downwardly biased estimate of the return to associate degrees in Model 2. Second, students who complete an associate degree and do *not* transfer may experience a pattern of growth in their earnings that is very different from those who complete an associate degree and *do* transfer.

The latter possibility, in particular, is supported by the evidence of a strong association between the field of study in which an associate degree is awarded and the likelihood of transferring to a four-year institution (Table 4). To illustrate, just 28 percent of students who completed an associate degree in the high-return field of health transferred to a four-year

institution, as did 26 percent of students who completed an associate's degree in the high-return field of engineering & industrial technologies. As a point of comparison, 64 percent of all associate degree recipients transferred to a four-year institution. Students who were awarded a degree in health or engineering & industrial technologies make up about 10.7 percent of the students who completed an associate degree, but, after excluding students who transferred in Model 2B, their representation doubles to 21.4 percent of recipients of associate degrees. Thus, the estimate of the return to associate degrees in Model 2B is based on a distribution of field of study that is meaningfully different from that of Model 2, potentially explaining (at least in part) the differences in the estimated return to associate degrees.

The other model in which substantive differences in results are observed is Model 2D, which excludes students who were 18 or 19 years of age at college entry. The estimated return to low-credit awards and short-term certificates in Model 2D is lower than is observed in Model 2, while the estimated return to associate degrees is stronger in Model 2D.

In considering explanations for these divergences, low pre-college earnings among the youngest students, who were dropped from Model 2D, potentially could explain the reduction in the return to low-credit awards and short-term certificates in Model 2D. By itself, however, low pre-college earnings cannot explain the greater return to associate degrees. Thus, it is worth considering alternative or supplementary explanations.

Among these, the students who were 18 or 19 years old at college entry were about three times as likely to transfer to a four-year institution as were students who were 20 years of age (29 percent versus 10 percent). Therefore, the observed differences between Model 2 and Model 2D may be partially a result of the disproportionate loss of transfer-oriented students, with the corresponding change in the distribution of field of study that was discussed for Model 2B. Furthermore, regardless of transfer, one would expect meaningful differences in field of study between older and younger students, possibly adding to any distributional dissimilarities resulting from the differential loss of transfer-orientated students.

Regarding both Models 2B and 2D, further research is needed to investigate the observed differences in the returns to credentials, relative to Model 2. In contrast to the approach used here and in prior research to test model sensitivity, it would be enlightening to execute tests of sensitivity that distinguish both the level *and* the field of study of credentials, much like Model 3 (Table 8). Although it will to add to the complexity of interpretation, it also will eliminate distributional differences in field of study as an explanation for differences in estimated returns.

College Exit

An important critique of recent research on the labor market returns to community college credentials is that much of it neglects the distinction between when a student completes a credential and when that student actually leaves college (Jaggars & Xu, 2015). Both this study and much of the prior work assume that the return to a credential will begin to accrue at the time that the credential is awarded. Adjustments to estimated quarterly earnings routinely are made to

account for the opportunity cost of being enrolled in college, whether before or after receiving a credential. However, these adjustments do not take into account the fact that many students will begin to engage in earnest with the labor market in their chosen field only after they have finished attending college altogether.

The justification for this critique is illustrated in the bottom panel of Table 6, presented earlier. As discussed, the top panel of Table 6 describes the distribution of the length of time that students' earnings were observed *after receiving a particular credential*. The bottom panel in Table 6 describes the distribution of the length of time that students' earnings were observed *after exiting all postsecondary institutions* (i.e., finishing or otherwise leaving college), including CCC system colleges and other four-year and less-than-four-year institutions.

If community college students left college immediately after completing a credential, the figures in the two panels would be the same. However, we see here that earnings are observed for a meaningfully shorter time after exiting college, as compared with after receiving a credential, demonstrating that students often remain in college after receiving a community college credential. For example, among the students who received a short-term certificate, earnings were observed for an average of 5.2 years following the receipt of the award but an average of 3.5 years following exit from all postsecondary institutions. The difference of 1.7 years is the average length of time that recipients of short-term certificates remained in college after receiving the award.

To explore the implications of this critique, I estimated an alternative to Model 2 that adds a measure of the number of quarters that have passed, as of time *t*, since a student exited all postsecondary education institutions (*Time Since* $Exit_{it}^{p}$). This variable takes on a value of zero for all quarters up to and including a student's last quarter in any postsecondary institution. Both the identity and square of time since exit were included in the model.

I interacted time since exit with a dummy variable for each of the *j* levels of community college credentials. Each of these variables was assigned a value of one if the student ever received the credential and zero otherwise. I also interacted time since exit with a dummy variable indicating whether a student ever attended a four-year institution and a dummy variable indicating whether a student ever attended a less-than-four-year institution other than a CCC system college. The new specification is presented as Model 4 below.

$$Earnings_{it} = \alpha + \beta_{jp}(Time\ Since\ Credential\ Award_{jit}{}^{p}) + \phi_{p}(Time\ Since\ Exit_{it}{}^{p}) + \varphi_{jp}(Credential_{ji} * Time\ Since\ Exit_{it}{}^{p}) + \gamma_{p}(Course\ Credit\ Load_{it}{}^{p}) + \delta(Enroll\ Four\ Year_{it}) + \zeta(Enroll\ Other\ PSI_{it}) + \eta_{p}(Time\ Since\ Four\ Year_{it}{}^{p}) + \theta_{p}(Time\ Since\ Other\ PSI_{it}{}^{p}) + \psi_{p}(Ever\ Four\ Year_{i} * Time\ Since\ Exit_{it}{}^{p}) + \omega_{p}(Ever\ Other\ PSI_{i} * Time\ Since\ Exit_{it}{}^{p}) + \cdots + \rho_{i} + \varepsilon_{it} \quad \text{(Model 4)}$$

The advantage of Model 4 over Model 2 is that the former allows each credential to have an effect on earnings immediately after the award of the credential that differs from the effect of the credential on earnings after the student exited college. By setting time since exit equal to time since the award of the credential, I am able to predict returns to credentials in a manner that better represents how returns are understood—returns after a student has left college and engaged with the labor market.

The estimates from Model 4 are presented in Table 11. Relative to the baseline Model 2, one observes in Table 11 a reduction in the estimated returns to low-credit awards and short-term certificates, suggesting that Model 2 overestimated the returns to these credentials. Still, the returns remain statistically significant and positive. In addition, one observes a strong increase in the return to associate degrees, particularly at one, three, and five years after receiving the degree and exiting college. These findings are similar to those observed in Model 2D, which excluded students who were less than 20 years at college entry.

Table 11: Estimated rate of change in return in quarterly earnings to community college credentials, accounting for differential post-award and post-college effects, as specified in Model 4

	Time Since Award Receipt		Time Since College Exit		Predicted Advantage in Quarterly Earnings vs. No Credential			
	Identity	Square	Identity	Square	One Year After Award	Three Years After Award	Five Years After Award	Seven Years After Award
Low-Credit Award	80.79***	-0.52	-7.16	-1.57*	$261	$583	$637	$423
	(11.95)	(0.41)	(19.29)	(0.61)				
Short-Term Certificate	105.08***	-1.34***	-51.27***	0.63*	$204	$543	$791	$948
	(5.51)	(0.19)	(8.56)	(0.29)				
Long-Term Certificate	129.49***	-2.67***	36.60***	-1.43***	$599	$1,403	$1,683	$1,438
	(7.11)	(0.27)	(10.26)	(0.37)				
Associate Degree	9.19**	0.66***	117.66***	-2.92***	$471	$1,196	$1,631	$1,776
	(3.00)	(0.14)	(6.11)	(0.26)				

Note. Dollars are adjusted for inflation to 2013Q4. $N_{students}$ = 1,115,386; $N_{student}$-quarters = 30,877,882.

*p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001

5. Conclusion

In this study, I drew on longitudinal data for 1.1 million students in California to estimate the effects of community college credentials on students' earnings, relative to students who do not earn a credential. In contrast to much of the recent work on this subject, which assumed that the effects of credentials on students' earnings are *constant* over time, I estimated the effects of credentials on the *rate of change* in students' earnings and allowed these effects to *vary* over time.

This proves to be an important departure from prior work as I find that the returns to low-credit awards and certificates (both short- and long-term) are strong initially but begin to flatten or decline by seven years after the award. In contrast, the arc of returns to associate degrees is considerably longer, with an earnings advantage over non-completing students that continues to widen through the seven-year span of time considered in this study. Notably, the longer arc of gains from associate degrees does *not* appear to be due simply to delayed workforce entry resulting from a greater likelihood among associate degree recipients of continuing into a baccalaureate program. Rather, this pattern is observed even among students who do not transfer to another postsecondary institution.

Importantly, prior research on the returns to short-term certificates has been divided in its conclusions on whether there is any return to short-term certificates and, if so, to whom these returns accrue (Bahr et al., 2015; Dadgar & Trimble, 2014; Jepsen et al., 2014; Liu et al., 2014; Xu & Trimble, 2015). This study indicates that the returns to short-term certificates for men are quite strong but, for women, quite weak. Of the states in which comparable individual fixed effects models of returns to short-term certificates have been estimated, the findings of this study align most closely with Michigan (Bahr et al., 2015) and North Carolina (Liu et al., 2014).[7]

More broadly, I find that the returns to all levels of community college credentials vary by race/ethnicity and gender, with short-term certificates being an extreme case of variation by gender. Black men and Black women experience especially strong returns to associate degrees and long-term certificates, relative to their peers of the same gender but different racial/ethnic background. White and Hispanic men experience especially strong returns to short-term certificates, relative to Black and Asian men. Statistically significant returns to low-credit awards are confined to just a few student subpopulations, specifically White men and White and Hispanic women.

It seems likely that some of the observed variation in returns by race/ethnicity and gender, as well as variation observed by age, may be explained at least in part by heterogeneity in students' educational plans, field of study in community college, and trajectory after leaving community college. In particular, I find a high level of variation by field of study in the returns to

[7] In my assessment of the alignment of this study's findings regarding short-term certificates with the findings from North Carolina, I am focusing on Table 6 in the study by Liu et al. (2014), which presents the results of their individual fixed effects model.

each credential level, and a strong association between credential level/field and transfer to a four-year institution. I also find compelling evidence of the need to distinguish returns *after a credential is awarded* from returns *after a student has finished (or otherwise left) postsecondary education*, as argued by Jaggars and Xu (2015). Differences in observed returns to credentials across categories of age, race/ethnicity, and gender would be one expected result of systematic variation by these demographic characteristics in field of study in community college and corresponding variation in the likelihood of transferring to a four-year institution.

Additional research on heterogeneity in returns across student subpopulations is sorely needed, and I recommend that this subject be investigated carefully in future research. In that regard, I presented in this study a relatively straightforward adaptation of the individual fixed effects model that differentiates post-award returns from post-exit returns, and that will support such investigations. It will be important in future work, however, to disaggregate effects of credentials by field of study, owing to the strong relationship between field of study and transfer.

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Appendix A

For the purposes of translating the semester in which a student entered the CCC system into an annual quarter, I focused on when the semester ended, treating the spring semester of a given year as occurring in the second quarter of that year, the summer semester as occurring in the third quarter, and the fall semester as occurring in the fourth quarter. For example, a fall 2002 semester of entry was converted to 2002Q4, a spring 2003 semester of entry was converted to 2003Q2, and a summer 2003 semester of entry was converted to 2003Q3. As operationalized here, no students in the analytical sample entered the CCC system in the first quarter of any year.

The translation to quarter units of time was handled in a somewhat different manner for the semester-based variables that addressed students' intensity of enrollment in the CCC system in a given semester and the amount of financial aid of a particular type that a student received in the CCC system in a given semester. Operationalizing intensity of enrollment involved assigning the number of credits attempted in each semester to the associated quarters in approximate correspondence to the proportion of overlap of semesters and quarters. Specifically, credits attempted in the first quarter of a given year were set equal to 100 percent of the credits attempted in the spring semester of that year, if any. Likewise, credits attempted in the fourth quarter were set equal to 100 percent of the credits attempted in the fall semester. Attempted credits in the second quarter were set equal to 75 percent of the credits attempted in the spring semester plus 25 percent of the credits attempted in the summer semester. Attempted credits in the third quarter were set equal to 75 percent of the credits attempted in the summer semester plus 25 percent of the credits attempted in the fall semester. The amount of financial aid of a given type received by a student was translated using this same method of proportional allocation. Though this operationalization strategy does not match perfectly to the academic calendar of every college, it is a reasonable approximation, and it is far superior to ignoring one quarter in each year completely or averaging across the four quarters all credits attempted or dollars received in a given year.

The other variables that required special consideration in terms of translation to quarter units of time concerned the opportunity costs of enrolling in postsecondary institutions outside of the CCC system, which, for sake of clarity, I describe here as external institutions. The dichotomous variables that I constructed to address enrollment in external institutions were based on NSC data that include the date of the reported enrollment in the external institution, whether the institution is a four-year institution or not, and a variety of other information, but do not include information about the intensity of enrollment or when a given term ended.

To construct the requisite variables, one might simply convert the dates of enrollment into the corresponding quarters, such that a January date is converted to Q1, while an August date is converted to Q3, and so on. However, this approach would ignore the fact that the academic terms of the external institutions often bridge two quarters. For example, a January enrollment date (Q1) often would indicate enrollment into the month April (Q2), as one would expect with a typical spring semester. Moreover, using the next reported date of enrollment for

that student at that institution to create *spells* of enrollment would not be adequate in every case because the student may not have enrolled in that institution in the summer term or may not have returned in the fall term.

Given that it was not feasible with these data to resolve all uncertainty around the periods of time in which a student was enrolled in an external institution, I selected a conservative approach for this analysis, treating every reported enrollment date as the beginning of a 12-week term. The result is that most enrollments in external institutions were presumed to span two quarters. For example, an August enrollment date in a given year was presumed to indicate enrollment in the external institution in the third and fourth quarters of that year. Importantly, I distinguished between four-year external institutions and less-than-four-year external institutions, creating a separate time-varying dummy variable for each type of institution, under the assumption that the capacity of students to maintain employment while attending college may differ, on average, between the two types of institutions.

Appendix B

Figure B.1: Distribution of Subfields of Study for all Credentials Awarded in the CCC System From Fall 2002 Through Summer 2013, by Level and Field of Study

Fields and Subfields	% of Low-Credit Awards	% of Short-Term Certificates	% of Long-Term Certificates	% of Associate Degrees	% of All Levels of Credentials
Agriculture & Natural Resources†					
Agriculture Technology & Sciences, General†	0.3%	2.8%	0.7%	4.9%	3.2%
Animal Science†	1.5%	7.8%	46.8%	45.9%	33.6%
Plant Science†	1.2%	3.0%	0.7%	2.2%	2.1%
Viticulture, Enology & Wine Business†	1.5%	3.3%	1.3%	2.7%	2.5%
Horticulture†	24.5%	56.2%	35.3%	21.8%	34.6%
Agriculture Business, Sales & Service†	0.0%	5.0%	1.0%	9.3%	5.9%
Food Processing & Related Technologies†	0.0%	0.0%	1.4%	0.5%	0.5%
Forestry†	0.0%	5.2%	1.5%	3.5%	3.4%
Natural Resources†	0.0%	4.8%	3.9%	6.5%	5.2%
Agricultural Power Equipment Technology†	69.6%	10.2%	6.7%	1.6%	7.8%
Other Agriculture & Natural Resources†	1.4%	1.6%	0.5%	1.2%	1.2%
Architecture & Related Technologies†					
Architecture & Architectural Technology†	88.1%	99.2%	99.5%	99.7%	98.9%
Other Architecture & Environmental Design†	11.9%	0.8%	0.5%	0.3%	1.1%
Environmental Sciences & Technologies†					
Environmental Science	0.0%	4.3%	1.2%	15.5%	4.0%
Environmental Studies	0.0%	4.7%	2.3%	24.4%	5.8%
Environmental Technology†	100.0%	91.0%	96.5%	60.1%	90.2%
Other Environmental Sciences & Technologies†					
Biological Sciences					
Biology, General	0.0%	10.4%	4.5%	93.9%	80.9%
Botany, General	0.0%	0.0%	0.0%	0.0%	0.0%
Microbiology	0.0%	1.5%	0.0%	0.1%	0.3%
Zoology, General	0.0%	0.0%	0.0%	0.0%	0.0%
Natural History	0.0%	0.8%	1.8%	0.0%	0.2%
Anatomy & Physiology	0.0%	2.6%	0.0%	1.2%	1.4%
Biotechnology & Biomedical Technology†	100.0%	76.3%	90.7%	4.6%	16.1%

Other Biological Sciences	0.0%	8.5%	3.0%	0.1%	1.2%
Business & Management†					
Business & Commerce, General†	10.8%	3.6%	7.4%	23.1%	15.4%
Accounting†	24.2%	29.4%	31.7%	15.8%	21.6%
Banking & Finance†	0.1%	0.7%	0.9%	0.5%	0.6%
Business Administration†	0.0%	3.3%	19.6%	32.7%	21.6%
Business Management†	4.4%	18.3%	12.7%	13.2%	14.3%
International Business & Trade†	0.3%	3.2%	0.8%	0.7%	1.4%
Marketing & Distribution†	0.8%	4.1%	3.3%	1.8%	2.5%
Logistic & Materials Transportation†	2.2%	1.5%	0.1%	0.1%	0.6%
Real Estate†	8.1%	6.6%	2.9%	2.2%	3.8%
Insurance†	0.0%	0.0%	0.0%	0.0%	0.0%
Office Technology†	45.2%	28.0%	20.4%	7.2%	16.0%
Labor & Industrial Relations†	0.0%	0.5%	0.0%	0.1%	0.2%
Customer Service	0.1%	0.2%	0.0%	0.0%	0.1%
Other Business & Management†	3.8%	0.9%	0.1%	2.7%	2.0%
Media & Communications†					
Media & Communications, General	0.0%	9.6%	1.4%	9.2%	7.8%
Journalism†	5.3%	3.3%	2.8%	11.8%	7.1%
Radio & Television†	52.6%	23.5%	24.8%	26.0%	25.0%
Public Relations†	0.0%	0.3%	0.0%	0.1%	0.2%
Technical Communications†	0.0%	3.7%	0.1%	0.6%	1.5%
Mass Communications†	5.3%	0.2%	0.0%	0.5%	0.3%
Film Studies	0.0%	4.5%	12.6%	14.7%	10.8%
Digital Media†	36.8%	48.6%	55.1%	35.5%	43.8%
Other Media & Communications†	0.0%	6.2%	3.2%	1.6%	3.5%
Information Technology†					
Information Technology, General†	45.1%	20.6%	16.1%	15.7%	18.3%
Computer Information Systems†	22.8%	13.3%	22.7%	29.6%	20.8%
Computer Science (Transfer)	0.0%	0.6%	1.0%	9.3%	4.0%
Computer Software Development†	21.0%	18.4%	18.7%	17.3%	18.0%
Computer Infrastructure & Support†	6.2%	28.0%	28.6%	21.6%	25.5%
World Wide Web Administration†	0.0%	3.2%	2.3%	0.9%	2.2%
Other Information Technology†	4.9%	16.0%	10.6%	5.6%	11.3%
Education					
Education, General (Transfer)	0.0%	0.3%	0.0%	6.0%	3.6%

Educational Aide †	0.0%	17.7%	8.7%	4.5%	8.8%
Special Education†	0.0%	8.8%	1.6%	3.2%	4.6%
Physical Education	100.0%	52.4%	8.8%	52.4%	47.5%
Recreation	0.0%	1.2%	0.2%	3.6%	2.5%
Health Education†	0.0%	0.3%	0.0%	6.6%	4.0%
Industrial Arts (Transfer)	0.0%	0.0%	0.0%	0.2%	0.1%
Sign Language	0.0%	15.2%	69.0%	21.0%	24.7%
Educational Technology†	0.0%	1.0%	0.0%	0.2%	0.4%
Other Education†	0.0%	3.2%	11.7%	2.4%	3.7%
Engineering & Industrial Technologies†					
Engineering, General (Transfer)	0.0%	0.2%	0.2%	11.3%	2.5%
Engineering Technology, General†	0.0%	0.2%	0.1%	1.3%	0.4%
Electronics & Electric Technology†	5.4%	13.4%	11.6%	17.8%	13.5%
Electro-Mechanical Technology†	0.0%	0.2%	0.6%	0.4%	0.4%
Printing & Lithography†	0.0%	1.0%	0.7%	0.7%	0.8%
Instrumentation Technology†	0.0%	0.0%	0.0%	0.1%	0.0%
Industrial Systems Technology & Maintenance†	0.1%	0.4%	2.6%	0.8%	1.2%
Environmental Control Technology (HVAC)†	0.0%	5.9%	7.4%	4.1%	5.8%
Diesel Technology†	8.9%	3.2%	3.0%	2.2%	3.1%
Automotive Technology†	54.5%	34.9%	16.2%	17.6%	26.3%
Automotive Collision Repair†	1.2%	2.0%	2.8%	1.3%	2.0%
Aeronautical & Aviation Technology†	0.0%	2.2%	11.5%	4.5%	5.5%
Construction Crafts Technology†	5.2%	7.2%	22.3%	6.2%	11.6%
Drafting Technology†	6.9%	7.0%	3.2%	10.8%	6.6%
Chemical Technology†	0.0%	0.1%	0.0%	0.1%	0.1%
Laboratory Science Technology†	0.0%	0.1%	0.4%	0.5%	0.2%
Manufacturing & Industrial Technology†	12.1%	12.1%	10.6%	8.5%	10.9%
Civil & Construction Management Technology†	3.3%	6.0%	4.0%	5.9%	5.3%
Water & Wastewater Technology†	0.3%	3.2%	1.5%	3.3%	2.6%
Marine Technology†	0.0%	0.2%	0.9%	0.3%	0.4%
Other Engineering & Industrial Technologies†	2.1%	0.6%	0.7%	2.4%	1.0%
Fine & Applied Arts					
Fine Arts, General	0.0%	0.8%	0.3%	12.0%	7.7%
Art	0.0%	2.8%	4.4%	32.6%	21.8%
Music	9.1%	6.8%	0.5%	12.3%	9.2%
Commercial Music†	12.1%	23.9%	27.2%	4.0%	12.0%

Technical Theater†	0.0%	3.0%	2.2%	1.0%	1.6%
Dramatic Arts	0.0%	4.3%	7.2%	7.7%	6.9%
Dance	6.1%	4.3%	0.4%	2.6%	2.6%
Applied Design	0.0%	0.9%	0.3%	0.4%	0.5%
Photography	21.2%	6.0%	3.6%	5.1%	5.0%
Applied Photography†	0.0%	19.9%	11.8%	5.3%	9.3%
Commercial Art†	27.3%	0.3%	4.5%	2.1%	2.2%
Graphic Art & Design†	21.2%	22.8%	34.9%	13.7%	19.2%
Other Fine & Applied Arts†	3.0%	4.3%	3.0%	1.2%	2.1%
Foreign Languages					
Foreign Languages, General	0.0%	5.9%	0.0%	23.7%	17.9%
French	3.9%	12.2%	8.3%	10.9%	11.2%
German	0.0%	7.3%	0.0%	2.9%	4.3%
Italian	7.7%	5.6%	0.0%	1.0%	2.5%
Spanish	0.0%	35.3%	83.3%	52.5%	47.0%
Russian	0.0%	1.5%	0.0%	0.3%	0.7%
Chinese	15.4%	8.8%	0.0%	1.3%	3.7%
Japanese	46.2%	17.2%	4.2%	6.3%	9.9%
Latin	0.0%	1.2%	0.0%	0.1%	0.4%
Hebrew	0.0%	0.0%	0.0%	0.1%	0.0%
Arabic	0.0%	3.7%	4.2%	0.9%	1.8%
Other Asian, South Asian & Pacific Islands	0.0%	0.3%	0.0%	0.1%	0.2%
Other Foreign Languages	26.9%	1.0%	0.0%	0.0%	0.4%
Health†					
Health Occupations, General†	0.0%	1.3%	0.1%	0.7%	0.6%
Hospital & Health Care Administration†	0.1%	0.0%	0.0%	0.0%	0.0%
Medical Laboratory Technology†	3.1%	1.3%	0.0%	0.3%	0.7%
Physician's Assistant†	0.0%	0.7%	1.3%	0.2%	0.5%
Medical Assisting†	2.3%	20.0%	6.2%	2.3%	6.3%
Hospital Central Service Technician†	0.5%	0.5%	0.0%	0.0%	0.1%
Respiratory Care/Therapy†	0.0%	0.1%	3.3%	4.6%	3.1%
Polysomnography†	0.0%	0.0%	0.1%	0.1%	0.0%
Electro-Neurodiagnostic Technology†	0.0%	0.0%	0.0%	0.1%	0.0%
Cardiovascular Technician†	0.0%	1.4%	1.1%	0.5%	0.8%
Orthopedic Assistant†	0.0%	0.3%	0.0%	0.1%	0.1%
Electrocardiography†	0.0%	0.5%	0.4%	0.0%	0.2%

Surgical Technician†	0.1%	0.3%	0.7%	0.2%	0.3%
Occupational Therapy Technology†	0.0%	0.0%	0.0%	0.6%	0.3%
Optical Technology†	0.0%	0.0%	0.0%	0.0%	0.0%
Speech-Language Pathology & Audiology†	0.1%	0.2%	0.6%	0.9%	0.6%
Pharmacy Technology†	0.0%	3.8%	1.4%	0.8%	1.4%
Physical Therapist Assistant†	0.0%	0.0%	0.0%	1.1%	0.6%
Health Information Technology†	0.0%	4.1%	3.4%	1.4%	2.2%
School Health Clerk†	0.0%	0.0%	0.0%	0.0%	0.0%
Radiologic Technology†	0.1%	0.3%	5.6%	5.3%	4.0%
Radiation Therapy Technician†	0.0%	0.0%	0.0%	0.1%	0.1%
Diagnostic Medical Sonography†	0.0%	0.4%	0.9%	0.4%	0.5%
Athletic Training & Sports Medicine†	0.0%	0.1%	0.0%	0.2%	0.1%
Nursing†	15.0%	20.8%	46.0%	68.6%	49.9%
Psychiatric Technician†	0.0%	0.0%	12.3%	0.9%	3.2%
Dental Occupations†	0.2%	6.4%	9.9%	4.8%	5.8%
Emergency Medical Services†	78.5%	25.0%	0.7%	0.2%	12.3%
Paramedic†	0.0%	5.6%	5.6%	1.0%	2.7%
Mortuary Science†	0.0%	0.0%	0.5%	0.6%	0.4%
Health Professions, Transfer Core Curriculum	0.0%	0.4%	0.0%	3.8%	2.0%
Community Health Care Worker†	0.0%	0.9%	0.0%	0.0%	0.2%
Massage Therapy†	0.0%	1.7%	0.0%	0.2%	0.4%
Kinesiology†	0.0%	0.0%	0.0%	0.1%	0.1%
Other Health Occupations†	0.0%	4.0%	0.0%	0.0%	0.7%
Family & Consumer Sciences†					
Family & Consumer Sciences, General†	0.0%	0.1%	0.0%	3.7%	1.1%
Interior Design & Merchandising†	0.0%	1.8%	11.2%	5.3%	4.4%
Fashion†	0.4%	1.7%	10.1%	5.6%	4.2%
Early Childhood Education†	15.3%	82.4%	49.4%	72.2%	72.6%
Nutrition, Foods & Culinary Arts†	69.8%	11.0%	23.1%	7.6%	13.3%
Hospitality†	10.6%	2.4%	5.5%	4.2%	3.6%
Family Studies†	0.0%	0.0%	0.1%	0.7%	0.2%
Gerontology†	3.8%	0.6%	0.6%	0.7%	0.7%
Other Family & Consumer Sciences†	0.0%	0.0%	0.0%	0.0%	0.0%
Law†					
Law, General	0.0%	0.7%	0.0%	3.7%	1.8%
Paralegal†	100.0%	99.3%	100.0%	96.3%	98.2%

Humanities						
	English	6.2%	14.2%	10.9%	33.7%	29.2%
	Language Arts	0.0%	0.0%	0.0%	22.8%	17.6%
	Classics	0.0%	0.5%	0.0%	0.0%	0.1%
	Speech Communication	93.8%	84.8%	63.8%	34.4%	45.5%
	Creative Writing	0.0%	0.5%	25.4%	0.9%	1.1%
	Philosophy	0.0%	0.0%	0.0%	6.8%	5.2%
	Religious Studies	0.0%	0.0%	0.0%	0.5%	0.4%
	Other Humanities	0.0%	0.0%	0.0%	1.0%	0.8%
Library Science†						
	Library Science, General	2.3%	5.6%	0.0%	2.5%	4.4%
	Library Technician (Aide)†	97.7%	93.7%	100.0%	96.8%	95.0%
	Other Library Science	0.0%	0.7%	0.0%	0.8%	0.6%
Mathematics						
	Mathematics, General	100.0%	100.0%	100.0%	100.0%	100.0%
Physical Sciences						
	Physical Sciences, General	----------	0.0%	4.8%	27.4%	23.9%
	Physics, General	----------	9.5%	51.8%	27.8%	26.0%
	Chemistry, General	----------	84.0%	28.9%	40.8%	45.6%
	Astronomy	----------	0.7%	4.8%	0.6%	0.7%
	Geology	----------	0.7%	0.0%	2.2%	2.0%
	Oceanography	----------	0.0%	0.0%	0.1%	0.1%
	Ocean Technology†	----------	4.4%	9.6%	0.7%	1.2%
	Earth Science	----------	0.4%	0.0%	0.6%	0.6%
	Other Physical Sciences	----------	0.3%	0.0%	0.0%	0.0%
Psychology						
	Psychology, General	100.0%	92.2%	100.0%	93.8%	93.8%
	Behavioral Science	0.0%	0.0%	0.0%	5.3%	5.2%
	Other Psychology	0.0%	7.8%	0.0%	0.9%	1.0%
Public & Protective Services†						
	Public Administration†	0.0%	0.5%	0.7%	0.4%	0.4%
	Human Services†	1.1%	14.2%	39.5%	14.3%	15.1%
	Administration of Justice†	70.8%	55.9%	36.4%	59.4%	57.3%
	Fire Technology†	26.3%	28.2%	23.3%	25.7%	26.4%
	Legal & Community Interpretation†	0.0%	0.8%	0.1%	0.2%	0.3%
	Other Public & Protective Services†	1.8%	0.4%	0.1%	0.1%	0.5%

Social Sciences					
Social Sciences, General	----------	1.0%	5.6%	77.6%	75.9%
Anthropology	----------	18.0%	7.3%	2.1%	2.4%
Ethnic Studies	----------	8.1%	3.9%	0.9%	1.1%
Economics	----------	2.8%	0.3%	4.1%	4.1%
History	----------	0.1%	0.0%	4.4%	4.3%
Geography	----------	43.0%	54.7%	0.8%	1.8%
Political Science	----------	0.6%	1.4%	2.6%	2.6%
Sociology	----------	20.1%	24.8%	7.0%	7.3%
International Studies	----------	6.2%	1.7%	0.3%	0.4%
Other Social Sciences	----------	0.1%	0.3%	0.2%	0.2%
Commercial Services†					
Custodial Services†	0.0%	0.6%	0.0%	0.0%	0.2%
Cosmetology & Barbering†	38.4%	67.2%	95.2%	32.0%	76.9%
Travel Services & Tourism†	59.9%	20.6%	2.8%	17.3%	11.3%
Aviation & Airport Management/Services†	1.8%	10.4%	2.0%	50.7%	11.2%
Other Commercial Services†	0.0%	1.3%	0.0%	0.0%	0.4%
Interdisciplinary Studies					
Liberal Arts & Sciences, General	83.2%	77.4%	97.0%	77.5%	79.5%
Biological & Physical Sciences and Mathematics	0.0%	1.8%	0.1%	11.2%	10.0%
Humanities	0.0%	1.6%	0.2%	7.3%	6.6%
General Studies	16.8%	17.8%	0.0%	0.1%	0.2%
Other Interdisciplinary Studies	0.0%	1.4%	2.7%	3.9%	3.8%

Note. †Indicates a field or subfield that is oriented primarily toward career and technical education (CTE).